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February 20, 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") dated October 27, 2023. This letter provides our responses. To facilitate the review, we will quote the Reviewer's comments first in *italics* and follow-up with our **response** in **red**.

Tetra Tech (TT) has reviewed specific submittal materials for the above-referenced Project to assist the Sherborn Zoning Board of Appeals (Board) in its Comprehensive Permit review of the proposed Farm Road Homes development. The following letter provides comments generated during our review of Applicant submittals and generally focus on substantive concerns that speak to issues whose eventual resolution may substantially impact Project design or could otherwise result in potentially unsafe conditions or unanticipated impacts.

The Project includes development of 32 units of housing on approximately 14 acres of land. The site is bounded by woodland to the north and east, Farm Road to the south and residential properties to the west. Wetland resource area is located on the western portion of the site and an isolated wetland located in the southeast corner of the site. Seven (7) private wells are proposed as water supply for the Project. Sanitary sewer system is proposed to route sewer flow to a proposed pump station and septic system located on the western portion of the site adjacent to the wetland resource area. The Applicant is proposing a solar array at the northern portion of the site on an existing cleared plateau to generate energy for the Project which will also be connected to the grid to supplement.

Our review is based on materials received from the Board comprising 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. Our initial comments are provided below.

SITE DESIGN (Farm Road Homes has previously responded to this section and this is an update)

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.*

   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 set 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.

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.*

   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 is from Farm Road, another is from the side driveway (Road B) with a good backout turning radius to the main access

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.*

   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.*

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.*

   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.

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. Note is also added to grade a shallow swale to intercept runoff from above to go around the steep slope area.*

   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 1.5:1 slope to improve the stability.

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.*

   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.

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.*

   Response: All solar arrays have been removed from the plan.

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.*

   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.

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.*
   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.

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.*

    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.

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.*
    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.

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

    Response: A roadway cross section is provided in the detail sheet. A profile is added to the plan.

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

    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.

14. *The Applicant should provide a stamped site survey to confirm the site was surveyed by a Massachusetts licensed professional land surveyor.*
    Response: Previously provided in the Comprehensive Permit Application and may be found on the town website or via the following link https://www.sherbornma.org/DocumentCenter/View/1087/ANR-Plan-of-Land-February-24-2022-PDF

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.*

    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.

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.*

    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.

17. *Plans are provided in color presumably for presentation purposes. We recommend all plans be provided in grayscale.*

    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.

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)*

    Response: We have previously discussed the proprietary spreadsheet issue: a). The detailed land use and the soil HSG rating based on 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.

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

    Response: The output report is provided in electronic files due to the size for print out.

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)*

    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 vise versa. See plan for details.

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)*

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.

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)*

    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.

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)*

    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 stormwater catch basins. No swale for sub-watershed AP-7 is claimed, which is removed from the model and sketch.

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)*

    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.

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)*

    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.

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)*

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

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*

    Response: All basins have more than 2 ft of groundwater separations. The language is a statement of fact that infiltration can happen without separation.

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)*

    Response: The TSS removal calculation sheet for Basin A is updated.

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)*

    Response: The entire project is set on 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 basins pretreatment. We use grass swale only to be conservative for three of them. We also added sediment forebays to all infiltration basins for better pretreatment so it is in compliance with the "standard 4".

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)*

    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 the 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 over simplified 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.

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)*

    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 TetraTech assume private water supply to review the project at this point of time.

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)*

    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.

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)*

    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 of 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.

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)*

    Response: We revised the O&M plan to state that "excessive snow can be trucked off site and disposed in the *permitted facilities"*

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)*

    Response: The annual maintenance budget is updated to reflect the current market price.

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)*

    Response: The O&M maintenance table is expanded for each item to have a line for better tracking and recording.

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.*

    Response: No credit is claimed in our calculations. We updated the stormwater checklist to note this.

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)*

    Response: Sump depth has been specified in the construction details to be a minimum of 4-ft.

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)*

    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.

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)*

    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.

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)*

    Response: Basin A has been re-shaped 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.

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)*

    Response: The basin is revised with fine tuned outlet control structures and larger basin size to provide a minimum of 1 ft free board.

43. *All infiltration basins shall include monitoring wells and drawdown devices. (Vol. 2, Ch. 2, Pg. 91)*

    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.

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*.

    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 proposes 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 the road safety on the project side in the future.

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.*

    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.

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.*

    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 CB#10 to CB#13. CB#10 now ties into CB#11. All the 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.

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.*

    Response: The report is thoroughly reviewed to correct any scrivener's errors as we can find.

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.*

    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 area 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.

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.*

    Response: The site work area except for the SAS and Basin A have a relatively flat grading and mostly loamy sand soil. Based on the experience working on 53 Farm Road, we do not expect much of an erosion and sediment control issue than a typical residential subdivision construction.

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.*

    Response: A Proposed limit of clearing had been provided.

WATER SUPPLY (See Mr. Bob Murchison's response by email on December 12, 2023)

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.*

    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.

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.

Response: No comments.

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.*

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.

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.*

    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.

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.*

    Response: The applicant as required by law will work with 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 all be on the same well or wells.

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.*

    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.

SEPTIC SYSTEM (The response was also provided to BOH in a separate letter dated February 2,2024 and slightly updated here)

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.)*

    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 design 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.

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.

Proposed: 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.

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

Response: The SAS monitoring wells were installed according to the SBOH requirement. The well installation details were provided in the hydrogeological evaluation report Appendix A.

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.*

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.

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.*

Response: The applicant will begin permitting with Sherborn Conservation Commission when the project review with ZBA is completed.

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.*

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.

Isolated wetland volume calculation

Feature	Elevation, ft	Area, sf	Vol. , cf	Vol. Gal	Vol. ac-ft
Bottom	199	2402			
Low water	208	4956	32424.79	242569.8	0.744
Annual high	214.5	21128	78686.42	588653.1	1.806
Total			111111.2	831222.9	2.551

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.*

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.

Dozens of bluegills

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.*

    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 mounding analysis provided to the BOH for detail. Therefore, no breakout will occur.

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.*

    Response: 1) As shown in 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.

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.*

    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.

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.

Response: If is the applicant's intention to comply with all applicable local, State, and Federal laws 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

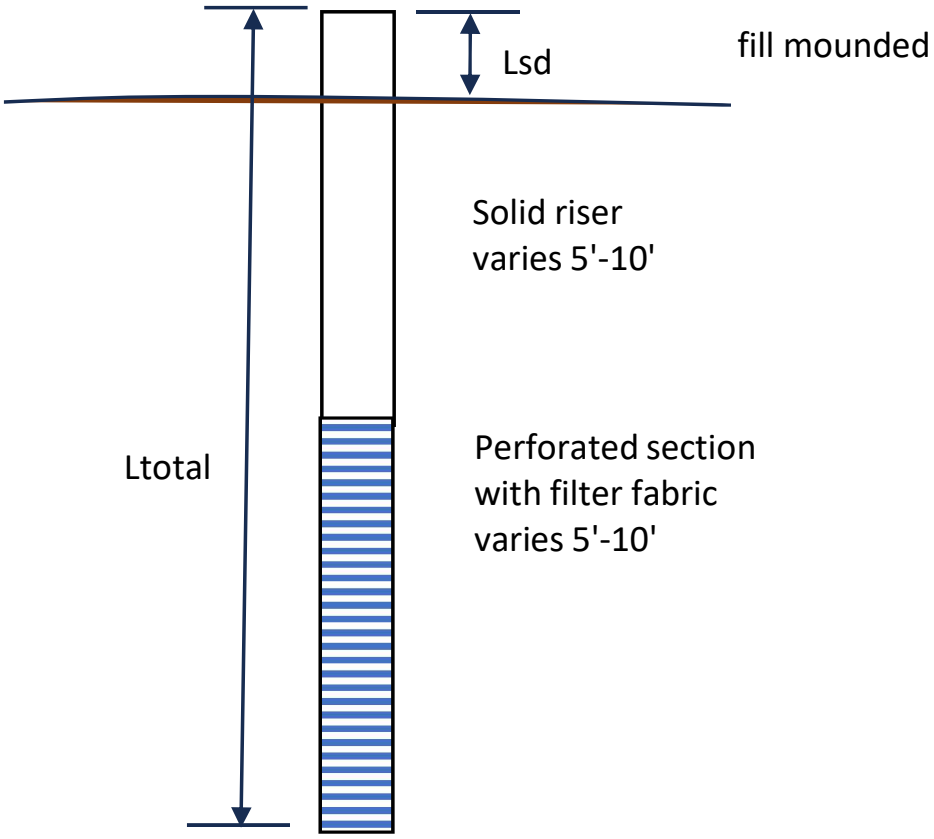
Francis Alves, E.I.T., CSE
Civil/Environmental Engineer

Cc: Bob Murchison
Paul Haverty, esq.

Appendix A: Well Logs, and Well Profile (from Hydrogeological Evaluation report)

The groundwater monitoring wells are 4" perforated pipe protected with filter fabric installed in the deep hole soil evaluation holes by excavator per Sherborn Board of Health requirement. Test pits 55-10, 55-10An, 55-11, 55-11An, 5-1, 5-2, and 5-3 were found dry and did not reflect the true water table rather for reference. See soil log in Appendix B. DHTP -11B just to verify soil and no monitoring pipe installed in it.

Test Pit	Soil Texture	Total depth, inches	Perc. Rate, mpi	Approx. GS elev, ft	Top of pipe elev., ft	Water depth below GS, ft		
						Outstanding pipe, in	11/24/2021	4/27/2021
DHTP 5-1	Till/LS	174	-	195.04	196.62	19	12.92	
DHTP 5-2	Till/LS	209.88	5	200.77	203.02	27	15.24	
DHTP 5-3	Till/LS	199.92	3	198.04	198.79	9	15.91	
DHTP 55-10	Till/LS	135.00	-	**196.92**	200.00	37.00	11.25	11.25
DHTP 55-10An	Till/LS	174.00	-	**192.10**	194.10	24.00	13.00	13.00
DHTP 55-11	Till/LS	192.00	4.00	**201.00**	203.00	24.00	15.42	15.58
DHTP 55-11An	Till/LS	216.00	3.00	**193.92**	197.50	43.00	15.42	16.25
DHTP 55-11B	Till/LS	120.00		**194.00**	N/A			



Typical Monitoring Well Profile

Creative Land & Water Engineering, LLC
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Tel: (508)281-1694 clawe@claweng.com

Subject: Permeability Estimate
65 Farm Road
Sherborn, MA 01770

Sieve by: Yankee **Date:** 1/9/2024
Calc.: DSW **Date:** 3-Feb-24
Job No.: J269-12 **Sheet:** 1 of 1

Hazen Method

Input report:

Test pit:	S1-SAS	Soil:	Medium to Coarse sand	
Shape factor:	0.011	D10 (cm):	0.00962	Better for range 0.01 to 0.03 cm
Void ratio (e):	0.51	D60 (cm):	0.5	
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	51.98	Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.005	

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	93.21014	1	Average
	(range 100-150)	range 1-5	
Calculated permeability (cm/s):	0.008626 , or	0.25	
	0.00034 ft/sec	0.009843	5.09E-03 ft/s
	29.34 ft/day	850.39	439.87 ft/day
Rawls value	16.54	16.54	16.54 ft/day

Percolation rate: 3 mpi

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Ref. 1. Hazen method
2. Kenney TC, Lau D, Ofoegbu GI (1984) Permeability of compacted granular materials, CanGeotech J 21 (4): 726-729

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Sieve by: Yankee **Date:** 1/9/2024
Calc.: DSW **Date:** 3-Feb-24
Job No.: J269-12 **Sheet:** 1 of 1

Hazen Method

Input report:

Test pit:	S2-SAS	Soil:	Medium loamy sand	
Shape factor:	0.011	D10 (cm):	0.003	Better for range 0.01 to 0.03 cm
Void ratio (e):	0.6	D60 (cm):	0.36143	
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	120.48	Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0015	

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	143.2397	1	Average
	range (100-150)	range 1-5	
Calculated permeability (cm/s):	0.001289 , or	0.0225	
	5.08E-05 ft/sec	0.000886 ft/s	4.68E-04 ft/s
	4.39 ft/day	76.54 ft/day	40.46 ft/day
Rawls value	4.82	4.82	4.82 ft/day
Percolation rate	5 mpi		

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

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Job No.: J269-12 **Sheet:** 1 of 1

Hazen Method

Input report:

Test pit:	S-A1- Basin A1	Soil:	Medium sandy loam	
Shape factor:	0.011	D10 (cm):	0.00116	Better for range 0.01 to 0.03 cm
Void ratio (e):	0.55	D60 (cm):	0.21529	
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	185.59	Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0005	

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	113.8901	1	Average
	range (100-150)	range 1-5	
Calculated permeability (cm/s):	0.000153 , or	0.0025	
	6.03E-06 ft/sec	9.84E-05 ft/s	5.22E-05 ft/s
	0.52 ft/day	8.50 ft/day	4.51 ft/day
Rawls value	2.04 ft/day	2.04 ft/day	2.04 ft/day

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

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Calc.: DSW **Date:** 3-Feb-24
Job No.: J269-12 **Sheet:** 1 of 1

Hazen Method

Input report:

Test pit:	SB2-Basin B2	Soil:	Medium loamy sand	
Shape factor:	0.011	D10 (cm):	0.004	Better for range 0.01 to 0.03 cm
Void ratio (e):	0.6	D60 (cm):	0.615	
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	153.75	Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0015	

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	143.2397	1	Average
	range (100-150)	range 1-5	
Calculated permeability (cm/s):	0.002292 , or	0.0225	
	9.02E-05 ft/sec	0.000886 ft/s	4.88E-04 ft/s
	7.80 ft/day	76.54 ft/day	42.17 ft/day
Rawls value	4.82	4.82	4.82 ft/day
Percolation rate	<2 mpi		

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

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Hazen Method

Input report:

Test pit:	SB1-Basin B1	Soil:	Medium to Coarse sand	
Shape factor:	0.011	D10 (cm):	0.00763	Better for range 0.01 to 0.03 cm
Void ratio (e):	0.67	D60 (cm):	0.02073	
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	2.72	Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0065	

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	191.0898	1	Average
	(range 100-150)	range 1-5	
Calculated permeability (cm/s):	0.011125 , or	0.4225	
	0.000438 ft/sec	0.016634	8.54E-03 ft/s
	37.84 ft/day	1437.17	737.50 ft/day
Rawls value	16.54	16.54	16.54 ft/day

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Ref. 1. Hazen method
2. Kenney TC, Lau D, Ofoegbu GI (1984) Permeability of compacted granular materials, CanGeotech J 21 (4): 726-729

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65 Farm Road
Sherborn, MA 01770

Sieve by: Yankee **Date:** 1/9/2024
Calc.: DSW **Date:** 3-Feb-24
Job No.: J269-12 **Sheet:** 1 of 1

Hazen Method

Input report:

Test pit:	SC-Basin C	Soil:	Medium sand	
Shape factor:	0.011	D10 (cm):	0.0094	Better for range 0.01 to 0.03 cm
Void ratio (e):	0.67	D60 (cm):	0.32736	
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	34.83	Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0055	

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	191.0898	1	Average
	(range 100-150)	range 1-5	
Calculated permeability (cm/s):	0.016885 , or	0.3025	
	0.000665 ft/sec	0.011909	6.29E-03 ft/s
	57.43 ft/day	1028.98	543.21 ft/day
Rawls value	16.54	16.54	16.54 ft/day

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Ref. 1. Hazen method
2. Kenney TC, Lau D, Ofoegbu GI (1984) Permeability of compacted granular materials, CanGeotech J 21 (4): 726-729

Clerical error corrected 11/20/2022
location is # 53 Farm Road.

SHERBORN BOARD OF HEALTH

The following information must be supplied to the Board of Health for its review before any approval can be given for the use of the well:

WELL AND PUMP TEST DATA (Must be signed by Well Contractor and by the company performing the pump test):

The well should be pumped for a period of four (4) hours at a fairly constant draw down water level. Record the following: 53 ~~55~~ 11/20/2022

LOCATION: ~~55~~ Farm Road DATE OF TEST: Nov 15, 2021
WELL DEPTH: 300 Feet WELL DIAMETER: 6 Inches
DEPTH OF LEDGE BELOW SURFACE GRADE: 18 Feet
DEPTH OF CASING: 40 Feet TYPE OF SEAL: Bent/Bentonite Pro Slue
DEPTH OF WATER LEVEL BELOW GROUND SURFACE BEFORE ANY PUMPING: 5.5' Feet
BEFORE TEST: 5.5 Feet
AT END OF TEST (4 Hours): 89.8' Feet
PUMPING RATE (SHOULD BE CONSTANT THROUGHOUT TEST):
STARTED PUMPING AT 5.5 AT RATE OF 12.6 GPM
STOPPED PUMPING AT 89.8 AT RATE OF 11.4 GPM
DURING PUMP TEST: DEPTH OF PUMP: 240 Feet SIZE OF PUMP: 1 HP
DEPTH OF PUMP TO BE INSTALLED FOR HOUSE Same Feet
SIZE OF PUMP TO BE INSTALLED FOR HOUSE Same HP

NAME OF WELL DRILLING COMPANY: Bay State Pump Company Inc
(Must be registered with the Commonwealth of Massachusetts)

Authorized Signature: [signature] VM

NAME OF COMPANY PERFORMING PUMP TEST: Bay State Pump Company Inc

Authorized Signature: [signature]

TWO (2) REQUIRED WATER ANALYSIS REPORTS: Pump Test

The following Bacteriological and Chemical Analyses must be performed by a Massachusetts DEP certified laboratory, and results submitted to the Board of Health. The first sample is to be taken at the well head and the second sample is to be taken from a tap in the building.

Total Coliform Bacteria	Total Iron
Total Bacteria (HPC)	Manganese
Ammonia Nitrogen	Color
Nitrite Nitrogen	Turbidity
Nitrate Nitrogen	Odor
Chloride	pH
Sodium	Total Alkalinity
Lead	Total Hardness
Arsenic	Volatile Organic Compounds (EPA 524 testing method)

9:AM 5.5' start
9:30 28' 12.6 GPM
10:AM 59.3' 12 GPM
10:30 70.5' 12 GPM
11:AM 76.5' 12 GPM
11:30 80.9' 11.76 GPM
NOON 83.9' 11.5 GPM
12:30 86.3' 11.4 GPM
1:PM 88' 11.4 GPM

Other parameters may be required on a case-by-case basis if deemed to be necessary in the opinion of the Board of Health.

5 Farm Rd

Well Test Date 5/20/80

Name and address of owner or builder Tel: 655-6195

D. McLAUGHLIN
20 DEXTER DR.

Location of property — Street and Lot #

LOT #1 FARM RD.

Name and address of well contractor

A+W

Type of well R.T. DRILLED Depth 520'

Diameter 6" Depth to ledge 17' 27' of casing

Duration of pump test 6 HRS

Gallons per minute at end of test 10 G.P.M.

Inspector: J Fenza

Driller:

5 Farm Rd

Well Test Date 5/20/80

Name and address of owner or builder Tel: 655-6195

D. McLAUGHLIN
20 DEXTER DR.

Location of property — Street and Lot #

LOT #1 FARM RD.

Name and address of well contractor

A+W

Type of well R.T. DRILLED Depth 520'

Diameter 6" Depth to ledge 17' 27' of casing

Duration of pump test 6 HRS

Gallons per minute at end of test 10 G.P.M.

Inspector: J Fenza

Driller:

Pequot Museum

DHTP 4-2

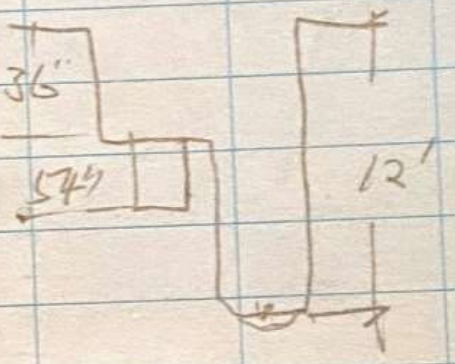
0-12	A	10YR 3/2	fri
12-36	B	2.5Y 6/6	fria
36-144+	C	2.5Y 6/4	dense stony
144+	Cr	fractured Ledge	

wkg. stg. w = 144"

pre 12=14
post 12=29

12	12=29	9	12=37
11	12=31	8	12=42
10	12=34	7	12=46
9	12=37	6	12=51

14/3 = 5 MPI



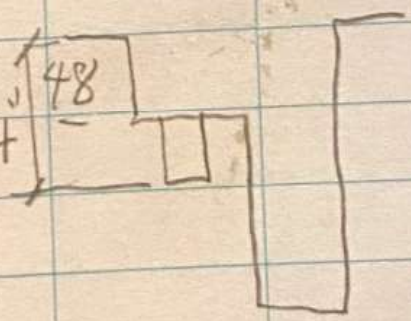
Lot 5
DHTP 5-2

0-4"	A	SL	10YR 3/2	fri
4-30"	B	SL	2.5Y 6/6	fri
30-180+	C	CO. L. S	2.5Y 5/4	fri-loose

aow mow

pre 3=25
end 3=40

12	3=40	9	3=54
11	3=44	8	3=59
10	3=49	7	4=04
9	3=54	6	4=09



15/3 = 5 MPI

11/10/2021 JJ Funkel

Lot 5

DHTP 5-3 perc

0-4 A S.L 10YR 3/2 fri

4-30 B S.L 2.5Y 6/6 fri L. Bedding

30-54 C1 M.S. 2.5Y 6/4 loose

54-180+ C2 CO.M.L.S 2.5Y 5/4 dense stone 20%

no weops, no stg

perc 5-3

pre 11:04 9 11:28

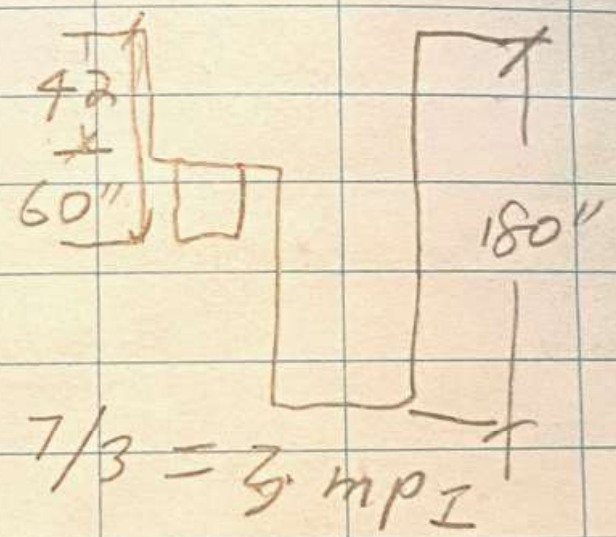
end 11:19 8 11:31

12 11:20 7 11:33

11 11:22 6 11:35

10 11:25

9 11:28



7/3 = 3 mp I

DHTP 5-1 (DEEP)

0-9" A S.L. 10YR 3/2 fri

9-36 B S.L. 2.5Y 6/6 fri. bldr

36-168+ C CO.M.L.S 2.5Y 5/4 dense strong 20%

no std, no weops

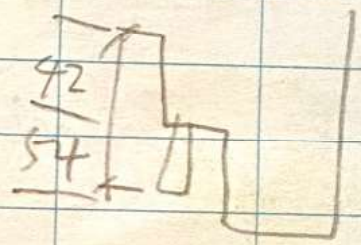
4/21/2021

Backarea

55-11 209-24 = 185 dry
55-11A 147-21 = 126 dry
55-10A 149-28 = 121 dry
55-10 172-37 = 135 dry

55-11

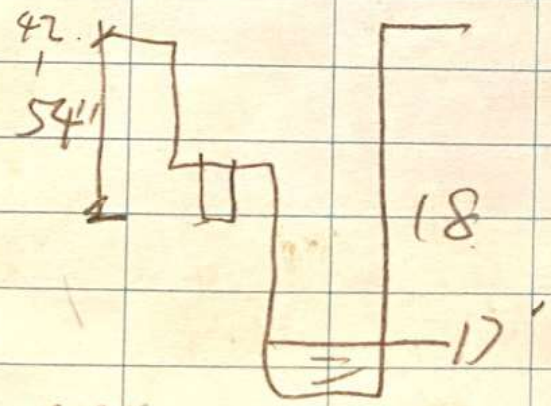
0-4 A S.L 10YR 3/2 fr
4-30 B SL 10YR 6/6 fr
30-192" C L.S 2.5Y 5/4 dense fri.
no weeps, no std.



55-11A N S.L 10YR 3/2 2+0
0-4" A SL 2.5Y 6/6 fri
4-32 B S.L 2.5Y 5/4 fri
32-216' C L.S. fri

weeps = 18' 17'
std = 18' → 17'

pre 1:49
end 2:04
12 2:04
11 2:06
10 2:09
9 2:12
8 2:15
7 2:8
6 2:2



9/3 = 3 PI

55-10 AN DEEP

0-6	A	S.L	10YR 3/2	fri
6-30	B	SL	2.5Y 6/6	fri
30-14.5	C	L.S.	2.5Y 6/4	fri - dense

weng = 14'
stag = 14'.

55-10 (DEEP)

0-6	A	SL	10YR 3/2	friable
6-30	B	SL	2.5Y 6/6	friable
30-135	C	L.S	2.5Y 6/4	dense-fri

no weng, stag dry

55-11 B (center to check ledge)

0-6	A	SL	10YR 3/2	fri
6-30	B	SL	2.5Y 6/6	fri
30-10+ 120'+	C	L.S	2.5Y 6/4	dense bony

55-9N

0-6	A	SL	10YR 3/2	fri
6-30	B	SL	2.5Y 6/6	fri
30-108	C	ML.S	2.5Y 6/4	fri
108+ 120'	C+ ledge	no weng	no stag	

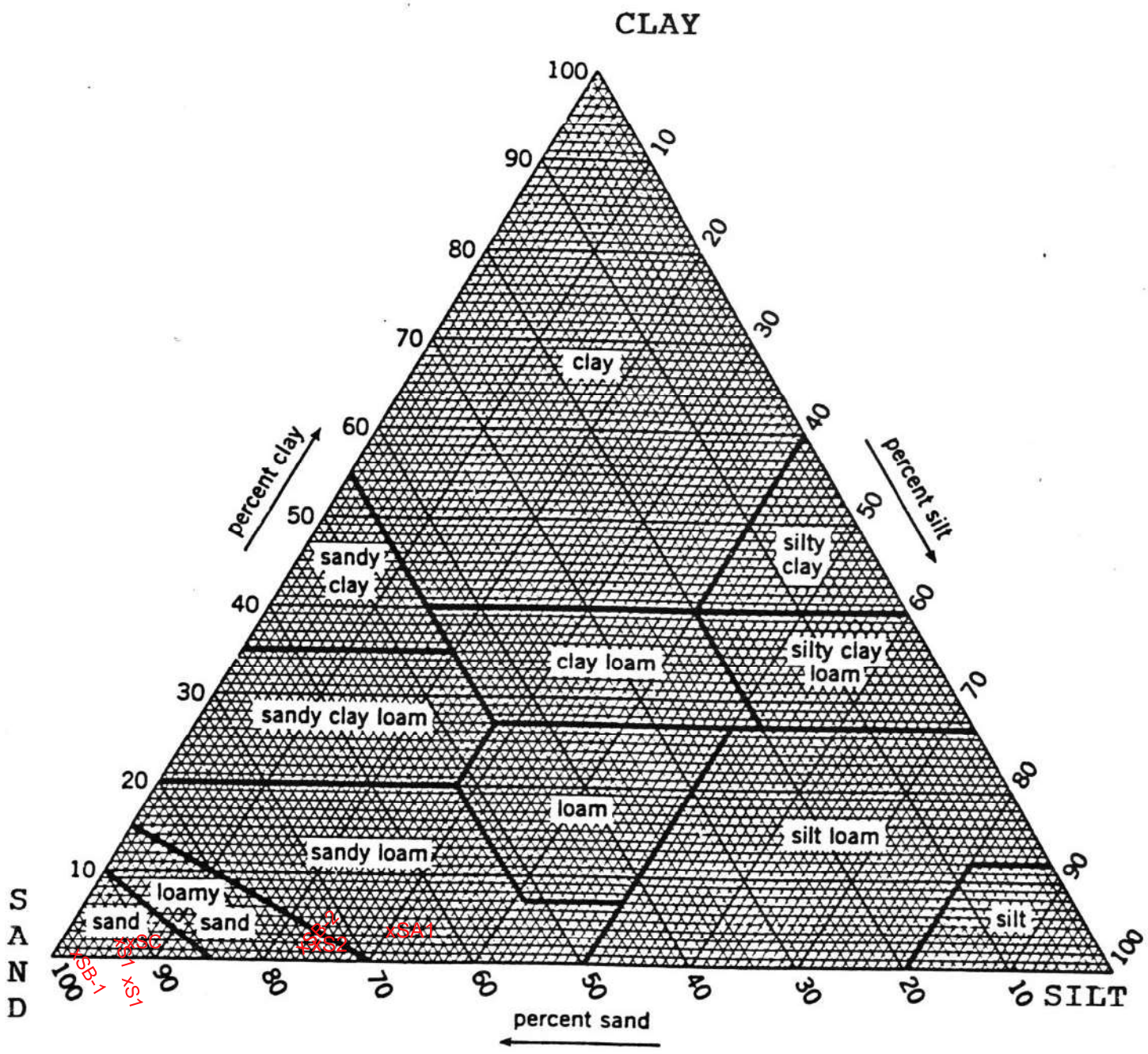
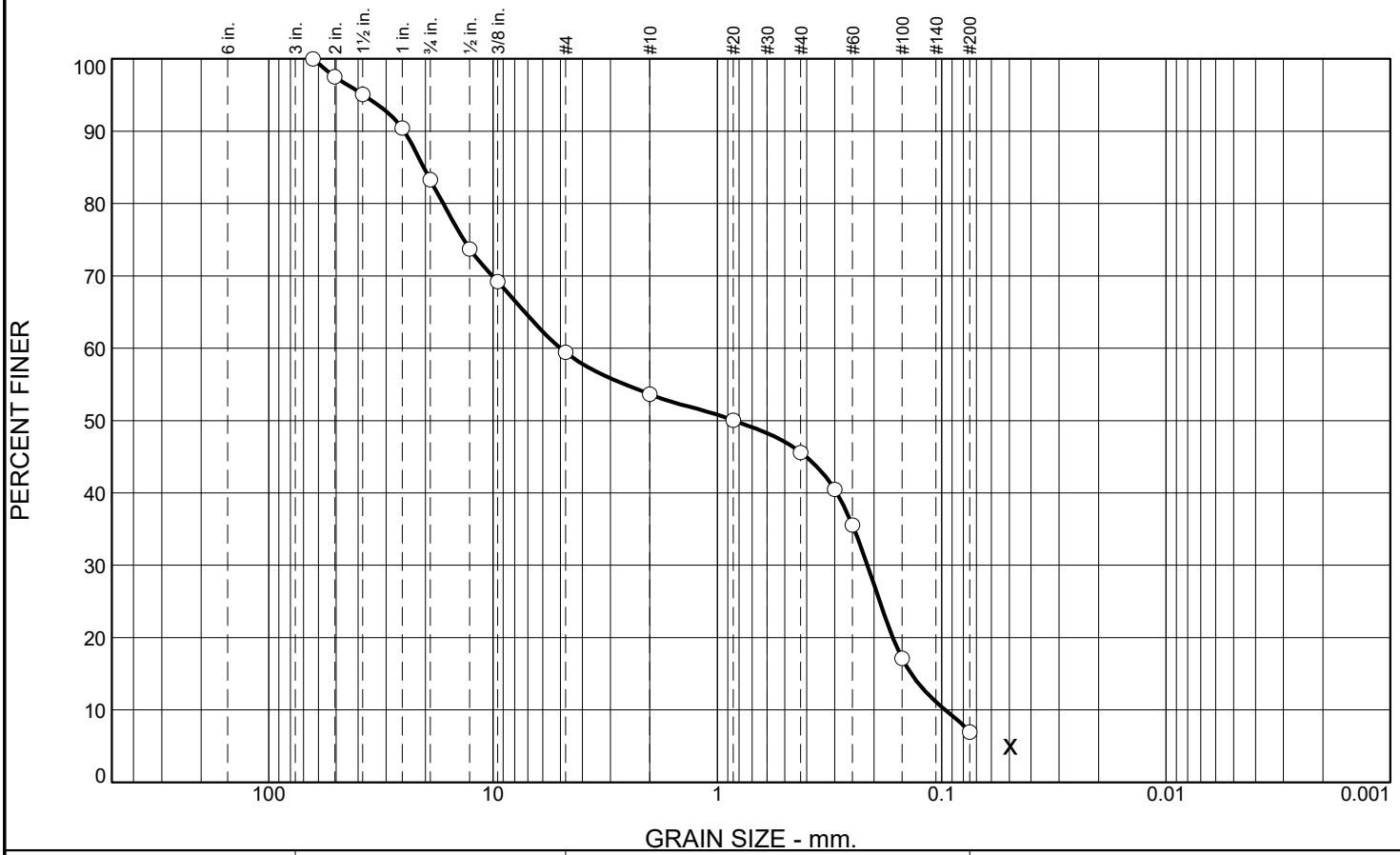


Figure 1: SOIL TEXTURAL TRIANGLE

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.7	23.9	5.8	8.0	38.6	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2-1/2"	100.0		
2"	97.5		
1.5	95.1		
1	90.4		
.75	83.3		
.5	73.7		
3/8	69.2		
#4	59.4		
#10	53.6		
#20	50.0		
#40	45.6		
#50	40.5		
#60	35.6		
#100	17.1		
#200	7.0		

* (no specification provided)

Material Description

Brown 2.5" max f/m sand and gravel trace silt
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 20.3667 D_{60}= 5.0006 D_{50}= 0.8422
D_{30}= 0.2143 D_{15}= 0.1366 D_{10}= 0.0962
C_u= 51.96 C_c= 0.10

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

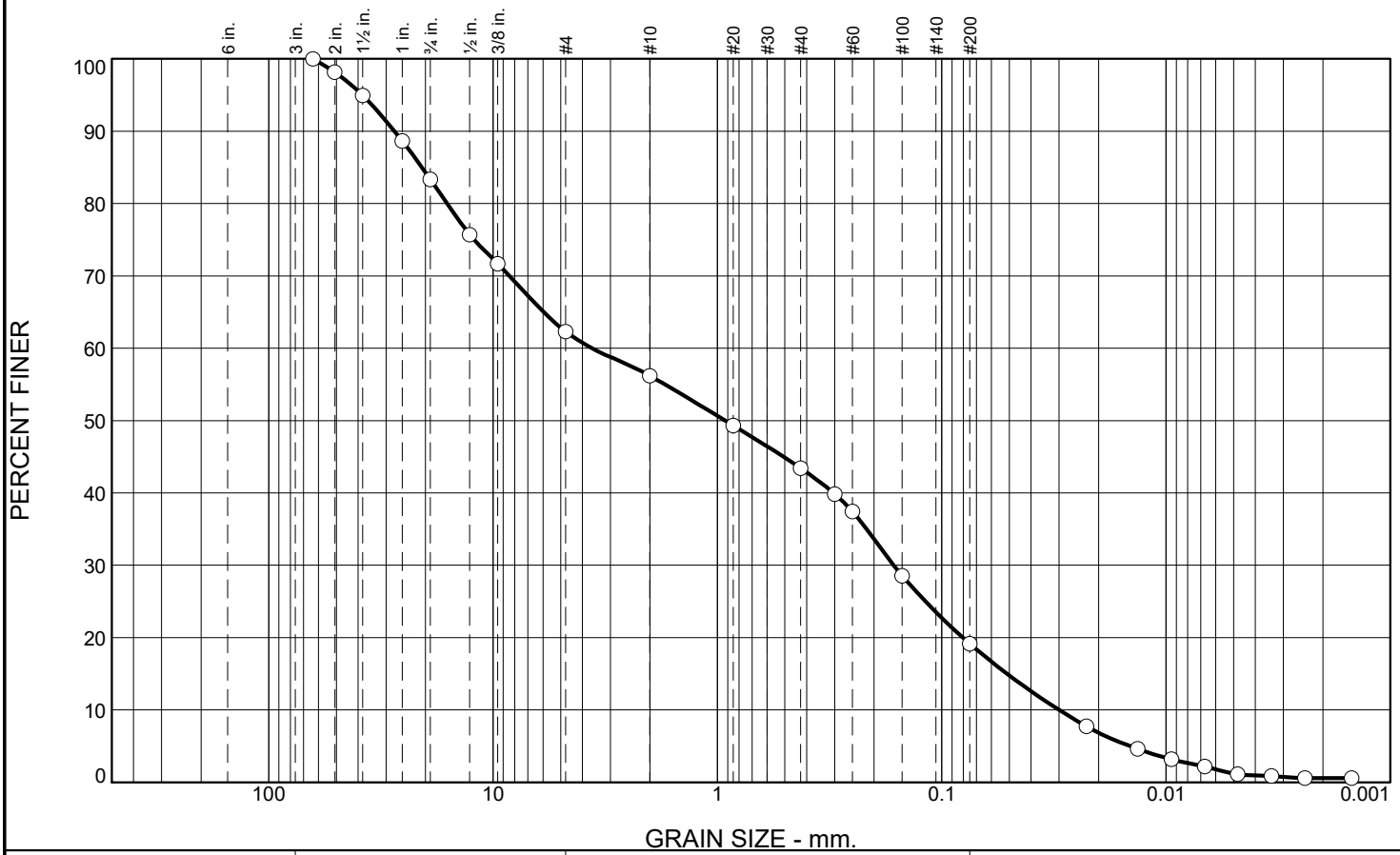
Sample No.: L-33929 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: S-1 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.6	21.1	6.1	12.8	24.2	18.0	1.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5"	100.0		
2"	98.2		
1.5	95.0		
1	88.7		
.75	83.4		
.5	75.7		
3/8	71.7		
#4	62.3		
#10	56.2		
#20	49.3		
#40	43.4		
#50	39.8		
#60	37.4		
#100	28.6		
#200	19.2		

* (no specification provided)

Material Description

Brown 2.5" max silty sand and gravel
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 20.7906 D_{60}= 3.6143 D_{50}= 0.9228
D_{30}= 0.1638 D_{15}= 0.0511 D_{10}= 0.0300
C_u= 120.63 C_c= 0.25

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

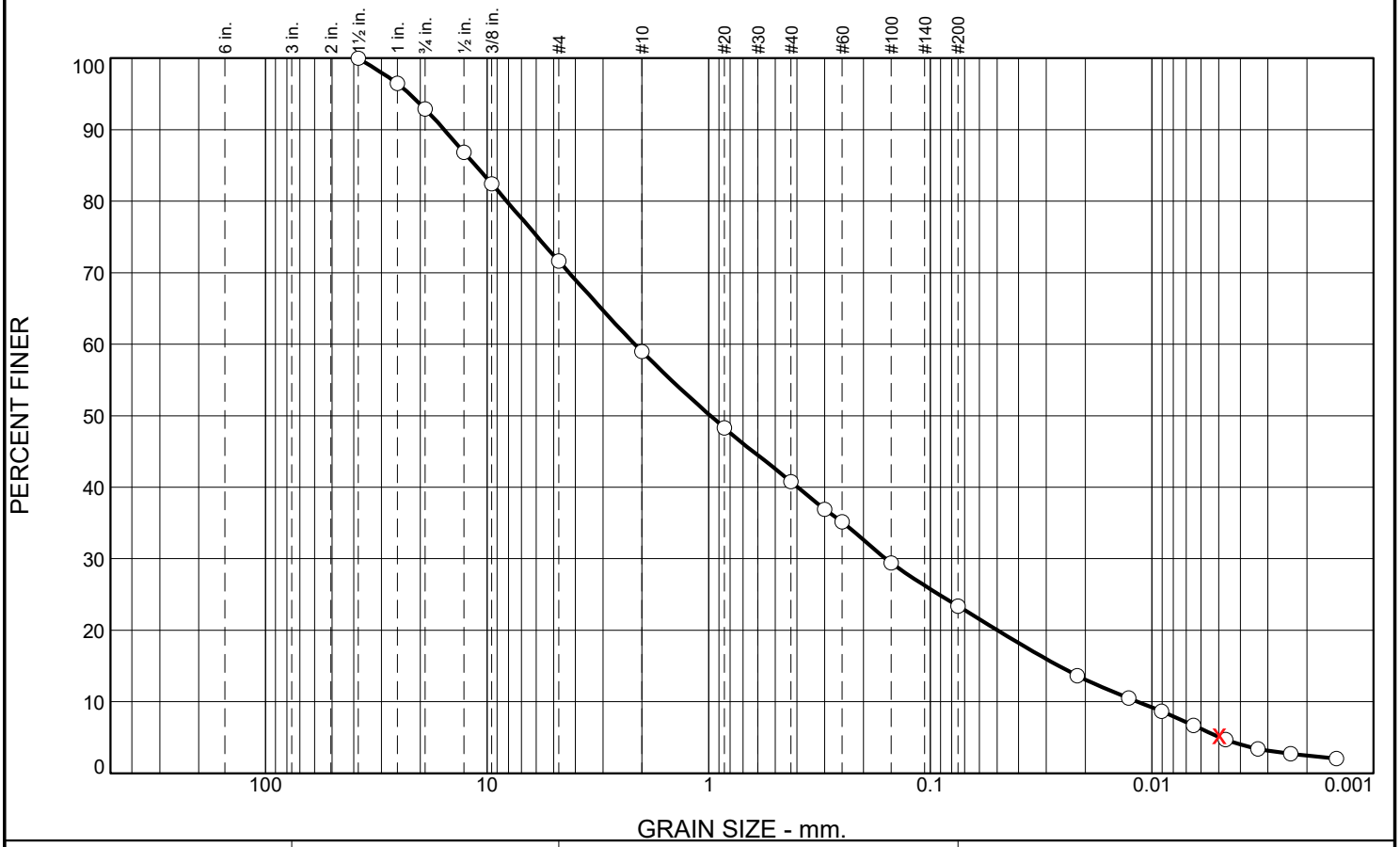
Sample No.: L-33931 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: S-2 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK / AH **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.1	21.3	12.6	18.2	17.4	18.3	5.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.5		
.75	92.9		
.5	86.8		
3/8	82.4		
#4	71.6		
#10	59.0		
#20	48.3		
#40	40.8		
#50	36.9		
#60	35.2		
#100	29.4		
#200	23.4		

* (no specification provided)

Material Description

Light brown 1.5" max silty sand some gravel
USDA Class II Sandy Loam

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 11.2532 D_{60}= 2.1529 D_{50}= 0.9818
D_{30}= 0.1587 D_{15}= 0.0263 D_{10}= 0.0116
C_u= 185.43 C_c= 1.01

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

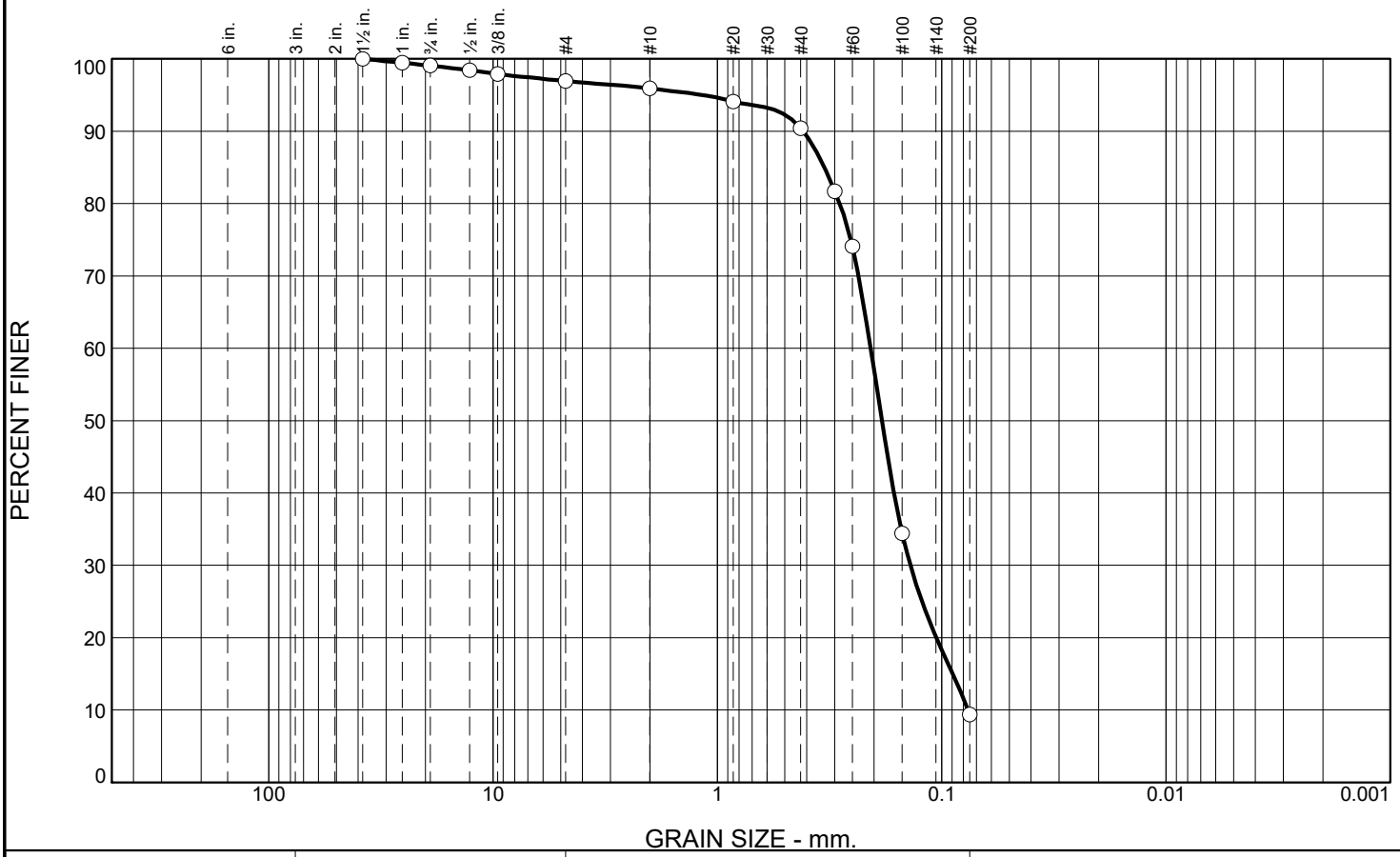
Sample No.: L-33926 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SA-1 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK / AH **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.9	2.2	1.0	5.5	81.0	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.5		
.75	99.1		
.5	98.5		
3/8	97.9		
#4	96.9		
#10	95.9		
#20	94.1		
#40	90.4		
#50	81.7		
#60	74.1		
#100	34.4		
#200	9.4		

* (no specification provided)

Material Description

Brown fine sand trace silt trace gravel
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.3335 D_{60}= 0.2073 D_{50}= 0.1847
D_{30}= 0.1378 D_{15}= 0.0893 D_{10}= 0.0763
C_u= 2.72 C_c= 1.20

Classification

USCS= SP-SM AASHTO= A-3

Remarks

Sample submitted by client on 01/03/24

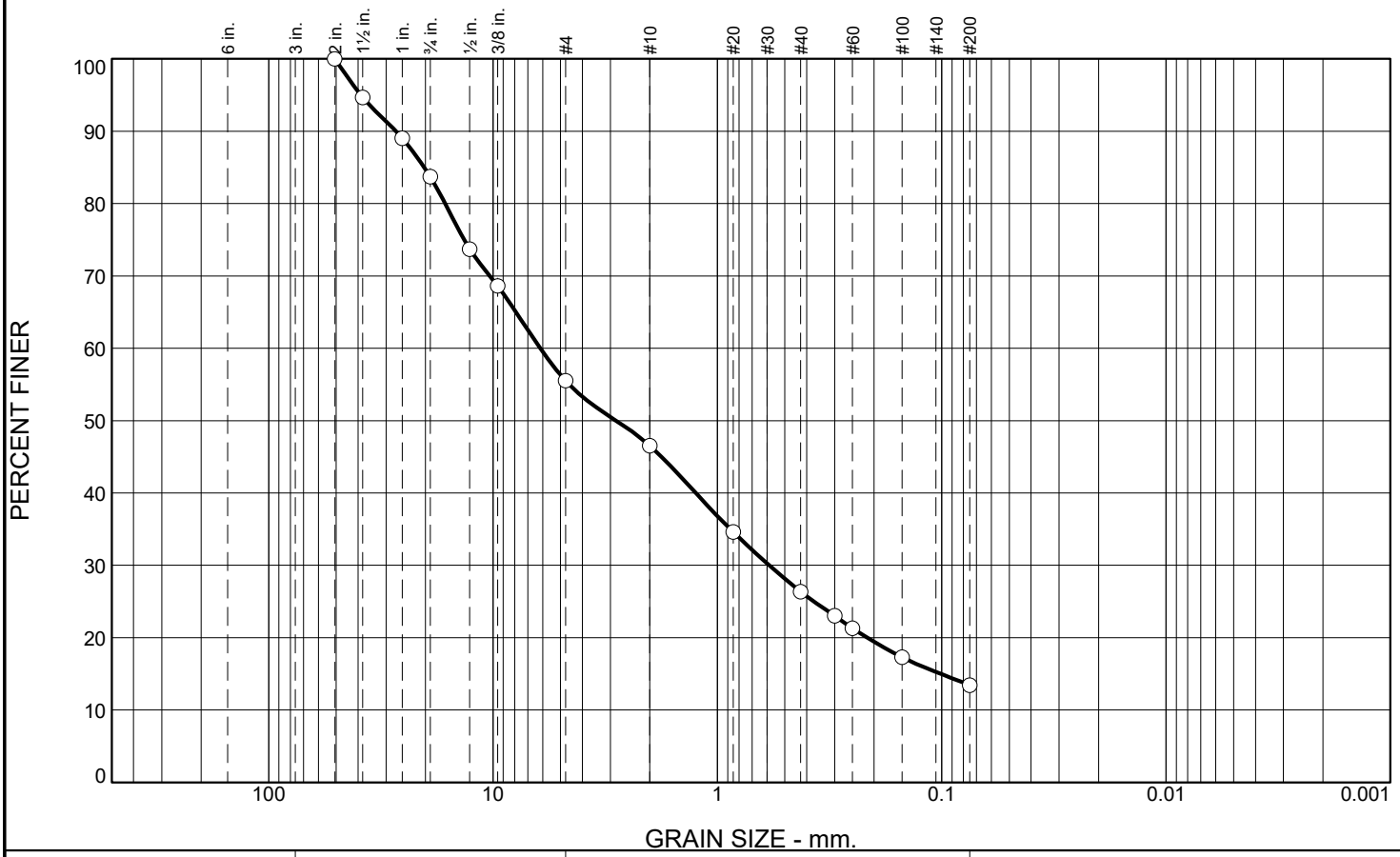
Sample No.: L-33928 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SB-1 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.3	28.2	9.0	20.1	13.0	13.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5	94.7		
1	89.0		
.75	83.7		
.5	73.7		
3/8	68.6		
#4	55.5		
#10	46.5		
#20	34.6		
#40	26.4		
#50	23.0		
#60	21.3		
#100	17.3		
#200	13.4		

* (no specification provided)

Material Description

Brown 2" max silty gravel and sand
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 20.2613 D_{60}= 6.1500 D_{50}= 2.8246
D_{30}= 0.5866 D_{15}= 0.1008 D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Sample submitted by client on 01/03/24

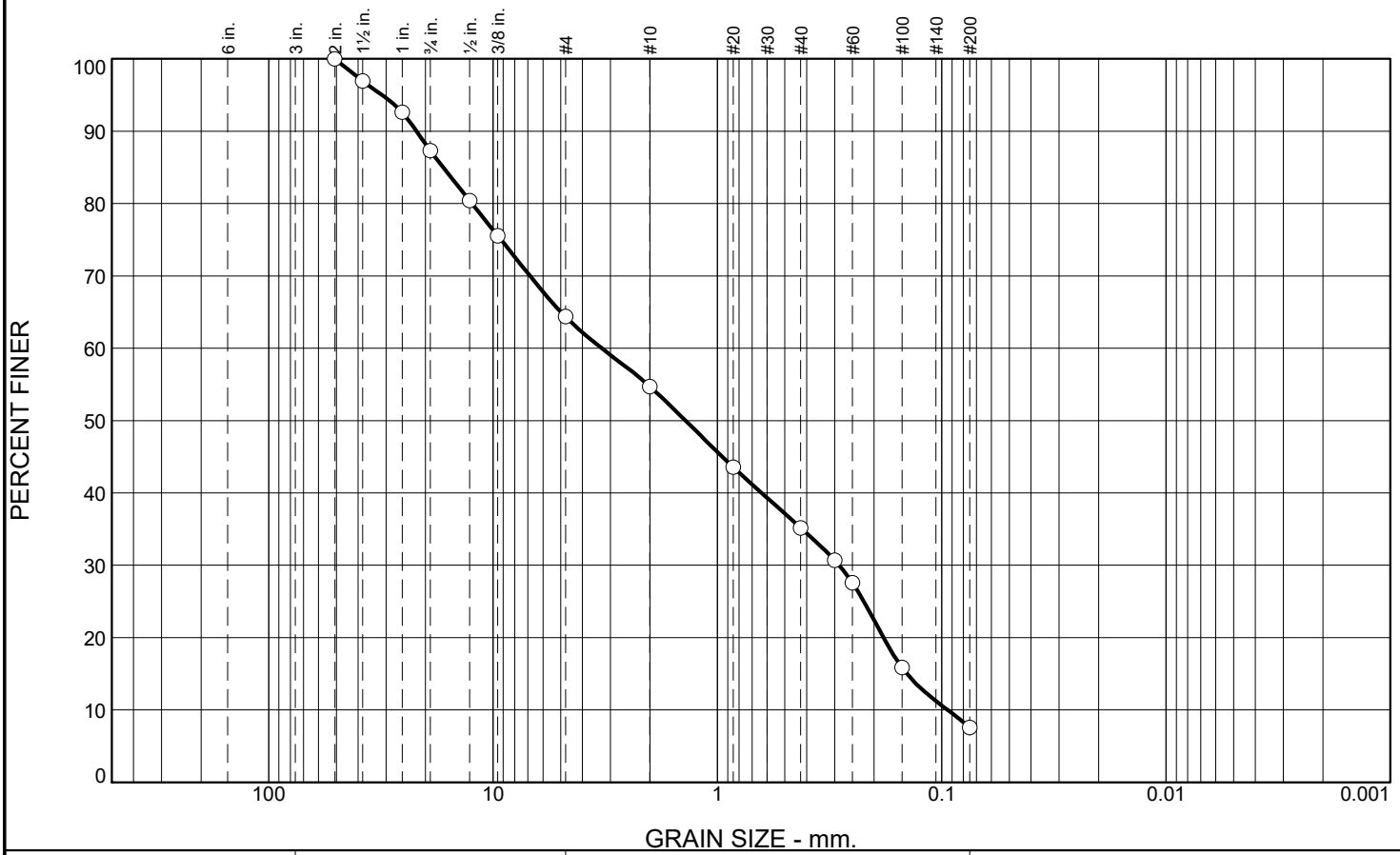
Sample No.: L-33930 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SB-2 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.7	22.9	9.7	19.5	27.6	7.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	96.9		
1	92.6		
.75	87.3		
.5	80.4		
3/8	75.6		
#4	64.4		
#10	54.7		
#20	43.6		
#40	35.2		
#50	30.7		
#60	27.6		
#100	15.8		
#200	7.6		

* (no specification provided)

Material Description

Brown 2" max f/m sand and gravel trace silt
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 16.6628 D_{60}= 3.2736 D_{50}= 1.3851
D_{30}= 0.2868 D_{15}= 0.1425 D_{10}= 0.0940
C_u= 34.84 C_c= 0.27

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

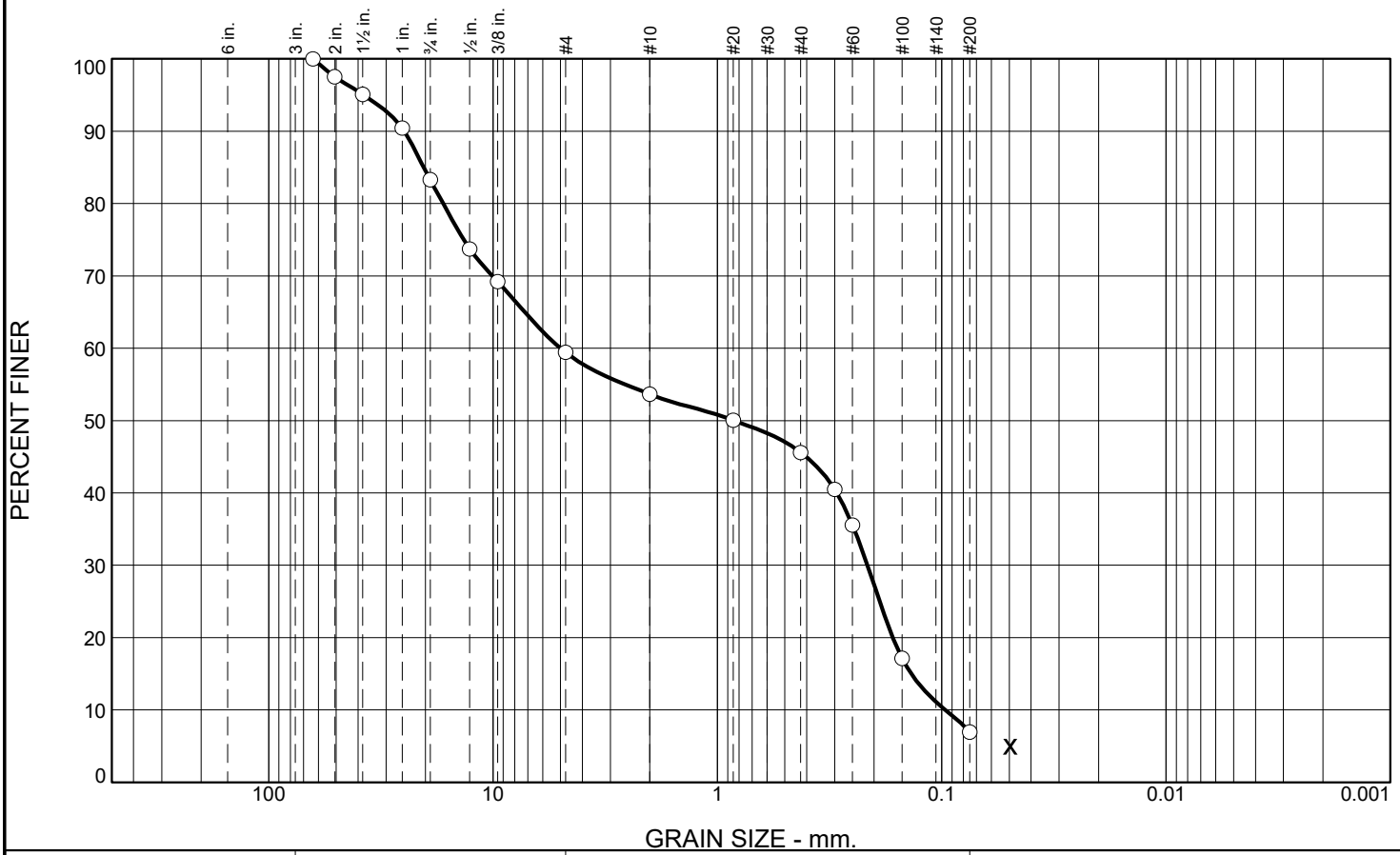
Sample No.: L-33927 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SC Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.7	23.9	5.8	8.0	38.6	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2-1/2"	100.0		
2"	97.5		
1.5	95.1		
1	90.4		
.75	83.3		
.5	73.7		
3/8	69.2		
#4	59.4		
#10	53.6		
#20	50.0		
#40	45.6		
#50	40.5		
#60	35.6		
#100	17.1		
#200	7.0		

* (no specification provided)

Material Description

Brown 2.5" max f/m sand and gravel trace silt
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 20.3667 D_{60}= 5.0006 D_{50}= 0.8422
D_{30}= 0.2143 D_{15}= 0.1366 D_{10}= 0.0962
C_u= 51.96 C_c= 0.10

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

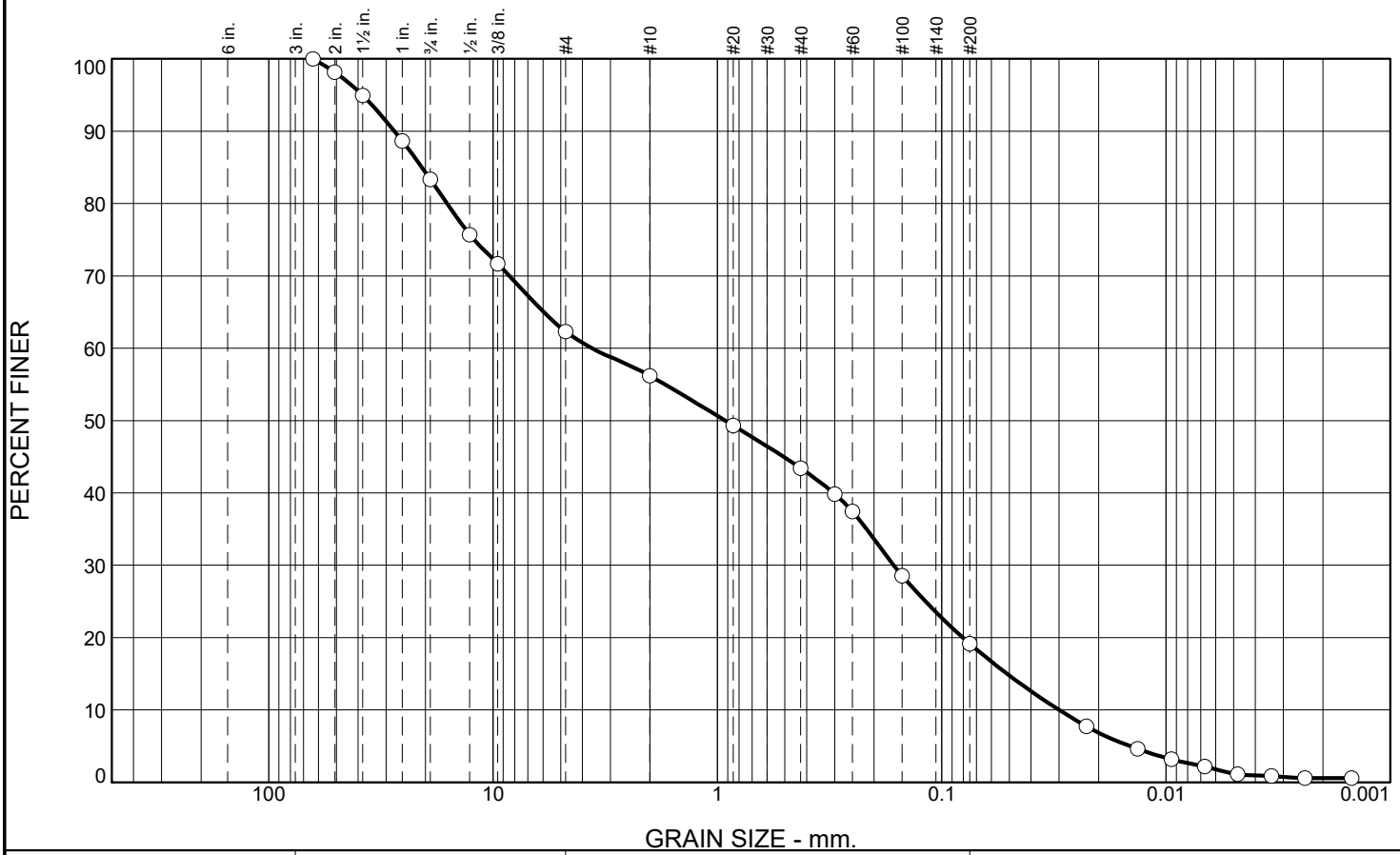
Sample No.: L-33929 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: S-1 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.6	21.1	6.1	12.8	24.2	18.0	1.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5"	100.0		
2"	98.2		
1.5	95.0		
1	88.7		
.75	83.4		
.5	75.7		
3/8	71.7		
#4	62.3		
#10	56.2		
#20	49.3		
#40	43.4		
#50	39.8		
#60	37.4		
#100	28.6		
#200	19.2		

* (no specification provided)

Material Description

Brown 2.5" max silty sand and gravel
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 20.7906 D_{60}= 3.6143 D_{50}= 0.9228
D_{30}= 0.1638 D_{15}= 0.0511 D_{10}= 0.0300
C_u= 120.63 C_c= 0.25

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

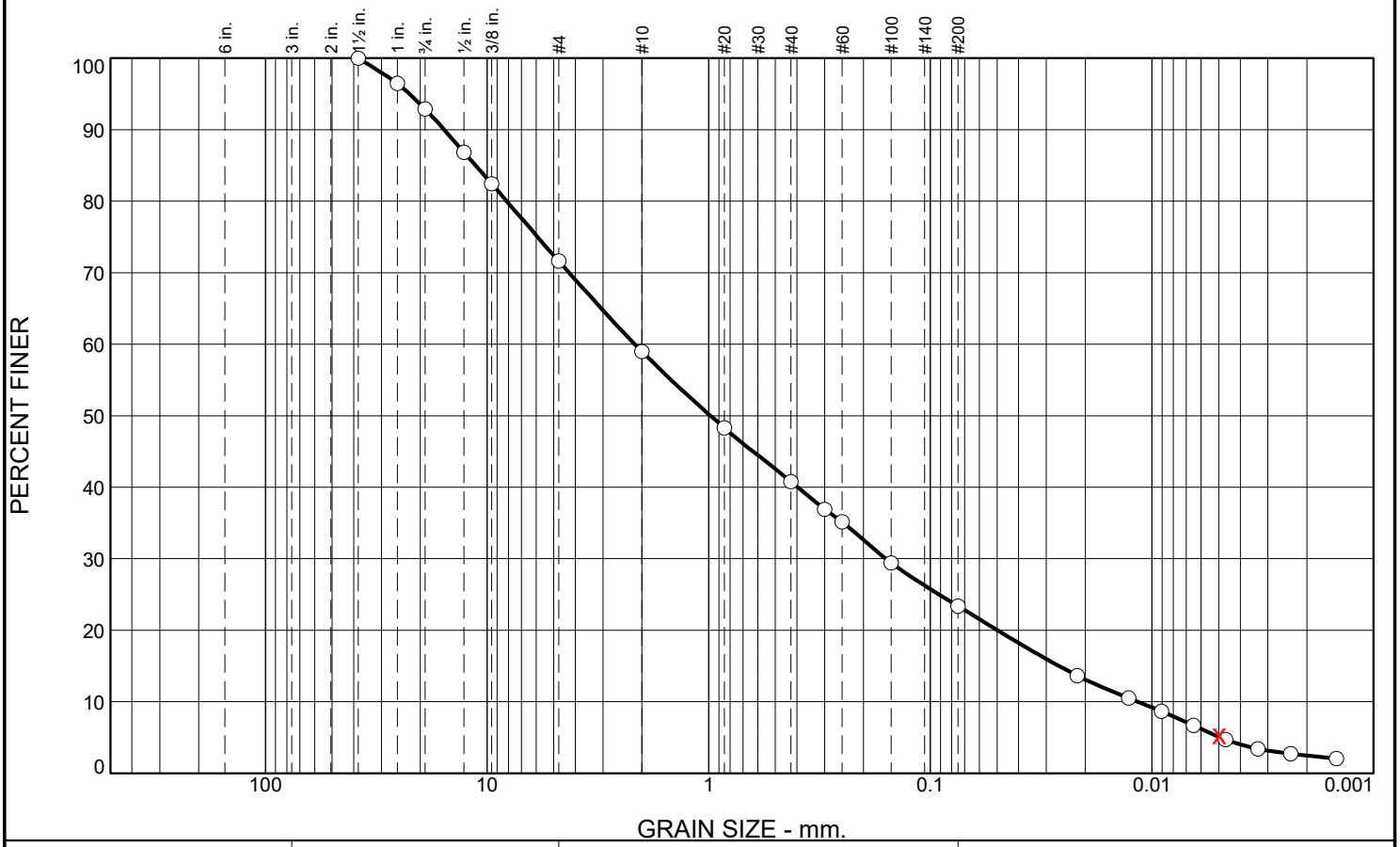
Sample No.: L-33931 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: S-2 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK / AH **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.1	21.3	12.6	18.2	17.4	18.3	5.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.5		
.75	92.9		
.5	86.8		
3/8	82.4		
#4	71.6		
#10	59.0		
#20	48.3		
#40	40.8		
#50	36.9		
#60	35.2		
#100	29.4		
#200	23.4		

* (no specification provided)

Material Description

Light brown 1.5" max silty sand some gravel
USDA Class II Sandy Loam

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 11.2532 D_{60}= 2.1529 D_{50}= 0.9818
D_{30}= 0.1587 D_{15}= 0.0263 D_{10}= 0.0116
C_u= 185.43 C_c= 1.01

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

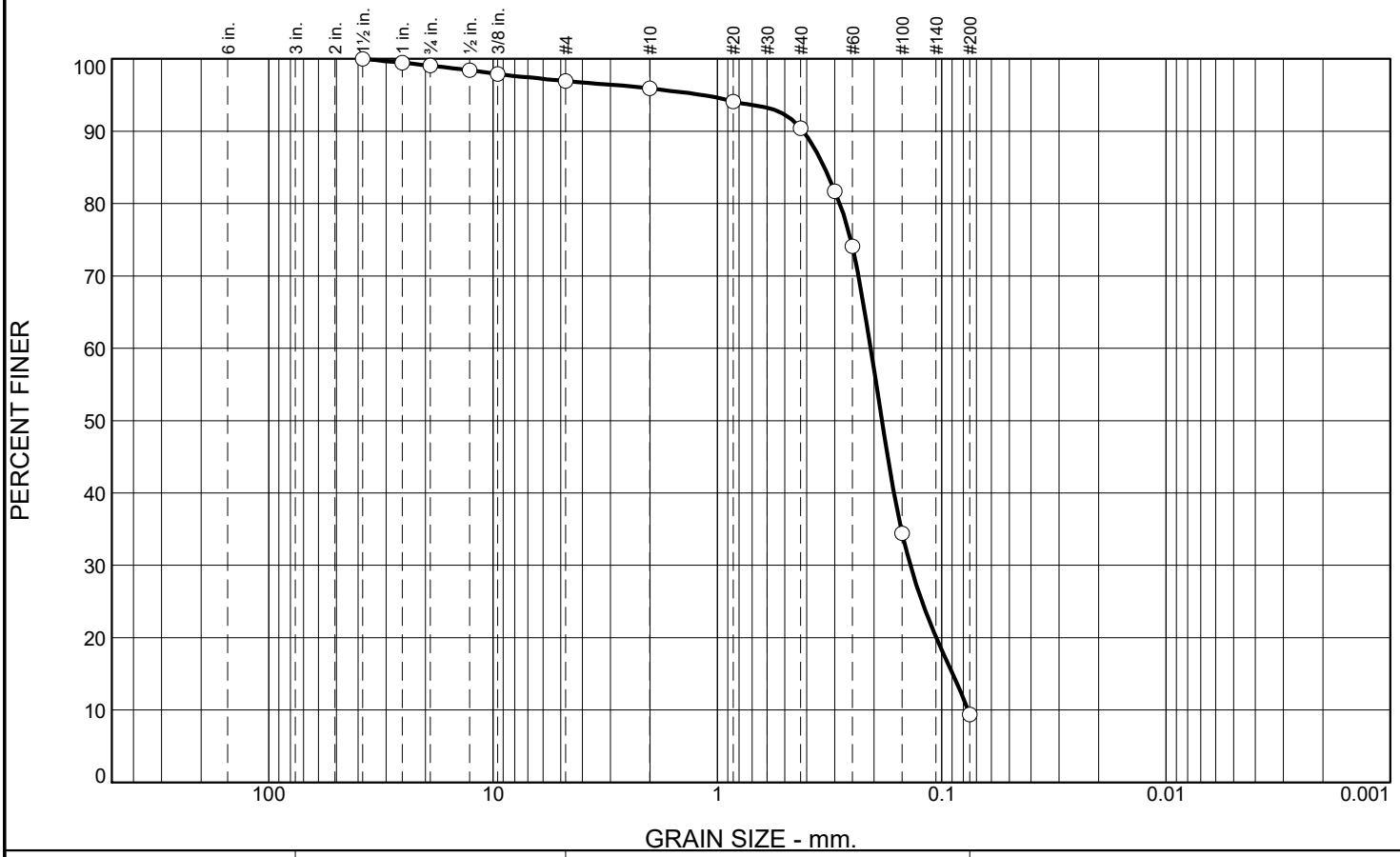
Sample No.: L-33926 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SA-1 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK / AH **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.9	2.2	1.0	5.5	81.0	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.5		
.75	99.1		
.5	98.5		
3/8	97.9		
#4	96.9		
#10	95.9		
#20	94.1		
#40	90.4		
#50	81.7		
#60	74.1		
#100	34.4		
#200	9.4		

* (no specification provided)

Material Description

Brown fine sand trace silt trace gravel
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.3335 D_{60}= 0.2073 D_{50}= 0.1847
D_{30}= 0.1378 D_{15}= 0.0893 D_{10}= 0.0763
C_u= 2.72 C_c= 1.20

Classification

USCS= SP-SM AASHTO= A-3

Remarks

Sample submitted by client on 01/03/24

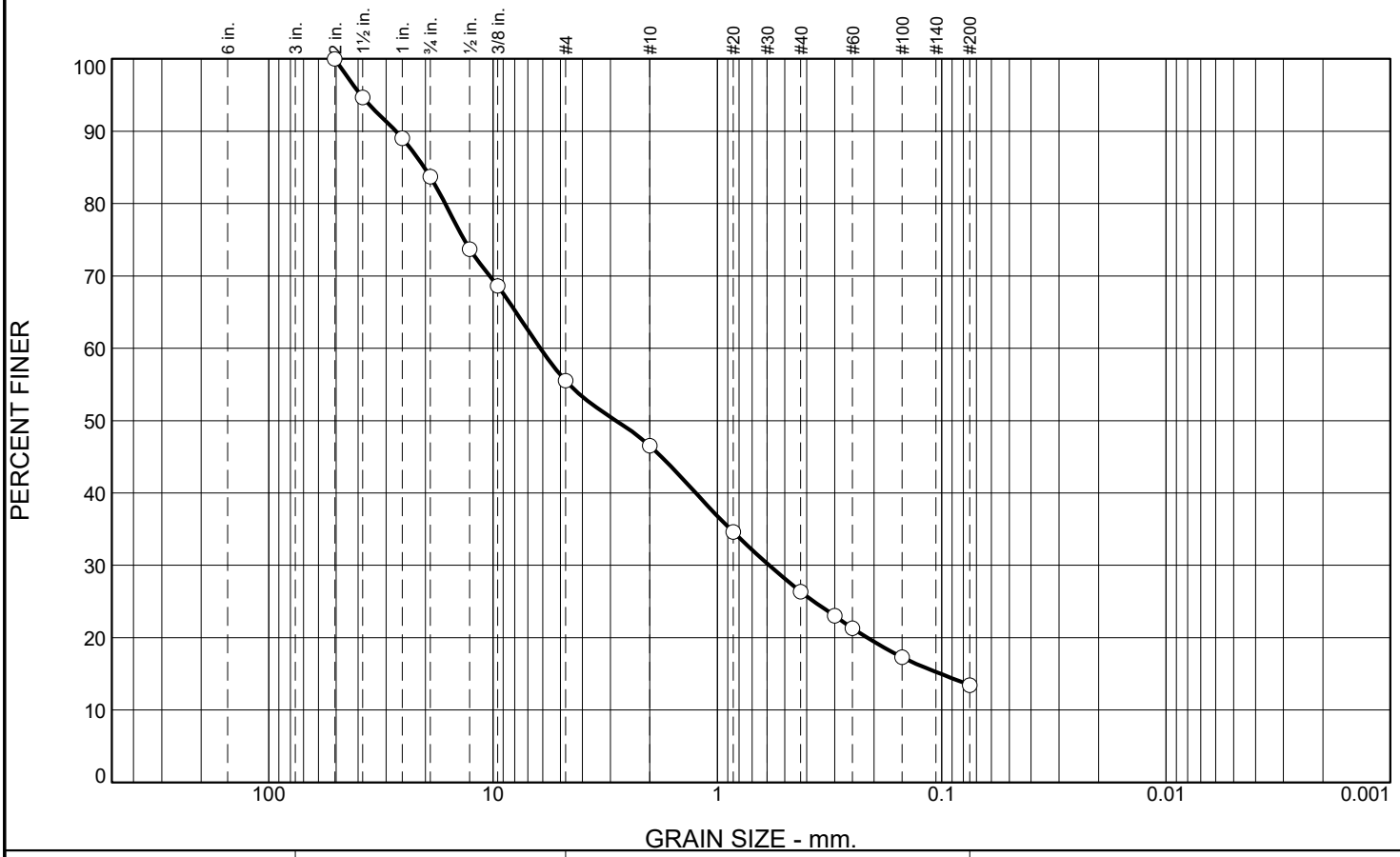
Sample No.: L-33928 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SB-1 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.3	28.2	9.0	20.1	13.0	13.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5	94.7		
1	89.0		
.75	83.7		
.5	73.7		
3/8	68.6		
#4	55.5		
#10	46.5		
#20	34.6		
#40	26.4		
#50	23.0		
#60	21.3		
#100	17.3		
#200	13.4		

* (no specification provided)

Material Description

Brown 2" max silty gravel and sand
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 20.2613 D_{60}= 6.1500 D_{50}= 2.8246
D_{30}= 0.5866 D_{15}= 0.1008 D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Sample submitted by client on 01/03/24

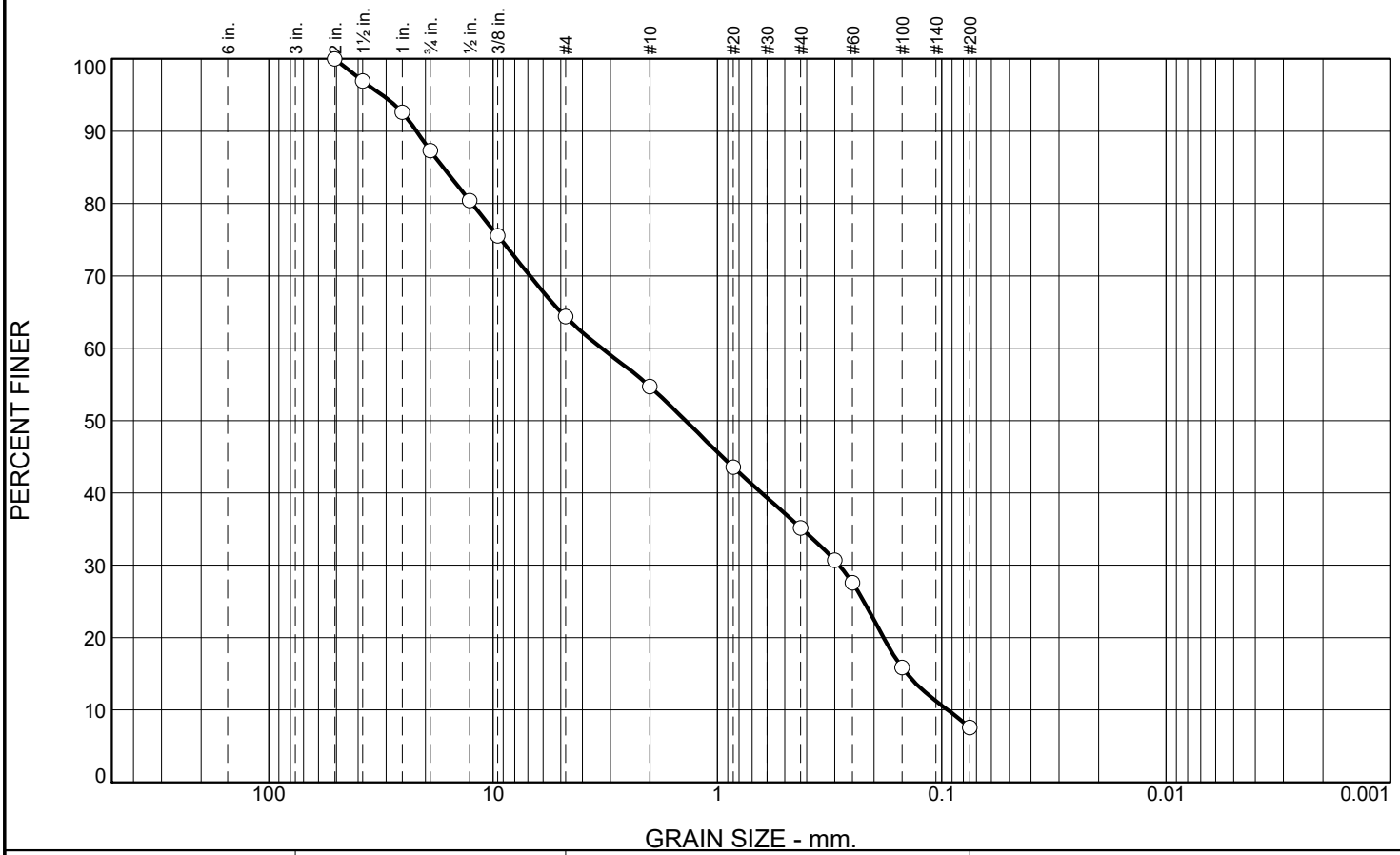
Sample No.: L-33930 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SB-2 Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.7	22.9	9.7	19.5	27.6	7.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	96.9		
1	92.6		
.75	87.3		
.5	80.4		
3/8	75.6		
#4	64.4		
#10	54.7		
#20	43.6		
#40	35.2		
#50	30.7		
#60	27.6		
#100	15.8		
#200	7.6		

* (no specification provided)

Material Description

Brown 2" max f/m sand and gravel trace silt
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 16.6628 D_{60}= 3.2736 D_{50}= 1.3851
D_{30}= 0.2868 D_{15}= 0.1425 D_{10}= 0.0940
C_u= 34.84 C_c= 0.27

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

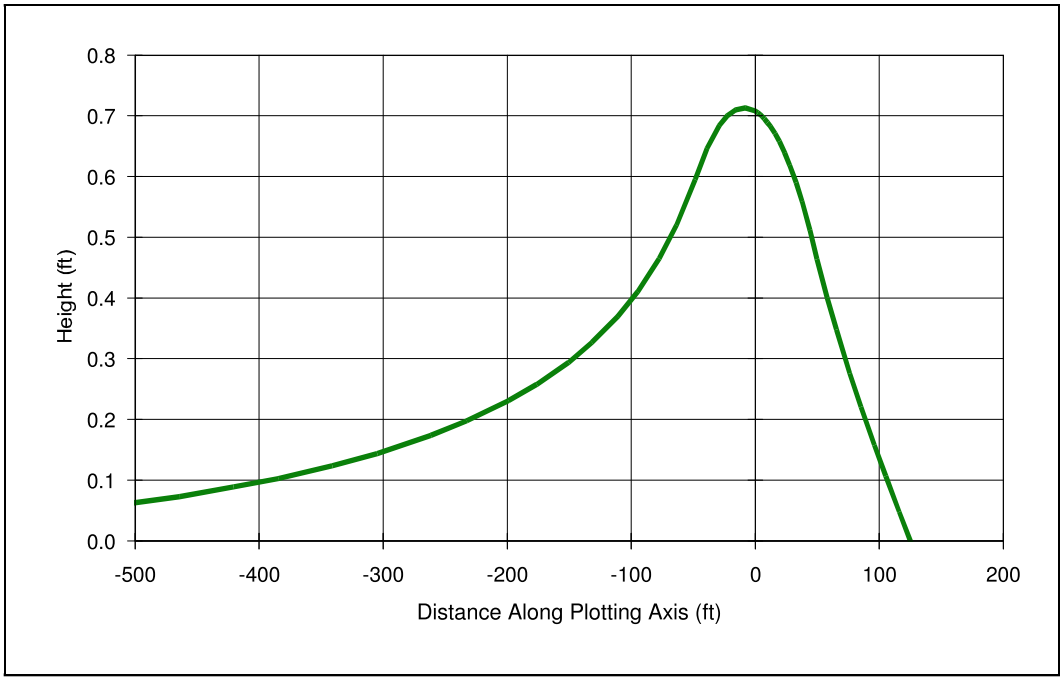
Sample No.: L-33927 **Source of Sample:** Farm Rd - Sherborn MA **Date:** 1/9/24
Location: SC Sample **Elev./Depth:** submitted

YANKEE ENGINEERING & TESTING, INC.

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK **Checked By:** SMM

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



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 2/2/2024 TIME: 9:48:50 AM

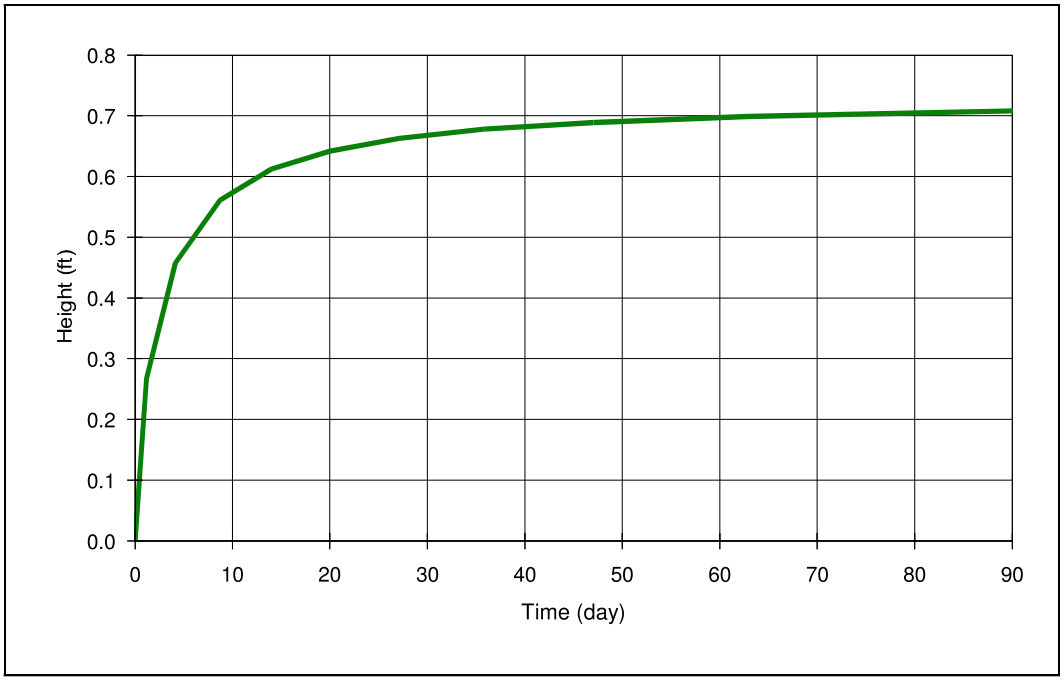
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 24 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	-500	-500	0.06
0	-420.5	-420	0.09
0	-341	-341	0.12
0	-261.4	-261	0.17
0	-199	-199	0.23
0	-150.5	-150	0.29
0	-110.9	-111	0.37
0	-77.4	-77	0.46
0	-48.4	-48	0.6
0	-29	-29	0.68
0	-15.8	-16	0.71
0	0	0	0.71
0	3.9	4	0.7
0	7.2	7	0.7
0	12.1	12	0.68
0	19.4	19	0.66
0	27.7	28	0.62
0	37.6	38	0.56
0	49.7	50	0.46
0	65.4	65	0.35
0	85.2	85	0.22
0	105.1	105	0.11
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: 2/2/2024 TIME: 9:49:27 AM

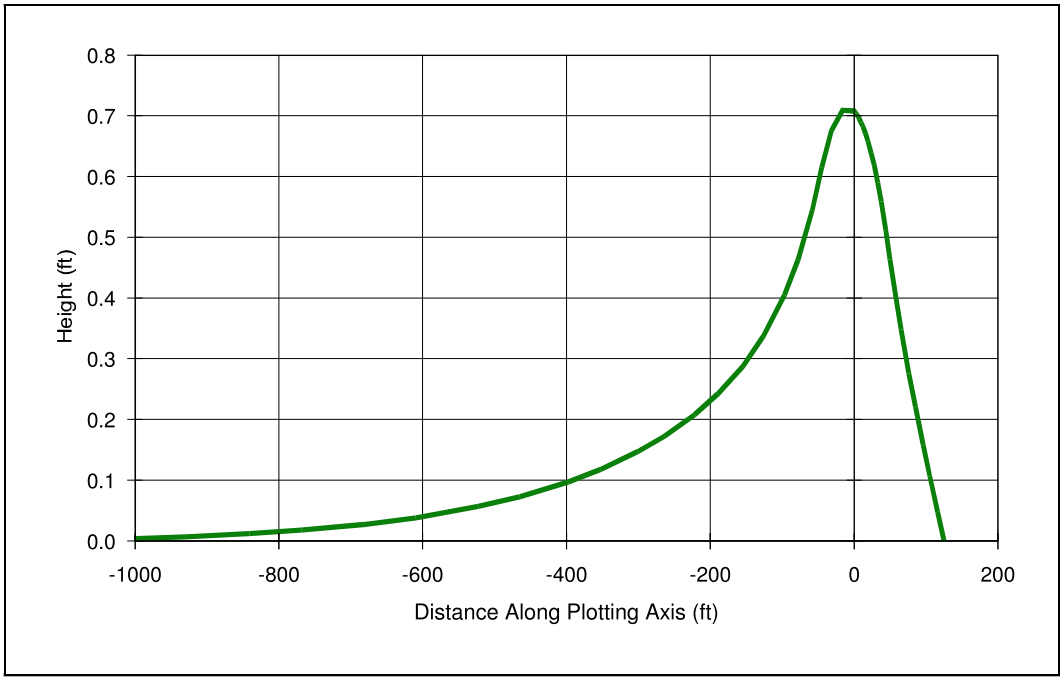
INPUT PARAMETERS

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: 24 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	0.27
4	0.46
9	0.56
14	0.61
20	0.64
27	0.66
36	0.68
47	0.69
63	0.7
90	0.71

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



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2

ANALYST: Desheng Wang

DATE: 2/2/2024 TIME: 10:52:22 AM

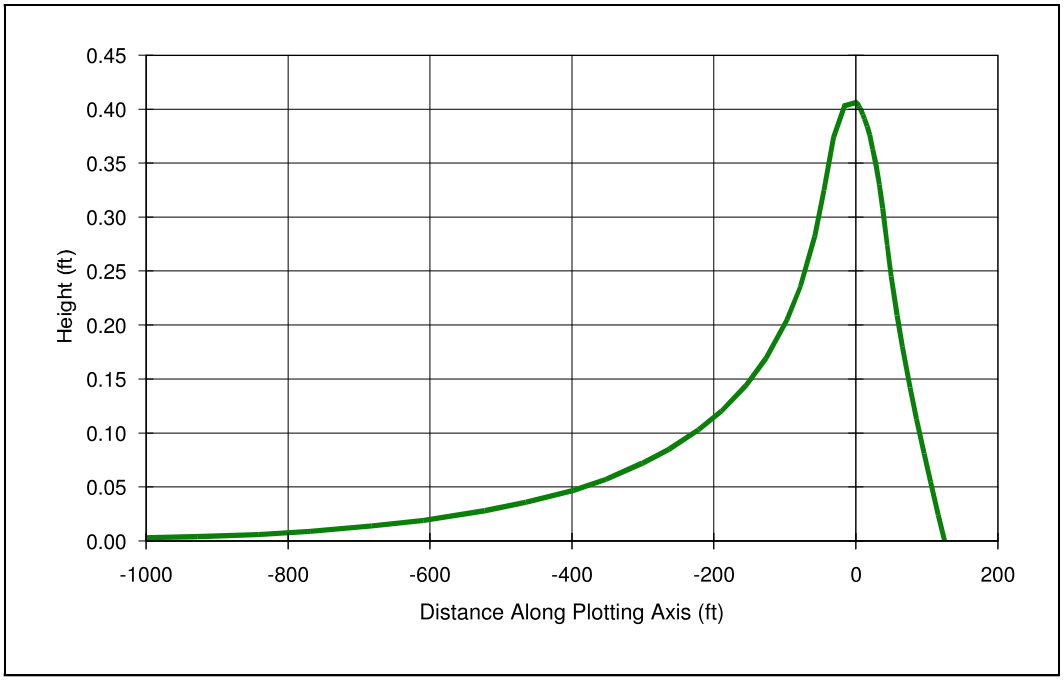
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 24 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	0.03
0	-522.9	-523	0.06
0	-397.9	-398	0.1
0	-301	-301	0.15
0	-221.8	-222	0.21
0	-154.9	-155	0.29
0	-96.9	-97	0.4
0	-58	-58	0.55
0	-31.5	-32	0.68
0	0	0	0.71
0	3.9	4	0.7
0	7.2	7	0.7
0	12.1	12	0.68
0	19.4	19	0.66
0	27.7	28	0.62
0	37.6	38	0.56
0	49.7	50	0.46
0	65.4	65	0.35
0	85.2	85	0.22
0	105.1	105	0.11
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: 2/2/2024 TIME: 10:54:47 AM

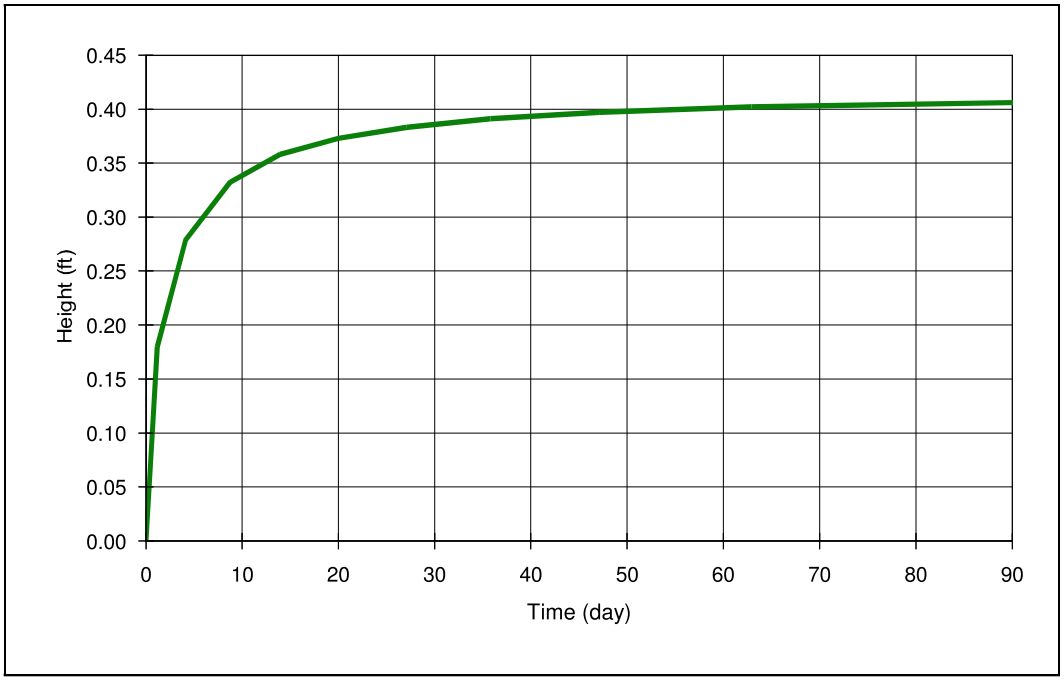
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 24 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	0.01
0	-681.9	-682	0.01
0	-522.9	-523	0.03
0	-397.9	-398	0.05
0	-301	-301	0.07
0	-221.8	-222	0.1
0	-154.9	-155	0.14
0	-96.9	-97	0.2
0	-58	-58	0.28
0	-31.5	-32	0.37
0	0	0	0.41
0	3.9	4	0.4
0	7.2	7	0.4
0	12.1	12	0.39
0	19.4	19	0.38
0	27.7	28	0.35
0	37.6	38	0.31
0	49.7	50	0.24
0	65.4	65	0.18
0	85.2	85	0.11
0	105.1	105	0.06
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: 2/2/2024 TIME: 10:55:22 AM

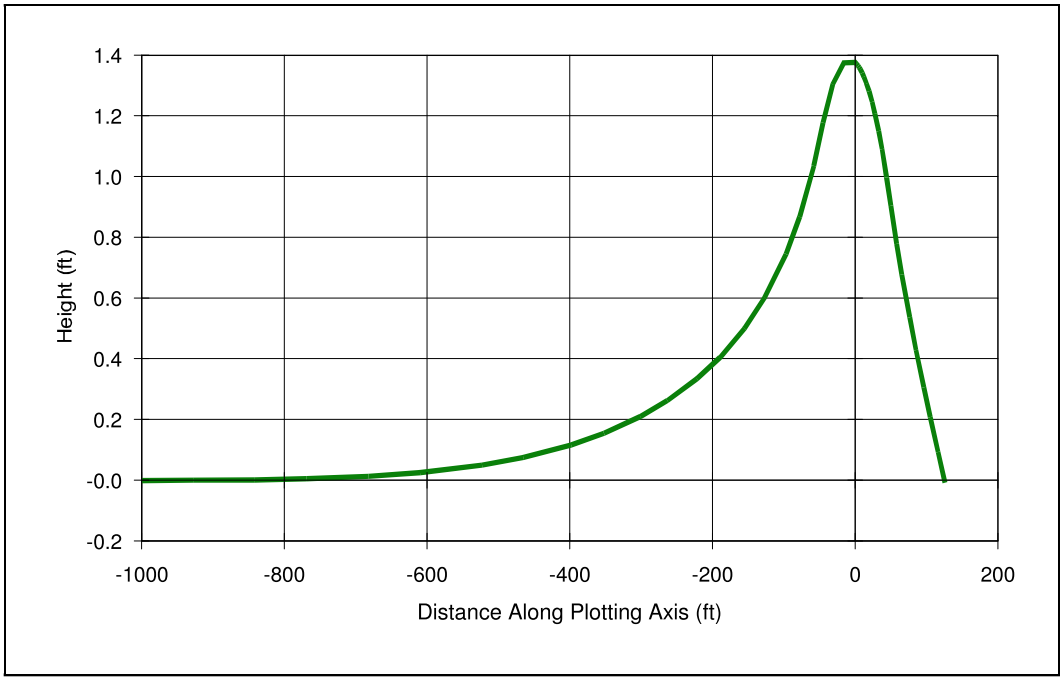
INPUT PARAMETERS

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: 24 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	0.18
4	0.28
9	0.33
14	0.36
20	0.37
27	0.38
36	0.39
47	0.4
63	0.4
90	0.41

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



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2 - 1/2 k

ANALYST: Desheng Wang

DATE: 2/2/2024 TIME: 11:00:02 AM

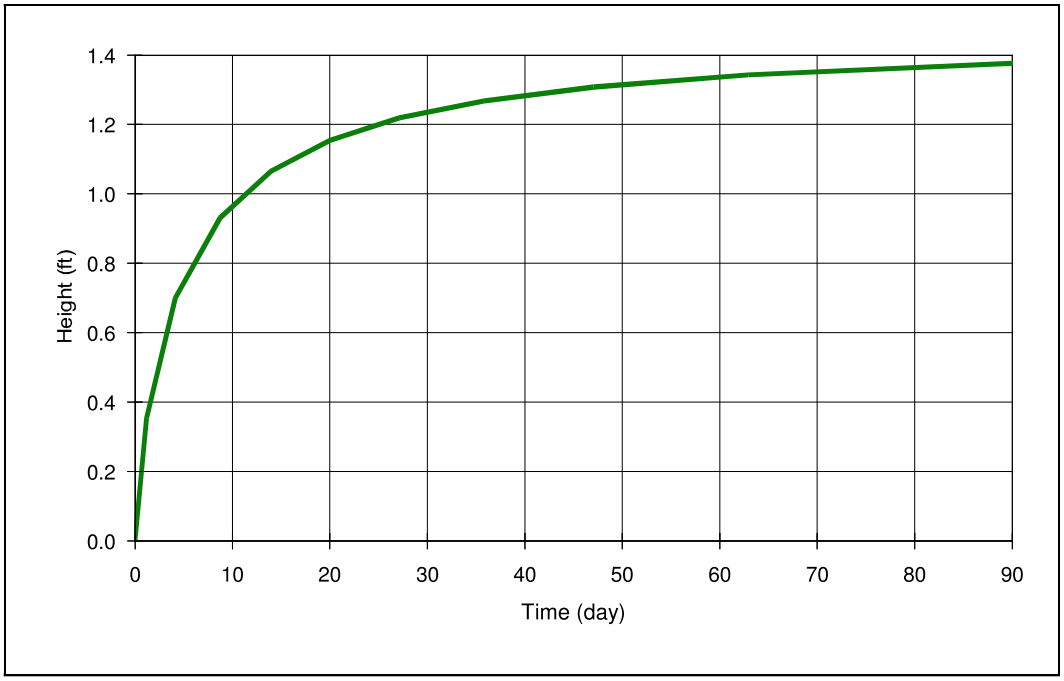
INPUT PARAMETERS

Application rate: 0.1 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 12 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
0	-681.9	-682	0.01
0	-522.9	-523	0.05
0	-397.9	-398	0.12
0	-301	-301	0.21
0	-221.8	-222	0.33
0	-154.9	-155	0.5
0	-96.9	-97	0.74
0	-58	-58	1.03
0	-31.5	-32	1.3
0	0	0	1.38
0	3.9	4	1.36
0	7.2	7	1.35
0	12.1	12	1.33
0	19.4	19	1.28
0	27.7	28	1.21
0	37.6	38	1.09
0	49.7	50	0.9
0	65.4	65	0.68
0	85.2	85	0.43
0	105.1	105	0.21
0	125	125	0

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



COMPANY: CLAWE

PROJECT: Farm Road Homes - SAS 1 and 2 - 1/2 k

ANALYST: Desheng Wang

DATE: 2/2/2024 TIME: 11:00:11 AM

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: 12 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	0.35
4	0.7
9	0.93
14	1.06
20	1.15
27	1.22
36	1.27
47	1.31
63	1.34
90	1.38