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EFFECTIVE, AFFORDABLE, AND SUSTAINABLE SOLUTIONS FOR LAND & WATER ENVIRONMENT

February 20, 2024
Updated April 17, 2024

To: Mr. Richard S. Novak, Chair
Sherborn Zoning Board of Appeals
19 Washington Street
Sherborn, MA 01770

Re: Civil Engineering Peer Review Response
Farm Road Homes – Comprehensive Permit

Dear Mr. Chair and Board Members:

Creative Land & Water Engineering, LLC (CLAWE) has received and reviewed the Civil Engineering Peer Review Letter from Tetra Tech (the "Reviewer") updated October 27, 2023 updated March 15, 2024. This letter provides our responses. To facilitate the review, we will quote the prior Reviewer's comments and our answers first and provide our answer to the latest comments in red.

Tetra Tech (TT)'s original review comments and Creative Land & Water Engineering, LLC (CLAWE)' are based on the following pertinent documents:

- A Project Narrative (Narrative) titled "Project Description – Comprehensive Permit Application, Farm Road Homes, Portion of 55-65 Farm Road, Sherborn MA."
- A plan set (Plans) titled "Comprehensive Permit Plan of Farm Road Homes at Farm Road, Sherborn, MA", dated July 6, 2023 with revisions through September 28, 2023, prepared by Creative Land & Water Engineering, LLC. (CLAWE)
- A Stormwater Report titled "Flood Impact Analysis and Stormwater Management, Farm Road Homes, 65 Farm Road, Sherborn, MA", dated September 28, 2023 with revisions through October 4, 2023, prepared by CLAWE.
- A MA Title V Report dated July 29, 2021 with revisions through January 20, 2022, prepared by CLAWE.
- A Firetruck Turning Analysis dated July 7, 2023, prepared by Vanasse & Associates Inc. (VAI)
- A Landscape Improvement Plan, dated July 17, 2023, prepared by Ryan Associates
- A Zoning Analysis summary table.
- Request for Determination of Applicability, Preliminary Approval Request DEP letter dated August 14, 2023
- Letters and reports submitted to DEP for well determination.
- Letter to MassDEP with attachments (including Sherborn Groundwater Protection Committee) from Mr. Brian and Ms. Mary Moore dated September 27, 2023.
- Letter to ZBA Additional Comments on Farm Road Homes - Restriction and Stormwater Management Plan dated October 3, 2023.

The Plans and accompanying materials were reviewed for good engineering practice, overall site plan efficiency, stormwater, utilities, wetlands and public safety as it relates to each of the subject areas. Traffic review was completed under separate cover and not dealt with in this series correspondences. New analysis or report will be provided and noted in our new responses to address any outstanding issues.

TT 3/15/24 Update

The Applicant has supplied TT with a revised submission addressing comments provided in our previous letter including the following documents:

- A Response to Comments letter dated February 20, 2024, prepared by CLAWE.
- A Letter describing plan changes since previous plan submission dated February 20, 2024, prepared by CLAWE.
- A plan set (Plans) titled "Comprehensive Permit Plan of Farm Road Homes at Farm Road, Sherborn, MA", dated July 6, 2023 with revisions through February 14, 2024, prepared by CLAWE.
- A septic plan set (Septic Plans) titled "Proposed Septic System, Farm Road Homes, 65 Farm Road, Sherborn, MA", dated November 30, 2023 with revisions through February 2, 2024, prepared by CLAWE.
- A Stormwater Report titled "Flood Impact Analysis and Stormwater Management, Farm Road Homes, 65 Farm Road, Sherborn, MA", dated September 28, 2023 with revisions through February 14, 2024, prepared by CLAWE.
- Supporting documentation dated February 20, 2024, prepared by CLAWE.
- A Letter from Sherborn Fire and Rescue Department dated January 12, 2023 (sic).
- A Hydrogeologic Report titled "Hydrogeologic Evaluations Report, Farm Road Homes, 65 Farm Road, Sherborn, MA" dated December 11, 2023, prepared by CLAWE.
- Particle size distribution reports dated January 9, 2024, prepared by Yankee Engineering & Testing, Inc. (YETI)

TT: The revised Plans and supporting information were reviewed against our previous comment letter (October 27, 2023) and comments have been tracked accordingly. Text shown in gray represents information contained in previous correspondence while new information is shown in black text.

It should be noted that information related to the Project is regularly being transmitted which is becoming increasingly difficult to track and include in the review of the Project, particularly as it relates to the proposed septic design and analysis. This letter reflects review of the Applicant provided materials specifically noted above and we expect further review may be required as subsequent information is submitted. We have also reviewed letters and reports provided by outside parties for consideration throughout the review process.

SITE DESIGN

The Site Plans provide a good introduction to the scope of the Project and its various components. The following specific comments are offered to identify areas where additional information is required, or changes are requested to address questions or support further review.

1. The Project roadway is approximately 750 feet in length which exceeds the maximum length allowed under local subdivision regulations (600 feet maximum). The Applicant shall coordinate with the Sherborn Fire Department to determine if the proposed roadway length poses a risk to emergency access.
   - *CLAWE 2/20/24 Response: As a 40B project, the common access driveway is not a subdivision roadway under the purview of subdivision regulations. We do agree with the reviewer that the safety of the access driveway should be considered relating to road width, length, and turning radius. The plans have been reviewed by the FD and this plan reflects their input on the roadway layout. See Chief Ward*

letter dated January 12, 2024. If any new comments or recommendations from Fire Department received, we will incorporate them into the plan updating (sic).

- TT 3/15/24 Update: Tetra Tech has reviewed the letter from the Sherborn Fire & Rescue Department (SFRD) which requests a strictly enforced no parking zone on all streets in the development. **We recommend the Applicant provide no parking signs on the Plans along the driveways to inform residents of the parking restriction.**
- CLAWE 4/17/2024: **"No Parking" sign is added to the trucking loading area as recommended.**

2. The access driveway for Units 1 through 7 is greater than 150 feet in length and does not include a turnaround. Additionally, a solar canopy is proposed over the adjacent parking which may impede access by emergency response vehicles. The Applicant shall coordinate with the Sherborn Fire Department to determine if the proposed access driveway poses a risk to emergency access.
   - *CLAWE 2/20/24 Response: The applicant has coordinated with the Sherborn Fire Department. From the site plan design engineering point of view, the main access provides a large turning radius to this side driveway, which is close to Farm Road. The Fire truck has two options to service these units: one if from Farm Road, another is from the side driveway (Road B) with a good backout turning radius to the main access.*
     - TT 3/15/24 Update: Tetra Tech has reviewed the letter from the SFRD which did not specify any concerns related to access for emergency response. Additionally, site driveways have not materially changed from earlier versions of the Plans. **In our opinion, this comment is resolved.**
     - CLAWE 4/17/2024: No response needed.
3. The proposed fire tank/cistern is located at the rear of the site but no method for Fire Department hydrant access is available at any other areas across the site. Typically, a dry hydrant system would be proposed throughout the development in this situation. The Applicant should provide written confirmation from the Sherborn Fire Department that this condition is acceptable. The proposed development is dense and confirming methods of fire suppression are critical to public safety.
   - *CLAWE 2/20/24 Response: At the request of the Sherborn Fire Department, Farm Road Homes has moved the fire cistern location further south on the property. The plan is updated to reflect this change and details of the dry hydrant.*
     - TT 3/15/24 Update: The cistern location has been relocated in the most recent version of the Plans which is dated before the changes were implemented. **We recommend the Applicant provide updated correspondence from the SFRD related to the cistern location.**
     - CLAWE 4/17/2024: The applicant will request an updated correspondence from the SFD.
4. The location of the fire cistern would require a pump truck to block the roadway in the event of a fire emergency at the site. We recommend the Applicant consider proposing a parking space for Fire Department use with dimensions suitable to accommodate the department's pump truck.
   - *CLAWE 2/20/24 Response: The location of the fire tank has been modified since the last plan revision. The fire tank is now located in the front of the development between the road and the pond. We have widened the road in this area to allow the fire truck to park and pump water without blocking the traffic. The parking area for the truck is approximately 10-ft wide by 45-long.*
     - TT 3/15/24 Update: The cistern location has been relocated and pavement area has been widened in the most recent version of the Plans. However, there is a drain culvert proposed parallel to the tank which appears to have minimal cover. The Plan does not include information related to proposed pipe material to confirm if it has necessary cover to withstand loading from the SFRD apparatus if it does park outside of the pavement limits and over the pipe. **We recommend the Applicant clarify the recommended pipe details on the plan and ensure the pipe has necessary cover.**
     - CLAWE 4/17/2024: The pipe material and cover is added to the plan. The pipe will be a 12" HDPE pipe with at least 12" of soil cover. We have slightly modified the grade in this area to allow for 12"

of soil cover and added a headwall at the end of culvert to accommodate the new grading.

5. A 1:1 slope is proposed at the bottom of a proposed retaining wall west of the proposed fire cistern. This may contribute to an unsafe condition as any erosion in the 1:1 slope may compromise the wall. The Applicant should detail top and bottom of wall elevations and include a detail of the wall on the Plans.
   - *CLAWE 2/20/24 Response: This area has shallow ledge including the slope area. We added a second retaining wall at the toe of slope of the steep slope section above the access terrace to have a 1.5:1 slope to improve the stability.*
     - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
     - CLAWE 4/17/2024: No response is needed.

6. A 1:1 slope is proposed upgradient of the northwest corner of the parking area at Units 1 through 7. It is unclear if this slope is contained on the subject property as it appears two iron rods were located in this area but the property line with #55 Farm Road does not appear to meet at those points. The Applicant shall clarify, through their licensed surveyor if the property limits provided are correct. Additionally, 1:1 slopes are prone to erosion and stormwater will be directed through this area.
   - *CLAWE 2/20/24 Response: The slope described is contained on the subject property. The iron rods noted are from previous boundaries and are no longer relevant. A shallow runoff interception swale is added to the plan to direct runoff away from the riprapped slope. This will apply for all similar areas. We also regraded the area close to Unit 1 to make the slope to 1.5:1.*
     - TT 3/15/24 Update: **We recommend the Applicant specify on the Plans that the proposed slope is to be rip-rapped consistent with other areas on site. All areas of rip-rap slope stabilization should be called out on the Plans.**
     - CLAWE 4/17/2024: All areas to be rip-rapped have been labeled on the plan for easier identification. We also added a note on all sheet with grading work that all rip-rapped slopes shall be underlain with Mirafi 140N or E.Q.

7. The Applicant should detail utility corridors for the proposed solar arrays and the wells. We anticipate utilities will be installed in the proposed access road along the east side of the Project and the installation may be complex with the number of wells and solar arrays proposed. The Applicant should also confirm if the utility company will require utility poles (load breaks, metering, recloser, etc.) at the interconnection point. Additionally, the wattage of the proposed system should be provided to determine if a waiver is needed from local bylaw which regulates ground-mounted solar facilities.
   - *CLAWE 2/20/24 Response: All solar arrays have been removed from the plan.*
     - TT 3/15/24 Update: The Applicant has removed the solar arrays from the Project scope and provided water connections to each of the units from the proposed well locations. There are many sewer/water crossings proposed, the pipe crossing detail does not provide any protection against cross contamination other than crushed stone. **We recommend additional protection at each crossing such as ductile iron sleeves of the water service and/or concrete encasement.**
     - CLAWE 4/17/2024: Water pipes crossing with sewer detail on the construction detail sheet is updated with a ductile iron sleeve or equal protection.

8. Grading and drainage scope is shown on adjacent Lot 2B. The Applicant shall confirm if that property is part of the Comprehensive Permit Application. If not, that scope should be removed from the Plans or shown in some other manner to differentiate it from the portion of the site dedicated to the Comprehensive Permit Application. Written confirmation from the abutter shall also be provided to confirm their acceptance of the proposed scope on their property.
   - *CLAWE 2/20/24 Response: The adjacent property known as Lot 2B is not part of the Comprehensive Permit Application. All grading lines on Lot 2B will be shaded out to indicate an existing condition.*
     - TT 3/15/24 Update: Off-site work on adjacent Lot 2B has been shown as existing. **In our opinion, this comment is resolved.**
     - CLAWE 4/17/2024: No response is needed.

9. We recommend a fence with gate be proposed at the well/solar array access road to prevent unauthorized access. This is suggested for the protection of the residents from access to potential high voltage

equipment associated with the array and protection of the wells from potential vehicular damage.

- *CLAWE 2/20/24 Response: A lockable gate is provided at the entrance of the access road to the wells on the northern hill. All solar arrays have been removed from the project plan.*
  - TT 3/15/24 Update: A gate has been proposed at the access road to the wells. **We recommend the Applicant coordinate with the SFRD to confirm if they require a Knox box or equal at the gate for emergency access.**
  - CLAWE 4/17/2024: This will be reviewed and resolved with SFD.

10. A retaining wall and solar arrays are proposed within the 15-foot pedestrian access easement on the east side of the Project. We recommend the Applicant provide easement documentation allowing this encroachment.

- *CLAWE 2/20/24 Response: All solar arrays have been eliminated. We examined the retaining walls near unit 29 partially inside the trail easement, which provides 7 ft space for pedestrian access. The land is held in common and does not require any easement for the retaining wall construction.*
  - TT 3/15/24 Update: Access appears to be maintained through the easement held in common ownership. **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

11. It is our understanding that horse stabling and/or farming once occurred at the site and several outbuildings remain in a dilapidated condition. The Applicant should clarify if they have performed any due diligence related to potential soil contamination at the site or known underground tanks.

- *CLAWE 2/20/24 Response: Most of the outbuildings on the property have been removed for re-use elsewhere. The few remaining small open structures will be demolished. The applicant is not aware of any underground tanks or other contamination on the site. Extensive exploratory test holes were dug in this area, and nothing was discovered. No spills of OHMs in the DEP record were found for the site.*
  - TT 3/15/24 Update: No records of contamination exist with MA DEP based on MA EEA Data Portal search. **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

12. A roadway profile and roadway cross-section should be included in the Plans.

- *CLAWE 2/20/24 Response: A roadway cross section is provided in the detail sheet. A profile is added to the plan.*
  - TT 3/15/24 Update: Plan and profiles have been added to the Plans. **We recommend water infrastructure be shown where applicable to ensure proper buried depth below frost is proposed.**
  - CLAWE 4/17/2024: The fire cistern will be type “D5” fiberglass tank. It will be 10 ft diameter and buried with 36” soil on top and 13 ft to bottom as required by the manufactory specifics.

13. We anticipate foundation drains will be required for each of the dwellings. Foundation drains should be provided on the Plans.

- *CLAWE 2/20/24 Response: Foundation drains are added for each of the buildings. Discharging will either be pumped or by gravity depending on the grading around each house.*
  - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed

14. The Applicant should provide a stamped site survey to confirm the site was surveyed by a Massachusetts licensed professional land surveyor.

- *CLAWE 2/20/24 Response: Previously provided in the Comprehensive Permit Application and may be found on the town website or via the following link* (link provided).
  - TT 3/15/24 Update: The Applicant provided a stamped ANR Plan in the original submission. **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed

15. The entire Project scope does not appear to be included on the development overview located on the cover sheet which is missing the solar array and other at-grade items such as maintenance access ways, limit of clearing, etc.
    - *CLAWE 2/20/24 Response: As requested, the cover sheet has been updated to include the surface infrastructure envelope or footprint for an overview of the overall development including road, houses, stormwater basins, wells, septic field, and access ways. Further details of the site can be found in the remaining sheets.*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed
16. The plans are very "busy" with a lot of information included on a small number of plans. We recommend sheets be added to the plans set particularly a separate Utilities Plan and Grading and Drainage Plan.
    - *CLAWE 2/20/24 Response: A separate utility plan is created for sewer, water, and electricity. It is important to show them altogether so to avoid any conflicting locations.*
        - TT 3/15/24 Update: The Applicant provided a utility plan and Plan and profiles. **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.
17. Plans are provided in color presumably for presentation purposes. We recommend all plans be provided in grayscale.
    - *CLAWE 2/20/24 Response: The color versions of the plans are provided for now for easy review and presentation. Grayscale plan will be provided for the final approval and record.*
        - TT 3/15/24 Update: **We recommend the final grayscale plan be reviewed to ensure existing and proposed information is properly shown.**
        - CLAWE 4/17/2024: We agree.

STORMWATER

The Project scope includes development of 32 units of housing clustered on approximately 14 acres of land. Stormwater runoff generated by the Project is proposed to discharge to traditional piped infrastructure and vegetated swales to direct runoff to four proposed infiltration basins. The Stormwater scope was reviewed against the Massachusetts Department of Environmental Protection (MA DEP) Stormwater Management Standards (Standards) and Stormwater Handbook (Handbook). The Project was also reviewed for general stormwater design elements and good engineering practice.

It is our concern that the information required to make reasonable conclusions on the viability of the proposed stormwater infrastructure is lacking and additional information is required to ensure the Project is feasible given the current development program. Furthermore, the density of the Project and site conditions/constraints provide minimal latitude for any deviations in the stormwater scope related to unforeseen site conditions.

The following comments are offered specific to the Project Stormwater design.

18. We recommend the Applicant provide the excel files for the Basin Outflow Analysis, Curve Numbers and Time of Concentration calculations as all calculations appear to have been completed on proprietary spreadsheets developed by the Applicant's engineer which is not typical in the industry and review of such is inefficient. The excel spreadsheets must be reviewed to ensure calculations and equations used are correct to ensure proper accounting of runoff. (Standard 2)
    - *CLAWE 2/20/24 Response: We have previously discussed the proprietary spreadsheet issue: a). The detailed land use and the soil HSG rating based on the NRCS soil map are listed in our table and easy to check as a simple area weighted CN is calculated on any commercial software. b) The time of concentration is calculated using TR-55 time of concentration formula as publicly available in literature. c) The basin outlet control structure is based on typical weir and orifice hydraulics and can be found in typical hydraulic books or handbooks.*
        - TT 3/15/24 Update: The Applicant has provided supplementary tables in the Stormwater Report detailing composite CN values and time of concentration for each sub-catchment. We manually

confirmed several of the calculations which appear to be consistent with accepted practice. **In our opinion, this comment is resolved.**

- CLAWE 4/17/2024 4/17/2024: No response is needed

19. The Applicant shall provide the HECHMS model printout for review to ensure proper accounting of runoff. (Standard 2)

- *CLAWE 2/20/24 Response: The output report is provided in electronic files due to the size for print out.*
  - TT 3/15/24 Update: The sub-catchment areas noted in the output files are in square miles with many areas showing as “0” due to the size of each sub-catchment and the units of the model. **We recommend the units be set to square feet or acres to confirm pre- and post-development areas. Additionally, the final Stormwater Report shall include a pdf of the output for the record.**
  - CLAWE The unit was due to the software requirements. However, they were originally mapped in square feet and covered to with the same scientific accuracy requirements. We will check out and make sure we have enough decimal points if the result is not actually 0.

20. It appears off-site areas from the north and from Farm Road may flow into the Project area. Off-site areas should be included in the analysis, particularly since that flow will be directed to proposed stormwater best management practices (BMP’s). Additional detail shall also be provided for the existing 10” corrugated metal culvert (presumably from Farm Road drainage) that discharges onto the property. This is required to ensure proper accounting of runoff in the analysis. (Standard 2)

- *CLAWE 2/20/24 Response: We checked the area to the north of the project site, there is about 9,161 SF area draining south to the property line. However, there is a mounded stone wall along the property line to divert the water to the further downgradient area that will not impact the drainage design on the project site. Therefore, we did not include the area in the analysis. For the same reason, the proposed grading of Farm Road as well as the proposed conditions will not have Farm Road runoff going into the onsite stormwater Bains. The 10” corrugated metal culvert will bypass our stormwater system to the downgradient and will not impact the design, or vice versa. See plan for details.*

  - TT 3/15/24 Update: We agree with the Applicant’s representation related to off-site tributary area to the site from the north. However, the Applicant noted that the cross-culvert at the driveway for the existing homes at 53 and 55 Farm Road is one of the control points for the analysis (CP #2). **As** such, any flow tributary to that culvert should also be included in the analysis to ensure it is sized accordingly to pass tributary flow. An existing conditions watershed plan should also be included in the analysis for reference.

  - CLAWE 4/17/2024: The flow to the culvert under the driveway of 53 Farm Road is total flow and it is far less than the 24” culvert capacity. The culvert capacity analysis sheet is provided below for easy reference.

Creative Land & Water Engineering, LLC
Environmental Science and Engineering
P.O. Box 584, Southborough, MA 01772
Tel: (508)281-1694 Email: deshengw@yahoo.com

Subject: Circular Pipe Analysis
Outflow Pipe
Road Crossing Culvert - Existing
Location: Farm Road Homes

By: DSW **Date:** 19-Apr-24
Chkd: **Date:**
Job No.: J269-12 **Sheet:** 1

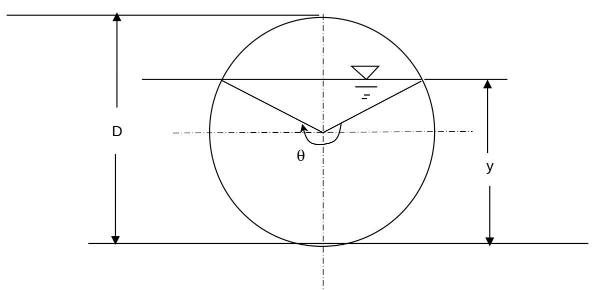
Input Report:

Project: **Outflow Pipe Capacity and Erosion Control Calculations**

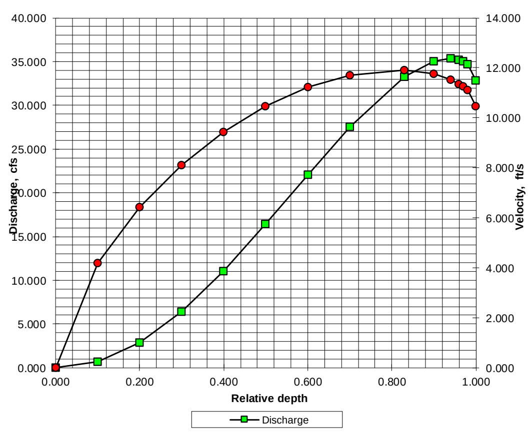
Pipe diameter (in):	24	Pipe length:	38.00	ft	Pipe x-sec., Ao (sq. ft):	3.142		
Slope (ft/ft):	0.0661	U/S INV, Zu:	196.42	ft	Pipe Manning's n:	0.023		
Calc. slope (ft/ft)	0.0661	D/S INV,Zd:	193.91	ft				
Fill height, ft	0.0000	Fill area, SF	0.00	SF	Filled pipe perimeter, ft	0.00		
Fill bottom width, ft	0	Fill Manning's n:	0.012					
Design Discharge (cfs):	8.31	Entrance Head:	1.58	ft	Flow Coef.: 0.54	Ent.mod coef.	1	
Design Velocity (ft/s):	6.65	E.L.F.:	17.08	cfs	Weir coef.: 2.65	Note	Round edge	
Design Storm (year):	100	W.L. at Inlet:	198	ft				
Design flow depth (in):	7.01							
Elev.	197.00							

Output Report: Remarks:

Entrance H ft	W.L. ft	Relative depth	Flow area A, sq. ft	Hyd. Rad. R, ft	Comp n	Velocity V, ft/s	Discharge Q, cfs	Angle, θ/2 rad.	Critical Flow Discharge cfs	Critical Flow Slope ft/ft	Entrance flow cfs	Weir flow cfs
0.000	196.420	0.000	0.000	0.000	0.0000	0.000	0.000	0.000			0.000	0.000
0.200	196.620	0.100	0.164	0.127	0.0230	4.198	0.686	0.644	0.342	0.016	0.077	0.000
0.400	196.820	0.200	0.447	0.241	0.0230	6.436	2.879	0.927	1.342	0.014	0.527	0.000
0.600	197.020	0.300	0.793	0.342	0.0230	8.122	6.438	1.159	2.958	0.014	1.539	0.000
0.800	197.220	0.4000	1.173	0.428	0.0230	9.440	11.078	1.369	5.153	0.014	3.176	0.000
1.000	197.420	0.5	1.571	0.500	0.0230	10.464	16.437	1.571	7.899	0.015	5.420	0.000
1.200	197.620	0.6	1.968	0.555	0.0230	11.222	22.086	1.772	11.192	0.017	8.198	0.000
1.400	197.820	0.7	2.349	0.592	0.0230	11.718	27.524	1.982	15.088	0.020	11.389	0.000
1.660	198.080	0.83	2.787	0.608	0.0230	11.924	33.237	2.292	21.544	0.028	15.861	0.000
1.800	198.220	0.9	2.978	0.596	0.0230	11.765	35.037	2.498	26.622	0.038	18.231	0.000
1.880	198.300	0.94	3.065	0.579	0.0230	11.539	35.362	2.647	31.235	0.052	19.498	0.000
1.920	198.340	0.96	3.099	0.566	0.0230	11.364	35.221	2.739	34.974	0.065	20.087	0.000
1.940	198.360	0.97	3.114	0.557	0.0230	11.250	35.035	2.793	37.751	0.077	20.365	0.000
1.960	198.380	0.98	3.127	0.547	0.0230	11.110	34.738	2.858	41.922	0.096	20.630	0.000
2.000	198.420	1	3.142	0.500	0.0230	10.464	32.874	3.142			21.094	0.000
2.200	198.62	1.1	3.142	0.500	0.0230	10.464	32.874	3.142			22.873	0.000



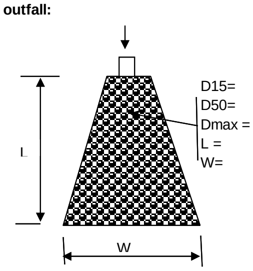
Average Dail flow:		gpd
Peak/Average ratio:	4.50	
Peak flow:	0	gpd
	0	cfs



For the given condition:

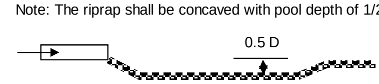
Discharge	Q (cfs)=	8.31	Stone specific gravity (Ss):	2.65
Width/Dia.	B (in) =	24	Stability factor (Sf):	1.2
Roughness	n=	0.023	Stone repose angle (Φ):	42.00
Slope	slope=	0.0661	Bank slope angle (θ):	18.00
Design Vel	V (ft/s)=	6.65	D50 correction factor (C):	1.00
Flow Depth (ft) =		0.58	Bank angle correction K1:	0.887
Channel riprap size:			D50 (in) =	5.52

Riprap at outfall:



D15=	2.759341134	inches
D50=	6	inches
Dmax =	9	inches
L =	16.12	ft
W=	12.45	ft
	or Channel width	

Note: The riprap shall be concaved with pool depth of 1/2 of D.



Ref. HEC No. 11, Design of Riprap Revetment, US DOT, FHWA, Publication No. FHWA-IP-89-016, March 1989

Fair, G.M. and Gayer, J.C. "Water Supply and Waste-water Disposal", 1st Ed., John Wiley & Sons, Inc., New York (1954), p.136.

21. The Applicant shall clarify if Lot 2B is included in this Application and whether the Applicant controls or has a written agreement with that owner to discharge stormwater runoff from the Project to that Property. Additionally, we recommend the analysis point for stormwater discharge from the Project site be the east property line of Lot 2B rather than the proposed culvert located on the west side of Lot 2B. This will ensure runoff is analyzed and mitigated prior to discharge to that lot. (Standard 2)
    - *CLAWE 2/20/24 Response: The culvert at the driveway was chosen as the control point as it is the most concerning point for flow restriction. There is a drainage easement on Lot 2B along Farm Road for the project to pass flow through. Given the flow are most go through the stormwater basin then to the easement, it is our best professional opinion that we should keep the control point at the culvert. As far as the concern to the property line with Lot 2B, the proposed Basin B2 will significantly reduce the drainage area to the property line, from 50,195 Sf to 12,817 SF, about 75% reduction. And the water from the rest will be directed to the Basin and overflow to the dedicated drainage easement at a reduced rate and volume. As the total flow to the culvert is reduced, and the area between the basin B2 and the culvert is existing off-site area, the flow is expected to remain the same, so the flow to the property line after the control would be reduced and there is no need to do a separate analysis.*
        - TT 3/15/24 Update: **See Update at Comment 20.**
        - CLAWE 4/17/2024: See response to Comment 20.
22. Many test pits shown on the Plans were not provided in Table D.1 in the Stormwater Report nor were logs provided in the Stormwater Report to confirm soil horizon information. The Applicant is proposing four infiltration basins dispersed throughout the site to mitigate stormwater runoff generated from the development as well as provide groundwater recharge and water quality treatment. All Infiltration BMP's shall include at least one test pit, performed by a Massachusetts certified soil evaluator, required to determine soil type, soil profile and depth to estimated seasonal high groundwater (ESHGW), all information should be provided using test pit logs. Infiltration Basins A, B1 and C are proposed in areas mapped as HSG C and D soils which is not recommended. (Standard 3)
    - *CLAWE 2/20/24 Response: In each of the infiltration areas, soil testing was performed to confirm the soil texture that is suitable for infiltration. Soil logs for the test pits for the current project scope have been provided as part of the plan set. See sheets 15 and 16.*
        - TT 3/15/24 Update: The Applicant has provided test pit logs for test pits conducted at each of the basins. It should be noted that the bottom of Basins A (55-9N), B1 (SWTP1) and B2 (65-10C) are all within two feet of ESHGW (as compared to their respective test pits) which is not allowed per MA DEP Stormwater Handbook. **All basins, including forebays (if proposed to infiltrate and included in the basin volume) shall be designed with minimum two feet separation from ESHGW.**
        - CLAWE 4/17/2024: Sediment forebays are modified for Basins A and B1 to have groundwater separation of minimum 2-ft. B2 is located downgradient of 65-10C and meets 2-ft groundwater separation (65-10D)..
23. Exfiltration swales are noted for catchment areas AP-1 through AP-3 in the schematic layout of the proposed stormwater system. The Applicant shall clarify where the exfiltration swales are located within the catchment areas and provide test pit data to confirm soils and ESHGW at the BMP's. (Standard 3)
    - *CLAWE 2/20/24 Response: We have added all the soil testing pits to the watershed plan and updated the swale features. All exfiltration swales have a minimum 2 ft groundwater separation with crushed stone trench in the bottom. All driveways have 12" wide and 12" 1-3" crushed stone side aprons and vegetated strip or grass swale on the path to the stormwater catch basins. No swale for sub-watershed AP-7 is claimed, which is removed from the model and sketch.*
        - TT 3/15/24 Update: It appears the infiltration swales are minimum two feet above ESHGW. **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.
24. A portion of the entrance drive is not directed to an infiltration BMP. A Capture Area Adjustment shall be provided for this area. (Standard 3)

- *CLAWE 2/20/24 Response: The grading at the driveway entrance is updated so the missing strip of land will now go to the swale leading to Basin B2.*
  - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

25. The Applicant shall provide the calculation method and calculation sheets for the determination of hydraulic conductivity used in groundwater mounding. Identify and include the test well used to determine the saturated thickness of the overburden. Field test methods for hydraulic conductivity shall be measured by the methods noted in the Handbook. Title V percolation tests shall not be used to test for saturated hydraulic conductivity in stormwater design. (Standard 3)
    - *CLAWE 2/20/24 Response: The information for reference wells of saturated hydraulic thickness and the information and references leading to the determination of hydraulic conductivities are provided in Appendix D for groundwater mounding analysis, which is updated or the stormwater management report.*
      - TT 3/15/24 Update: The MA DEP Stormwater Handbook is explicit in which methods are acceptable for determining saturated hydraulic conductivity. The acceptable methods are included in Volume 3, Chapter 1, Page 11 & 12 of the Handbook. If Rawl's rates are intended to be used for determining static recharge, then infiltration rates shall match those provided in the Handbook in Volume 3, Chapter 1, Page 22. **We recommend the Applicant confirm which of the accepted methods was used to ensure the analysis meets the requirements of the Handbook.**
      - CLAWE 4/17/2024: The Rawl's value was used to calculate the infiltration rate for recharge and the hydrogeosieve XL calculated hydraulic conductivity is used for updating mounding analysis. See attached report for details. All stormwater basins will be dewatered in three days.

26. Stormwater basin elevation along with groundwater mounding should be added to (or in separate cross-sections) the cross-sections identified in Section E to demonstrate there is no breakout or interference with the groundwater mound from the septic systems. (Standard 3)
    - *CLAWE 2/20/24 Response: The detailed groundwater mounding profile is provided in Stormwater report Appendix G for each basin. We do not see any breakout risk for any of the basins. Given basins have outflow control structure to drain for large storm event. The normal less than 2-year storm will have very minimum groundwater mounding impact, which counts for 96% of rain events.*
      - TT 3/15/24 Update: **See Update at Comment 25 related to hydraulic conductivity at each basin.**
      - CLAWE 4/17/2024: See updated response to Comment 25.

27. Appendix D of the Stormwater Report notes that an unsaturated zone is not required under an infiltration BMP. This conflicts with the MA DEP Handbook which requires a minimum two-foot separation to estimated seasonal high groundwater (ESHGW) for Infiltration BMP's. (Standard 3)
    - *CLAWE 2/20/24 Response: All basin have more than 2 ft of groundwater separations. The language is a statement of fact that infiltration can happen without separation.*
      - TT 3/15/24 Update: Proposed basins do not have the required separation from groundwater. **See Update at Comment 22.**
      - CLAWE 4/17/2024: See updated response to Comment 22

28. The Total Suspended Solids (TSS) removal worksheet for Basin A notes a water quality swale located between the proposed catch basin and the oil/grit separator. Piping is proposed between those two structures and the water quality swale should be removed from the calculation. (Standard 4)
    - *CLAWE 2/20/24 Response: The TSS removal calculation sheet for Basin A is updated.*
      - TT 3/15/24 Update: Each basin treatment train (deep sump/hooded CB, WQ Unit, Forebay, Infiltration Basin) will provide the required 80% TSS removal. **However, we recommend proposed in-line leaching catch basins (contained within the proposed roadside swales) also contain hoods to prevent downstream transport of debris.**
      - CLAWE 4/17/2024: We added a note and detail to all inline leaching catch basins for T hood at the outlet.

29. The Applicant notes that 80% TSS removal is achieved at Basin B1 and B2, infiltration basins achieve 80% TSS removal only when proper pre-treatment is provided ahead of the basin. Runoff enters through a rip-rap apron then directly discharges to the basin without a forebay or any other pre-treatment BMP. The TSS removal worksheet notes presence of a grassed channel which is non-existent in the treatment train to the "B" basins. Basin C should have its own TSS removal worksheet as the treatment train design for that basin does not match the "B" basins. (Standard 4)

- *CLAWE 2/20/24 Response: The entire project is set on a county side style road and driveway. There will be no conventional gutter channel flow. There will be 12" wide and 12" deep 3" stone apron along both sides of the road then sheet flow to grass strip or swale leading to catch Bains or to basin directly. Therefore, the treatment train for Basins B1, B2 and C will be grass swale, or combination of grass swale and catch basin pre-treatment. We use grass swale only to be conservative for three of them. We also added sediment forebays to all infiltration basins for better pre-treatment so it is in compliance with the "standard 4".*
    - TT 3/15/24 Update: **See Update at Comment 28.**
    - CLAWE 4/17/2024: See updated response to Comment 28.

30. The Applicant shall confirm which Water Quality Unit or Oil/Grit Separator is being proposed and provide TSS removal efficiencies based on MA DEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices. (Standard 4)

- *CLAWE 2/20/24 Response: They are customized treatment units that we have been designed and used effectively in the past 30 years for easy access of maintenance and effective in treatment. We have followed similar hydrodynamic analysis for Stormceptor design: treat 1" runoff from pavement, with a bypass mechanism to let cleaner higher flow bypass the separator, using New Jersey TSS particle size protocol for TSS removal analysis. The details are attached in Appendix C and in the detail sheet of the plan. For the sake of the oversimplified DEP credit and complicated STEP, we only claimed 25% TSS removal rate though our analysis shows that we can achieve more than 80% TSS removal rate.*
    - TT 3/15/24 Update: The Project meets the required TSS removal rate with the proposed catch basins, forebays and infiltration basins. The water quality units are an added benefit for removal of additional TSS. **In our opinion, this comment is resolved.**
    - CLAWE 4/17/2024: No response is needed.

31. The Project has not yet received final determination regarding their status as a potential public water supply. Specifically, development (including stormwater mitigation) is restricted within a Zone I wellhead protection area. Project development scope and stormwater design may vary significantly from the current proposed development depending on the outcome of that determination. (Standard 6)

- *CLAWE 2/20/24 Response: See Mr. Bob Murchison's response early on this issue. We designed the project based on private water supply condition as shown in the communication with DEP, we request that Tetra Tech assume private water supply to review the project at this point of time.*
    - TT 3/15/24 Update: We have reviewed the Project as if the wells are considered private. However, we reserve the right to modify our review if that condition changes in the future. **In our opinion, this comment is resolved.**
    - CLAWE 4/17/2024: No response is needed.

32. The Project appears to meet the requirements for coverage under the current US EPA NPDES General Permit for Discharges from Construction Activities (CGP). We recommend a Condition requiring the Applicant provide proof of coverage under the NPDES CGP and provide a copy of the approved Stormwater Pollution Prevention Plan (SWPPP) prior to construction. (Standard 8)

- *CLAWE 2/20/24 Response: We have updated our SWPPP for the stormwater report and will file EPA NOI for NPDES CGP permit 2022. We agree that the approval of ZBA can condition this.*
    - TT 3/15/24 Update: **Condition recommended in original comment.**

- CLAWE 4/17/2024: We will comply with the recommendation when project is approved.

33. The Applicant should include Project schedule and phasing on the Erosion Control Plan. Additionally, stockpile areas, laydown areas, temporary sediment basins, etc. should be included on the Plans to confirm proper management of construction period stormwater runoff. (Standard 8)
    - *CLAWE 2/20/24 Response: While it is not practical to provide a detailed project schedule at this point in time. We provide a detailed construction sequencing and erosion control plan to minimize construction impacts. We also provided a brief construction phase plan here. Phase I: stake limit of work, install perimeter erosion control line, clear the working area (half of the site is already open area), construction for access way. Phase II: stormwater basin construction, model house construction. Phase III: Construction of houses, septic system construction, water supply well drilling and lay out water and sewer lines and electric/cable lines. Phase IV: continue with house construction and stabilize each house yard and pave the common driveway and driveway to each house.*
        - TT 3/15/24 Update: The Applicant has provided a preliminary erosion control plan which shows erosion control limits, soil stockpile locations, etc. It should be noted that post-development stormwater BMP's shall not be used to control construction period runoff, particularly in this case where infiltration BMP's are proposed. Once a contractor is chosen for the Project, we expect a detailed SWPPP will be developed which should be provided to the Town. **Condition recommended in Comment 32.**
        - CLAWE 4/17/2024: See updated response to Comment 32.

34. The Applicant notes in the Stormwater Operation and Maintenance Plan (O&M Plan) that snow will be hauled off-site to the town snow dump during heavy snow events. We recommend the Applicant revise this section to include off-site removal to permitted facilities as we are unaware of any local snow disposal sites. (Standard 9)
    - *CLAWE 2/20/24 Response: We revised the O&M plan to state that "excessive snow can be trucked off site and disposed in the permitted facilities."*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

35. The proposed annual maintenance budget appears to be minimal, and we anticipate significantly higher cost to inspect and maintain the system. We recommend the Applicant re-evaluate these costs and include budget for inspection and development of reports. (Standard 9)
    - *CLAWE 2/20/24 Response: The annual maintenance budget is updated to reflect the current market price.*
        - TT 3/15/24 Update: The revised budget appears to be more realistic given the Project scope. **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

36. The Applicant should expand the inspection and maintenance log in the O&M Plan to ensure each structure has a separate line item for proper tracking of inspection and maintenance performed. Additionally, the proposed well/solar array access roads should be added to the O&M plan to ensure they are properly maintained. (Standard 9)
    - *CLAWE 2/20/24 Response: The O&M maintenance table is expanded for each item to have a line for better tracking and recording.*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

37. The Applicant is requesting a Low Impact Development (LID) credit (Credit 1) as noted in the MA DEP

Stormwater Checklist included in the Stormwater Report. The Project does not meet the Standards for compliance with Credit 1 due to the following: total impervious area at the site is approximately 16.9% which exceeds the maximum 15%, protected conservation area is not proposed and rooftop area is not disconnected.

- *CLAWE 2/20/24 Response: No credit is claimed in our calculations. We updated the stormwater checklist to note this.*
  - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

38. The proposed catch basin detail does not specify sump depth. All catch basins shall be deep sump (four-foot min.) hooded catch basins to achieve 25% TSS removal credit. (Vol. 2, Ch. 2, Pg. 2)

- *CLAWE 2/20/24 Response: Sump depth have been specified in the construction details to be a minimum of 4-ft.*
  - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

39. The berm elevation (218.5) for Infiltration Basin B1 is located within 10 feet of the front property line which conflicts with General Setback Requirements noted in the Handbook for Infiltration BMP's. (Vol. 1, Ch. 1, Pg. 8)

- *CLAWE 2/20/24 Response: Infiltration Basin B1 has been re-shaped and the inside berm elevation of 218 is now approximately 11-ft from the property line. This is in line with the current DEP standard for setback measurement.*
  - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

40. The Applicant is proposing use of water quality swales to assist in treatment of runoff for total suspended solids (TSS). However, the swales shown on the Plans do not appear to meet the design requirements noted in the Handbook. Specifically, water quality swales must have pretreatment in the form of sediment forebays or pea stone diaphragm/vegetated filter strip. Additionally, the swales must have a hydraulic residence time of at least 9 minutes to achieve proper treatment of the water quality volume. (Vol. 2, Ch. 2, Pg. 77)

- *CLAWE 2/20/24 Response: The swale consists of grassed open top and a slightly elevated basin inlet with deep sump for further pretreatment. Therefore, there is adequate pretreatment before the water will enter subsurface trench area. The site has countryside style common driveways with 3" stone apron edge. There will be no untreated runoff going to the swale subsurface crushed portion. If there is any real concern, we can eliminate the subsurface stone trench and perforated pipe, which will still allow us to claim the 50% TSS removal rate benefit for grass swale. It is inadvisable to do that in our professional opinion.*
  - TT 3/15/24 Update: **See Update at Comment 28.**
  - CLAWE 4/17/2024: See updated response to Comment 28.

41. Basin A is located upgradient of an approximate 30% slope. Infiltration basins shall not be located within 50 feet of a slope greater than 15%. (Vol. 2, Ch. 2, Pg. 88)

- *CLAWE 2/20/24 Response: Basin A has been reshaped and relocated and the inside bottom (208) of the basin is now located approximately 51 feet from a 3:1 slope to the same elevation, which meets the 50 ft setback requirement in DEP current measurement practice.*
  - TT 3/15/24 Update: The Applicant maintains an infiltration BMP within 50 feet of a minimum 15% slope. This topic was discussed in length during our meeting with the Applicant and their engineer at town hall on January 9, 2024 and it was agreed that the basin would be converted to detention to

limit possibility of the groundwater impact to the slope. **We recommend the Applicant revise the design to meet the setback requirements of the Stormwater Handbook.**

- CLAWE As the updated plan shows, we did provide minimum 51 ft setback from the 15% slope downgradient. As we understand, the setback is measured from the inside toe of slope to the same elevation break at the outer slope, which is the way used by DEP for measuring setback from infiltration basin to wetlands.

42. The Applicant is proposing to mitigate increase in runoff up to the 100-year event using infiltration basins. All infiltration basins shall be designed to include one-foot of freeboard from the design storm event. (Vol. 2, Ch. 2, Pg. 91)
    - *CLAWE 2/20/24 Response: The basin is revised with the fine tuned outlet control structures and larger basin size to provide a minimum of 1 ft free board.*
        - TT 3/15/24 Update: All basins now maintain the required one-foot of freeboard from the 100-year event. **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

43. All infiltration basins shall include monitoring wells and drawdown devices. (Vol. 2, Ch. 2, Pg. 91)
    - *CLAWE 2/20/24 Response: Monitoring wells and drawdown devices have been added to all the infiltration basins. Practically, in our 30 years of professional experience, we have not seen anyone need to use emergency dewatering. It is easier to use a dewatering pump than a pipe in the basin.*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

44. In prior hearings, abutters noted issues with ponding and icy conditions in Farm Road adjacent to the catch basin structures in the road south of proposed Units 1 and 2. We recommend the Applicant examine the drainage in Farm Road along the frontage of the Project and address these concerns as the Project driveway is adjacent to this area and potential for impacts to safety along Farm Road will be increased.
    - *CLAWE 2/20/24 Response: We have conducted field visits with the peer reviewer and town officials. There is a section of land abutting Farm Road near the aforementioned catch basin is higher than the roadway on both side of the road. Right after heavy rain, we observed water seeping out the side of the slope from both sides of the roadway. This is a historic natural condition for many decades. We realize that it is a public safety concern. The project design proposed a swale with crushed stone and perforated pipe along the roadway on the project side, which will intercept any runoff and deliver to infiltration basin B2. This will permanently eliminate the seepage in the future and improve road safety on the project side in the future.*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

45. We recommend the Applicant consider relocating the proposed O&M access for Basin A to limit grading on the slope upgradient of Basin A. It appears access could be provided along the wall adjacent to Unit 18 with careful design.
    - *CLAWE 2/20/24 Response: As recommended, we have relocated the proposed O&M access for Basin A. The access is now provided off the access to the leaching field.*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

46. The Applicant shall confirm if CB #12 and CB #13 are designed as overflow devices. It is unclear the intent of these structures. Additionally, the pipe from CB#10 is located along the existing stone wall and nearly coincident with the right of way line which will require removal of the wall and impacts to the right of way during construction. We recommend these areas be redesigned to ensure the existing stone wall and

existing vegetation can remain.

- *CLAWE 2/20/24 Response: Yes, both CB#12 and CB#13 are indeed overflow devices and are also leaching catch basins to maximize groundwater recharge. We have removed the pipe that connected to CB#10 to CB#13. CB#10 now ties into CB#11. All catch basins inside the swale except for CB#12 and CB#13 are inlet leaching catch basins with slightly elevated rim elevation to allow runoff pretreated by the grass swale before getting into the basin with solid deep sump for additional treatment and then to a perforated pipe embedded in crashed stones. With this re-design, only a small portion of the existing field stone wall will have to be altered to install the proposed retaining wall. We would like to note that said field stone wall is in a dilapidated condition and is barely visible to passers-by due to it being a very low wall with significant vegetation overgrowth.*
    - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
    - CLAWE 4/17/2024: No response is needed.

47. The Stormwater Report contains numerous scrivener's errors and references to other projects. We recommend the Applicant complete a quality review of the Stormwater Report and other submission documents prior to future submissions to ensure the information provided is consistent with the proposed Project and organized in a manner that is easily reviewable.
    - *CLAWE 2/20/24 Response: The report is thoroughly reviewed to correct any scrivener's errors as we can find.*
        - TT 3/15/24 Update: The revised Stormwater Report has corrected many of the errors. **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

EROSION AND SEDIMENTATION CONTROL

The Applicant has included provisions for erosion and sediment control as part of the Project scope. The following comments are offered specific to the Project and potential for off-site erosion during construction.

48. The Applicant should provide earthwork calculations on the Plans to assist reviewers and the public in understanding the size and scale of earthwork operations for the Project. Additionally, a Construction Management Plan is recommended to detail truck travel routes, project phasing, hours of operation, equipment laydown areas, stockpile locations, etc.
    - *CLAWE 2/20/24 Response: The most impact area will be the septic leaching fields and stormwater basins. The common driveways and houses are in relatively flat areas and will have very minimum erosion and sediment impact. We are breaking down the cut and fill in a few areas: 1) septic SAS and I/A construction area; 2) stormwater basin areas; 3) Well access road; 4) driveway and houses (not provided for this item at this time).*

      We have provided construction sequencing and phase plan for the project. Any stockpiles will be in upper flat areas outside any buffer zones to BVW.

      Trucking route will be worked out with Sherborn DPW and Fire department when project receive its approval and prior to commencement of any earth work.
        - TT 3/15/24 Update: The Applicant noted approximately 10,667 CY of material that will require export from the site. **We recommend a Condition requiring the Applicant prepare a construction management plan prior to construction.**
        - CLAWE 4/17/2024: We agree with this recommendation.

49. The proposed development is dense, and we anticipate issues maintaining post-development stormwater controls in a clean condition during construction. This is a concern particularly after the roadway has been paved and houses begin to be constructed.
    - *CLAWE 2/20/24 Response: The site work area except for the SAS and Basin A have a relatively flat grading and mostly loam sand soil. Based on the experience working on 53 Farm Road, we do not expect much of an erosion and sediment control issue other than typical residential subdivision*

construction.

- TT 3/15/24 Update: It should be noted that post-development stormwater BMP's shall not be used to control construction period runoff, particularly in this case where infiltration BMP's are proposed. Once a contractor is chosen for the Project, we expect a detailed SWPPP will be developed which should be provided to the Town. **Condition recommended in Comment 32.**
- CLAWE 4/17/2024: Temporary sediment basin will be created for erosion control purposes and not to use stormwater basins.

50. The Applicant should provide limit of clearing and limit of work on the Plans. These limits shall be strictly adhered to unless permitted otherwise.
    - *CLAWE 2/20/24 Response: A proposed limit of clearing had been provided.*
        - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
        - CLAWE 4/17/2024: No response is needed.

WATER SUPPLY

The Plans indicate the Project will be served by 7 private water supply wells for the proposed 32 units. It is our concern that the information required to make reasonable conclusions on the viability of the proposed water supply is lacking and additional information is required to ensure the Project is feasible given the current development program. Furthermore, the density of the Project and site conditions/constraints provide minimal latitude for any deviations in the water supply scope related to unforeseen site conditions or impacts the system may have on the aquifer and abutting properties.

The following comments are offered specific to Project water supply and related analysis or lack thereof.

51. Clean potable water is perhaps the most important part of any development. In the case of Farm Road Homes, the only potential source is from the local bedrock aquifer. MA DEP has provided preliminary approval to allow this development to be considered a private supply rather than public. However, we recommend that in either case the water supply be evaluated during this initial permitting phase since well yield and water quality may have the potential to alter the Project scope based on well placement, impact and degraded water quality.
    - *CLAWE 2/20/24 Response: Water supply evaluation is not required at this point in the permitting process under local or state regulation. The Sherborn BOH has regulations for semi-public water supplies that have been used by market rate projects in the past. Furthermore, the Sherborn ZBA has recently issued a Comprehensive Permit based on a theoretical municipal water supply which requires legislation and a significant further regulatory process.*
        - TT 3/15/24 Update: It should be noted that the Project received MA DEP Preliminary Approval let for exemption from being regulated as a PWS, which was based on a set of plans and documentation that pre-dated current versions. The MA DEP letter requires the Applicant provide the locally approved set of plans and documentation in order for MA DEP to make a Final Determination on the PWS exemption. **We recommend a Condition requiring the Applicant provide the MA DEP Final Determination Letter (if granted) and provide a safe, viable water supply per all applicable requirements, guidelines and Comprehensive Permit Conditions prior to issuance of any building permit on the Project.**
        - CLAWE 4/17/2024: The applicant will comply with all DEP final approval conditions and recommendations for water supply applied to this project.

52. The ZBA requested a comparison between a public water supply (PWS) and private water supply. We are not advocating one way or the other on a MA DEP decision, however, through discussion with DEP, this type of water supply has been allowed in several developments in the state including one previously in the Town of Sherborn. A PWS is typically centralized, while a private supply in this case will be divided into individual groups. Based on the information presented below it is far more costly to operate a PWS than a private supply. In addition, water quality can change over short distances in bedrock and multiple

parameters may require treatment in a centralized system.

In this case, if the MA DEP considers this a PWS it would be considered a Community supply under 310 CMR 22.00 because it would serve greater than 25 persons as their primary residence year round. This requires a higher degree of permitting and long-term operation and maintenance than a Non-Transient or Transient public water supply, both of which do not serve the same population full time. The requirements for developing a PWS can be found in the DEP Guidelines for Public Water Supplies-Chapter 4 (Guidelines).

A PWS would require:

a) A Zone I protective radius that no activity other than passive recreation be allowed around the well head and the Zone I must be owned or controlled by the PWS. The minimum Zone I radius is 100 feet for a well that would produce 1,000 gallons per day (gpd). Typically, the Zone I for a residential development is based on Title V design flow based on the preliminary number (septic plans are not yet available) that would be for 76 bedrooms or 8,360 gpd. Using the Zone I formula from the Guidelines (150 X log of pumping rate in gpd-350) from a single well, the Zone I would be 238 feet or approximately 4 acres. However, it is typical to install more wells relatively close together to shrink the Zone I to a more palatable area exclusion area.

b) For a Community supply, a back-up well is needed with the same Zone I requirements. Back-up wells are usually placed within 20 feet of the production well.

c) A Community supply would require a 48-hour constant rate pumping test. If one well was proposed on this Project, it would be conducted at 8 gallons per minute (gpm) in order to be approved for 6 gpm. Both drawdown and recovery are measured, those measurements must meet specific requirements. This test in some cases requires the monitoring of other wells in the area to assess impact.

d) Water quality testing requirements are attached and are referred to in the Guidelines. Prior to the test (when well is installed) basic water quality is tested along with volatile organic compounds and more recently inclusion of PFAS6 compounds (Method 537) in the testing regime.

e) Once approved (the well yield, Zone I and any treatment needed) the PWS is overseen by a Certified Water Operator who ensures compliant operation of the PWS and performs required sampling. For a Community supply, this sampling schedule is more expensive than for other PWS types.

For a private supply, DEP has developed the Private Well Guidelines, which contains a Model Board of Health (BOH) Bylaw that can be adopted by local BOH. Review of the Sherborn BOH Bylaw for a potable water supply would indicate it is not as robust as the suggested DEP Bylaw. We anticipate the Sherborn BOH would consider these wells as semi-public. The Sherborn BOH requires a 4-hour pumping test with no drawdown measurements to show basic yield and basic water quality, along with volatile organic compounds analysis.

Based on the above analysis a site with a PWS is far more expensive for installation and long-term operation than the private supplies proposed.

- *CLAWE 2/20/24 Response: No comments.*
  - TT 3/15/24 Update: Original comment provided for comparison of Public vs. private water supplies. **No further update required.**
  - CLAWE 4/17/2024: No response is needed.

53. We recommend the proposed wells be installed and tested for both quantity, quality and potential impact during this initial permitting phase. The wells should be installed consistent with the requirements of a Community PWS, using similar methods described above. Protective setbacks should be implemented in the design meeting a minimum of Title 5, not Zone I requirements unless required by MA DEP in their final approval.

- *CLAWE 2/20/24 Response: Tetra Tech's recommendation above is inconsistent with Sherborn BOH and MA DEP requirements and timing for market rate housing. Once again, this recommendation subjects the Project to unequal treatment in violation of G.L.c. 40B, s. 20.*

- TT 3/15/24 Update: **See Update at Comment 51.**
- CLAWE 4/17/2024: No response is needed.

54. The Applicant shall detail method for replenishing the proposed fire cistern. Additional information on its inspection and maintenance, including associated costs should be provided to ensure future homeowners are aware of the costs associated with the upkeep of the cistern.

- *CLAWE 2/20/24 Response: The fill level of the cistern will be checked quarterly by the Sherborn Fire Department (as is there practice for other on-site cisterns in Sherborn). The cistern will be re-filled as necessary by using on site wells or a water truck if necessary. This will be detailed in the operations and maintenance manual provided by the developer to the association.*
  - TT 3/15/24 Update: **We recommend a Condition requiring the Applicant provide the O&M Manual to the Town/ZBA prior to issuance of any occupancy permits.**
  - CLAWE 4/17/2024: We agree with this recommendation.

55. The Applicant shall clarify unit distribution to each of the private wells (which serve multiple units each) and if the affordable units will be evenly distributed across the wells. This is required to ensure the affordable units are not disproportionately affected in the event of a well failure.

- *CLAWE 2/20/24 Response: The applicant as required by law will work with the MA Housing in the future to determine which homes will be designated as affordable. As a practical matter, the affordable homes will not be bunched up on the site and therefore will not be all on the same well or wells.*
  - TT 3/15/24 Update: The Applicant has provided unit distribution for each well on the Utility Plan. **We recommend a Condition requiring the affordable units (once finalized) be adequately distributed across the wells to prevent disproportional impact to those residents in the event of a well failure.**
  - CLAWE 4/17/2024: No response is needed.

56. Well #6 and #7 are located adjacent to developed areas where potential exists for contamination of the wells. The Applicant shall clarify method for ensuring these wells are properly protected.

- *CLAWE 2/20/24 Response: MA DEP has carefully reviewed the location of the wells and has not expressed any concerns on the locations for private wells. The identified well locations are in compliance with Sherborn BOH and MA DEP regulations.*
  - **TT 3/15/24 Update: See Update at Comment 51.**
  - CLAWE 4/17/2024: No response is needed.

SEPTIC SYSTEM

The Plans indicate the Project will be served by a centralized Septic System with upstream pump station and sanitary sewer infrastructure to collect sewerage generated from the Project. The following comments are offered specific to Project septic design and related analysis or lack thereof.

57. The Applicant shall confirm use of the USGS Winchendon overburden well in the Frimpter calculation. The Winchendon well is located over 50 miles to the northeast and in a different drainage basin. We recommend the Applicant consider using the nearby Norfolk or Dover wells or a combination of both. (it is understood that the nearby wells are located in sand and gravel but receive similar rainfall.)

- *CLAWE 2/20/24 Response: Most of the test pits were observed dry during high groundwater season. According to Title 5, the observed water table is considered accurate per 310 CMR 15.103 (3)(b)1. The adjustment using Frimpter method is to accommodate the local bylaw requirements at the time of our soil evaluation in the case of a local bylaw system designed and has been approved by the SBOH. Winchendon well is the most fitting reference well in till considering many factors. The nearby well does not fit the soil and groundwater condition here.*
  - TT 3/15/24 Update: **In our opinion, this comment is resolved.**

- CLAWE 4/17/2024: No response is needed.

58. The Project is subject to nitrogen aggregation/loading under the Guidelines for Title 5 Aggregation of Flows and Nitrogen Loading 310 CMR 15.216. The septic system design flow is greater than 2,000 gallons per day and "(2) areas of residential new construction, as defined in Title 5, where both on-site systems and on-site drinking water supply wells are proposed (310 CMR 15.214(2)). These areas are the so-called private well areas." Based on this, the Applicant should perform the hydrogeologic assessment required to determine nitrogen loading and then calculate the nitrogen load and propose treatment if warranted.

- *CLAWE 2/20/24 Response: A hydrogeological evaluation report is provided to address the issue. Both general nitrogen loading per 310 CMR 15.216 and a detailed nitrogen budget analysis according to DEP Policy BRP/DWM/Pep-P99-7 are provided to confirm that the proposed SAS will comply with all required DEP standards.*
  - TT 3/15/24 Update: The following comments are related to the nitrogen loading calculations required in the *Guidelines for Title 5 Aggregation of Flows and Nitrogen Loading 310 CMR 15.216 (2016)* (DEP Method). **The Applicant shall re-evaluate the analysis as noted below.**

    a) Soil particle size is a regularly accepted method to determine hydraulic conductivity for DEP Groundwater Discharge Permits and other projects requiring groundwater mounding analysis. However, the analysis needs to meet applicable conditions. The Hazen formula does not always meet these applicable conditions. The publicly available spreadsheet HydrogeoSieveXL has a number of formulas that identify the applicable conditions for each formula in the spreadsheet for a specific particle distribution curve. Therefore, hydraulic conductivity shall be re-evaluated to ensure it meets applicable requirements.

    Response: As recommended, we used HydrogeoSieveXL (by Geology Dept of Kansas University) to reanalyze all six samples taken from the site. The results are summarized in the following table, detailed analysis sheets are attached to this letter as Appendix A:

Summary of Hydraulic Conductivity Analysis using Hydrogeosiev XL V 2.3.2
Developed by J. F. Devlin, Dept of Geology, University of Kansas, September 2016
Farm Road Homes, Sherborn, MA

Sample	Soil texture	Kgm		Kam		Average of Kgm and Kam	Design K	Currently used K	Rawl's		Note
		m/d	ft/d	m/d	ft/d	ft/d	ft/day	ft/day	in/hr	ft/day	
S1	M.S.	10.33	33.89	25.86	84.84	49.36	19.46	24.00	8.27	16.54	
S2	M. L.S.	1.53	5.02	22.46	73.69				2.41	4.82	SAS
SA1	S.L	0.65	2.13	26.75	87.76	44.95	2.13	4.51	1.02	2.04	Basin A
SB1	M.S.	6.21	20.37	6.85	22.47	21.42	20.37	38.00	8.27	16.54	Basin B1
SB2	Co. L.S.	4.82	15.81	244.63	802.59	409.20	15.81	42.70	2.41	4.82	Basin B2
SC	M.S.	11.17	36.65	45.79	150.23	93.44	36.65	57.43	8.27	16.54	Basin C

Note: Kgm = geometric mean; Kam = arithmetic mean

As we can see the previously used hydraulic conductivity is well fit in between the geometric mean and arithmetic mean (except for SB1), while the geometric mean is more conservative. The Kgm for SAS is 81% of used before. We will use the conservative Kgm to check the groundwater mounding heights for SAS and stormwater basins to make sure the design meets all requirements. See Appendix C for detail and following discussions under raised comments.

    b) The saturated thickness used in the mounding calculation does not match the available data and should be re-evaluated. Additional bedrock well data is available through the MassDEP Well Viewer and should be evaluated in conjunction with well location topographic data at those locations. This could be supplemented with boring(s) to bedrock in the area of the proposed location of the system. (As discussed below, the same could be completed for the stormwater systems). The Applicant shall re-evaluate saturated thickness based on available data.

Response: We have shown three bedrock wells surrounding the SAS and the ILSF in the stormwater basin areas to the upper east of the site. The saturated thickness of the aquifer in this area is very close to 14.5 ft, which is confirmed by more well study. As recommended, we pulled out more DEP wells around the swamp wetland bordering an intermittent stream, which is a glacial ravine flowing north to south evident by the intermittent stream. A total of 41 wells were found around the perimeter including previously used wells at 49, 53, 55 Farm Road. See Appendix B for detailed list and well location map. After reviewing their data completeness in well depth, depth to bedrock, static level, and yield, we used 8 wells fairly distributed around the wetland that have more complete data for further analysis. The average depth of well is 524 ft, depth to bedrock 28.13 ft, and average static water 10.54 ft, which give a saturated thickness of overburden of 17.59 ft. Given that wells were not measured water level in high groundwater season, 2 – 6 ft of groundwater correction is expected, and the high groundwater saturated thickness would range 19.59 ft to 23.59 ft. As groundwater mounding is controlled by average saturated thickness around the SAS or storm water basins, it would be reasonable to use 19.59 ft on the safe side. In addition, the average bedrock aquifer yields 12.33 gpm, which will add more water dissipation capacity to the system. Based on the pumping data, it is estimated that the bedrock has a hydraulic conductivity of 0.085 ft/day. Assuming the top 1500 ft of bedrock is permeable as the deepest well drilled is over 1000 ft, then it is equivalent to about 6.38 ft of aquifer with the same hydraulic conductivity of the overburden soil of about 20 ft/day. This will make the effective aquifer depth of 26 ft to 30 ft. Therefore, it can be seen that the 14.5 ft saturated thickness used in our analysis is very conservative, which we will kept for the new mounding analysis.

c) The Hantush analytical groundwater mounding model identified in the DEP Method is applicable for subsurface conditions and should be revised with new hydraulic conductivity and saturated thickness, with the limited amount of data it will produce a similar mound to MODFLOW without the groundwater gradient component. DEP does not allow for a constant head boundary when using this model to identify potential breakout to wetlands. DEP would typically not allow a rise at the wetland boundary above 0.1 feet for a groundwater discharge permit. However, in this case, as the discharge is under 10,000 gpd this would be determined by the Sherborn BOH. The Applicant shall revise the groundwater mounding model based on re-evaluated hydraulic conductivity not above.

Response: We have updated groundwater mounding analysis using the more accurate hydraulic conductivity values for SAS and stormwater basins. As far as constant head boundary condition at groundwater discharge wetland is just a fact which has been used for many projects before by different hydrogeologists. We are currently doing a project in Wayland using the same setting and reviewed by DEP Northeast Region. Even MODFLOW simulation allows to use drain and river boundary condition, which is a constant head boundary condition. We are not aware of any restriction in Title 5 hydrogeological analysis requirements not allowing constant head boundary condition to be sued. We do not know any written performance standards or procedure that can accurately show 0.1 ft of water level change in groundwater discharge wetland by a SAS groundwater mounding impact as when groundwater reaches a natural breaking point, water will flowing downhill hundreds of times faster and will not cause any visible rise in water level. On the other hand, the water level fluctuation in rivers and wetland can be several feet due to surface runoff surge during large storm events, which is normally a short time event and does not impact the normal groundwater flow for long term. Groundwater has seasonal fluctuation, which is normally more than groundwater mounding height in loamy sand and sand soil condition. With all said, our updated groundwater mounding analysis is carried out for both constant head and no constant head boundary conditions at wetland. The results show that the groundwater mounding height for no constant head at 1.17 ft in center of Fields 1 and 2, versus 0.87 ft with constant head, 0.65 ft versus 0.41 ft in Field 3. The combined value using “no constant head” is 1.57 ft in Fields 1 and 2 and 1.37 ft in Field 3 were used to check the septic design and to update the groundwater map for AOI and nitrogen loading analysis. It shows the groundwater separation including mounding will remain more than 6.51 ft as updated in the following table 9.1. See Appendix C for details.

As no constant head restriction in stormwater regulations, we updated stormwater basin mounding analysis with constant head at wetland border. The new mounding analysis also shows increased groundwater mounding heights in stormwater basins. However, they will all dewater in 72 hours. See Appendix C for details.

Table 9.1. Hydraulic profile design Summary of SAS (rev 2/2/2024. 4/17/2024)

Line	Bottom Elev, ft	Dist to Ref well DHTP-11An, ft	EHGW with wet well, ft	Mound EHGW, ft	GW Sep, ft	EHGW with dry well, ft	Mound GW using dry tp, ft	GW Sep, ft
L 1-1	195.33	52.34	180.66	182.23	13.10	187.25	188.82	6.51
L1-2	194.83	50.565	180.62	182.19	12.64	186.68	188.25	6.58
L1-3	194.33	49.235	180.59	182.16	12.17	186.10	187.67	6.66
L1-4	193.83	47.98	180.56	182.13	11.70	185.53	187.10	6.73
L1-5	193.33	47.38	180.55	182.12	11.21	184.95	186.52	6.81
L1-6	192.83	89.75	181.49	182.22	10.61	184.38	185.95	6.88
L2-1	192.33	0	179.50	181.07	11.26	183.80	185.37	6.96
L2-2	191.83	0	179.50	181.07	10.76	183.23	184.80	7.03
L2-3	191.33	47.6	180.56	182.13	9.20	182.66	184.23	7.10
L2-4	190.83	48.2	180.57	182.14	8.69	182.08	183.65	7.18
L2-5	190.33	48.255	180.57	182.14	8.19	181.51	183.08	7.25
L2-6	189.83	51.105	180.63	182.20	7.63	180.93	182.50	7.33
L3-1	193.33	37	180.32	181.69	11.64	184.95	186.32	7.01
L3-2	192.83	35	180.28	181.65	11.18	184.38	185.75	7.08
L3-3	192.33	0	179.50	180.87	11.46	183.80	185.17	7.16
L3-4	191.83	33	180.23	181.60	10.23	183.23	184.60	7.23
L3-5	191.33	36	180.30	181.67	9.66	182.66	184.03	7.30
L3-6	190.83	41	180.41	181.78	9.05	182.08	183.45	7.38
Average					10.58			7.01
Minimum					7.63			6.51

Note: The combined max mounding height in L1 and L2s 1.57 ft
The max mounding height in L3 is 1.37 ft

d) Once the groundwater mound has been recalculated per the DEP Model, the mound would need to be fit into the groundwater flow map to determine groundwater divides for calculation of the AOI for the nitrogen loading model, in accordance with the DEP model parameters.

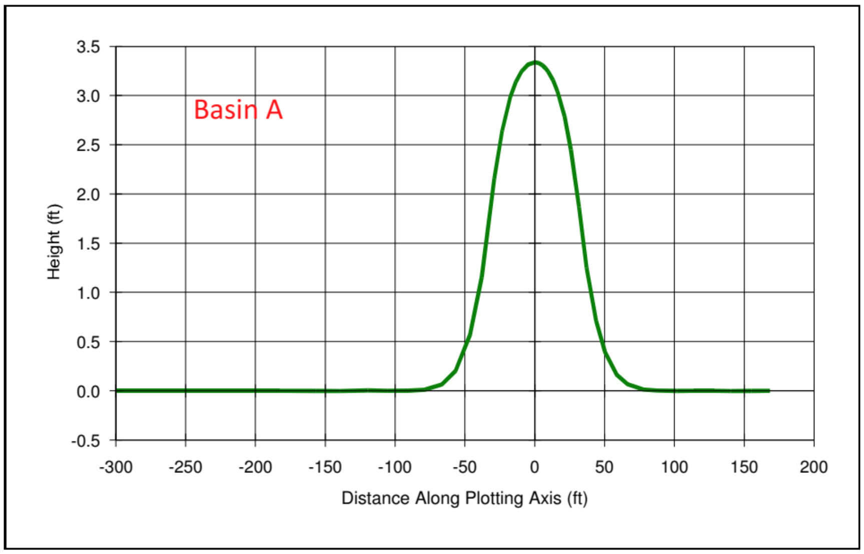
Response: The groundwater map is updated with the groundwater mounding height incorporated into the groundwater elevations in the SAS area. Stormwater basin has only short term mounding and is located upgradient of SAS area more than 100 ft. It will not impact the overall groundwater flow pattern. See Appendix D for updated groundwater flow map.

e) Based on stormwater guidelines and on the depth to ESHGW beneath the proposed stormwater basins, groundwater mounding calculations would be required for each system unless basin bottoms are raised. However, based on the relative co-location of Basin A and the

SAS it would be helpful to understand the interaction between the periodic stormwater discharge of this basin and the continuous septic discharge. It would be difficult to do this with an analytical model but could be done numerically (MODFLOW). It should be noted that additional stormwater discharge could reduce nitrogen load, but periodically temporarily increase breakout elevation.

Response: Stormwater Basin A is located 100 ft away from SAS and located significantly higher than the SAS. Our groundwater mounding analysis shows that even under 100-yr storm event, the groundwater mounding from Basin A will not extend to the SAS area. The average annual recharge of stormwater basin is small and will help to dilute the nitrogen level. As all stormwater basins will have static storage volume to retain average annual storm runoff the impervious area will produce more water than existing condition to dilute nitrogen level. The nitrogen level at the downgradient property line will be less than 5 mg/l. See updated nitrogen loading analysis in Appendix D.

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



f) The DEP model would only apply to the Project. The systems to the south at 53 and 55 Farm Road are regulated under Title 5 which allows 440 gallons/day per acre. This statement assumes that these lots are not considered aggregate.

Response: No. 53 and 55 Farm Road are two independent single-family-house lots meet SBOH and Tile 5 requirements independently.

59. No information was provided on method of installation or boring logs for the wells listed in the soil tables.

- *CLAWE 2/20/24 Response: The SAS monitoring wells were installed according to SBOH requirement. The well installation details were provided in the hydrogeological evaluation report Appendix A.*
    - TT 3/15/24 Update: **In our opinion, this comment is resolved.**
    - CLAWE 4/17/2024: No response is needed.

60. The ZBA requested information related to resident comments heard in the October 4, 2023 meeting related to depth to bedrock and affects from any blasting at the Project site. In order to understand the affects of the Project on the surrounding areas, the Applicant should develop a geologic cross-section(s) that would show depth to bedrock, soil type, foundation elevations and seasonal high groundwater across the site.

This will allow visual evaluation for the ZBA and the public for review.

- *CLAWE 2/20/24 Response: A table of house unit with basement elevation, ledge, estimated high groundwater is added to sheets 12 and 13 of the comprehensive permit plan.*
  - TT 3/15/24 Update: Cross-sections of the Project would be easier for all parties to understand boundaries of bedrock across the site and potential need for blasting during construction. For example, groundwater breakout was observed along the Project frontage with Farm Road and ledge was encountered in test pits in this area suggesting subsurface geological features in the area that may not be entirely understood, and which could have measured impact on post-development groundwater conditions at the site and downgradient receptors. **We continue to recommend geologic cross-sections of the site for additional clarification and ease of review by all parties.**
  - CLAWE 4/17/2024: On Sheet 17 of 22 (Drainage and Sewer Profiles) we provided 5 profiles for the roads of the subdivision and in the profiles we showed the test pits where we encountered ledge and noted the ledge elevation. We have added a house summary table (see sheet 16) in which the estimated ledge elevation can be seen at the location of each house. We believe that with the ledge information shown on the plans, on the road profiles, and on the house summary, that enough information has been provided so that boundaries of bedrock across the site can be determined and properly accessed for blasting work.

WETLANDS

Areas jurisdictional to the Massachusetts Wetlands Protection Act (WPA) are located on-site which include resource area to the west of the site and potential Isolated Land Subject to Flooding (ILSF) located at the southeast corner of the site. The following comments are offered specific to the Project's potential impact on wetland resources.

61. The Project includes development within area jurisdictional to the Massachusetts WPA and therefore we anticipate the Project will require permitting through the Sherborn Conservation Commission once a final plan is developed for the Project.
    - *CLAWE 2/20/24 Response: The applicant will begin permitting with Sherborn Conservation Commission when the project review with ZBA is completed.*
      - TT 3/15/24 Update: **We recommend a Condition requiring the Applicant acquire an Order of Conditions for Project scope within MA WPA jurisdiction.**
      - CLAWE 4/17/2024: We agree with the recommendation.
62. Farm Road Pond may meet the characteristics of ILSF as pond volume (based on topography) appears to exceed ¼ acre-foot and to an average depth greater than 6-inches. However, additional information is required to determine if the watershed produces the required ¼ acre-foot of stormwater volume in the one-year storm event. Additionally, historical aerial imagery (Google Earth, April 2005 Aerial) shows the extents of the pond approximately 90 feet from the east edge of the existing gravel site road which appears to differ from that provided on the Plans. We recommend the Applicant show the farthest known extent of the pond on the Plans and provide documentation used to determine the extents for review.
    - *CLAWE 2/20/24 Response: Based on our field survey data and topographic information, the isolated wetland was confirmed to be an ILSF. See volume calculation table for details. A plan compiled available aerial photos and the recent highwater surveying data is added to the plan set for flood compensatory design. The survey data are very consistent with the historic aerial photos in flood extent. The maximum flooding elevation is at about 216 ft.*

      (Table provided in Applicant response letter)
      - TT 3/15/24 Update: As confirmed by the Applicant, the area is considered ILSF. **In our opinion, this comment is resolved.**
      - CLAWE 4/17/2024: No response is needed.

63. Farm Road Pond is mapped as a potential vernal pool in MassGIS (as shown on MassMapper). The

Applicant should provide documentation whether any studies have been performed to rule out existence of a vernal pool at that location. If no studies have been performed, we recommend this be completed prior to issuance of a Comprehensive Permit for the Project since presence of a vernal pool may alter Project scope.

- *CLAWE 2/20/24 Response: On July 21, 2023, the pond was surveyed and found containing plenty of mature fish (bluegill). Therefore, it is not qualified as a vernal pool according to 310 CMR 10.04. See the following photos for reference.*

  (Photos included in Applicant response letter)

  - TT 3/15/24 Update: The pond contains adult fish populations as noted in the reporting which does not meet the definition of a Vernal Pool as defined in 310 CMR 10.04. **In our opinion, this comment is resolved.**
  - CLAWE 4/17/2024: No response is needed.

64. The proposed septic system is located upgradient of an approximate 20% slope and within the 100-foot buffer to the adjacent wetland to the west of the site. The Applicant shall provide documentation that septic effluent will not breakout of the slope and flow to the wetland.

- *CLAWE 2/20/24 Response: Title 5 allows for 33% fill around septic field which is steeper than the natural 20% slope. As we showed in our groundwater table, the SAS area has deep soil and the normal high groundwater is almost at the same level of the wetland. The ground water mounding is less than 1 ft. See groundwater mounded analysis provided to the BOH for detail. Therefore, no breakout will occur.*
  - TT 3/15/24 Update: **See Update at Comment 60.**
  - CLAWE 4/17/2024: We believe that we have provided enough information to show that there will be no groundwater breakout within 100 ft of the SAS even with the larger (1.57 ft) updated groundwater mounding height. This is much more than the 50 ft minimal wetland setback requirement that is a natural groundwater breakout. Title 5 only requires 15 ft setback from 33% slope per 310CMR15.255 (2), which is steeper than the natural downgradient slope of the SAS for this project.

65. The Applicant is reducing runoff and volume to the Farm Road Pond area in all storm events analyzed. The Applicant shall provide documentation that reduction in runoff to the area will not negatively impact private water supply, ground water supply, pollution prevention and wildlife habitat.

- *CLAWE 2/20/24 Response: 1) as shown in the stormwater management report, the project site design applied low impact development style using country road and many swales and the infiltration basins well distributed to manage stormwater peak and volume. As a result, the overall site will have more water resources and more groundwater recharge meeting all DEP stormwater management standards. 2) The applicant provided nitrogen loading analysis and sited the SAS in an area with good soil condition and deep groundwater separation meeting drinking water standards at the downgradient receptor (property line and wetlands). Therefore, the project will not impact groundwater supply both in quantity and quality.*
  - TT 3/15/24 Update: The proposed stormwater design exceeds the required recharge volume by a wide margin, 2,256 cf required vs. 25,894 cf provided based on static volume in each basin below lowest outlets, plus additional as basins fill during storm events. Groundwater recharge is also provided in the swales and leaching catch basins which is not considered in the recharge accounting which will provide additional recharge volume. It is anticipated this level of recharge combined with surface discharge from the basins and SAS may increase flow (baseflow and overland flow) to the wetland. **See Update at Comment 58 for commentary related to groundwater modeling.**
  - CLAWE 4/17/2024: See response to Comment 58 for answer.

66. Filling is proposed adjacent to the pond and potentially within a revised limit of the potential ILSF. We recommend the Applicant provide analysis that flooding extents as a result of the proposed development will not impact abutting properties.

- *CLAWE 2/20/24 Response: The Applicant provided a detailed survey of maximum flooding and compared with historical aerial photos to confirm the maximum flooding. The minor volume fill in the fringe of the flooding area (215.2 ft to 216 ft) will be compensated by more storage volume around the* *pond. Therefore, the abutting land will not be negatively impacted.*

- TT 3/15/24 Update: The Applicant is reducing surface runoff to CP #3 control point (ILSF) in the post-development condition. This should help decrease the timing and extent of flooding at the ILSF area in addition to the proposed compensatory storage. However, it appears the northern portion of the proposed 215.25 contour may be missing from the grading plan. **All grading associated with the proposed compensatory storage should be shown on the grading plans for consistency.**

  CLAWE 4/17/2024: We checked the grading line for ILSF compensatory storage area and clarified the contour line at 215.25.

ADDITIONAL COMMENTS

67. The proposed fire water cistern is expected to be installed in the groundwater table. We recommend a Condition requiring the Applicant provide buoyancy calculations for the cistern for review prior to construction.

    CLAWE 4/17/2024: We agree with the recommendation.

68. Additional grading detail is needed at the discharge from DMH #3. It does not appear the proposed swale is graded to contain flow and direct to Basin A.

    CLAWE 4/17/2024: We checked the grading and updated the grading lines with head wall. The swale is also made deeper and steep downgradient of the pipe outfall to assure the flow to Basin A.

69. Due to potentially high groundwater conditions across the site, we recommend all utility trenches include bentonite or equal check dams to prevent groundwater migration through the trenches.

    CLAWE 4/17/2024: A typical cross section of bentonite or equal check dam has been added to the construction details and a note is added to the construction sequencing as note #9 and states that “All utilities shall be checked for groundwater condition and bentonite, or equal check dams be added where high groundwater is observed”.

70. Elevations do not match between the Plan and construction detail for Basin B2.

    CLAWE 4/17/2024: The grading contours are checked and updated as needed. The top of berm elevation on the construction detail has been updated to match the plan.

71. The current design does not provide any protection from debris migration into the infiltration galleys at Basin B2. Grass clippings and other organic matter is expected to enter the galleys which have no means for inspection and maintenance. Inspection ports for the galleys are also recommended to ensure the limits of the galleys can be properly inspected.

    CLAWE 4/17/2024: The grate access can provide access to the subsurface galley. It is updated so that the grate will be protected with filter fabric and crushed stones to prevent debris from entering the subsurface galley. One additional 4” inspection port is added to the end unit.

These comments are offered as guides for use during the Town’s review and additional comments are likely to be generated during the course of review. The Applicant shall be advised that any absence of comment shall not relieve him/her of the responsibility to comply with all applicable local, state and federal regulations for the Project. If you have any questions or comments, please feel free to contact us at (508) 786-2200.

In summary, we showed that the project team has provided all requested information and showed that the project is in full compliance with the design standards for stormwater and septic system design. Significant amount additional data analysis using third party software and DEP well data confirmed the project site overburden aquifer depth and hydraulic conductivity used for the analysis in our earlier analysis was in line with the new data analysis. The project as designed will not have significant negative impact on abutting properties and downgradient wetland resources according to the applied standards and rules and regulations.

Feel free to contact us if you have any questions.

Sincerely,

Creative Land & Water Engineering, LLC

By

Desheng Wang, Ph.D., P.E., CWS, CSE

Francis Alves, E.I.T., CSE
Civil/Environmental Engineer

Cc: Bob Murchison
Paul Haverty, esq.

Appendix A: HydrogeoSieve XL Analysis for Hydraulic Conductivity using sieve gradation

HydrogeoSieveXL

v 2.3.2

Developed by
J.F. Devlin
Dept. of Geology
University of Kansas
Developed April 29, 2014, most recent update September, 2016

This program is electronic supplementary material for the article
Devlin, J.F. 2015. HydrogeoSieveXL: an Excel-based tool to estimate hydraulic conductivity from grain-size

v.2.3.2 updated to include the Shephard, 1989 method, July, 2019

Introduction

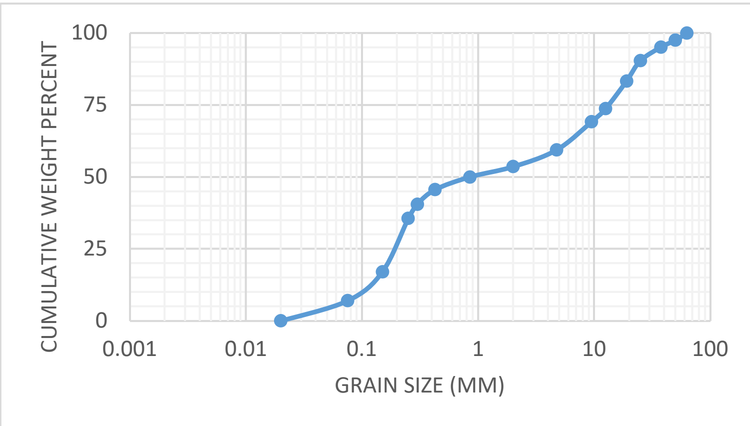
HydrogeoSieveXL is a utility aimed at providing hydrogeologists a quick and comprehensive means of obtaining hydraulic conductivity (*K*) estimates from grain size analyses. Note that the methods tend to be most accurate in handling the coarser fractions of material common to aquifers, i.e., sand and gravel, although the values of *K* that are generated are generally only approximate. The presence of significant fractions of fine fractions further degrades the quality of the *K* estimates.   This worksheet contains six tabbed worksheets: 1) this manual, 2) the HydrogeoSieveXLworksheet where all the computational work is done, and 3) a worksheet with sample data from selected literature sources 4) a table of equations used in the K estimations, and their sources, 5) a reference list with citations to contributing literature, 6) a sheet that summarizes the grain size data in a format suitable for pdf report generation and 7) a sheet that summarizes the K estimation calculations in a format suitable for pdf report generation. Following is an overview of the operation of the worksheet "Input" in the form of a tutorial that covers all the features of HydrogeoSieveXL.

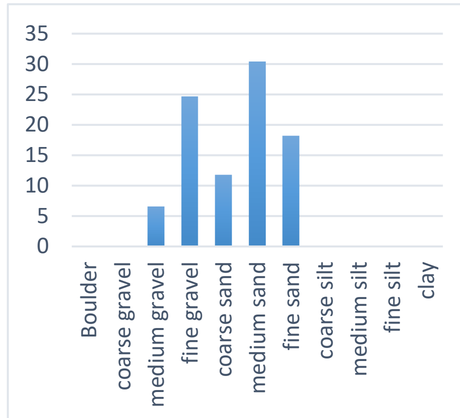
Grain Size Analysis Report | Date: 4/16/2024

Sample Name: S-1

Mass Sample (g): 100 | T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
63	0	0	100
50	25	0.025	97.5
37.5	24	0.024	95.1
25	47	0.047	90.4
19	71	0.071	83.3
12.5	96	0.096	73.7
9.5	45	0.045	69.2
4.75	98	0.098	59.4
2	58	0.058	53.6
0.85	36	0.036	50
0.425	44	0.044	45.6
0.3	51	0.051	40.5
0.25	49	0.049	35.6
0.15	185	0.185	17.1
0.075	101	0.101	7
0.02	70	0.07	0

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.090	Uniformity Coef.	12.73
d17	0.156	n computed	0.28
d20	0.186	g (cm/s^2)	980.00
d50	0.664	ρ (g/cm^3)	0.9981
d60	1.145	μ (g/cm s)	0.0098
de (Kruger)	0.491	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.444	tau (Sauerbrei)	1.053
de (Zunker)	0.459	$d_{geometric\ mean}$	1.040
de (Zamarin)	0.475	σ_ϕ	2.693
Io (Alyameni)	-0.054		

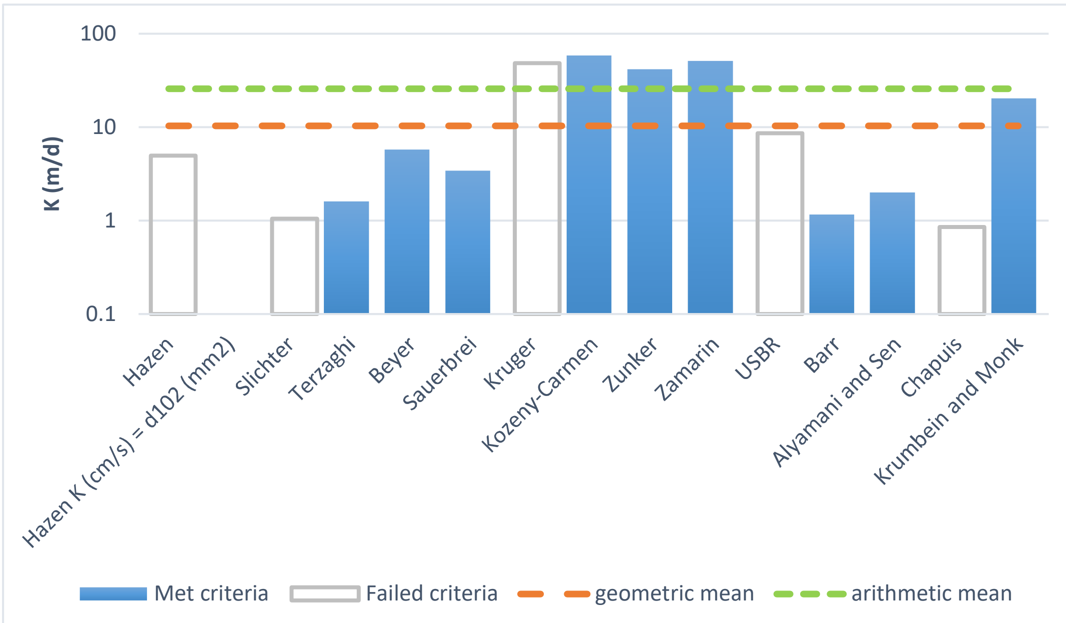
mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	0
8 - 16	medium gravel	6.6
2 - 8	fine gravel	24.7
0.5 - 2	coarse sand	11.8
0.25 - 0.5	medium sand	30.4
0.063 - 0.25	fine sand	18.2
0.016 - 0.063	coarse silt	
0.008 - 0.016	medium silt	
0.002 - 0.008	fine silt	
<0.002	clay	

K from Grain Size Analysis Report — Date: 4/16/2024

Sample Name: S-1

Mass Sample (g): 100 — T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.573E-02	.573E-04	4.95	
Hazen K (cm/s) = d_{10} (mm)		.000E+00	0.00	
Slichter	.121E-02	.121E-04	1.04	
Terzaghi	.186E-02	.186E-04	1.61	
Beyer	.666E-02	.666E-04	5.75	
Sauerbrei	.397E-02	.397E-04	3.43	
Kruger	.557E-01	.557E-03	48.15	
Kozeny-Carmen	.676E-01	.676E-03	58.45	
Zunker	.484E-01	.484E-03	41.84	
Zamarin	.592E-01	.592E-03	51.14	
USBR	.991E-02	.991E-04	8.57	
Barr	.135E-02	.135E-04	1.16	
Alyamani and Sen	.232E-02	.232E-04	2.01	
Chapuis	.989E-03	.989E-05	0.85	
Krumbein and Monk	.237E-01	.237E-03	20.44	
Shepherd	.842E-01	.842E-03	72.73	
geometric mean	.120E-01	.120E-03	10.33	
arithmetic mean	.299E-01	.299E-03	25.86	

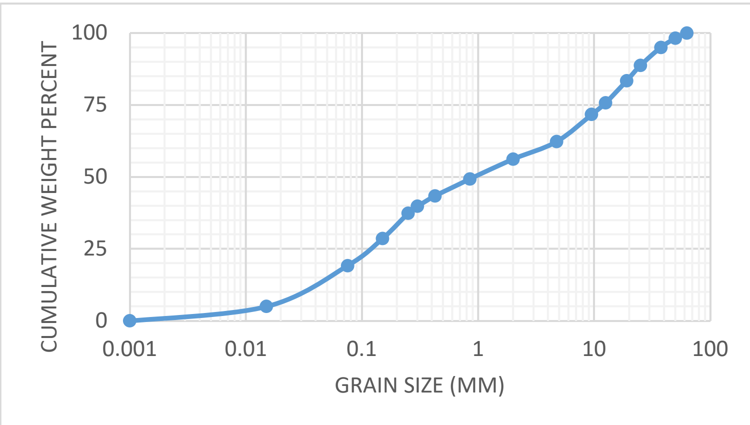
33.87 ft/day

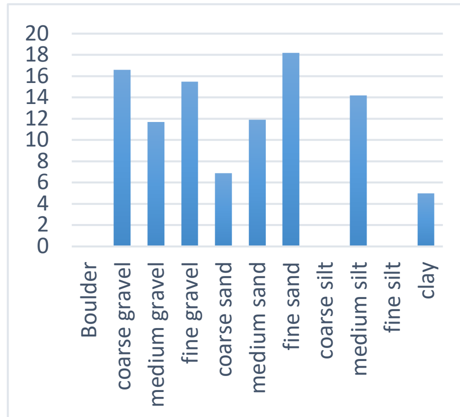
Grain Size Analysis Report   Date: 4/16/2024

Sample Name: S-2

Mass Sample (g): 100   T (oC) 20

Poorly sorted gravelly sand with fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
63	0	0	100
50	1.8	0.018	98.2
37.5	3.2	0.032	95
25	6.3	0.063	88.7
19	5.3	0.053	83.4
12.5	7.7	0.077	75.7
9.5	4	0.04	71.7
4.75	9.4	0.094	62.3
2	6.1	0.061	56.2
0.85	6.9	0.069	49.3
0.425	5.9	0.059	43.4
0.3	3.6	0.036	39.8
0.25	2.4	0.024	37.4
0.15	8.8	0.088	28.6
0.075	9.4	0.094	19.2
0.015	14.2	0.142	5
0.001	5	0.05	0

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.036	Uniformity Coef.	102.78
d17	0.066	n computed	0.26
d20	0.081	g (cm/s^2)	980.00
d50	0.967	ρ (g/cm^3)	0.9981
d60	3.713	μ (g/cm s)	0.0098
de (Kruger)	0.090	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.029	tau (Sauerbrei)	1.053
de (Zunker)	0.042	$d_{geometric\ mean}$	0.933
de (Zamarin)	0.066	σ_ϕ	3.791
Io (Alyameni)	-0.197		

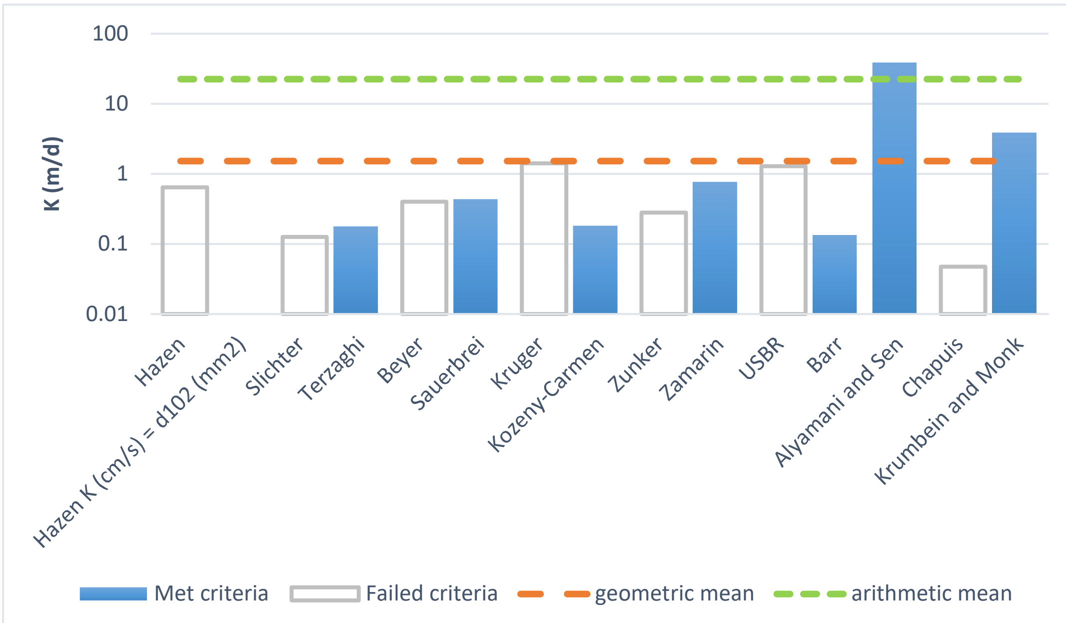
mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	16.6
8 - 16	medium gravel	11.7
2 - 8	fine gravel	15.5
0.5 - 2	coarse sand	6.9
0.25 - 0.5	medium sand	11.9
0.063 - 0.25	fine sand	18.2
0.016 - 0.063	coarse silt	
0.008 - 0.016	medium silt	14.2
0.002 - 0.008	fine silt	
<0.002	clay	5

K from Grain Size Analysis Report Date: 4/16/2024

Sample Name: S-2

Mass Sample (g): 100 T (oC) 20

Poorly sorted gravelly sand with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.739E-03	.739E-05	0.64	
Hazen K (cm/s) = d_{10} (mm)		.000E+00	0.00	
Slichter	.145E-03	.145E-05	0.13	
Terzaghi	.207E-03	.207E-05	0.18	
Beyer	.463E-03	.463E-05	0.40	
Sauerbrei	.506E-03	.506E-05	0.44	
Kruger	.162E-02	.162E-04	1.40	
Kozeny-Carmen	.211E-03	.211E-05	0.18	
Zunker	.321E-03	.321E-05	0.28	
Zamarin	.887E-03	.887E-05	0.77	
USBR	.149E-02	.149E-04	1.29	
Barr	.156E-03	.156E-05	0.13	
Alyamani and Sen	.452E-01	.452E-03	39.02	
Chapuis	.543E-04	.543E-06	0.05	
Krumbein and Monk	.452E-02	.452E-04	3.91	
Shepherd	.156E+00	.156E-02	135.03	
geometric mean	.177E-02	.177E-04	1.53	
arithmetic mean	.260E-01	.260E-03	22.46	

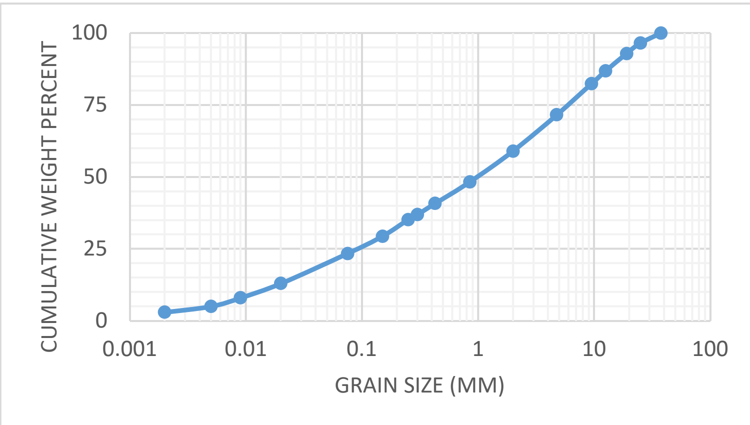
5.02 ft/d

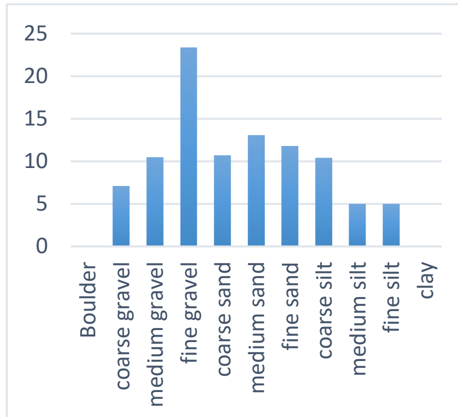
Grain Size Analysis Report | Date: 4/16/2024

Sample Name: SA

Mass Sample (g): 100 | T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
37.5	0	0	100
25	3.5	0.035	96.5
19	3.6	0.036	92.9
12.5	6.1	0.061	86.8
9.5	4.4	0.044	82.4
4.75	10.8	0.108	71.6
2	12.6	0.126	59
0.85	10.7	0.107	48.3
0.425	7.5	0.075	40.8
0.3	3.9	0.039	36.9
0.25	1.7	0.017	35.2
0.15	5.8	0.058	29.4
0.075	6	0.06	23.4
0.02	10.4	0.104	13
0.009	5	0.05	8
0.005	3	0.03	5
0.002	2	0.02	3

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.013	Uniformity Coef.	165.54
d17	0.041	n computed	0.26
d20	0.057	g (cm/s^2)	980.00
d50	1.033	ρ (g/cm^3)	0.9981
d60	2.218	μ (g/cm s)	0.0098
de (Kruger)	0.059	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.026	tau (Sauerbrei)	1.053
de (Zunker)	0.027	$d_{geometric\ mean}$	0.763
de (Zamarin)	0.028	σ_ϕ	3.890
Io (Alyameni)	-0.241		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	7.1
8 - 16	medium gravel	10.5
2 - 8	fine gravel	23.4
0.5 - 2	coarse sand	10.7
0.25 - 0.5	medium sand	13.1
0.063 - 0.25	fine sand	11.8
0.016 - 0.063	coarse silt	10.4
0.008 - 0.016	medium silt	5
0.002 - 0.008	fine silt	5
<0.002	clay	

K from Grain Size Analysis Report

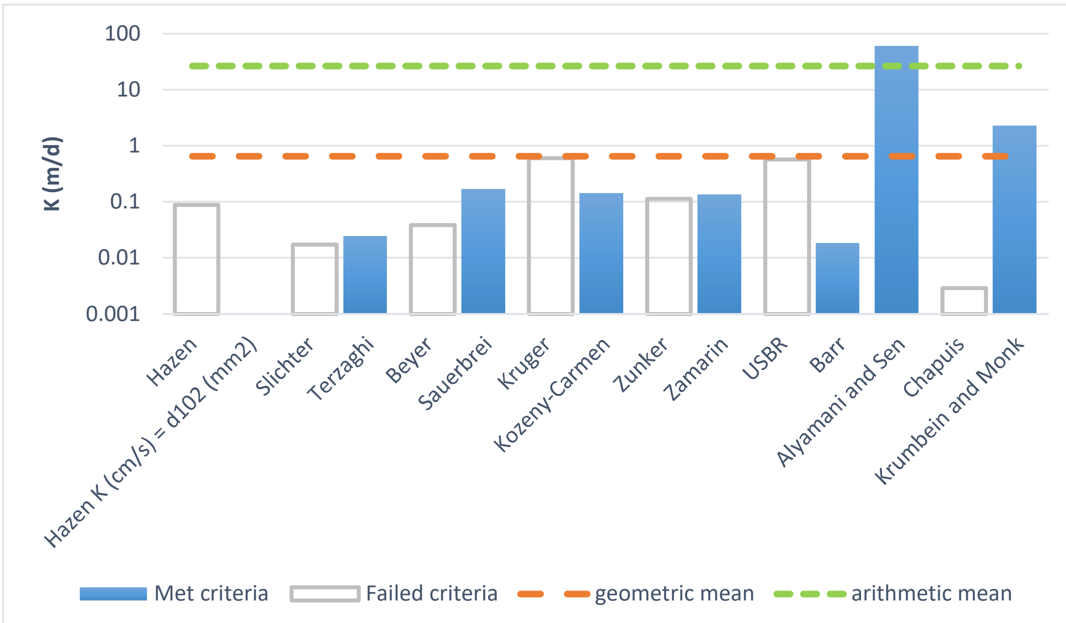
Date: 4/16/2024

Sample Name: SA

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.102E-03	.102E-05	0.09	
Hazen K (cm/s) = d_{10} (mm)		.000E+00	0.00	
Slichter	.200E-04	.200E-06	0.02	
Terzaghi	.285E-04	.285E-06	0.02	
Beyer	.445E-04	.445E-06	0.04	
Sauerbrei	.198E-03	.198E-05	0.17	
Kruger	.696E-03	.696E-05	0.60	
Kozeny-Carmen	.167E-03	.167E-05	0.14	
Zunker	.131E-03	.131E-05	0.11	
Zamarin	.158E-03	.158E-05	0.14	
USBR	.656E-03	.656E-05	0.57	
Barr	.214E-04	.214E-06	0.02	
Alyamani and Sen	.702E-01	.702E-03	60.62	
Chapuis	.332E-05	.332E-07	0.00	
Krumbein and Monk	.265E-02	.265E-04	2.29	
Shepherd	.174E+00	.174E-02	150.59	
geometric mean	.754E-03	.754E-05	0.65	
arithmetic mean	.310E-01	.310E-03	26.75	

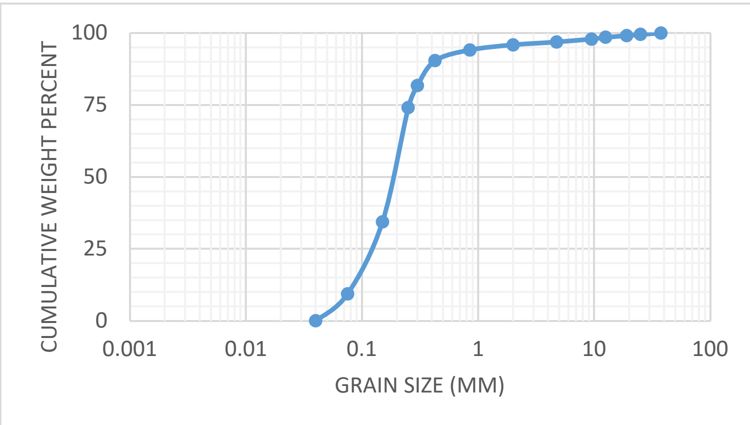
2.14 ft/d

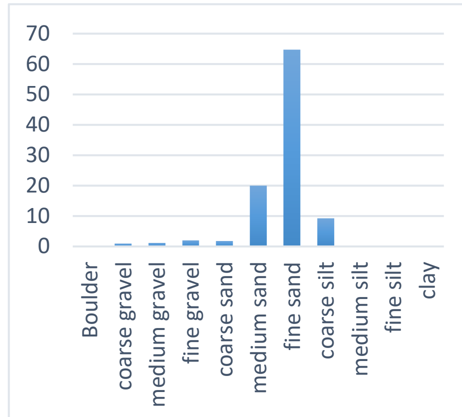
Grain Size Analysis Report — Date: 4/16/2024

Sample Name: SB1

Mass Sample (g): 100 — T (oC) 20

Moderately well sorted sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
37.5	0	0	100
25	0.5	0.005	99.5
19	0.4	0.004	99.1
12.5	0.6	0.006	98.5
9.5	0.6	0.006	97.9
4.75	1	0.01	96.9
2	1	0.01	95.9
0.85	1.8	0.018	94.1
0.425	3.7	0.037	90.4
0.3	8.7	0.087	81.7
0.25	7.6	0.076	74.1
0.15	39.7	0.397	34.4
0.075	25	0.25	9.4
0.04	9.3	0.093	0.1

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.077	Uniformity Coef.	2.79
d17	0.098	n computed	0.41
d20	0.107	g (cm/s^2)	980.00
d50	0.189	ρ (g/cm^3)	0.9981
d60	0.214	μ (g/cm s)	0.0098
de (Kruger)	0.156	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.143	tau (Sauerbrei)	1.053
de (Zunker)	0.147	$d_{geometric\ mean}$	0.203
de (Zamarin)	0.151	σ_ϕ	1.151
Io (Alyameni)	0.049		

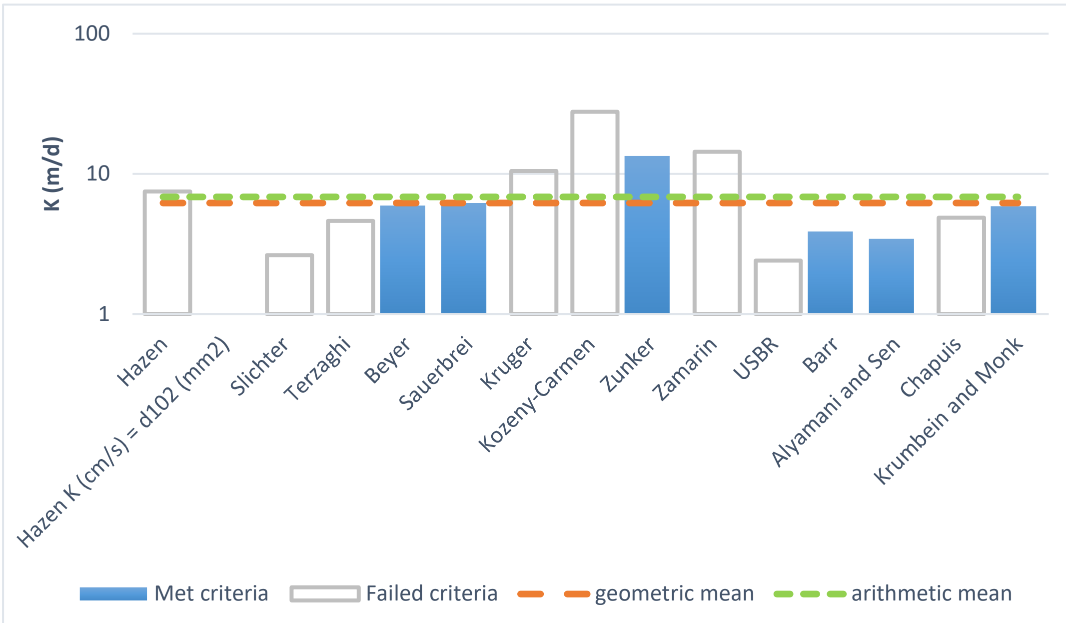
mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	0.9
8 - 16	medium gravel	1.2
2 - 8	fine gravel	2
0.5 - 2	coarse sand	1.8
0.25 - 0.5	medium sand	20
0.063 - 0.25	fine sand	64.7
0.016 - 0.063	coarse silt	9.3
0.008 - 0.016	medium silt	
0.002 - 0.008	fine silt	
<0.002	clay	

K from Grain Size Analysis Report | Date: 4/16/2024

Sample Name: SB1

Mass Sample (g): 100 | T (oC) 20

Moderately well sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.867E-02	.867E-04	7.49	
Hazen K (cm/s) = d_{10} (mm)		.000E+00	0.00	
Slichter	.304E-02	.304E-04	2.63	
Terzaghi	.533E-02	.533E-04	4.60	
Beyer	.686E-02	.686E-04	5.93	
Sauerbrei	.716E-02	.716E-04	6.18	
Kruger	.121E-01	.121E-03	10.46	
Kozeny-Carmen	.320E-01	.320E-03	27.63	
Zunker	.156E-01	.156E-03	13.46	
Zamarin	.166E-01	.166E-03	14.35	
USBR	.278E-02	.278E-04	2.40	
Barr	.449E-02	.449E-04	3.88	
Alyamani and Sen	.399E-02	.399E-04	3.45	
Chapuis	.563E-02	.563E-04	4.86	
Krumbein and Monk	.680E-02	.680E-04	5.87	
Shepherd	.106E-01	.106E-03	9.16	
geometric mean	.719E-02	.719E-04	6.21	
arithmetic mean	.793E-02	.793E-04	6.85	

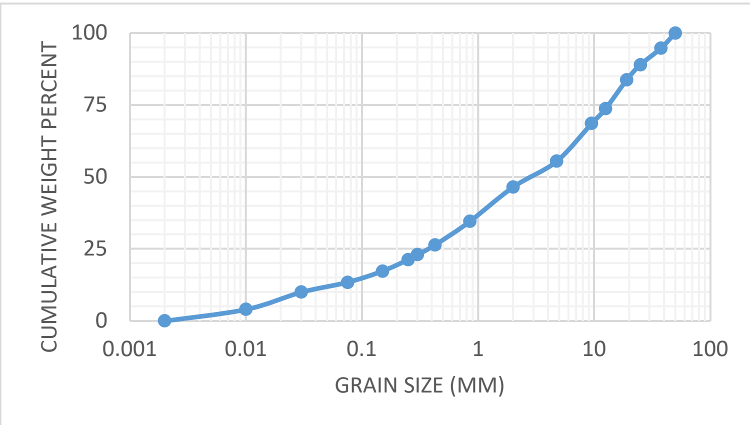
20.37 ft/d

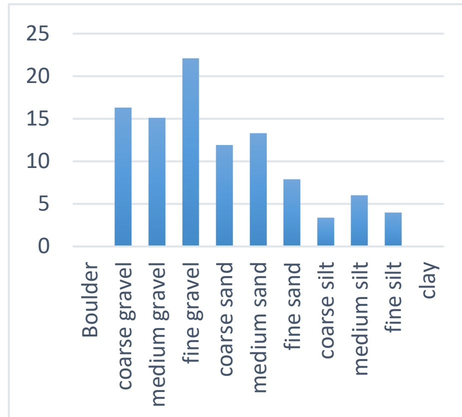
Grain Size Analysis Report Date: 4/16/2024

Sample Name: SB2

Mass Sample (g): 100 T (oC) 20

Poorly sorted sandy gravel low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
50	0	0	100
37.5	5.3	0.053	94.7
25	5.7	0.057	89
19	5.3	0.053	83.7
12.5	10	0.1	73.7
9.5	5.1	0.051	68.6
4.75	13.1	0.131	55.5
2	9	0.09	46.5
0.85	11.9	0.119	34.6
0.425	8.2	0.082	26.4
0.3	3.4	0.034	23
0.25	1.7	0.017	21.3
0.15	4	0.04	17.3
0.075	3.9	0.039	13.4
0.03	3.4	0.034	10
0.01	6	0.06	4
0.002	3.99	0.0399	0.01

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.030	Uniformity Coef.	212.72
d17	0.144	n computed	0.26
d20	0.218	g (cm/s^2)	980.00
d50	3.069	ρ (g/cm^3)	0.9981
d60	6.382	μ (g/cm s)	0.0098
de (Kruger)	0.089	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.056	tau (Sauerbrei)	1.053
de (Zunker)	0.065	$d_{geometric\ mean}$	1.684
de (Zamarin)	0.076	σ_ϕ	3.558
Io (Alyameni)	-0.730		

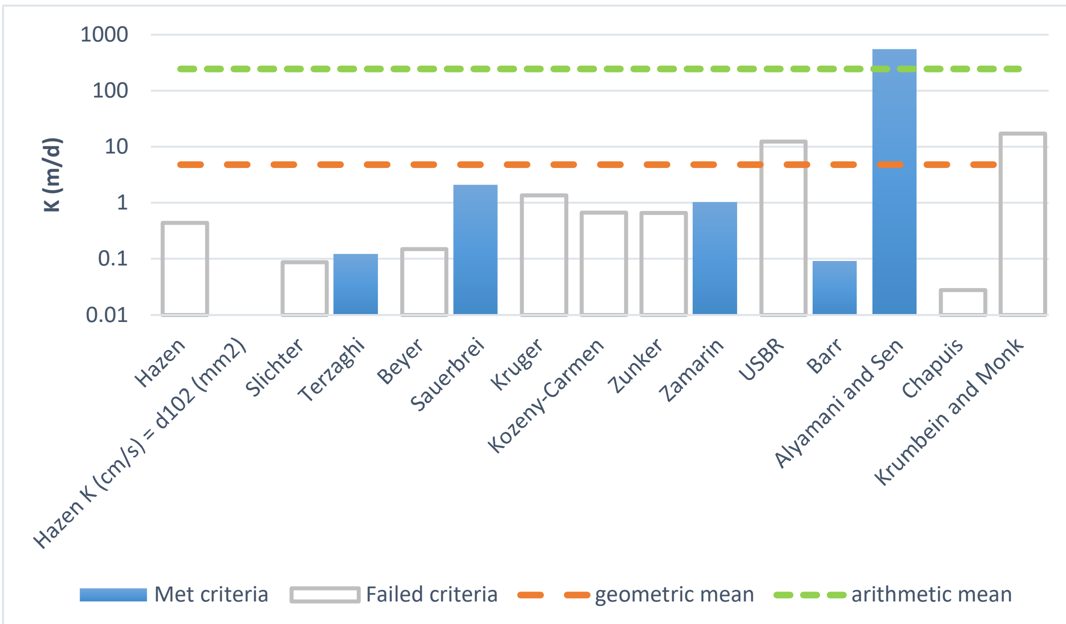
mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	16.3
8 - 16	medium gravel	15.1
2 - 8	fine gravel	22.1
0.5 - 2	coarse sand	11.9
0.25 - 0.5	medium sand	13.3
0.063 - 0.25	fine sand	7.9
0.016 - 0.063	coarse silt	3.4
0.008 - 0.016	medium silt	6
0.002 - 0.008	fine silt	3.99
<0.002	clay	

K from Grain Size Analysis Report | Date: 4/16/2024

Sample Name: SB2

Mass Sample (g): 100 | T (oC) 20

Poorly sorted sandy gravel low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.510E-03	.510E-05	0.44	
Hazen K (cm/s) = d_{10} (mm)		.000E+00	0.00	
Slichter	.100E-03	.100E-05	0.09	
Terzaghi	.143E-03	.143E-05	0.12	
Beyer	.173E-03	.173E-05	0.15	
Sauerbrei	.244E-02	.244E-04	2.11	
Kruger	.156E-02	.156E-04	1.35	
Kozeny-Carmen	.769E-03	.769E-05	0.66	
Zunker	.760E-03	.760E-05	0.66	
Zamarin	.119E-02	.119E-04	1.03	
USBR	.143E-01	.143E-03	12.33	
Barr	.107E-03	.107E-05	0.09	
Alyamani and Sen	.643E+00	.643E-02	555.82	
Chapuis	.322E-04	.322E-06	0.03	
Krumbein and Monk	.200E-01	.200E-03	17.25	
Shepherd	.105E+01	.105E-01	908.61	
geometric mean	.558E-02	.558E-04	4.82	
arithmetic mean	.283E+00	.283E-02	244.63	

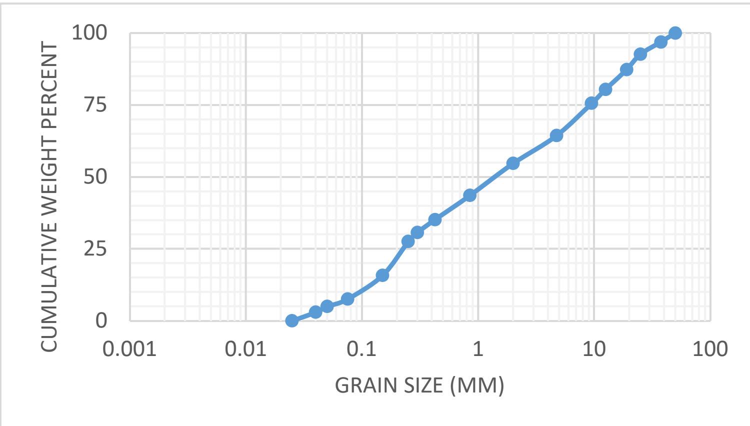
15.82 ft/d

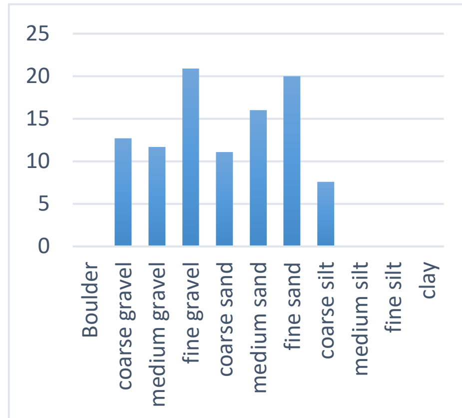
Grain Size Analysis Report   Date: 4/16/2024

Sample Name: SC

Mass Sample (g): 100   T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
50	0	0	100
37.5	3.1	0.031	96.9
25	4.3	0.043	92.6
19	5.3	0.053	87.3
12.5	6.9	0.069	80.4
9.5	4.8	0.048	75.6
4.75	11.2	0.112	64.4
2	9.7	0.097	54.7
0.85	11.1	0.111	43.6
0.425	8.4	0.084	35.2
0.3	4.5	0.045	30.7
0.25	3.1	0.031	27.6
0.15	11.8	0.118	15.8
0.075	8.2	0.082	7.6
0.05	2.6	0.026	5
0.04	2	0.02	3
0.025	2.99	0.0299	0.01

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.097	Uniformity Coef.	36.13
d17	0.160	n computed	0.26
d20	0.186	g (cm/s^2)	980.00
d50	1.513	ρ (g/cm^3)	0.9981
d60	3.503	μ (g/cm s)	0.0098
de (Kruger)	0.278	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.260	tau (Sauerbrei)	1.053
de (Zunker)	0.265	$d_{geometric\ mean}$	1.402
de (Zamarin)	0.271	σ_ϕ	3.090
Io (Alyameni)	-0.257		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	12.7
8 - 16	medium gravel	11.7
2 - 8	fine gravel	20.9
0.5 - 2	coarse sand	11.1
0.25 - 0.5	medium sand	16
0.063 - 0.25	fine sand	20
0.016 - 0.063	coarse silt	7.59
0.008 - 0.016	medium silt	
0.002 - 0.008	fine silt	
<0.002	clay	

K from Grain Size Analysis Report

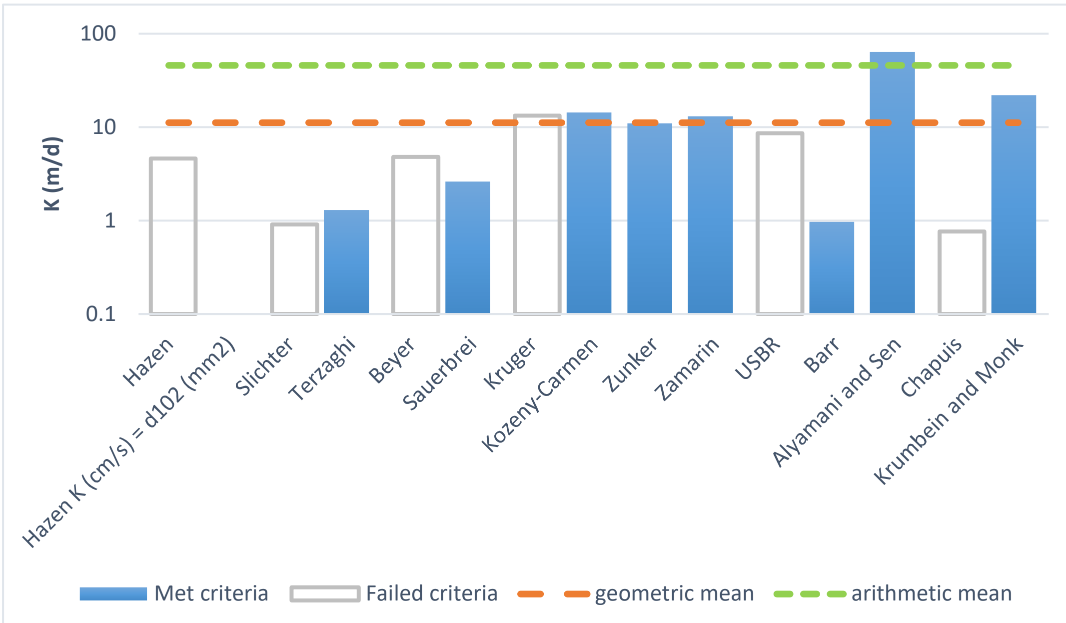
Date: 4/16/2024

Sample Name: SC

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.534E-02	.534E-04	4.61	
Hazen K (cm/s) = d_{10} (mm)		.000E+00	0.00	
Slichter	.105E-02	.105E-04	0.91	
Terzaghi	.150E-02	.150E-04	1.29	
Beyer	.554E-02	.554E-04	4.79	
Sauerbrei	.302E-02	.302E-04	2.61	
Kruger	.153E-01	.153E-03	13.23	
Kozeny-Carmen	.167E-01	.167E-03	14.40	
Zunker	.127E-01	.127E-03	11.01	
Zamarin	.151E-01	.151E-03	13.06	
USBR	.991E-02	.991E-04	8.56	
Barr	.113E-02	.113E-04	0.97	
Alyamani and Sen	.739E-01	.739E-03	63.88	
Chapuis	.880E-03	.880E-05	0.76	
Krumbein and Monk	.256E-01	.256E-03	22.08	
Shepherd	.327E+00	.327E-02	282.81	
geometric mean	.129E-01	.129E-03	11.17	
arithmetic mean	.530E-01	.530E-03	45.79	

36.66 ft/d

Appendix B: DEP well Analysis for aquifer thickness around 65 Farm Road

Table B1. Existing Well Information and Analysis (DEP and SBOH data

Well #	Well Location	Well Depth (ft)	Depth to Bedrock (ft)	Static Water Level (ft)	Date of SWL measured	Yield (GPM)	Saturated depth of soil, ft	Note
1	65 Farm Rd	605	n/a	80	6/17/2008	30		
2	53 Farm Rd	300	18	5.5	11/15/2021	11.4	14.5	2 ft GW correction
2a	55 Farm Rd	520	17	5	5/20/1980	10		
3	49 Farm Rd	400	25	5	10/13/2005	20	20	based on higher water 5 ft
4	35 Farm Rd	140	9	2	5/25/1997	15		
5	**15 Farm Rd**	**600**	33	15	2/2/2016	2	18	measured during high water season
6	1 Farm Rd	520	17	n/a	n/a	3		
7	25 S. Main St	205	8	40	10/24/1989	5		
8	21 S. Main St	n/a	n/a	n/a	n/a	n/a		
9	21 S. Main St	20	n/a	15	9/15/2003	n/a		
10	11 S. Main St	n/a	n/a	n/a	n/a	n/a		
11	11 Leland Drive	400	14	25	12/17/1982	3.5		Not representative
12		505	15	15	12/17/1982	4		Not representative
13		450	12	30	12/17/1982	n/a		Not representative
14		400	13	15	12/17/1982	7.5		
15	2 N. Main St	1000	19	11.4	n/a	10.6		
16	2 N. Main St	1140	19	11.4	11/5/2013	10.6	14	EHGW=5'
17	20 N. Main St	410	8	n/a	11/16/1983	12		Date water sample delivered to lab
18	22 N. Main St	800	n/a	40	8/27/1997	3.5		
19	24 N. Main St	24	n/a	n/a	n/a	n/a		
20	26 N. Main St	12	n/a	8	10/10/1996	n/a		
21	26 N. Main St	12	n/a	6	3/8/2006	n/a		
22	30 N. Main St	124	n/a	10	9/17/2007	n/a		
23	36 N. Main St	565	20	13	7/24/1993	5	15	8' GW adj for low water season
24	2 Eliot St	125	65	20	6/7/1994	16	50	5' GW adj for low water seaosn
25	10 Eliot St	400	44	6	5/6/1994	12	41	3' GW adj
26	10 Pine Hill Ln	n/a	n/a	n/a	n/a	n/a		
27	41 Eliot St	305	20	34	6/10/1994	12		
28	45 Eliot St	185	20	55	10/15/2021	75		
29	45 Eliot St	120	n/a	10	11/22/2021	n/a		
30	53 Eliot St	520	n/a	25	2/17/2022	n/a		
31	53 Eliot St	n/a	68	n/a	n/a	n/a		
32	53 Lake St	505	**82**	35	5/30/2003	2.5		
33	87 Lake St	n/a	21	n/a	n/a	n/a		
34	87 Lake St	305	48	42	11/13/1973	10		
35	91 Lake St	230	10	58	6/22/1994	17		
36	101 Lake St	185	69	40	1/10/1990	40		
37	101 Lake St	465	30	30	8/9/2000	20		
38	125 Lake St	300	25	42	6/11/2004	8		
39	89 Farm Rd	520	13	4	3/21/2008	18.11		not in the same watershed
40	100 Farm Rd	145	8	30	4/15/2008	40		not in the same watershed
41	**64 Farm Rd**	305	18	20	9/23/2008	8		
n/a - not available								
	Average							
		523.75	28.13	10.54		12.33	19.59	with 2 ft HGW adj
	Bedrock section	495.63	1500				23.59	with 6 ft HGW adj
	Draw down assum	100						
	Bedrock K, ft/day	0.085						
	Equivalent H, ft	6.38	assuming 1500 ft of bedrock aquifer					
	at 20 ft/day							

Red colored data are used for analysis due to the complete information and location in similar geological setting.

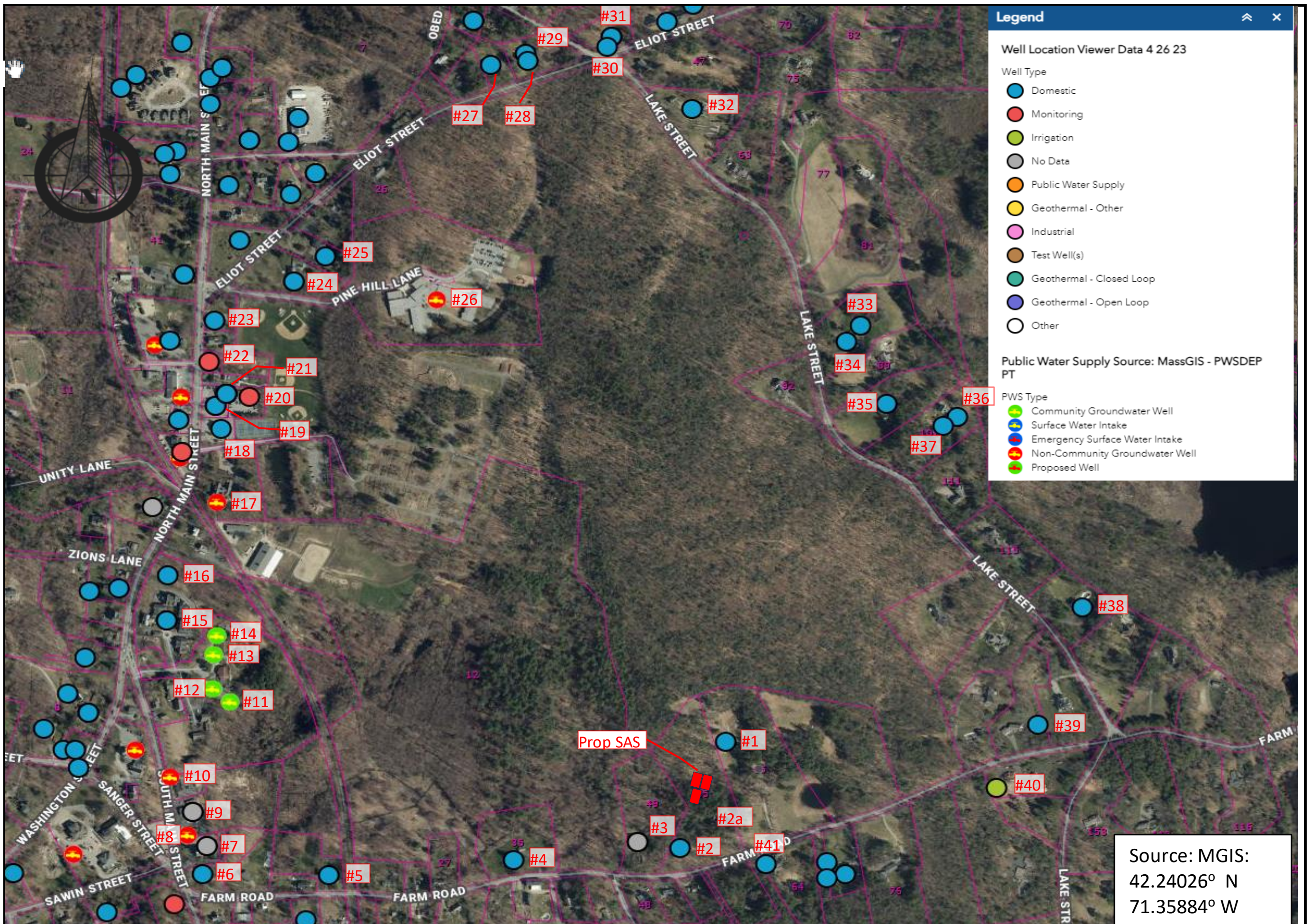


Figure B1: Location of Exising DEP Wells	Project: 65 Farm Road Sherborn - Massachusetts	Prepared by: Creative Land & Water Engineering, LLC Environmental Scientists and Engineers P.O.Box 584 - Southborough - MA - 01772 774-454-0266 http://claweng.com

Creative Land & Water Engineering, LLC
Environmental Science and Engineering
P.O. Box 584, Southborough, MA 01772
Tel: (508)281-1694 email: desehngw@yahoo.com

Subject: Well Drawdown
Farm Rd
Sherborn, MA
Location: Middlesex

By: DSW **Date:** 18-Apr-24
Chkd: **Date:**
Job No.: J269-12 **Sheet:** 1 of 1

Confined Aquifer Condition (Steady State): 53 Farm Road

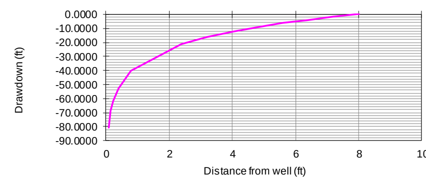
Input Report:

Equilibrium Head (ft) =	234.5	Pumping rate (gpm) =	11.4	K
Transmissivity T (ft^2/s) =	0.00023	Equilibrium radius (ft) =	8	9.81E-07 ft/s
Storage Coef.. S =	0.21			0.084742 ft/day

Output Report:

Radius, r (ft)	r/re	Dawdown (ft) h(r) - h(re) = Q/(2*pi*T) ln (r/re)	Water from Storage (gallon)
0.08	0.01	-80.9342	0.961968
0.16	0.02	-68.7524	2.425027
0.24	0.03	-61.6265	7.245799
0.4	0.05	-52.6489	31.29499
0.8	0.1	-40.4671	336.2316
2.4	0.3	-21.1594	535.8579
3.2	0.4	-16.1035	789.7991
4	0.5	-12.1818	1098.496
4.8	0.6	-8.9776	1462.185
5.6	0.7	-6.2684	1881.004
6.4	0.8	-3.9217	2355.045
7.2	0.9	-1.8517	2884.369
8	1	0.0000	2884.369
		Pumped	4.216914 hrs

Confined Aquifer



Unconfined Aquifer Condition (Steady State):

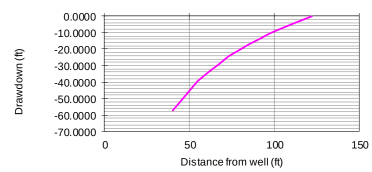
Input Report:

Equilibrium Head (ft) =	234	Pumping rate (gpm) =	12
Conductivity, K (ft/s)	0.0000004	Equilibrium radius (ft) =	122
Specific Yield, S =	0.21		

Output Report

Radius, r (ft)	r/re	Dawdown (h(r)-h(re) (ft) h(r)^2- h(re)^2= Q/(pi*K) ln (r/re)	h (r)	Water from Storage (gallon)
40.26	0.33	-57.4506	234	110946.6
48.8	0.4	-46.2174	234	198257.2
54.9	0.45	-39.6598	234	292723.7
61	0.5	-33.9760	234	394310.6
67.1	0.55	-28.9700	234	502975.5
73.2	0.6	-24.5044	234	618674
79.3	0.65	-20.4788	234	741361.1
85.4	0.7	-16.8183		870993.1
91.5	0.75	-13.4650		1007528
97.6	0.8	-10.3737		1150924
103.7	0.85	-7.5083		1301143
109.8	0.9	-4.8396		1622883
122	1	0.0000		1622883

Unconfined

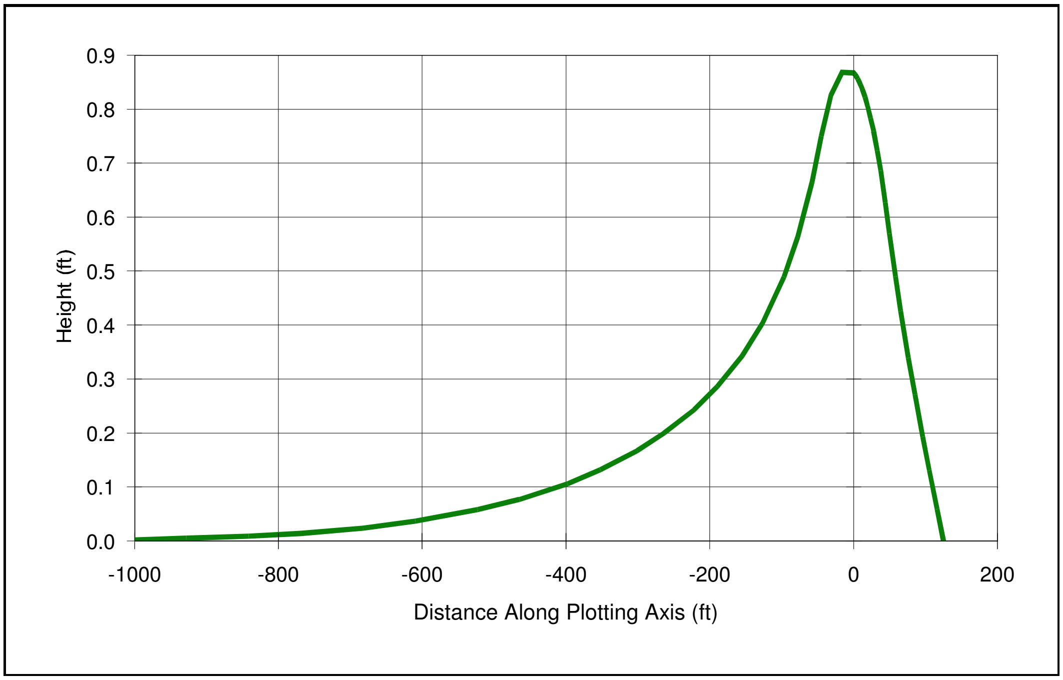


Aquifer Drawdown analysis V 1.0 (c) , by Desheng Wang, Ph.D., P.E., Creative Land & Water Engineering, LLC

Appendix C: Updated Groundwater Mounding Analysis using Hantush method

Parameters	Leaching Field		Note
Recharge area	SAS 1+2	SAS3	1. All trenches are placed more than 8 ft above the estimated highgroundwater and not be impacted by groundwater mounding. 2. Hydraulic conductivity is updated using Hydrogeosieve XL
Dimension, Length, ft	92	82	
Dimension, Width, ft	82	46	
Area, sq. ft	7544.00	3772.00	
Recharge Vol. Cu ft (per day or event)	745.10	372.55	
Duration, day	90	90	
Recharge rate, cu ft/day/sq. ft	0.10	0.10	
Dewater time, day	90	90	
GW Separation, ft	8.49	12.58	
Distance to wetland, ft	125	125	
Maximum mounding height (with constant head at wetland), ft	0.87	0.41	
Maximum mounding height (No constant head at wetland), ft	1.17	0.65	
Estimated effective Max MH, ft	**1.57**	**1.37**	
Impact mounding height by other systems, ft	**0.4**	**0.72**	
Combined Mound height, ft	**1.57**	**1.37**	
Bottom of Trench, ft	**192.58**	**192.08**	
Top of stones, ft			
EHGW, ft	184.09	179.5	
	average		
Bottom aquifer, ft	**170**	**170**	
Flood routing elev, ft	291.670	291.670	
Top of grade, ft	292.5	275.5	
Aquafer depth, ft	14.5	14.5	
Hydraulic Conductivity, ft/day	19.46	19.46	
Groundwater mound rage, ft	See ground water map		

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:43:45 PM

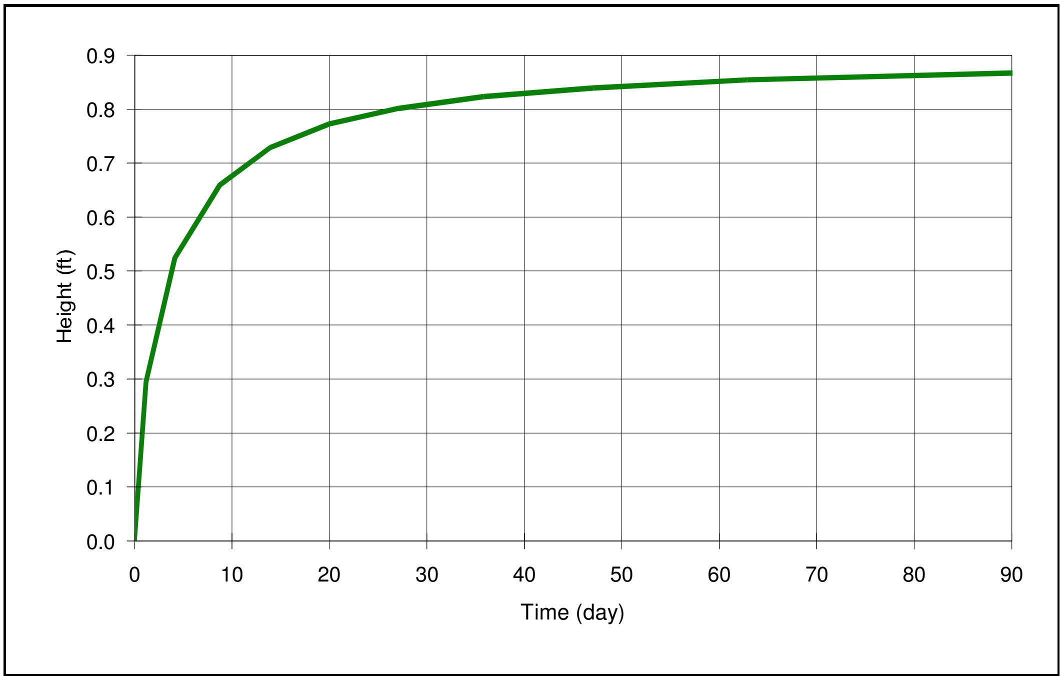
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
Constant head boundary used at: 125 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 46 ft
Total volume applied: 67896 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-1000	-1000	0
0	-841	-841	0.01
0	-681.9	-682	0.02
0	-522.9	-523	0.06
0	-397.9	-398	0.11
0	-301	-301	0.17
0	-221.8	-222	0.24
0	-154.9	-155	0.34
0	-96.9	-97	0.49
0	-58	-58	0.66
0	-31.5	-32	0.83
0	0	0	0.87
0	3.9	4	0.86
0	7.2	7	0.85
0	12.1	12	0.84
0	19.4	19	0.81
0	27.7	28	0.76
0	37.6	38	0.69
0	49.7	50	0.57
0	65.4	65	0.43
0	85.2	85	0.27
0	105.1	105	0.13
0	125	125	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:45:19 PM

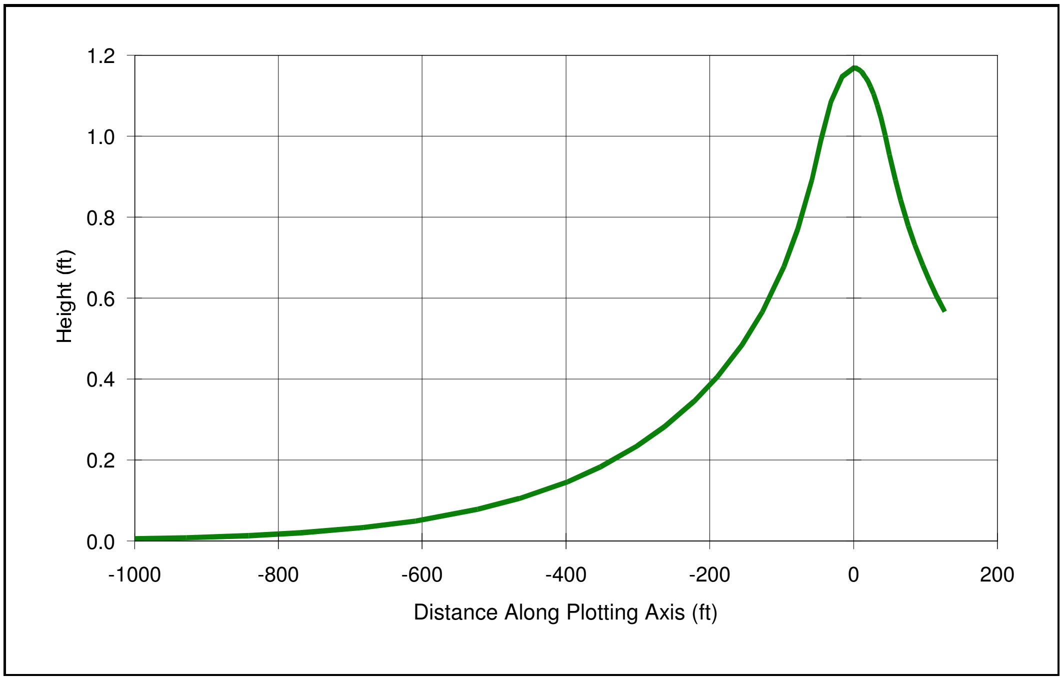
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
Constant head boundary used at: 125 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 67896 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.3
4	0.52
9	0.66
14	0.73
20	0.77
27	0.8
36	0.82
47	0.84
63	0.85
90	0.87

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:45:46 PM

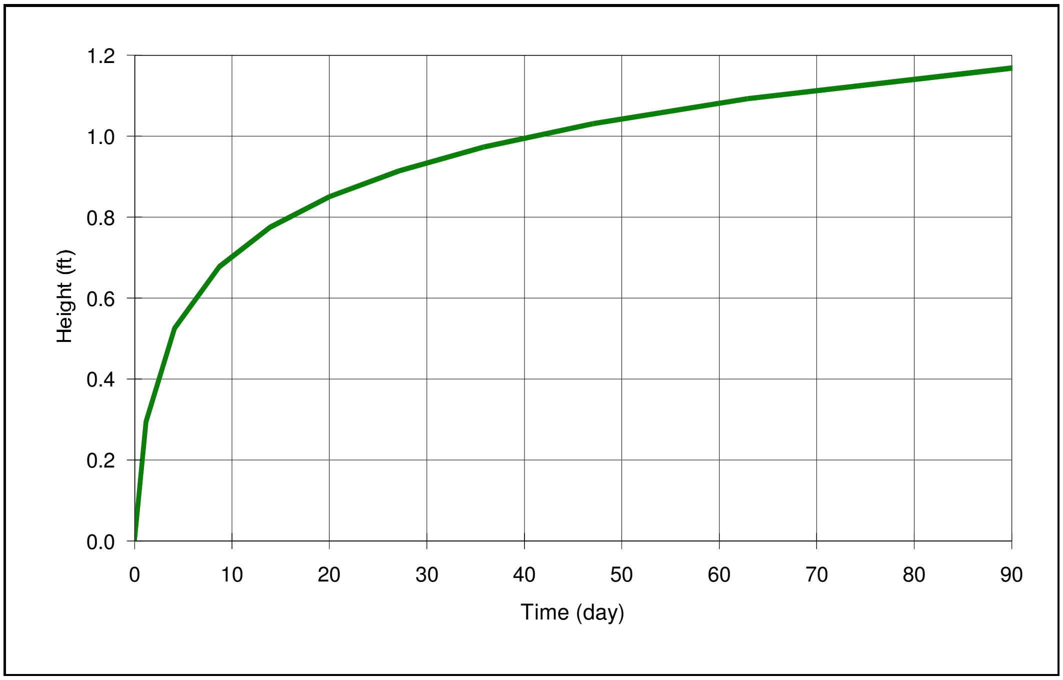
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
No constant head boundary used
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 46 ft
Total volume applied: 67896 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-1000	-1000	0.01
0	-841	-841	0.01
0	-681.9	-682	0.03
0	-522.9	-523	0.08
0	-397.9	-398	0.15
0	-301	-301	0.24
0	-221.8	-222	0.34
0	-154.9	-155	0.48
0	-96.9	-97	0.68
0	-58	-58	0.89
0	-31.5	-32	1.08
0	0	0	1.17
0	3.9	4	1.17
0	7.2	7	1.16
0	12.1	12	1.16
0	19.4	19	1.14
0	27.7	28	1.1
0	37.6	38	1.05
0	49.7	50	0.95
0	65.4	65	0.84
0	85.2	85	0.73
0	105.1	105	0.64
0	125	125	0.57

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:46:27 PM

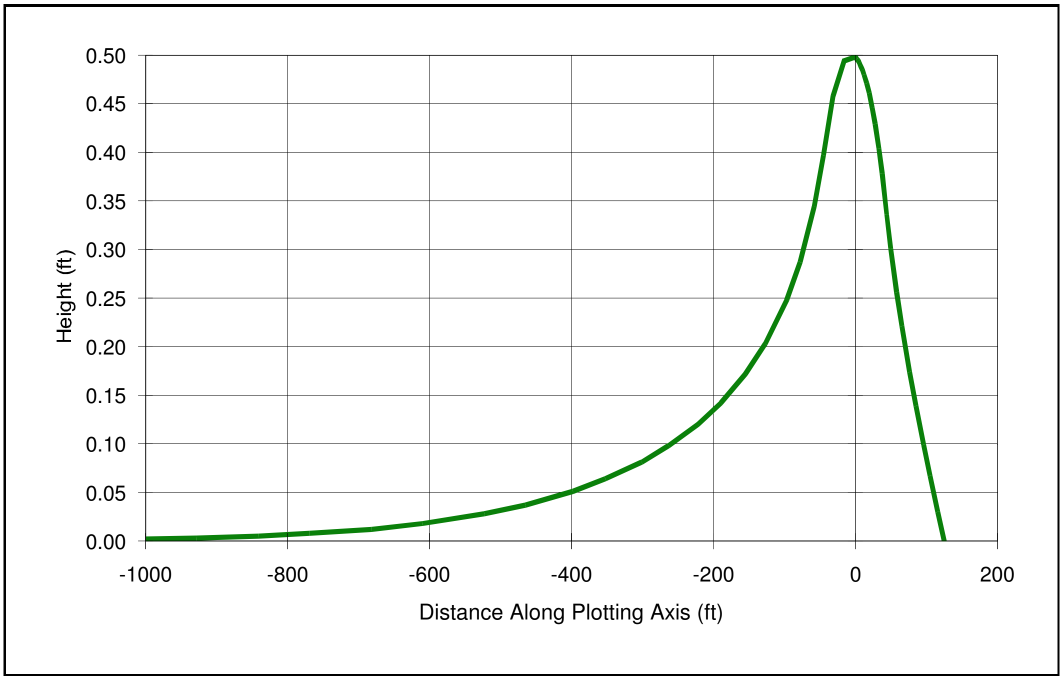
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
No constant head boundary used
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 67896 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.3
4	0.53
9	0.68
14	0.78
20	0.85
27	0.91
36	0.97
47	1.03
63	1.09
90	1.17

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 3

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:50:09 PM

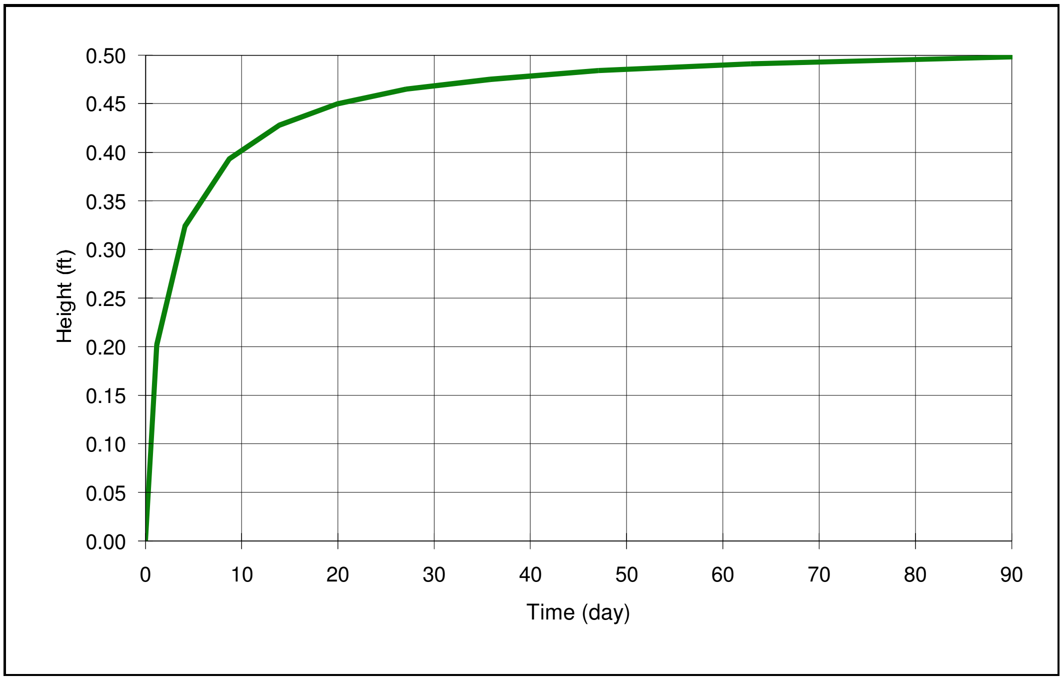
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 82 ft
Width of application area: 46 ft
Constant head boundary used at: 125 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 41 ft
Total volume applied: 33948 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-1000	-1000	0
0	-841	-841	0
0	-681.9	-682	0.01
0	-522.9	-523	0.03
0	-397.9	-398	0.05
0	-301	-301	0.08
0	-221.8	-222	0.12
0	-154.9	-155	0.17
0	-96.9	-97	0.25
0	-58	-58	0.34
0	-31.5	-32	0.46
0	0	0	0.5
0	3.9	4	0.49
0	7.2	7	0.49
0	12.1	12	0.48
0	19.4	19	0.46
0	27.7	28	0.43
0	37.6	38	0.38
0	49.7	50	0.3
0	65.4	65	0.22
0	85.2	85	0.14
0	105.1	105	0.07
0	125	125	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 3

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:50:27 PM

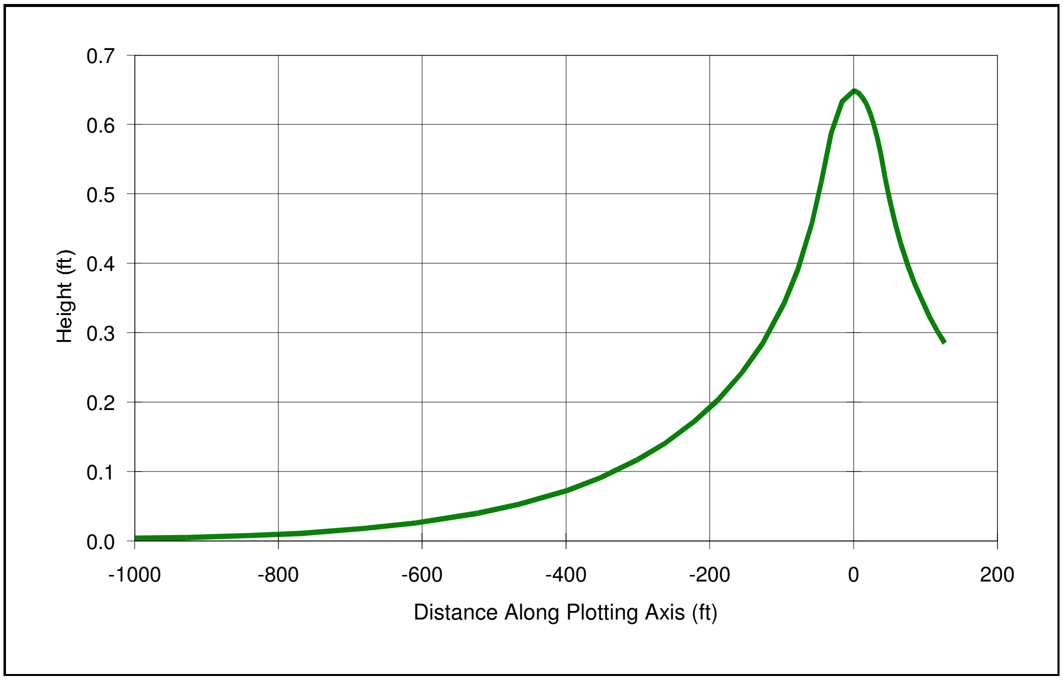
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 82 ft
Width of application area: 46 ft
Constant head boundary used at: 125 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 33948 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.2
4	0.32
9	0.39
14	0.43
20	0.45
27	0.46
36	0.48
47	0.48
63	0.49
90	0.5

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 3

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:51:26 PM

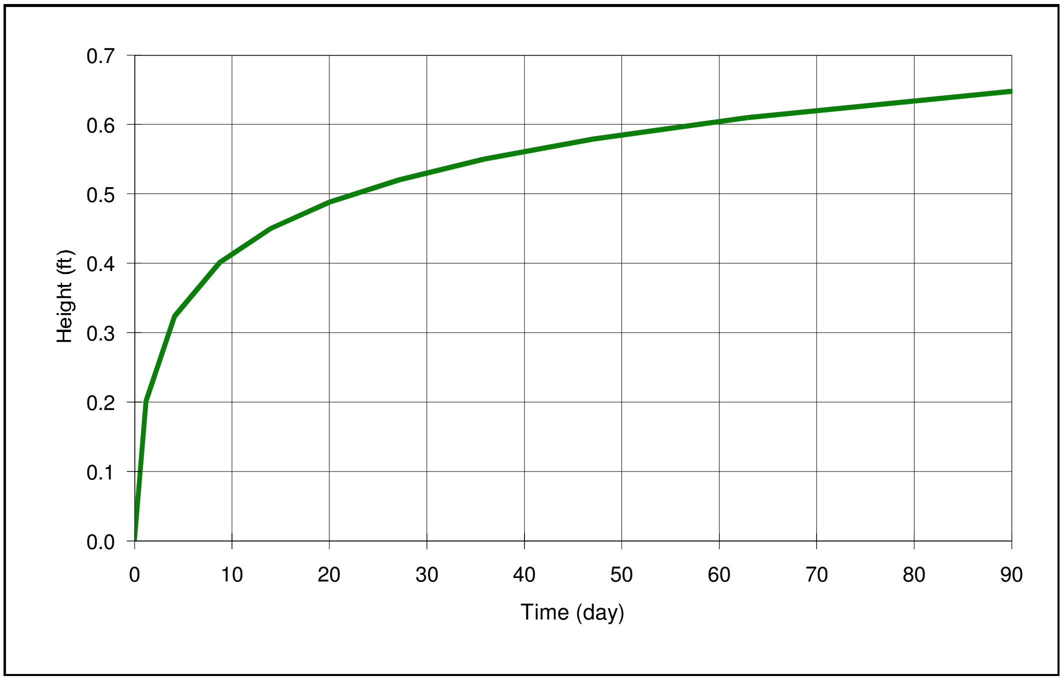
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 82 ft
Width of application area: 46 ft
No constant head boundary used
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 41 ft
Total volume applied: 33948 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-1000	-1000	0
0	-841	-841	0.01
0	-681.9	-682	0.02
0	-522.9	-523	0.04
0	-397.9	-398	0.07
0	-301	-301	0.12
0	-221.8	-222	0.17
0	-154.9	-155	0.24
0	-96.9	-97	0.34
0	-58	-58	0.46
0	-31.5	-32	0.59
0	0	0	0.65
0	3.9	4	0.65
0	7.2	7	0.64
0	12.1	12	0.64
0	19.4	19	0.63
0	27.7	28	0.6
0	37.6	38	0.56
0	49.7	50	0.49
0	65.4	65	0.43
0	85.2	85	0.37
0	105.1	105	0.32
0	125	125	0.29

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 3

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 9:51:56 PM

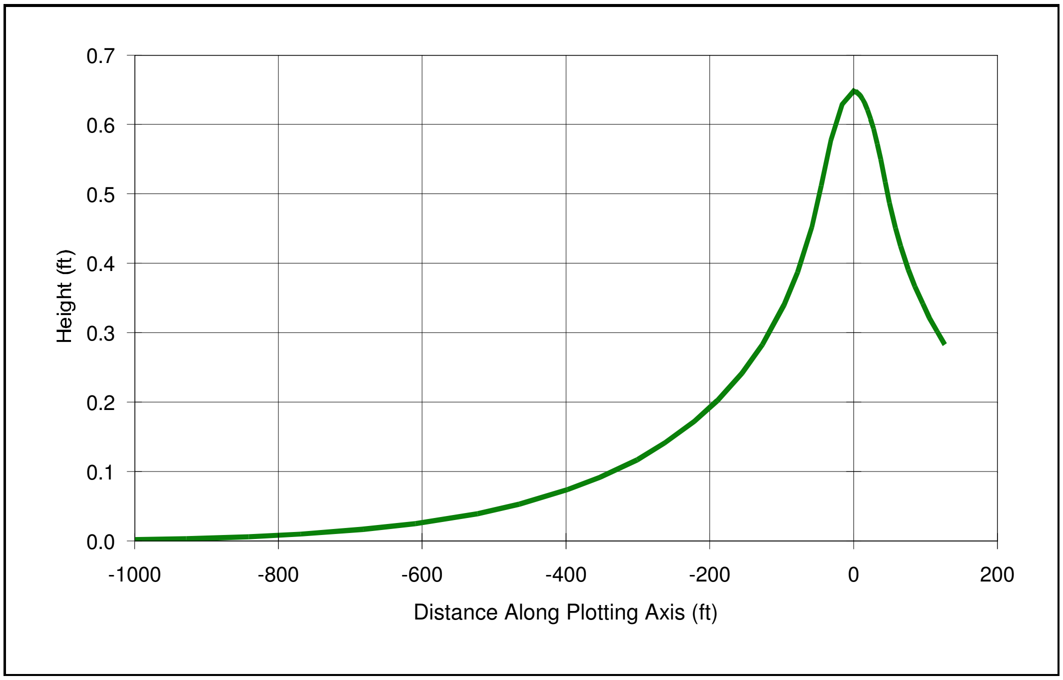
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 82 ft
Width of application area: 46 ft
No constant head boundary used
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 33948 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.2
4	0.32
9	0.4
14	0.45
20	0.49
27	0.52
36	0.55
47	0.58
63	0.61
90	0.65

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 3

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 10:07:10 PM

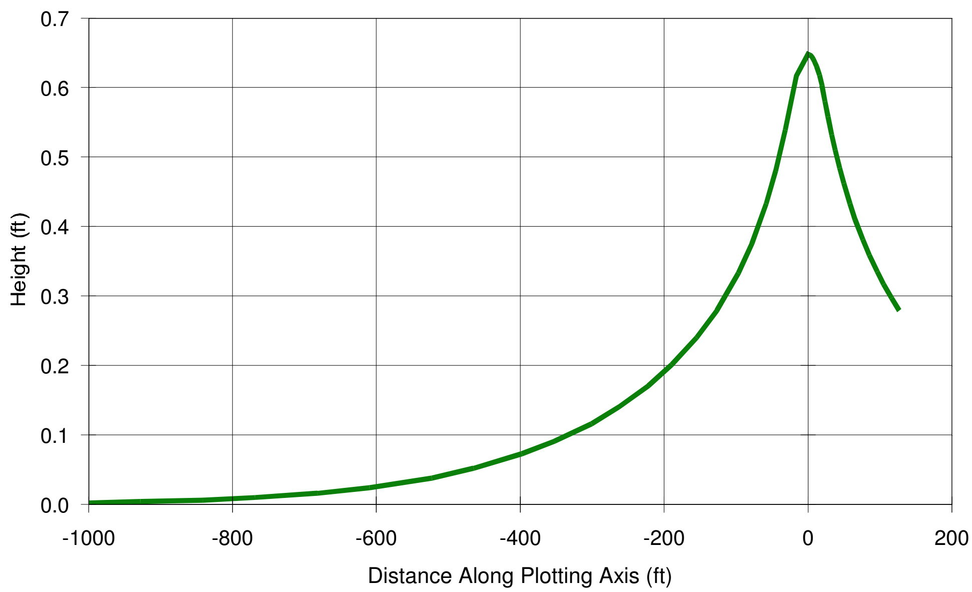
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 82 ft
Width of application area: 46 ft
No constant head boundary used
Plotting axis from Y-Axis: 29 degrees
Edge of recharge area:
positive X: 22.7 ft
positive Y: 41 ft
Total volume applied: 33948 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-484.8	-874.6	-1000	0
-407.7	-735.6	-841	0.01
-330.6	-596.4	-682	0.02
-253.5	-457.3	-523	0.04
-192.9	-348	-398	0.07
-145.9	-263.3	-301	0.12
-107.5	-194	-222	0.17
-75.1	-135.5	-155	0.24
-47	-84.8	-97	0.34
-28.1	-50.7	-58	0.45
-15.3	-27.6	-32	0.58
0	0	0	0.65
1.9	3.4	4	0.65
3.5	6.3	7	0.64
5.9	10.6	12	0.64
9.4	16.9	19	0.62
13.4	24.2	28	0.59
18.2	32.9	38	0.55
24.1	43.5	50	0.49
31.7	57.2	65	0.42
41.3	74.6	85	0.37
51	91.9	105	0.32
60.6	109.3	125	0.29

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 3

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 10:10:10 PM

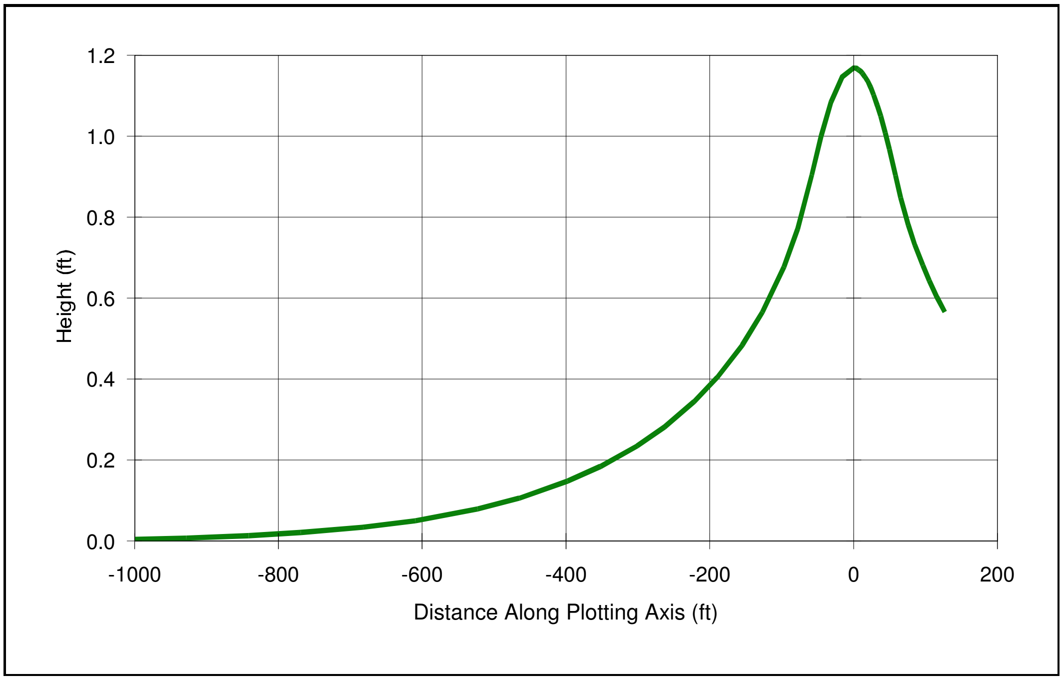
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 82 ft
Width of application area: 46 ft
No constant head boundary used
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 23 ft
positive Y: 0 ft
Total volume applied: 33948 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-1000	0	-1000	0
-841	0	-841	0.01
-681.9	0	-682	0.02
-522.9	0	-523	0.04
-397.9	0	-398	0.07
-301	0	-301	0.12
-221.8	0	-222	0.17
-154.9	0	-155	0.24
-96.9	0	-97	0.33
-58	0	-58	0.43
-31.5	0	-32	0.54
0	0	0	0.65
3.9	0	4	0.65
7.2	0	7	0.64
12.1	0	12	0.63
19.4	0	19	0.6
27.7	0	28	0.56
37.6	0	38	0.51
49.7	0	50	0.46
65.4	0	65	0.41
85.2	0	85	0.36
105.1	0	105	0.32
125	0	125	0.28

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 10:12:52 PM

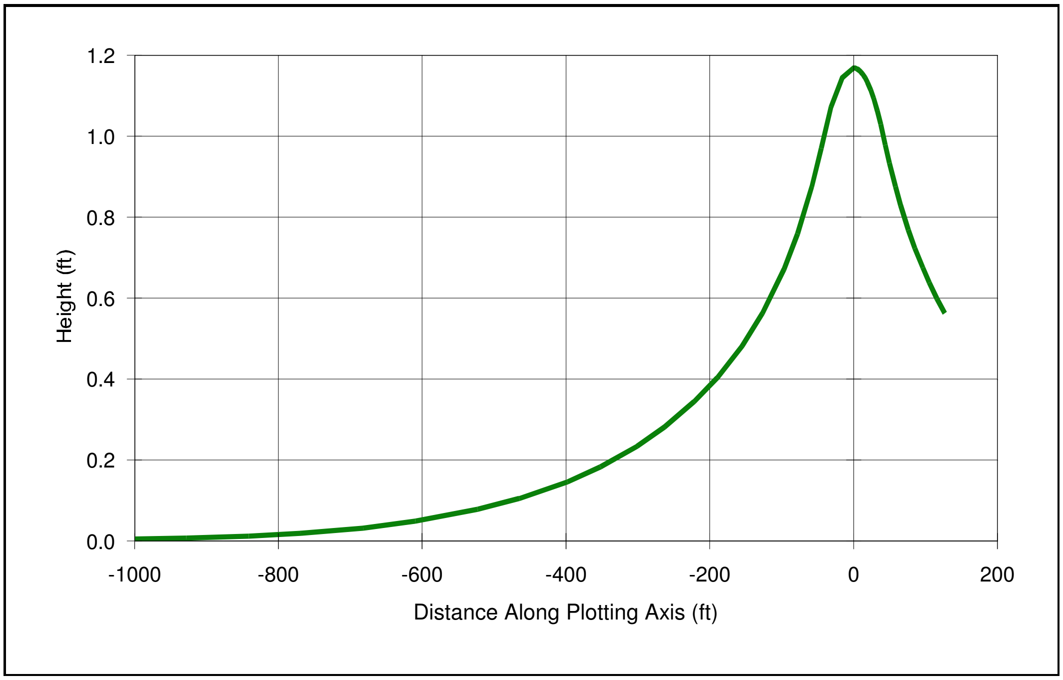
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
No constant head boundary used
Plotting axis from Y-Axis: 41.7 degrees
Edge of recharge area:
positive X: 41 ft
positive Y: 46 ft
Total volume applied: 67896 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-665.4	-746.5	-1000	0
-559.6	-627.8	-841	0.01
-453.7	-509.1	-682	0.03
-347.9	-390.4	-523	0.08
-264.7	-297	-398	0.15
-200.3	-224.7	-301	0.24
-147.6	-165.6	-222	0.34
-103.1	-115.6	-155	0.48
-64.5	-72.3	-97	0.68
-38.6	-43.3	-58	0.9
-21	-23.5	-32	1.08
0	0	0	1.17
2.6	2.9	4	1.17
4.8	5.4	7	1.16
8.1	9	12	1.16
12.9	14.5	19	1.14
18.4	20.7	28	1.1
25	28.1	38	1.05
33.1	37.1	50	0.97
43.5	48.8	65	0.85
56.7	63.6	85	0.73
69.9	78.5	105	0.64
83.2	93.3	125	0.57

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 10:15:40 PM

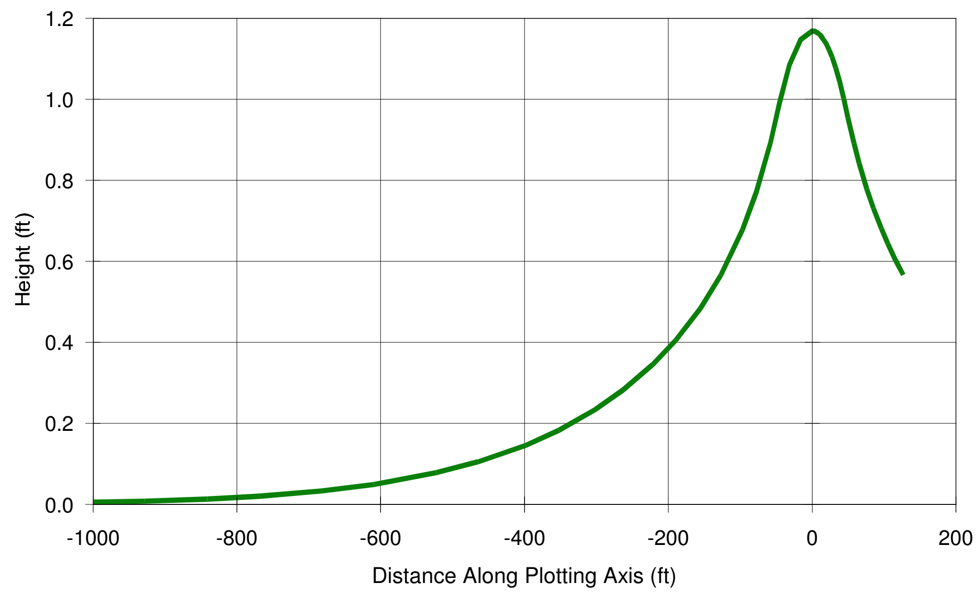
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
No constant head boundary used
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 41 ft
positive Y: 0 ft
Total volume applied: 67896 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-1000	0	-1000	0
-841	0	-841	0.01
-681.9	0	-682	0.03
-522.9	0	-523	0.08
-397.9	0	-398	0.15
-301	0	-301	0.23
-221.8	0	-222	0.34
-154.9	0	-155	0.48
-96.9	0	-97	0.67
-58	0	-58	0.88
-31.5	0	-32	1.07
0	0	0	1.17
3.9	0	4	1.17
7.2	0	7	1.16
12.1	0	12	1.15
19.4	0	19	1.13
27.7	0	28	1.09
37.6	0	38	1.03
49.7	0	50	0.93
65.4	0	65	0.83
85.2	0	85	0.72
105.1	0	105	0.64
125	0	125	0.57

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 4/17/2024 TIME: 10:16:03 PM

INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 19.46 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 92 ft
Width of application area: 82 ft
No constant head boundary used
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 46 ft
Total volume applied: 67896 c.ft

MODEL RESULTS

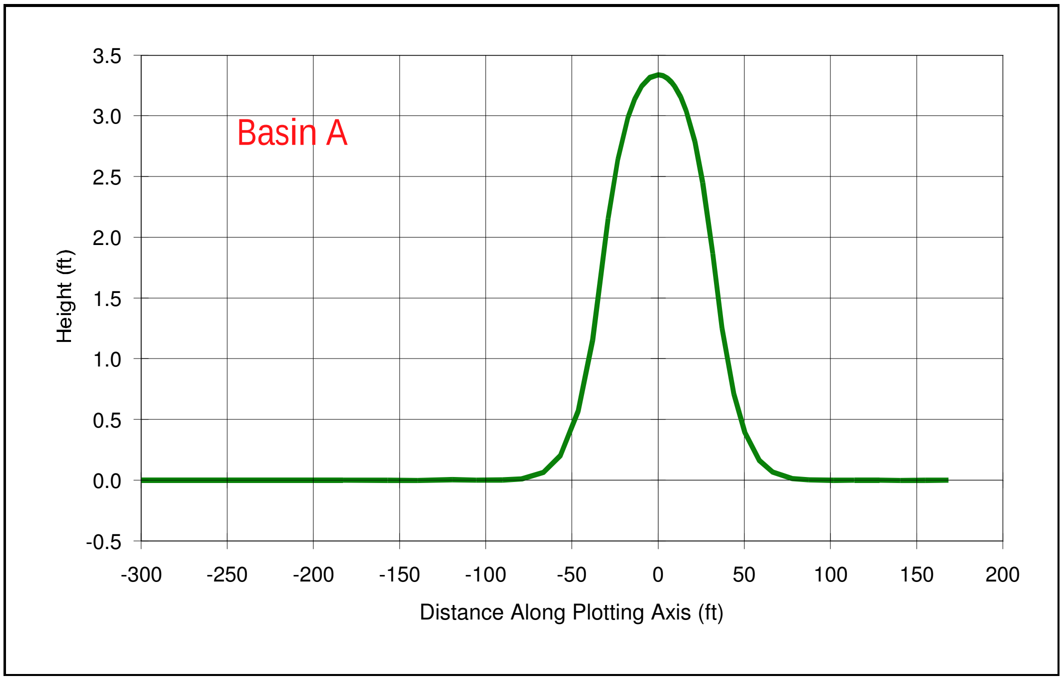
X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-1000	-1000	0.01
0	-841	-841	0.01
0	-681.9	-682	0.03
0	-522.9	-523	0.08
0	-397.9	-398	0.15
0	-301	-301	0.24
0	-221.8	-222	0.34
0	-154.9	-155	0.48
0	-96.9	-97	0.68
0	-58	-58	0.89
0	-31.5	-32	1.08
0	0	0	1.17
0	3.9	4	1.17
0	7.2	7	1.16
0	12.1	12	1.16
0	19.4	19	1.14
0	27.7	28	1.1
0	37.6	38	1.05
0	49.7	50	0.95
0	65.4	65	0.84
0	85.2	85	0.73
0	105.1	105	0.64
0	125	125	0.57

Table 4. Summary of Groundwater Mounding Analysis (updated 4/17/2024)

Parameters	Stormwater - 100 Year					Note
Recharge area	Basin A	Basin B1	Basin B2	Basin C		All Basins will be dewatered in less than three days.
Dimension, Length, ft	152	132	77.03	111		
Dimension, Width, ft	46.09	19.20	28.95	21.00		
Area, sq. ft	7006.00	2534.00	2230.00	2331.00		
Recharge Vol. Cu ft (per day or event)	6398.00	15246	6969	12196		
Duration, day	1	1	1	1		
Recharge rate, cu ft/day/sq. ft	0.91	6.02	3.13	5.23		
Dewater time, day	3	3	3	3		
GW Separation, ft	2.63	2.21	3.77	6.25		
Distance to wetland, ft	167	50	291	60		
Maximum mounding height, ft	3.34	5.77	5.8	3.89		
Estimated effective Max MH, ft	**2.772**	**2.922**	**4.176**	**3.89**		
Impact mounding height by other systems, ft	**0**	**0**	**0**	**0**		
Combined Mound height, ft	**3.34**	**5.77**	**5.8**	**3.89**		
3-day residual height, ft	2.3	0.61	1.26	0.37		
5-day residual height, ft	**1.75**	**0.28**	**0.2**	**0.12**		
Estimated effective 3d MH, ft	**2.3**	**0.45**	**1.26**	**0.37**		
Estimated effective 5d MH, ft	**1.78**	**0.15**	**0.7**	**0.26**		
Bottom of Basin, ft	**208**	**215.5**	**204.5**	**219**		
Top of stones, ft						
EHGW, ft	205.37	213.29	200.73	212.75		
	average					
Bottom aquifer, ft	**190.87**	**198.29**	**186.23**	**197.75**		
3 day elevation, ft	**207.67**	**213.9**	**201.99**	**213.12**		
Flood routing elev, ft	211.46	217.41	210.87	220.42		
Top of grade, ft	212.5	218.5	212.5	221.5		
Aquafer depth, ft	14.5	15	14.5	15		
Hydraulic Conductivity, ft/day	2.13	20.37	15.81	36.65		

* mounded water tables for stormwater management area are at 3-day.

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin A

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:00:26 PM

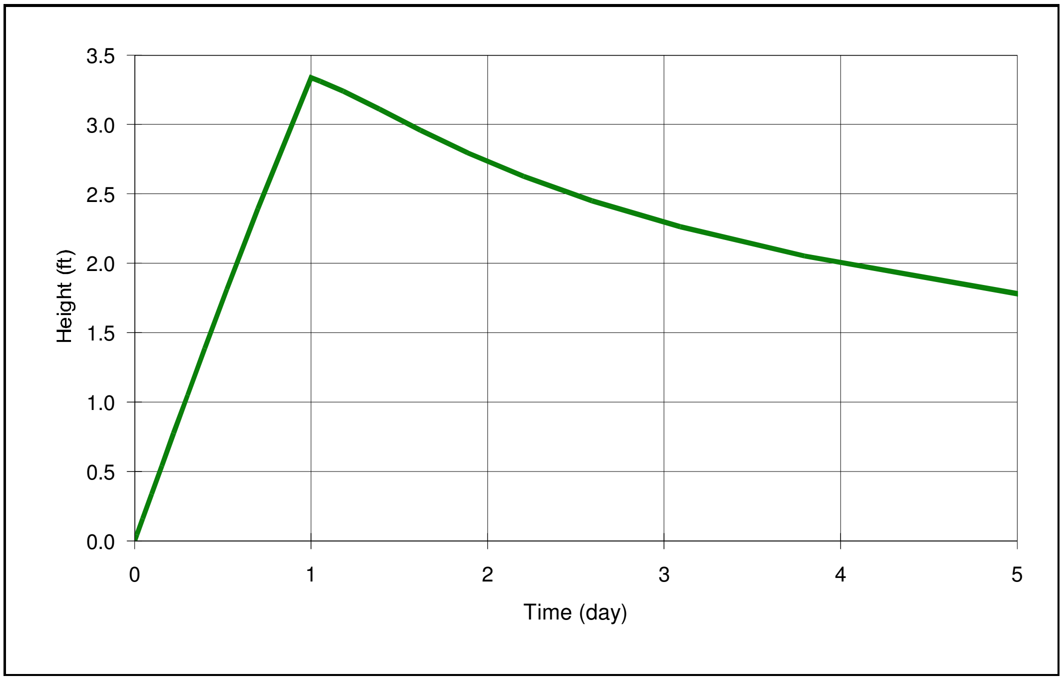
INPUT PARAMETERS

Application rate: 0.91 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 2.13 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 152 ft
Width of application area: 46.09 ft
Constant head boundary used at: 167 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 23 ft
positive Y: 23 ft
Total volume applied: 6375.169 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-212.1	-212.1	-300	0
-178.4	-178.4	-252	0
-144.7	-144.7	-205	0
-110.9	-110.9	-157	0
-84.4	-84.4	-119	0
-63.9	-63.9	-90	0
-47.1	-47.1	-67	0.06
-32.9	-32.9	-46	0.57
-20.6	-20.6	-29	2.16
-12.3	-12.3	-17	2.99
-6.7	-6.7	-9	3.25
0	0	0	3.34
3.7	3.7	5	3.31
6.8	6.8	10	3.24
11.4	11.4	16	3.04
18.3	18.3	26	2.45
26.2	26.2	37	1.25
35.5	35.5	50	0.4
47	47	66	0.07
61.7	61.7	87	0
80.5	80.5	114	0
99.3	99.3	140	0
118.1	118.1	167	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin A

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:01:07 PM

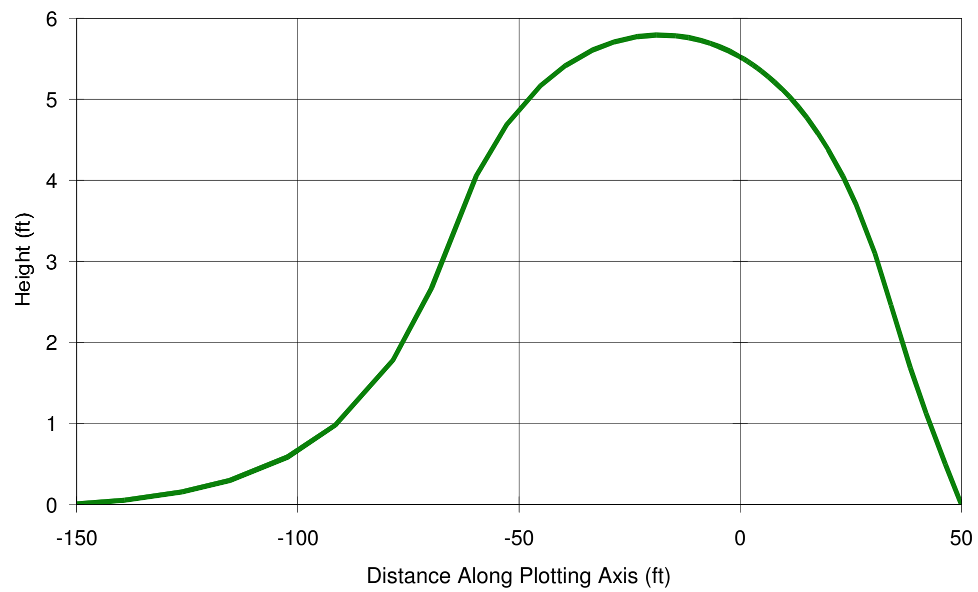
INPUT PARAMETERS

Application rate: 0.91 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 2.13 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 152 ft
Width of application area: 46.09 ft
Constant head boundary used at: 167 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 6375.169 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.05
0	0.16
0.1	0.34
0.2	0.54
0.2	0.78
0.3	1.05
0.4	1.39
0.5	1.81
0.7	2.39
1	3.34
1.1	3.31
1.2	3.24
1.4	3.11
1.6	2.96
1.9	2.8
2.2	2.63
2.6	2.45
3.1	2.26
3.8	2.05
5	1.78

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B1

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:01:45 PM

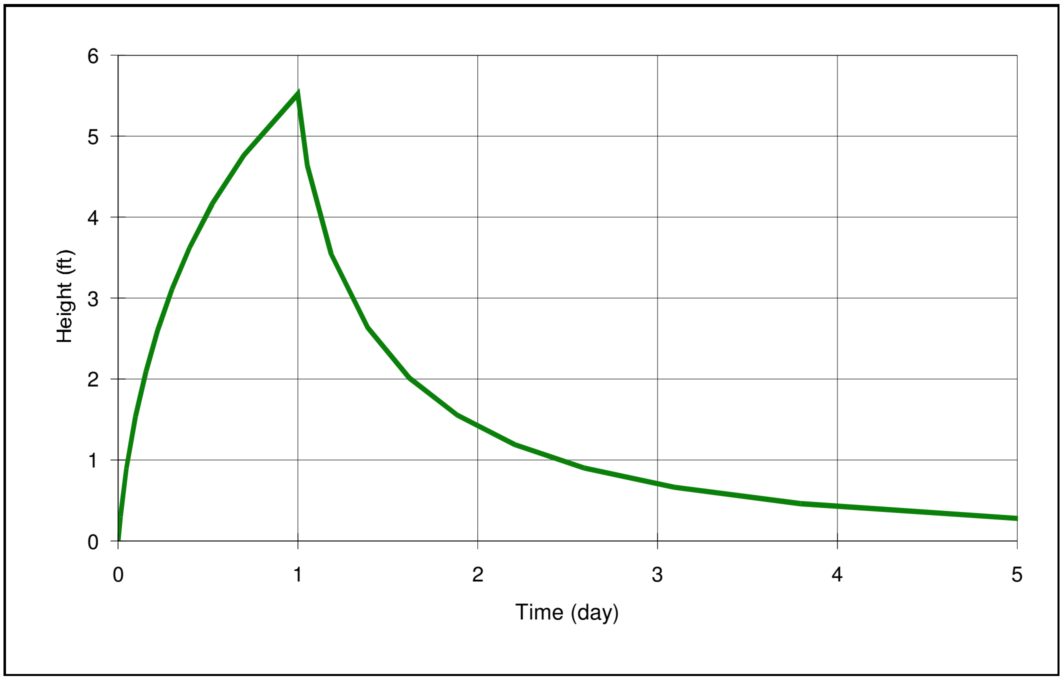
INPUT PARAMETERS

Application rate: 6.02 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 20.37 ft/day
Initial saturated thickness: 15 ft
Length of application area: 132 ft
Width of application area: 19.2 ft
Constant head boundary used at: 50 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 66 ft
Total volume applied: 15257.09 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-150	-150	0.01
0	-126.2	-126	0.15
0	-102.3	-102	0.58
0	-78.4	-78	1.78
0	-59.7	-60	4.05
0	-45.2	-45	5.16
0	-33.3	-33	5.61
0	-23.2	-23	5.77
0	-14.5	-15	5.78
0	-8.7	-9	5.72
0	-4.7	-5	5.65
0	0	0	5.52
0	1.6	2	5.47
0	2.9	3	5.42
0	4.8	5	5.34
0	7.7	8	5.21
0	11.1	11	5.03
0	15	15	4.77
0	19.9	20	4.38
0	26.1	26	3.71
0	34.1	34	2.46
0	42	42	1.12
0	50	50	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B1

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:02:05 PM

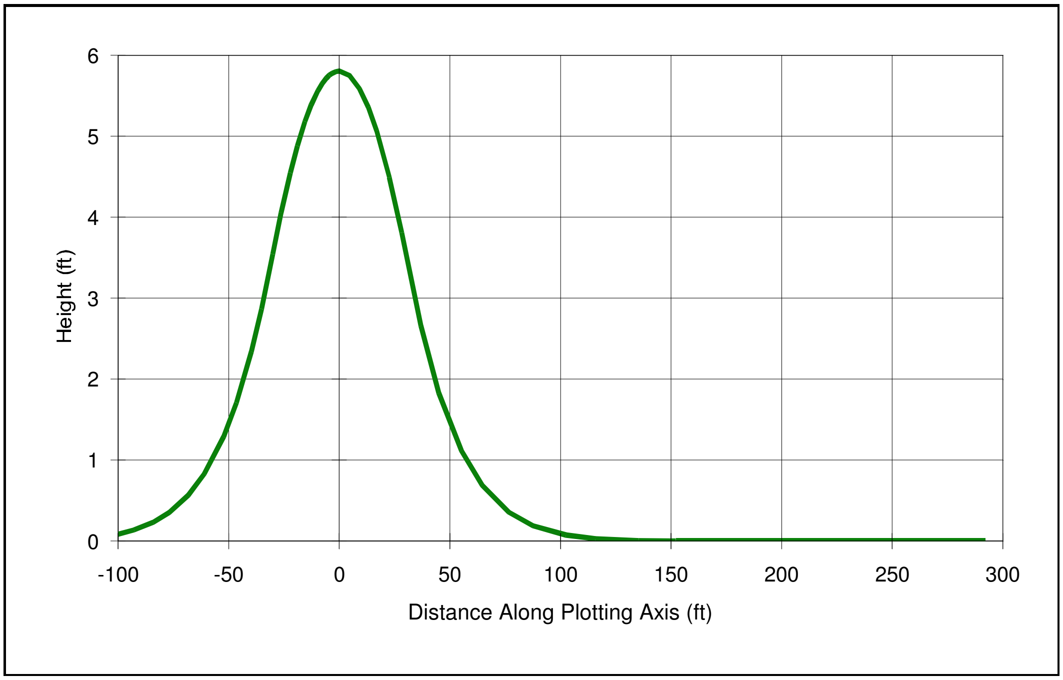
INPUT PARAMETERS

Application rate: 6.02 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 20.37 ft/day
Initial saturated thickness: 15 ft
Length of application area: 132 ft
Width of application area: 19.2 ft
Constant head boundary used at: 50 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 15257.09 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.3
0	0.89
0.1	1.54
0.2	2.09
0.2	2.61
0.3	3.11
0.4	3.62
0.5	4.16
0.7	4.76
1	5.52
1.1	4.64
1.2	3.55
1.4	2.64
1.6	2.01
1.9	1.55
2.2	1.19
2.6	0.9
3.1	0.66
3.8	0.46
5	0.28

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B2

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:02:34 PM

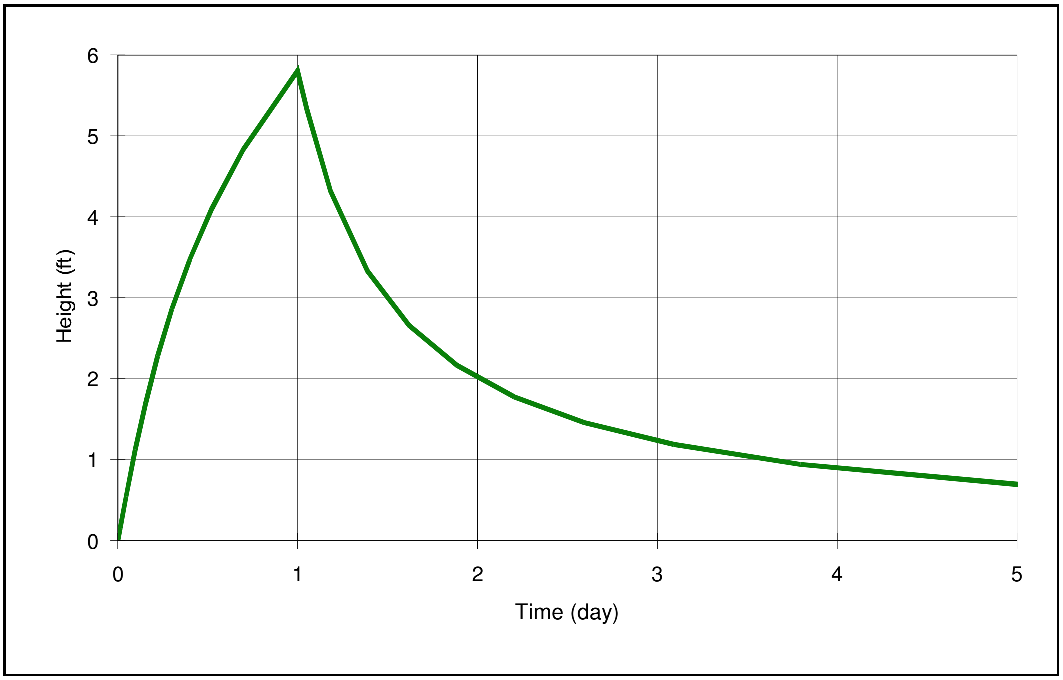
INPUT PARAMETERS

Application rate: 3.13 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 15.81 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 70.3 ft
Width of application area: 42.4 ft
Constant head boundary used at: 291 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 21.2 ft
positive Y: 21.2 ft
Total volume applied: 9329.654 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-70.7	-70.7	-100	0.08
-59.5	-59.5	-84	0.23
-48.2	-48.2	-68	0.57
-37	-37	-52	1.29
-28.1	-28.1	-40	2.34
-21.3	-21.3	-30	3.54
-15.7	-15.7	-22	4.55
-11	-11	-15	5.18
-6.9	-6.9	-10	5.56
-4.1	-4.1	-6	5.72
-2.2	-2.2	-3	5.78
0	0	0	5.8
6.5	6.5	9	5.58
11.9	11.9	17	5.07
19.9	19.9	28	3.81
31.9	31.9	45	1.83
45.6	45.6	65	0.69
61.9	61.9	88	0.19
81.9	81.9	116	0.03
107.6	107.6	152	0
140.3	140.3	198	0
173.1	173.1	245	0
205.8	205.8	291	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B2

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:02:42 PM

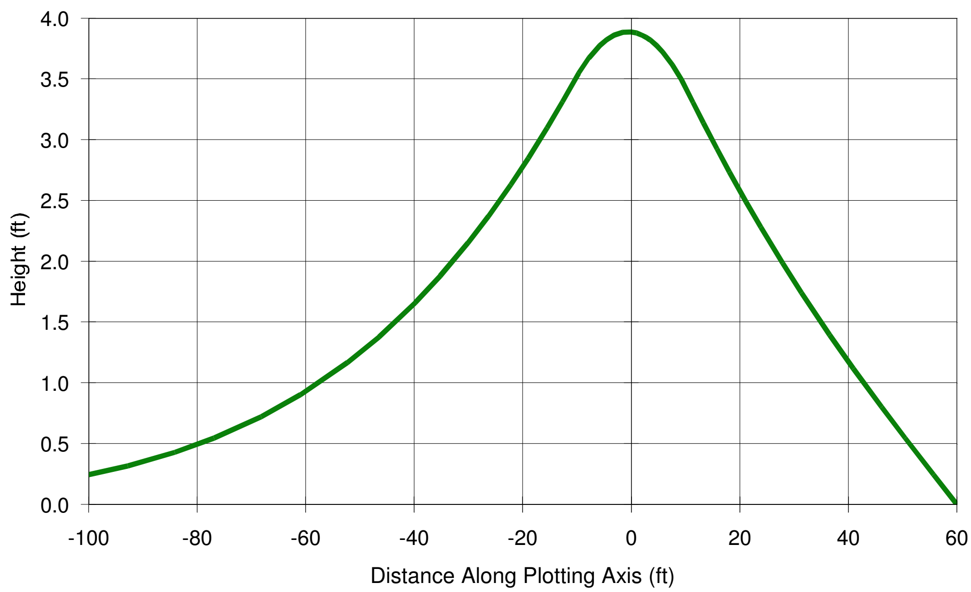
INPUT PARAMETERS

Application rate: 3.13 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 15.81 ft/day
Initial saturated thickness: 14.5 ft
Length of application area: 70.3 ft
Width of application area: 42.4 ft
Constant head boundary used at: 291 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 9329.653 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.16
0	0.55
0.1	1.13
0.2	1.71
0.2	2.28
0.3	2.86
0.4	3.46
0.5	4.1
0.7	4.84
1	5.8
1.1	5.32
1.2	4.32
1.4	3.33
1.6	2.66
1.9	2.16
2.2	1.78
2.6	1.46
3.1	1.19
3.8	0.94
5	0.7

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin C

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:06:47 PM

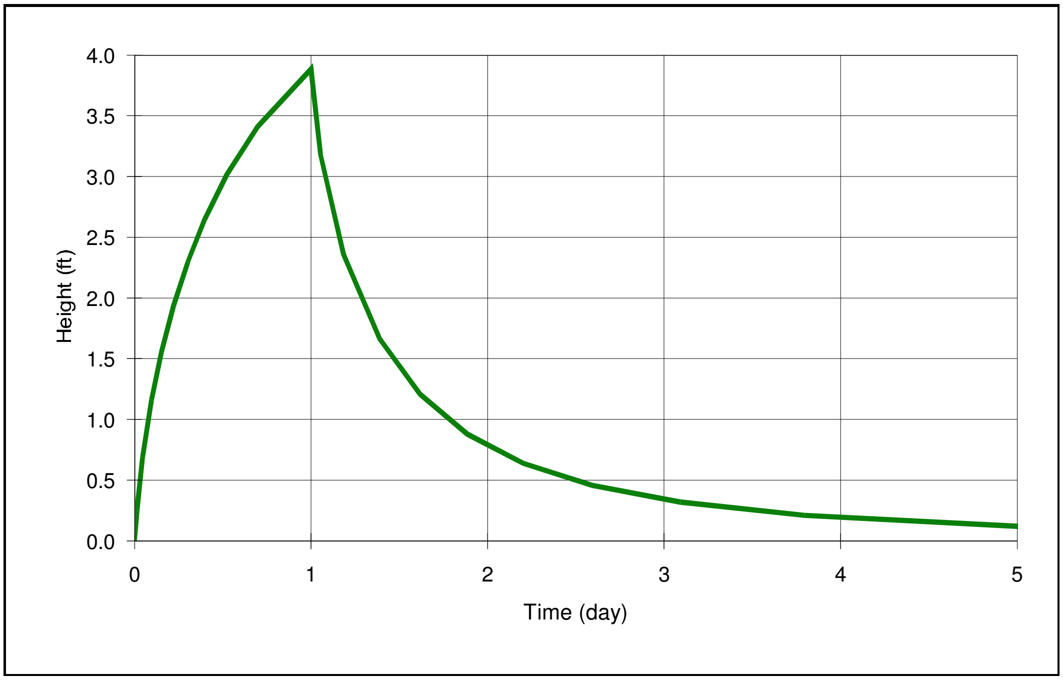
INPUT PARAMETERS

Application rate: 5.23 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 36.65 ft/day
Initial saturated thickness: 15 ft
Length of application area: 111 ft
Width of application area: 21 ft
Constant head boundary used at: 60 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 10.5 ft
positive Y: 0 ft
Total volume applied: 12191.13 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-100	0	-100	0.24
-84.1	0	-84	0.43
-68.2	0	-68	0.72
-52.3	0	-52	1.17
-39.8	0	-40	1.66
-30.1	0	-30	2.15
-22.2	0	-22	2.63
-15.5	0	-15	3.1
-9.7	0	-10	3.55
-5.8	0	-6	3.77
-3.2	0	-3	3.86
0	0	0	3.89
1.9	0	2	3.86
3.5	0	3	3.82
5.8	0	6	3.72
9.3	0	9	3.49
13.3	0	13	3.14
18.1	0	18	2.74
23.9	0	24	2.28
31.4	0	31	1.74
40.9	0	41	1.12
50.5	0	50	0.55
60	0	60	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin C

ANALYST: Desheng Wang

DATE: 4/18/2024 TIME: 11:07:07 PM

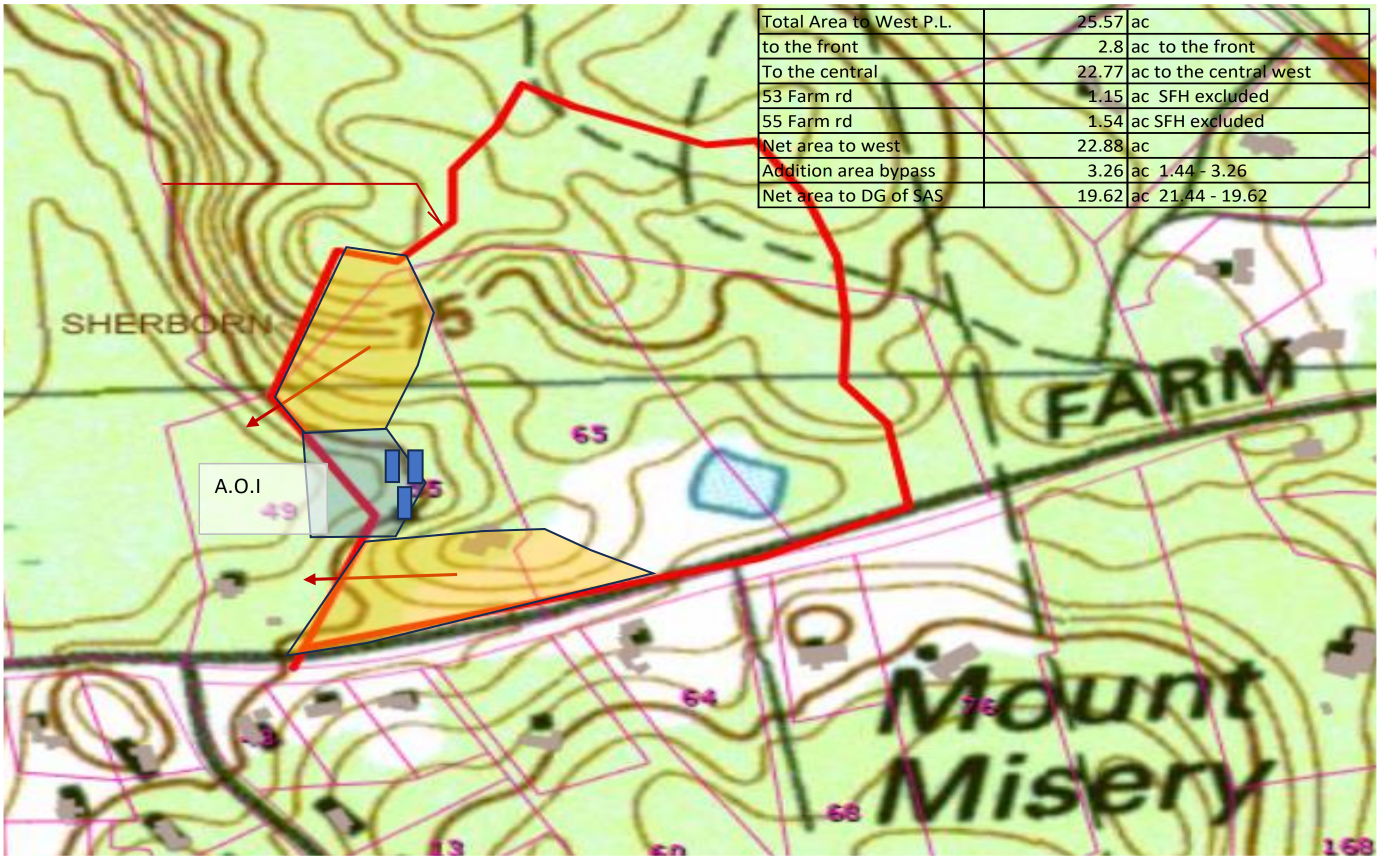
INPUT PARAMETERS

Application rate: 5.23 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 36.65 ft/day
Initial saturated thickness: 15 ft
Length of application area: 111 ft
Width of application area: 21 ft
Constant head boundary used at: 60 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 12191.13 cft

MODEL RESULTS

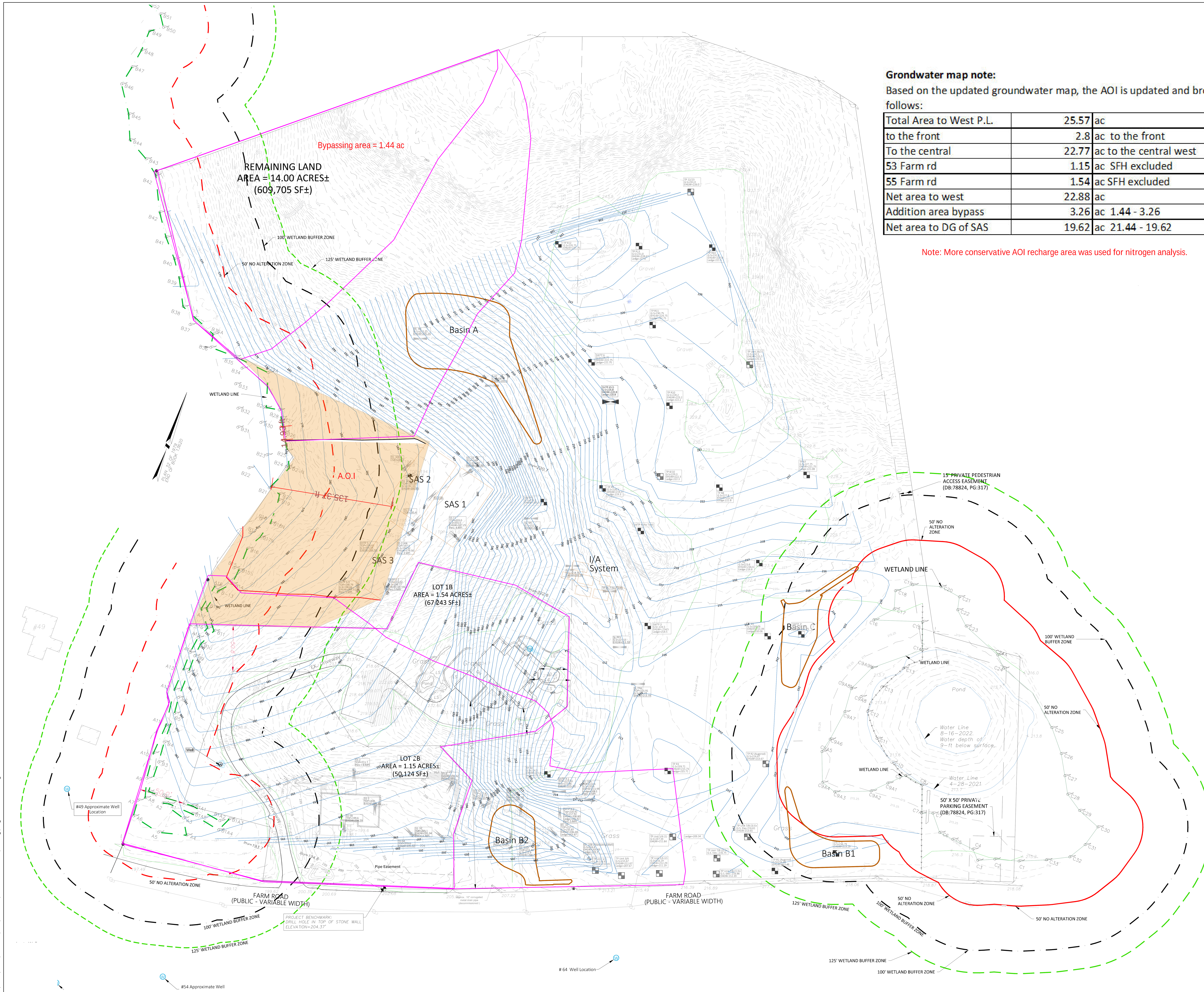
Time (day)	Mound Height (ft)
0	0
0	0.25
0	0.69
0.1	1.16
0.2	1.56
0.2	1.94
0.3	2.3
0.4	2.65
0.5	3.02
0.7	3.41
1	3.89
1.1	3.19
1.2	2.36
1.4	1.67
1.6	1.2
1.9	0.88
2.2	0.64
2.6	0.46
3.1	0.32
3.8	0.21
5	0.12

Appendix D: Water budget and nitrogen loading analysis



Total Area to West P.L.	25.57	ac
to the front	2.8	ac to the front
To the central	22.77	ac to the central west
53 Farm rd	1.15	ac SFH excluded
55 Farm rd	1.54	ac SFH excluded
Net area to west	22.88	ac
Addition area bypass	3.26	ac 1.44 - 3.26
Net area to DG of SAS	19.62	ac 21.44 - 19.62

Figure G1 . Area of Impact plan



Grondwater map note:

Based on the updated groundwater map, the AOI is updated and broken down as follows:

Total Area to West P.L.	25.57	ac
to the front	2.8	ac to the front
To the central	22.77	ac to the central west
53 Farm rd	1.15	ac SFH excluded
55 Farm rd	1.54	ac SFH excluded
Net area to west	22.88	ac
Addition area bypass	3.26	ac 1.44 - 3.26
Net area to DG of SAS	19.62	ac 21.44 - 19.62

Note: More conservative AOI recharge area was used for nitrogen analysis.

LEGEND

CATCHBASIN
ROOF DRAIN
VENT
WELL
ELECTRIC METER
UTILITY POLE
GUY WIRE
LIGHT POLE
HANDHOLE
SIGN
MAILBOX
POST
WETLAND FLAG
TEST PIT LOCATED
DECIDUOUS TREE
CONIFEROUS TREE
SHRUB
OHW — OVERHEAD WIRE
60 — INDEX CONTOUR
59 — INTERMEDIATE CONTOUR
+58.7 SPOT GRADE
TW: TOP OF WALL
EOP EDGE OF PAVEMENT
OH OVERHANG
MBW MASONRY BLOCK WALL
RTW RAILROAD TIE WALL
TOP TOP OF PIPE

APPROVED UNDER MASSACHUSETTS GENERAL LAW CHAPTER 40B

DATE APPROVED:
DATE ENDORSED:
SHERBORN ZONING BOARD OF APPEALS

I HEREBY CERTIFY THAT 20 DAYS HAVE LAPSED SINCE THE SHERBORN ZONING BOARD OF APPEALS APPROVAL HAS FILED WITH THE SHERBORN TOWN CLERK AND THAT NO APPEAL HAS BEEN FILED WITH THIS OFFICE.

DATE

JACKLYN R. MORRIS
SHERBORN TOWN CLERK

Creative Land & Water Engineering, LLC
Environmental Scientists and Engineers
P.O. Box 584 - Southborough - MA - 01772
774-454-0266 www.claweng.com

Plan Title:	Groundwater Contours
Project Name:	Farm Road Homes
Site Address:	65 Farm Road, Sherborn, MA
Owner:	Fenix Partners Farm Road Development, LLC
Client:	Robert Murchison
Project No:	J269-12
Drawn by:	FA
Date:	02/26/24
Sheet No:	1 of 1
Designed by:	DSW, FA
Approved by:	DSW
Scale:	Indicated

Rev.:	Date:	Description	By:
1	04/17/24	Groundwater Contours	FA

COMMONWEALTH OF MASSACHUSETTS
DESHENG WANG
CIVIL
NO.39511
REGISTERED PROFESSIONAL ENGINEER

Table G3. Output Nitrogen Concentration at downgradient Receptor- Budget Analysis						
Scenario	Sewage flow GPD	Effluent Nitrogen mg/l	Lawn fertilize %	Off site Recharge	Calculated Nitrogen at Downgradient, mg/l	Assumptions for notrogen budget analysis
1	8360	19	0	yes	3.89	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
2	8360	35	0	yes	6.95	1. Using Title 5 design daily flow for sewage nitrogen loading without I/A treatment. 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
3	8360	19	0	no	5.6	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge IS NOT included.
4	8360	19	40	yes	6.32	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will be fertilized 3. Off site upgradient area recharge included.
5	8360	19	40	yes	4.38	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume no lawn will be fertilized 3. All area upgradient AOI area recharge included.

		Table G4.	**Nitrogen Loading Analysis**									
			SCN #1 Nitrogen Loading - 65 Farm Road - With full I/A Treatment									
Assumption:		1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;										
		2. Assume all lawn will not be fertilized.										
		3. Offsite upgradient recharge included.										
Nitrogen Loading:										Treated Sewage	Treated quality	Treatment factor
			Concentration		Site Input		factor	lb/yr		%	mg/l	
	Sewage		35	mg/l	8360	gpd	0.00304301	483.35		100.00%	19	0.543
	Fertilizer		33	lbs/acre/yr	0	acres	1	0.00				
	Golf course fertilizer		3.5	lbs/acre	0	acres	1	0.00				
	rain water-impvious		1.5	mg/l	7.49	acre-ft	2.71643614	30.52				
	Rain water-lawn,forest, pond		0.05	mg/l	32.17	acre-ft	2.71643614	4.37				
	Total load							**518.24**	**lb**			
Capacity												
	Sewage		10	mg/l	8360	gpd	0.00304301	254.40	lb			
	rain water-impvious		10	mg/l	7.49	acre-ft	2.71643614	203.46	lb			
	Rain water-lawn,forest, pond		10	mg/l	32.17	acre-ft	2.71643614	873.88	lb			
	Total capacity with		**3.89**	mg/l				**1331.73**	**lb**			
	Budget	OK!						813.49	lb			
			SCN #2 Nitrogen Loading - 65 Farm Road - Without I/A Treatment									
Assumption:		1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;										
		2. Assume all lawn will not be fertilized.										
		3. Offsite upgradient recharge included.										
Nitrogen Loading:										Treated Sewage	Treated quality	Treatment factor
			Concentration		Site Input		factor	lb/yr		%	mg/l	
	Sewage		35	mg/l	8360	gpd	0.00304301	890.38		0.00%	19	1.000
	Fertilizer		33	lbs/acre/yr	0	acres	1	0.00				
	Golf course fertilizer		3.5	lbs/acre	0	acres	1	0.00				
	rain water-impvious		1.5	mg/l	7.49	acre-ft	2.71643614	30.52				
	Rain water-lawn,forest, pond		0.05	mg/l	32.17	acre-ft	2.71643614	4.37				
	Total load							**925.27**	**lb**			
Capacity												
	Sewage		10	mg/l	8360	gpd	0.00304301	254.40	lb			
	rain water-impvious		10	mg/l	7.49	acre-ft	2.71643614	203.46	lb			
	Rain water-lawn,forest, pond		10	mg/l	32.17	acre-ft	2.71643614	873.88	lb			
	Total capacity with		**6.95**	mg/l				**1331.73**	**lb**			
	Budget	OK!						406.46	lb			
			SCN# 3 Nitrogen Loading - 65 Farm Road - With I/A Treatment and onsite recharge only									
Assumption:		1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;										
		2. Assume all lawn will not be fertilized.										
		3. Onsite recharge only.										
Nitrogen Loading:										Treated Sewage	Treated quality	Treatment factor
			Concentration		Site Input		factor	lb/yr		%	mg/l	
	Sewage		35	mg/l	8360	gpd	0.00304301	483.35		100.00%	19	0.543
	Fertilizer		33	lbs/acre/yr	0	acres	1	0.00				
	Golf course fertilizer		3.5	lbs/acre	0	acres	1	0.00				
	rain water-impvious		1.5	mg/l	7.49	acre-ft	2.71643614	30.52				
	Rain water-lawn,forest, pond		0.05	mg/l	17.06	acre-ft	2.71643614	2.32				
	Total load							**516.19**	**lb**			
Capacity												
	Sewage		10	mg/l	8360	gpd	0.00304301	254.40	lb			
	rain water-impvious		10	mg/l	7.49	acre-ft	2.71643614	203.46	lb			
	Rain water-lawn,forest, pond		10	mg/l	17.06	acre-ft	2.71643614	463.42	lb			
	Total capacity with		**5.60**	mg/l				**921.28**	**lb**			
	Budget	OK!						405.09	lb			
			SCN# 4 Nitrogen Loading - 65 Farm Road - With I/A Treatment and onsite recharge only									
Assumption:		1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;										
		2. Assume all lawn (2 acres) will be fertilized.										
		3. Onsite recharge only.										
Nitrogen Loading:										Treated Sewage	Treated quality	Treatment factor
			Concentration		Site Input		factor	lb/yr		%	mg/l	
	Sewage		35	mg/l	8360	gpd	0.00304301	483.35		100.00%	19	0.543
	Fertilizer		33	lbs/acre/yr	2	acres	1	66.00				
	Golf course fertilizer		3.5	lbs/acre	0	acres	1	0.00				
	rain water-impvious		1.5	mg/l	7.49	acre-ft	2.71643614	30.52				
	Rain water-lawn,forest, pond		0.05	mg/l	17.06	acre-ft	2.71643614	2.32				
	Total load							**582.19**	**lb**			
Capacity												
	Sewage		10	mg/l	8360	gpd	0.00304301	254.40	lb			
	rain water-impvious		10	mg/l	7.49	acre-ft	2.71643614	203.46	lb			
	Rain water-lawn,forest, pond		10	mg/l	17.06	acre-ft	2.71643614	463.42	lb			
	Total capacity with		**6.32**	mg/l				**921.28**	**lb**			
	Budget	OK!						339.09	lb			

			SCN# 5 Nitrogen Loading - 65 Farm Road - With I/A Treatment and updated AOI									
Assumption:		1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;										
		2. Assume no lawn (0 acres) will be fertilized.										
		3. A.O.I area recharge only.										
Nitrogen Loading:										Treated Sewage	Treated quality	Treatment factor
			Concentration		Site Input		factor	lb/yr		%	mg/l	
	Sewage		35	mg/l	8360	gpd	0.00304301	483.35		100.00%	19	0.543
	Fertilizer		33	lbs/acre/yr	0	acres	1	0.00				
	Golf course fertilizer		3.5	lbs/acre	0	acres	1	0.00				
	rain water-impvious		1.5	mg/l	7.49	acre-ft	2.71643614	30.52				
	Rain water-lawn,forest, pond		0.05	mg/l	26.62	acre-ft	2.71643614	3.62				
	Total load							**517.49**	**lb**			
Capacity												
	Sewage		10	mg/l	8360	gpd	0.00304301	254.40	lb			
	rain water-impvious		10	mg/l	7.49	acre-ft	2.71643614	203.46	lb			
	Rain water-lawn,forest, pond		10	mg/l	26.62	acre-ft	2.71643614	723.12	lb			
	Total capacity with		**4.38**	mg/l				**1180.97**	**lb**			
	Budget	OK!						663.49	lb			

Figure G2 : Water Budget - Proposed Conditions (with off site area)

Project:	Homes at Farm Road	User:	DSW	Date:	04/18/24	Check:		Date:	
	65 Farm Road	Precip. (in):	45.60	Snowfall (in):	45	Lake evap. (in):	26.00	Runoff (in):	26.00
	Sherborn, MA	Wet-trans1:	2.00	Wet-trans2:	1.80	Open water:	1.00	Job:	269-12
								Sheet:	1 of 2

Land use	Vegetation (%)		Hydrologic	Area	Rainfall	Interception	Transpiration	Available Water		Natural Recharge	Natural Runoff	Man-made Recharge		Total Recharge	Managed Runoff
	Deciduous	Evergreen	Soil Group	Acres	Inches	Inches	Inches	Inches	Ac-ft	Ac-ft	ac-ft	% of runoff	Ac-ft	Ac-ft	Ac-ft
Impervious				2.220	45.60	0.88	0.00	44.72	8.27	0.41	7.86	90.00%	7.07	7.49	0.79
Lawns			a		45.60	4.15	11.13	30.32	0.00	0.00	0.00	90.00%	0.00	0.00	0.00
			b	4.350	45.60	4.15	12.31	29.14	10.56	7.58	2.99	0.00%	0.00	7.58	2.99
			c		45.60	4.15	12.31	29.14	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d	0.000	45.60	4.15	12.00	29.45	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Meadow			a		45.60	4.49	11.13	29.98	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			b		45.60	4.49	11.86	29.26	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			c		45.60	4.49	12.31	28.80	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d		45.60	4.49	12.00	29.11	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Forests	15	85	a		45.60	10.83	12.28	22.48	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	b		45.60	6.28	13.32	26.00	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	c	15.370	45.60	6.28	13.32	26.00	33.30	26.14	7.16	0.00%	0.00	26.14	7.16
	75	25	d		45.60	6.93	13.84	24.83	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Wetland-1	90	10	d	0.940	45.60	4.49	52.00	-10.89	-0.85	-1.55	0.70	0.00%	0.00	-1.55	0.70
Wetland-2	90	10	c		45.60	5.95	46.80	-7.15	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Man-made pond			c		45.60		26.00	19.60	0.00	0.00	0.00	100.00%	0.00	0.00	0.00
Total				22.88					51.28	32.58	18.70		7.07	39.66	11.63
Depth (in)					45.60		18.70		26.90	17.09	9.81		3.71	20.80	6.10

Figure G2a : Water Budget - Proposed Conditions (Area to AOI mapped)

Project:	Homes at Farm Road	User:	DSW	Date:	04/18/24	Check:		Date:	17-Apr-24
	65 Farm Road	Precip. (in):	45.60	Snowfall (in	45	Lake evap. (in):	26.00	Runoff (in):	26.00
	Sherborn, MA	Wet-trans1:	2.00	Wet-trans2:	1.80	Open water:	1.00	Job:	269-12
								Sheet:	1 of 2

Land use	Vegetation (%)		Hydrologic	Area	Rainfall	Interception	Transpiration	Available Water		Natural Recharge	Natural Runoff	Man-made Recharge		Total Recharge	Managed Runoff
	Deciduous	Evergreen	Soil Group	Acres	Inches	Inches	Inches	Inches	Ac-ft	Ac-ft	ac-ft	% of runoff	Ac-ft	Ac-ft	Ac-ft
Impervious				2.220	45.60	0.88	0.00	44.72	8.27	0.41	7.86	90.00%	7.07	7.49	0.79
Lawns			a		45.60	4.15	11.13	30.32	0.00	0.00	0.00	90.00%	0.00	0.00	0.00
			b	4.350	45.60	4.15	12.31	29.14	10.56	7.58	2.99	0.00%	0.00	7.58	2.99
			c		45.60	4.15	12.31	29.14	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d	0.000	45.60	4.15	12.00	29.45	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Meadow			a		45.60	4.49	11.13	29.98	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			b		45.60	4.49	11.86	29.26	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			c		45.60	4.49	12.31	28.80	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d		45.60	4.49	12.00	29.11	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Forests	15	85	a		45.60	10.83	12.28	22.48	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	b		45.60	6.28	13.32	26.00	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	c	12.110	45.60	6.28	13.32	26.00	26.24	20.60	5.64	0.00%	0.00	20.60	5.64
	75	25	d		45.60	6.93	13.84	24.83	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Wetland-1	90	10	d	0.940	45.60	4.49	52.00	-10.89	-0.85	-1.55	0.70	0.00%	0.00	-1.55	0.70
Wetland-2	90	10	c		45.60	5.95	46.80	-7.15	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Man-made pond			c		45.60		26.00	19.60	0.00	0.00	0.00	100.00%	0.00	0.00	0.00
Total				19.62					44.22	27.04	17.18		7.07	34.11	10.11
Depth (in)					45.60		18.55		27.05	16.54	10.51		4.33	20.86	6.18

Figure G3 : Water Budget - Proposed Conditions no offsite area

Project:	Homes at Farm Road	User:	DSW	Date:	04/18/24	Check:		Date:	
	65 Farm Road	Precip. (in):	45.60	Snowfall (in):	45	Lake evap. (in):	26.00	Runoff (in):	26.00
	Sherborn, MA	Wet-trans1:	2.00	Wet-trans2:	1.80	Open water:	1.00	Job:	269-12
								Sheet:	1 of 2

Land use	Vegetation (%)		Hydrologic	Area	Rainfall	Interception	Transpiration	Available Water		Natural Recharge	Natural Runoff	Man-made Recharge		Total Recharge	Managed Runoff
	Deciduous	Evergreen	Soil Group	Acres	Inches	Inches	Inches	Inches	Ac-ft	Ac-ft	ac-ft	% of runoff	Ac-ft	Ac-ft	Ac-ft
Impervious				2.220	45.60	0.88	0.00	44.72	8.27	0.41	7.86	90.00%	7.07	7.49	0.79
Lawns			a		45.60	4.15	11.13	30.32	0.00	0.00	0.00	90.00%	0.00	0.00	0.00
			b	4.350	45.60	4.15	12.31	29.14	10.56	7.58	2.99	0.00%	0.00	7.58	2.99
			c		45.60	4.15	12.31	29.14	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d	0.000	45.60	4.15	12.00	29.45	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Meadow			a		45.60	4.49	11.13	29.98	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			b		45.60	4.49	11.86	29.26	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			c		45.60	4.49	12.31	28.80	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d		45.60	4.49	12.00	29.11	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Forests	15	85	a		45.60	10.83	12.28	22.48	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	b		45.60	6.28	13.32	26.00	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	c	6.490	45.60	6.28	13.32	26.00	14.06	11.04	3.02	0.00%	0.00	11.04	3.02
	75	25	d		45.60	6.93	13.84	24.83	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Wetland-1	90	10	d	0.940	45.60	4.49	52.00	-10.89	-0.85	-1.55	0.70	0.00%	0.00	-1.55	0.70
Wetland-2	90	10	c		45.60	5.95	46.80	-7.15	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Man-made pond			c		45.60		26.00	19.60	0.00	0.00	0.00	100.00%	0.00	0.00	0.00
Total				14.00					32.04	17.48	14.57		7.07	24.55	7.49
Depth (in)					45.60		18.13		27.47	14.98	12.49		6.06	21.04	6.42