Appendix Supplementary Data for Groundwater Mounding Analysis and Updated Groundwater Mounding Analysis

To address the peer review comments regarding the determination of the input parameters, specifically, the saturated soil (unconsolidated aquifer) depth and the hydraulic conductivity (permeability of the soils), we had a meeting on December 20, 2023 with Mr. Peter Dillon, a Hydrogeologist of Tetra Tech and Mr. Mark Oram of the Board of Health Agent.

1. We showed that the nearby well drill logs (49, 53 and 55 Farm Road) were carefully evaluated and found that the well at 53 Farm Road is consistent with the area of the proposed SAS. The saturated soil thickness of 14.5 ft will be used to update the groundwater mounding analysis. This number is very consistent with the deep hole soil testing data. Given that the mounding will spread hundreds of feet, the aquifer depth is conservatively quantified as further downstream the aquifer depth will be thicker. 49 Farm Road well has 25 ft soil over ledge and about 22 ft of saturated soil. See Table S1 for a summary of the well condition. The over 10 gpm yield in all three wells also indicated that the aquifer here is very consistently productive and permeable. The man-dug isolated wet pond on 65 Farm Road has a depth of 15 ft under normal high water, therefore the saturated soil aquifer depth will be at least 15 ft.
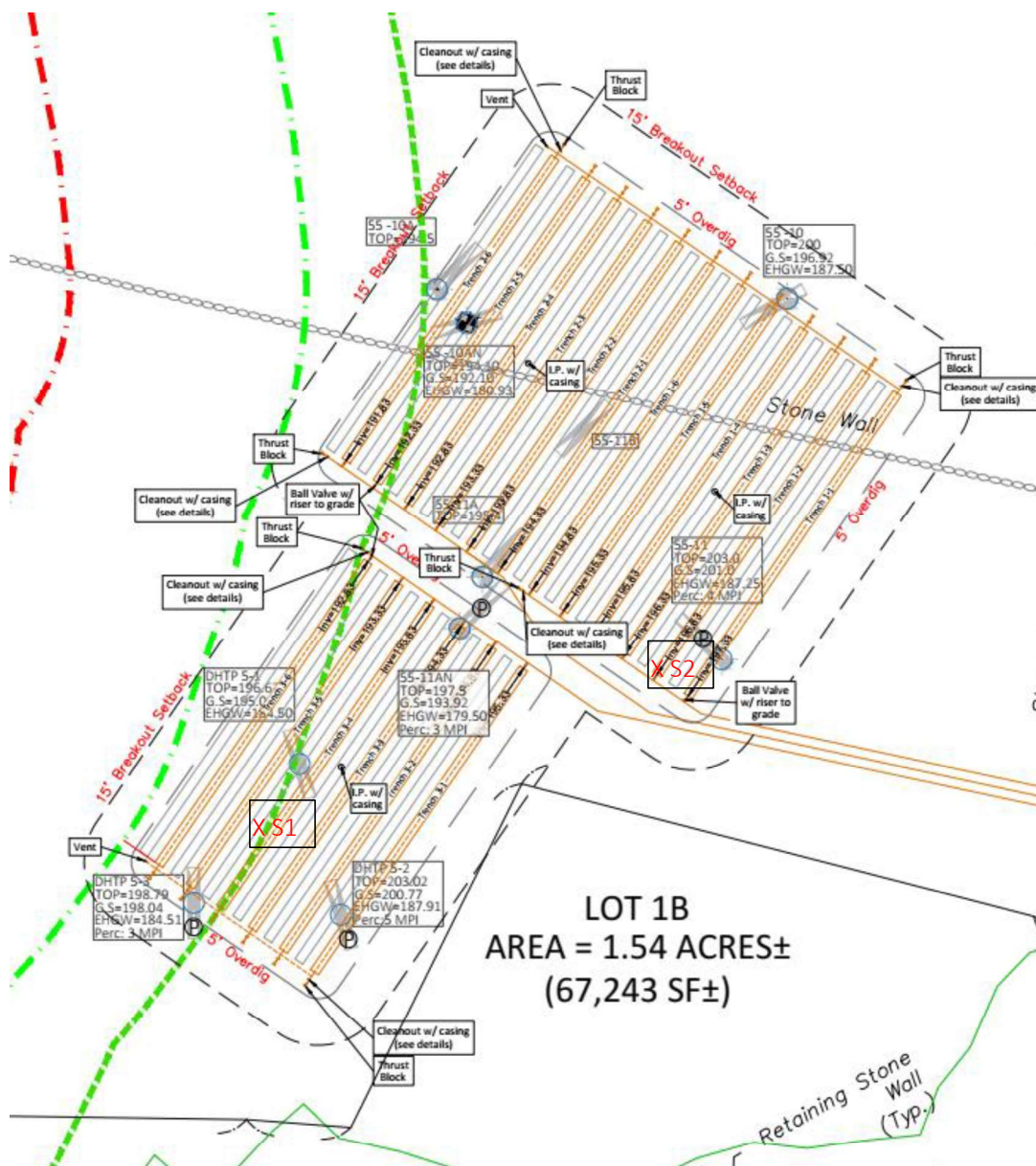
Table S1. Existing Well Data around the proposed SAS

Location	Date drilled	Well depth, ft	Well Cap, gpm	Gravel depth, ft	Water depth, ft	GW correction, ft	unconsolidated Aq. Depth, ft	Note
49 Farm Rd*	10/25/2005	400	10	25	5	2	22	Similar el. with SAS on opposite of Wetland
53 Farm Rd	11/15/2021	300	11	18	5.5	2	14.5	Similar ele with SAS on the same side of wetland
55 Farm Rd	5/20/1980	520	10	17				30+ ft above SAS on the same side of wetland
64 Farm Rad	1980s			15			15	Man-made pond in 1980s

*Water level is estimated based on offsite observation and onsite soil testing, which could be higher.

2. We also showed that the hydraulic conductivity in documented literature for loamy sand condition is consistent with what we used. See attached extract from a book of soil and rock properties. Mr. Dillon recommended that we take two soil samples from the SAS area to do a grain size sieve analysis, which would accurately confirm the soil texture and provide data for permeability analysis. On January 3, 2024, we took two soil samples witnessed by Mr. Oram from the upper limit of the SAS and down gradient limit of SAS. The two samples together with four soil samples taken from the four proposed stormwater management basins were delivered to Yankee Engineering Testing for sieve analysis. The sieve analysis showed that the soil at the lower limit (S1) is coarse medium sand and the soil at the upper limit of the SAS (S2) is loamy sand. This is consistent with general geological observations, soil in upper hill tends to be well mixed siltier condition than the lower flattened area. And the site has a general deep groundwater condition is another collateral evidence of the well drained soil condition. Out of six soil samples, only one soil was tested sandy loam that is close to loamy sand in upper hill area for stormwater Basin A. Three of them are actually sand and two are loamy sand. See Tabe S2 for a summary and attached lab report for details.

Based on the grain size distribution, we calculated the permeability of all six soil samples using two methods: Hazen and Kenny. The result is summarized in Table S3.

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Table S2. Summary of soil texture analysis based on sieve analysis, 65 Farm Rd, Sherborn, MA

Soil Sample	Location	Sand, silt, and Clay compsition				Soil texture per USDA
		Sand % 0.05-2 mm	Silt % 0.002-0.05mm	Clay % <0.002mm	Total %	
S1	lower edge of SAS	92.53	5.6	1.87	100	medium sand
S2	upper edge of SAS	73.66	24.56	1.78	100	medium loamy sand
SA1	Stormwater Basin A	66.1	30.5	3.4	100	medium sand loam
SB-1	Stormwater Basin B-1	97.91	2.09	0	100	fine medium sand
SB-2	Stormwater Basin B-2	75.64	22.86	1.5	100	medium loamy sand
SC	Stormwater Basin C	91.46	6.71	1.83	100	medium sand

Location of soil samples in SAS area

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Table S3. Summary of hydraulic conductivity (permeability) analysis

Soil Sample	Location	estimated K, ft/day	Average K, ft/day	Typical K for silt/sand*	Design K	Soil texture per USDA
S1	lower edge of SAS	29-850	439	153	24	medium sand
S2	upper edge of SAS	4.39-76	40	28		medium loamy sand
SA1	Stormwater Basin A	0.52-8.5	4.51	28		medium sand loam
SB-1	Stormwater Basin B-1	37.84-1437.17	737	153		fine medium sand
SB-2	Stormwater Basin B-2	7.80-76.54	42.17	28		medium loamy sand
SC	Stormwater Basin C	57.43-1028	543.21	153		medium sand

* Ameratunga, Jay, Sivakugan, N., and Das, B. M. Correlations of soil and rock properties in geotechnical engineering, Springer 2016.

A computer program using Hantush method is used to calculate the groundwater mounding from the proposed septic system. The parameters were determined by onsite soil testing as follows.

Sewage Discharge Rate   = 8360 GPD

Hydraulic Conductivity   = 24 ft/day. (see previous section)

Specific Yield   = 0.26   (R. Brown Groundwater, Elsevier Applied Sci. Publishers LTD 1986)

Impervious Datum   = 0-50 ft. BGS, conservative value 14.5 based on the well drilling data at 53 Farm road and check with 49 and 55 Farm road well drilling data. is used, See Table s1

Groundwater Table   = 279.5 ft. medium value with Frimpter adjustment (soil evaluation, and monitoring)

Effective Leaching Area   = 92 ft x 82 ft (L1-# and L2-#); 82 ft x 46 ft (L3-#)

Groundwater mounding time = 90 days –recommended by DEP guideline.

The calculated maximum groundwater mounding heights are 0.91 ft (L1 and L2), 0.81 ft (L3). These values are added to the adjusted groundwater table at each trench line conservatively to make sure the maximum mounded high ground water table would be at least 4 ft below the bottom of each trench. See Tables 9.1 and 9.2 for summary. The septic design plan has been updated with this new mounding analysis. The updated computer model output is attached for reference.

It can be seen that there will be at least 7.17 ft groundwater separation assuming the high groundwater is at the dry test pit bottom. It will be at least 8.29 ft if the water table is based on the observed water tables in the two wet wells.

Table 9.1 - Hydraulic profile design summary of SAS (Rev. 2/2/2024)

Line	Bottom Elev, ft	Dist to Ref well DHTP-11An, ft	EHGW with wet well, ft	Mound EHGW, ft	GW Sep, ft	EHGW with dry well, ft	Mound GW using dry tp, ft	GW Sep, ft
L 1-1	195.33	52.34	180.66	181.57	13.76	187.25	188.16	7.17
L1-2	194.83	50.565	180.62	181.53	13.30	186.68	187.59	7.24
L1-3	194.33	49.235	180.59	181.50	12.83	186.10	187.01	7.32
L1-4	193.83	47.98	180.56	181.47	12.36	185.53	186.44	7.39
L1-5	193.33	47.38	180.55	181.46	11.87	184.95	185.86	7.47
L1-6	192.83	89.75	181.49	182.40	10.43	184.38	185.29	7.54
L2-1	192.33	0	179.50	180.41	11.92	183.80	184.71	7.62
L2-2	191.83	0	179.50	180.41	11.42	183.23	184.14	7.69
L2-3	191.33	47.6	180.56	181.47	9.86	182.66	183.57	7.76
L2-4	190.83	48.2	180.57	181.48	9.35	182.08	182.99	7.84
L2-5	190.33	48.255	180.57	181.48	8.85	181.51	182.42	7.91
L2-6	189.83	51.105	180.63	181.54	8.29	180.93	181.84	7.99
L3-1	193.33	37	180.32	181.13	12.20	184.95	185.76	7.57
L3-2	192.83	35	180.28	181.09	11.74	184.38	185.19	7.64
L3-3	192.33	0	179.50	180.31	12.02	183.80	184.61	7.72
L3-4	191.83	33	180.23	181.04	10.79	183.23	184.04	7.79
L3-5	191.33	36	180.30	181.11	10.22	182.66	183.47	7.86
L3-6	190.83	41	180.41	181.22	9.61	182.08	182.89	7.94
Average					11.16			7.64
Minimum					8.29			7.17

Note: The combined max mounding height in L1 and L2 is 0.91 ft

The max mounding height in L3 is 0.81 ft

Table 9.2 - Summary of groundwater mounding analysis – SAS (Rev 2/2/2024)

Parameters	Leaching Field		Note
	SAS 1+2	SAS3	
Recharge area			
Dimension, Length, ft	92	82	
Dimension, Width, ft	82	46	
Area, sq. ft	7544.00	3772.00	
Recharge Vol. Cu ft (per day or event)	745.10	372.55	
Duration, day	90	90	
Recharge rate, cu ft/day/sq. ft	0.10	0.10	
Dewater time, day	90	90	
GW Separation, ft	8.49	12.58	
Distance to wetland, ft	125	125	
Maximum mounding height, ft	0.71	0.41	All trenches are placed more than 8 ft above the estimated highgroundwater and not be impacted by groundwater mounding.
Estimated effective Max MH, ft	**0.91**	**0.81**	
Impact mounding height by other systems, ft	**0.2**	**0.4**	
Combined Mound height, ft	**0.91**	**0.81**	
Bottom of Trench, ft	**192.58**	**192.08**	
Top of stones, ft			
EHGW, ft	184.09	179.5	
	average		
Bottom aquifer, ft	**170**	**170**	
Flood routing elev, ft	291.670	291.670	
Top of grade, ft	292.5	275.5	
Aquafer depth, ft	14.5	14.5	
Hydraulic Conductivity, ft/day	24.00	24.00	
Groundwater mound rage, ft	841	841	

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

Subject:	Permeability Estimate		
65 Farm Road		**Sieve by:** Yankee	**Date:** 1/9/2024
Sherborn, MA 01770		**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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Subject: Permeability Estimate

65 Farm Road   **Sieve by:** Yankee   **Date:** 1/9/2024
Sherborn, MA 01770   **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

Creative Land & Water Engineering, LLC	**Subject:** Permeability Estimate			
Environmental Science and Engineering	65 Farm Road	**Sieve by:** Yankee	**Date:**	1/9/2024
P.O. Box 584, Southborough, MA 01772	Sherborn, MA 01770	**Calc.:** DSW	**Date:**	3-Feb-24
Tel: (508)281-1694 clawe@claweng.com		**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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65 Farm Road	**Sieve by:** Yankee	**Date:** 1/9/2024
Sherborn, MA 01770	**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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Subject: Permeability Estimate

65 Farm Road   **Sieve by:** Yankee   **Date:** 1/9/2024
Sherborn, MA 01770   **Calc.:** DSW   **Date:** 3-Feb-24
                         Job No.: J269-12   **Sheet:** 1 of 1

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

Subject: Permeability Estimate	
65 Farm Road	**Sieve by:** Yankee **Date:** 1/9/2024
Sherborn, MA 01770	**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 1/20/2022
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 *[signature] 1/20/2022*

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: Sand/Bentonite & Boro Shoe
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]*

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

    Authorized Signature: *[signature]*

TWO (2) REQUIRED WATER ANALYSIS REPORTS:
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.

Pump Test

Total Coliform Bacteria	Total Iron	9:AM 5.5' start
Total Bacteria (HPC)	Manganese	9:30 28' 12.6 GPM
Ammonia Nitrogen	Color	10:AM 59.3' 12 GPM
Nitrite Nitrogen	Turbidity	10:30 70.5' 12 GPM
Nitrate Nitrogen	Odor	11:AM 76.5' 12 GPM
Chloride	pH	11:30 80.9' 11.76 GPM
Sodium	Total Alkalinity	NOON 83.9' 11.5 GPM
Lead	Total Hardness	
Arsenic	Volatile Organic Compounds (EPA 524 testing method)	
		12:30 86.3' 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.
    1:PM 88' 11.4 GPM

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 Rot. 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 Finga

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 Rot. 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 Finja

Driller:

Pequot Museum

DHTP 4-2

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

ω bj. 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
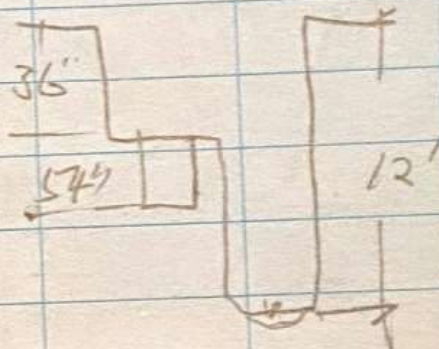
14/3 = 5 mPI

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 - Lose

NOW   NOW

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 SJ Farm Rel
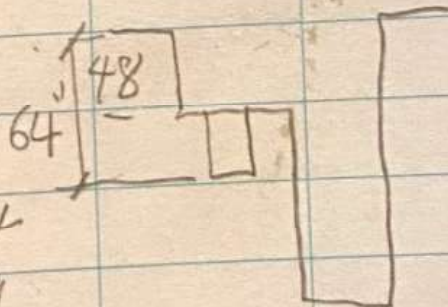
Lot 5

BH7P 5-3   perc

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

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

30-54   C₁   m.s.   2.5Y6/4   loose

54-180⁺ C₂ co.m.L.S   2.5Y5/4   dense
stone 20%

no weaps, no sty w

perc 5-3

pre 11:04   9 11:28   42

end 11:19   8 11:31

12 11:20   7 11:33   60"

11 11:22   6 11:35

10 11:25

9 11:28

180"

$7/3 = \frac{1}{2}$ mp I
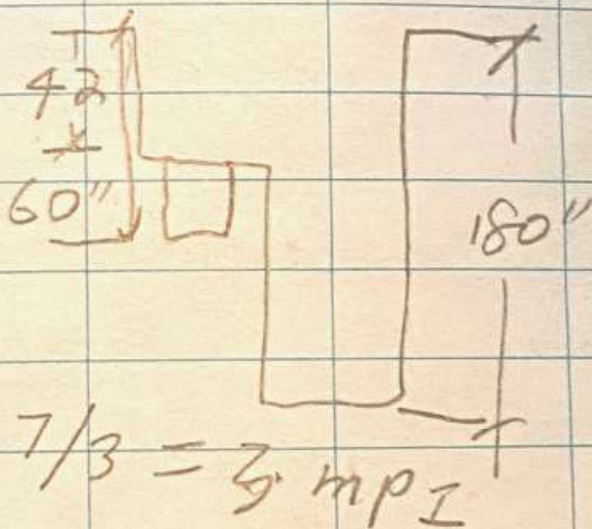
BH7P 5-1 (DEEP)

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   2.5Y5/4   dense
stony 20%

no std, no weaps

Back area   4/21/2021

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   10YR3/2   fr
4-30   B   SL   10YR6/6   fr
30-192"   C   C.S   2.5Y5/4 dense-fr
               no weeps, no std.

55-11 N   S.L 10YR3/2 2Y0 sy
0-4"   A   S.L 2.5Y6/6 fr b   42/54
4-32   B   S.L 2.5Y5/4 fr b
32-236' C C.S.   fr b
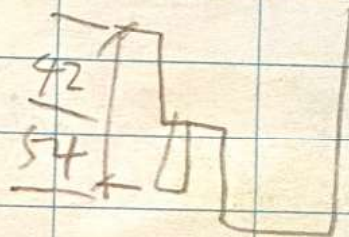
                weeps = 18' 17'
                stg   = 18' → 17'

pre 1:49
end 2:04
12   2:04
11   2:06
10   2:09
9   2:12
8   2:15   9/3 = 3 PI
7   2:18
6   2:21
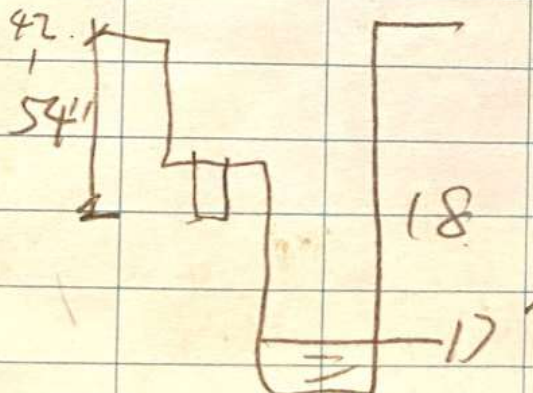
55-10AN DEEP

0-6	A	S.L	10YR3/2	fri
6-30	B	SL	2.5Y6/6	fri
30-14.5	C	LS	2.5Y6/4	fri-dense

weng = 14'
stg = 14'

55-10   (DEEP)

0-6	A	SL	10YR3/2	friable
6-30	B	SL	2.5Y6/6	friable
30-135	C	L.S	2.5Y6/4	dense-fri

no wng, stg dry

55-11B (center to check ledge)

0-6	A	SL	10YR3/2	fri
6-30	B	SL	2.5Y6/6	fri
30-10+	C	L.S	2.5Y6/4	dense
120'+				bony

55-9N

0-6	A	SL	10YR3/2	fri
6-30	B	SL	2.5Y6/6	fri
30-108	C ML.S	2.5Y6/4	fri
108'	C	ledge

120'   no wng no stg
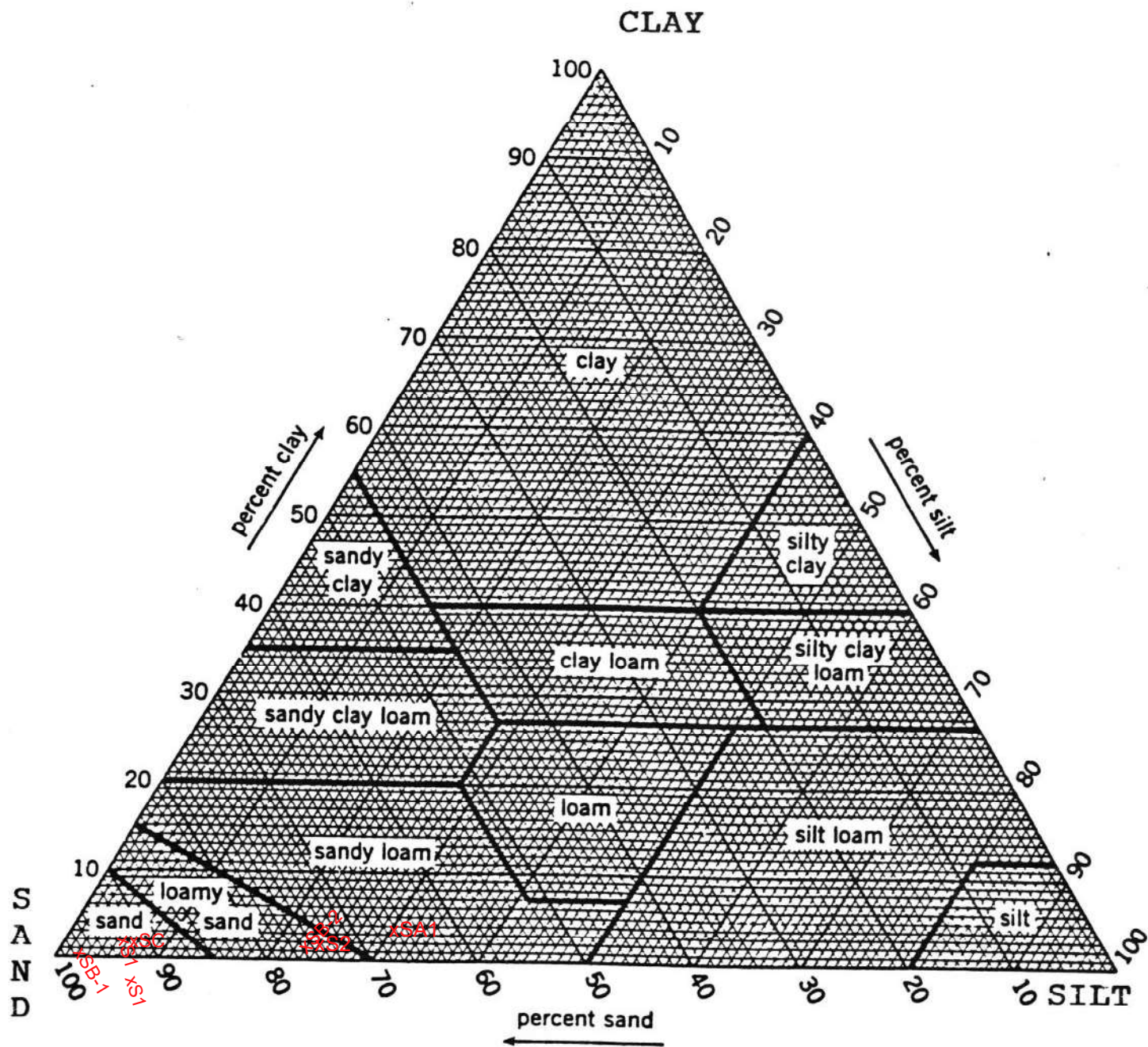
Figure 1: SOIL TEXTURAL TRIANGLE

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
Location: S-1 Sample
Source of Sample: Farm Rd - Sherborn MA
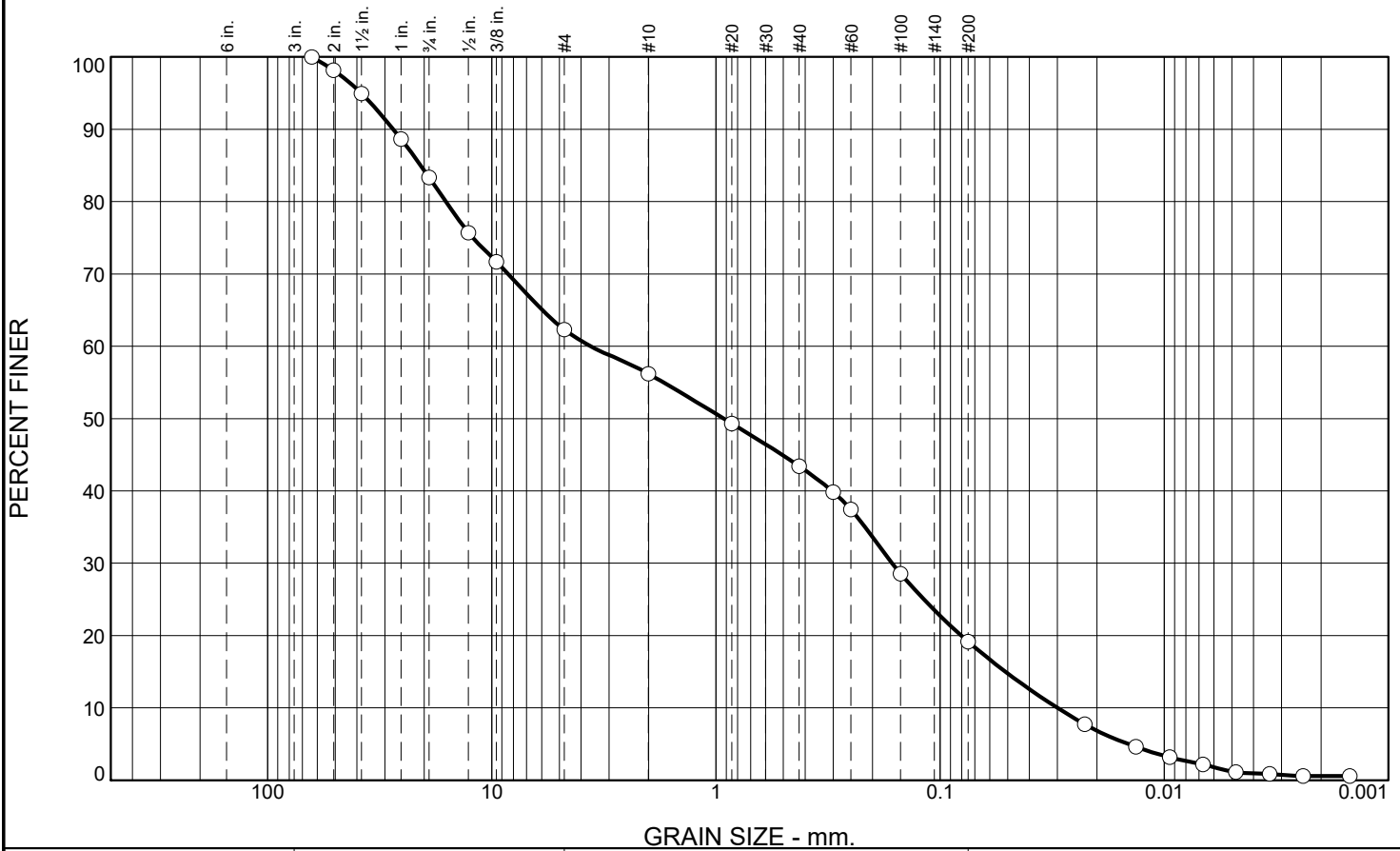**Date:** 1/9/24
Elev./Depth: submitted

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
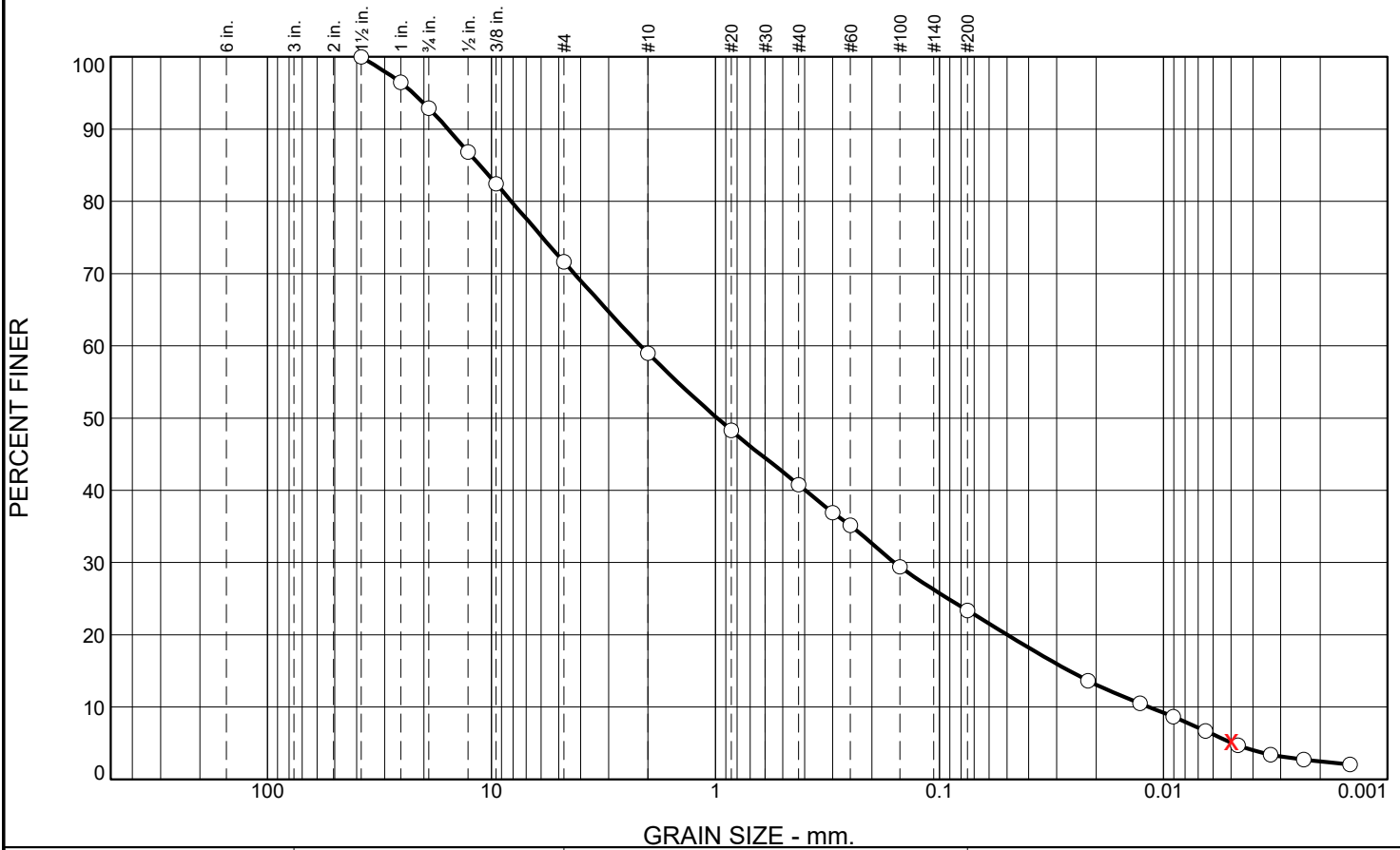**Location:** S-2 Sample   **Elev./Depth:** submitted

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

GRAIN SIZE - mm.

% +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
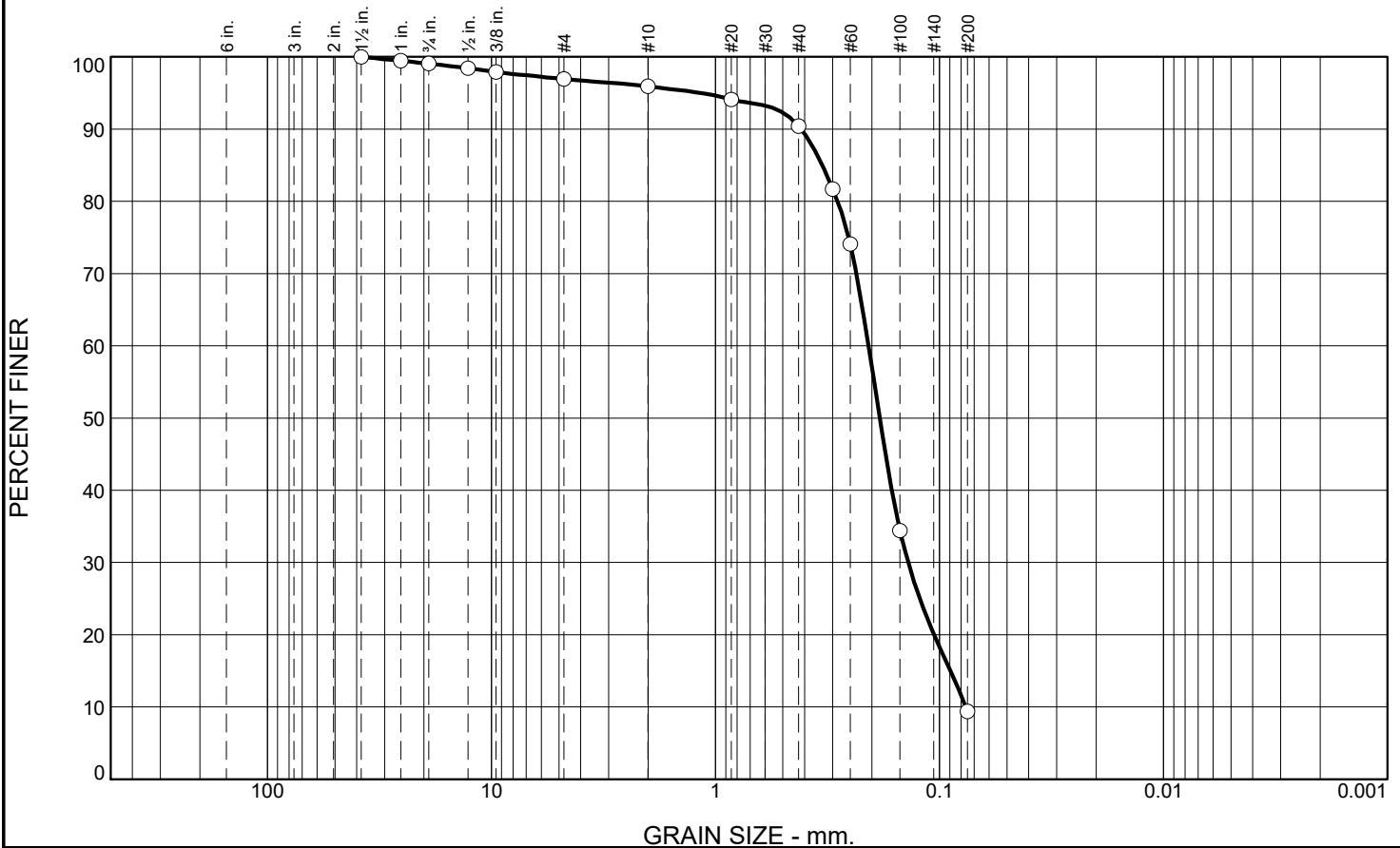**Location:** SA-1 Sample   **Elev./Depth:** submitted

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
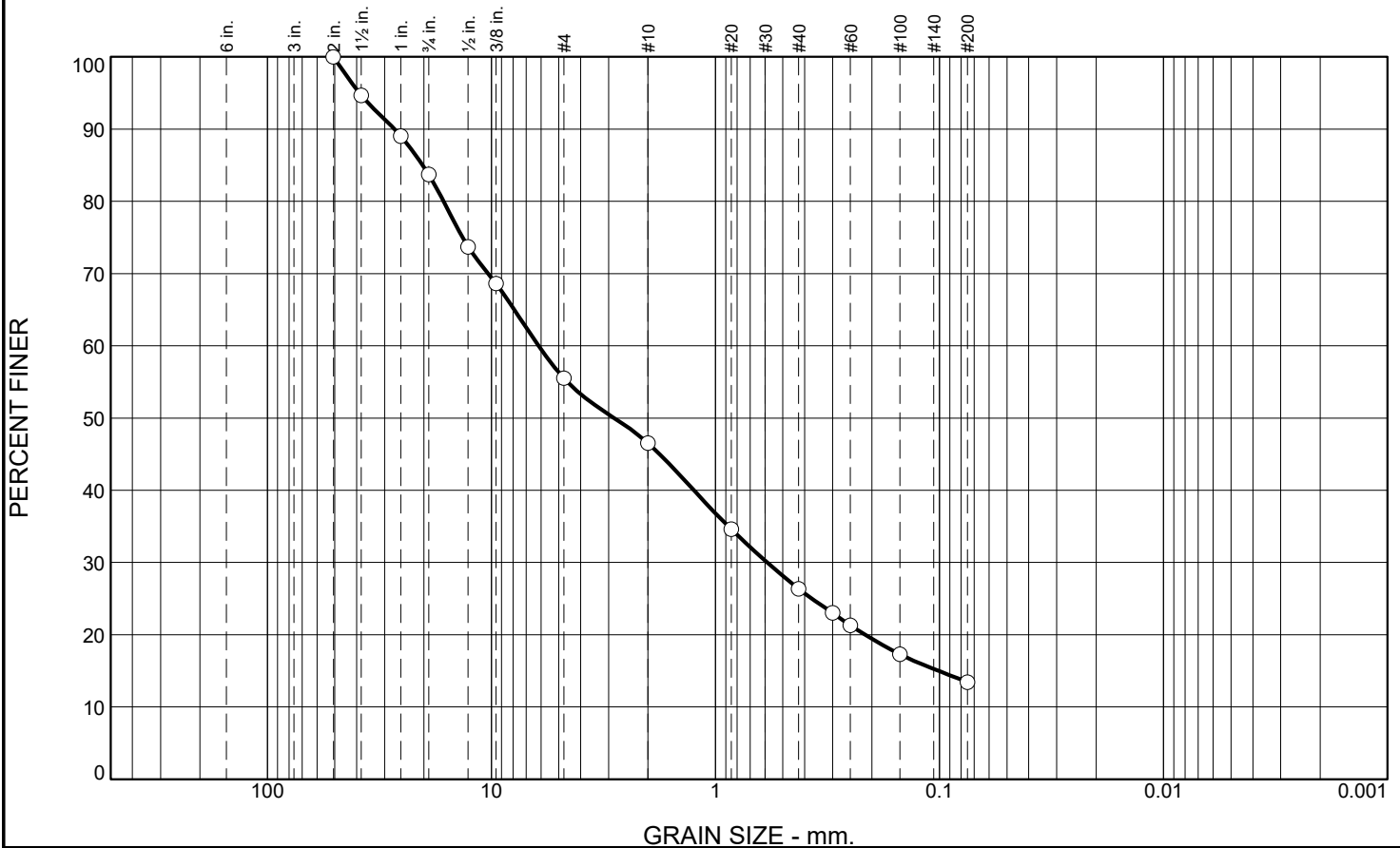**Location:** SB-1 Sample   **Elev./Depth:** submitted

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
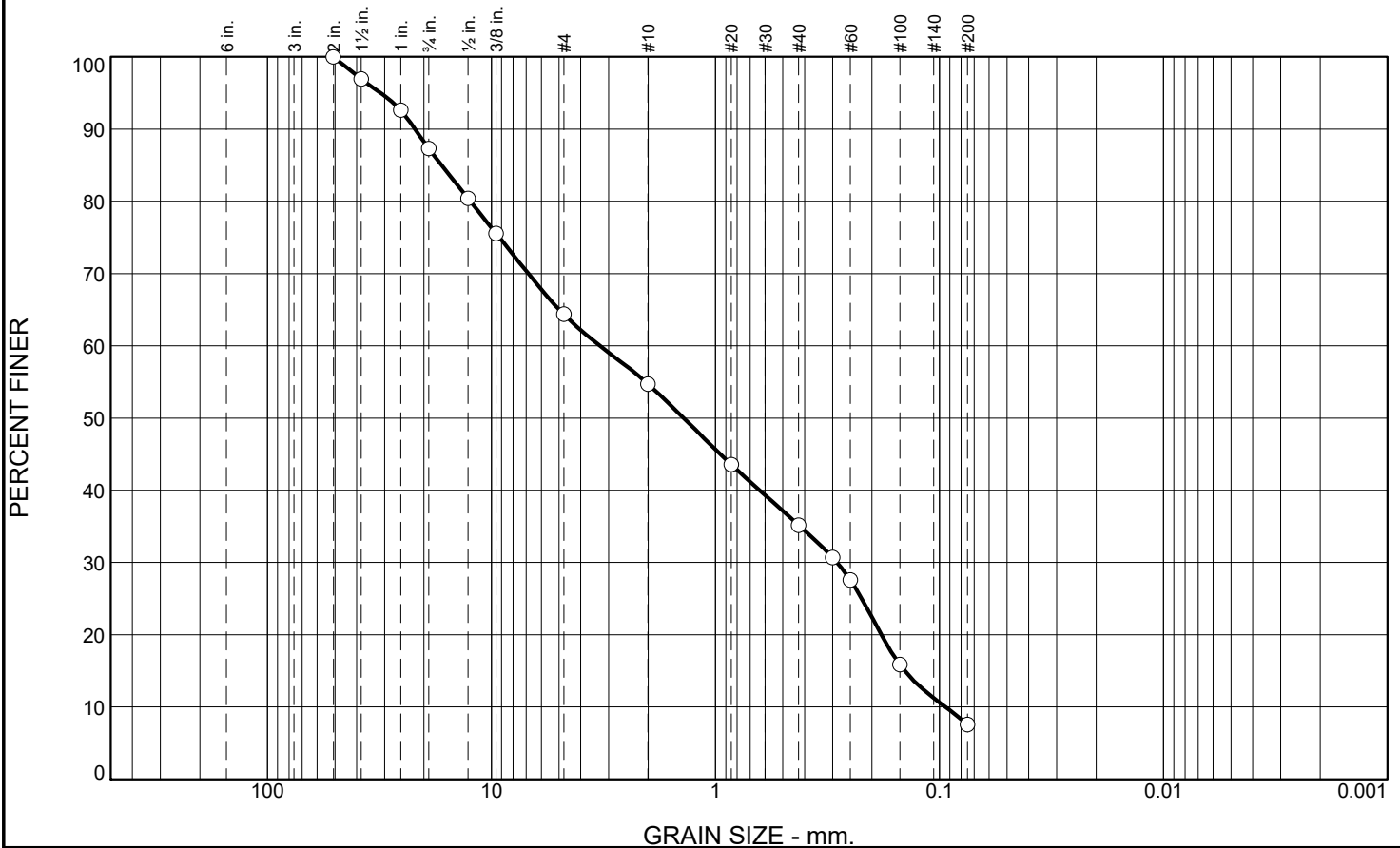**Location:** SB-2 Sample   **Elev./Depth:** submitted

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
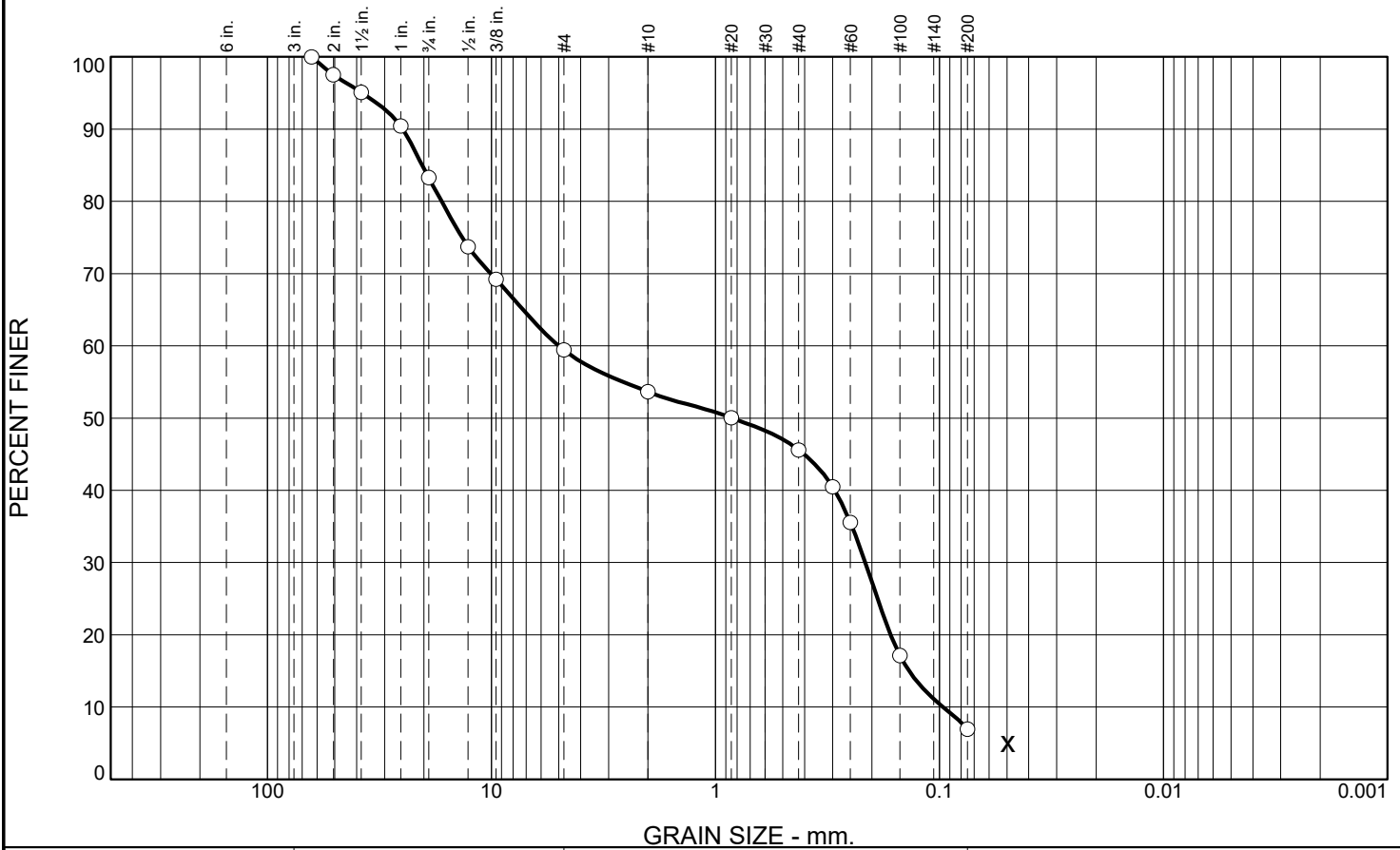**Location:** SC Sample   **Elev./Depth:** submitted

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
Location: S-1 Sample
Source of Sample: Farm Rd - Sherborn MA
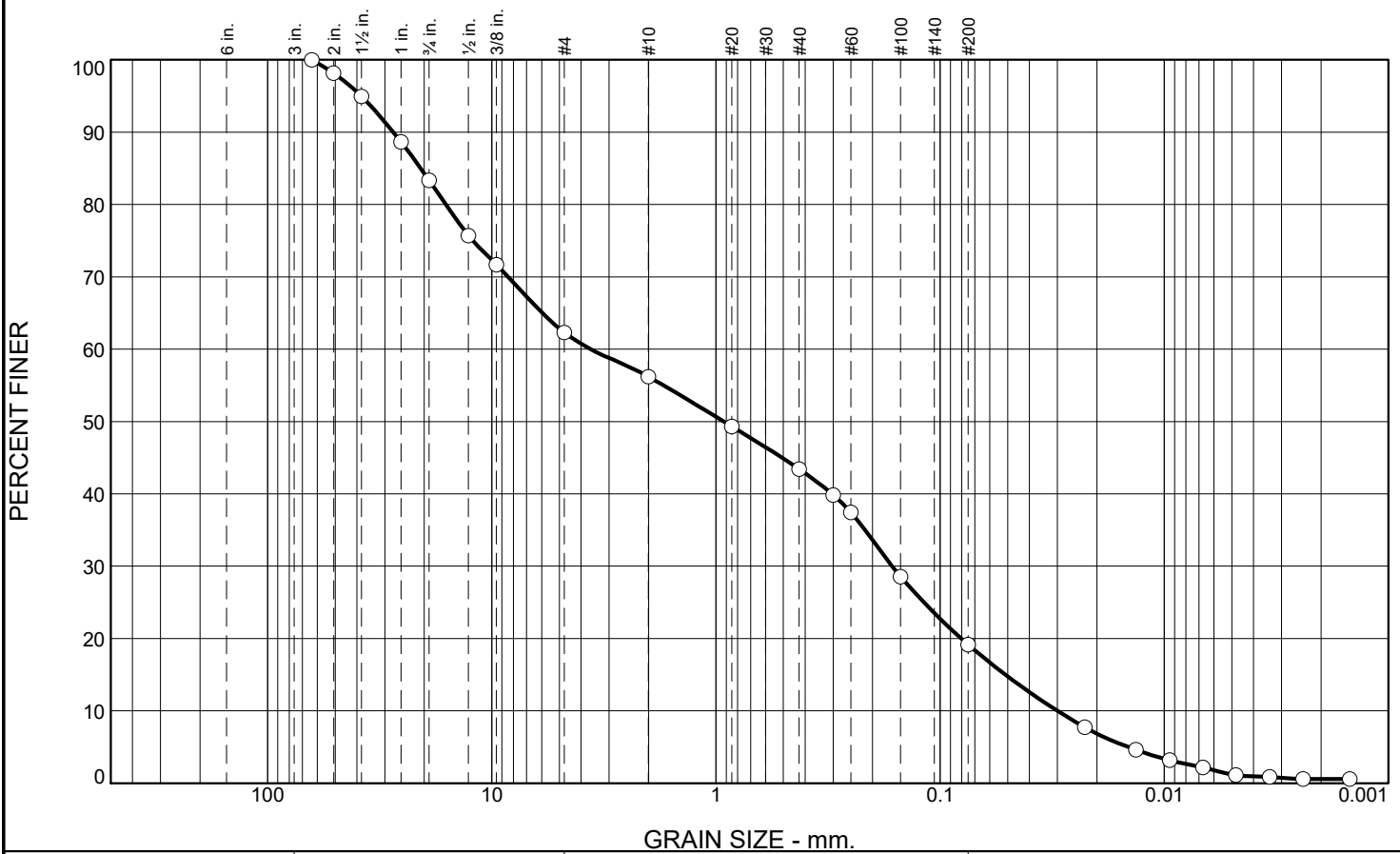**Date:** 1/9/24
Elev./Depth: submitted

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
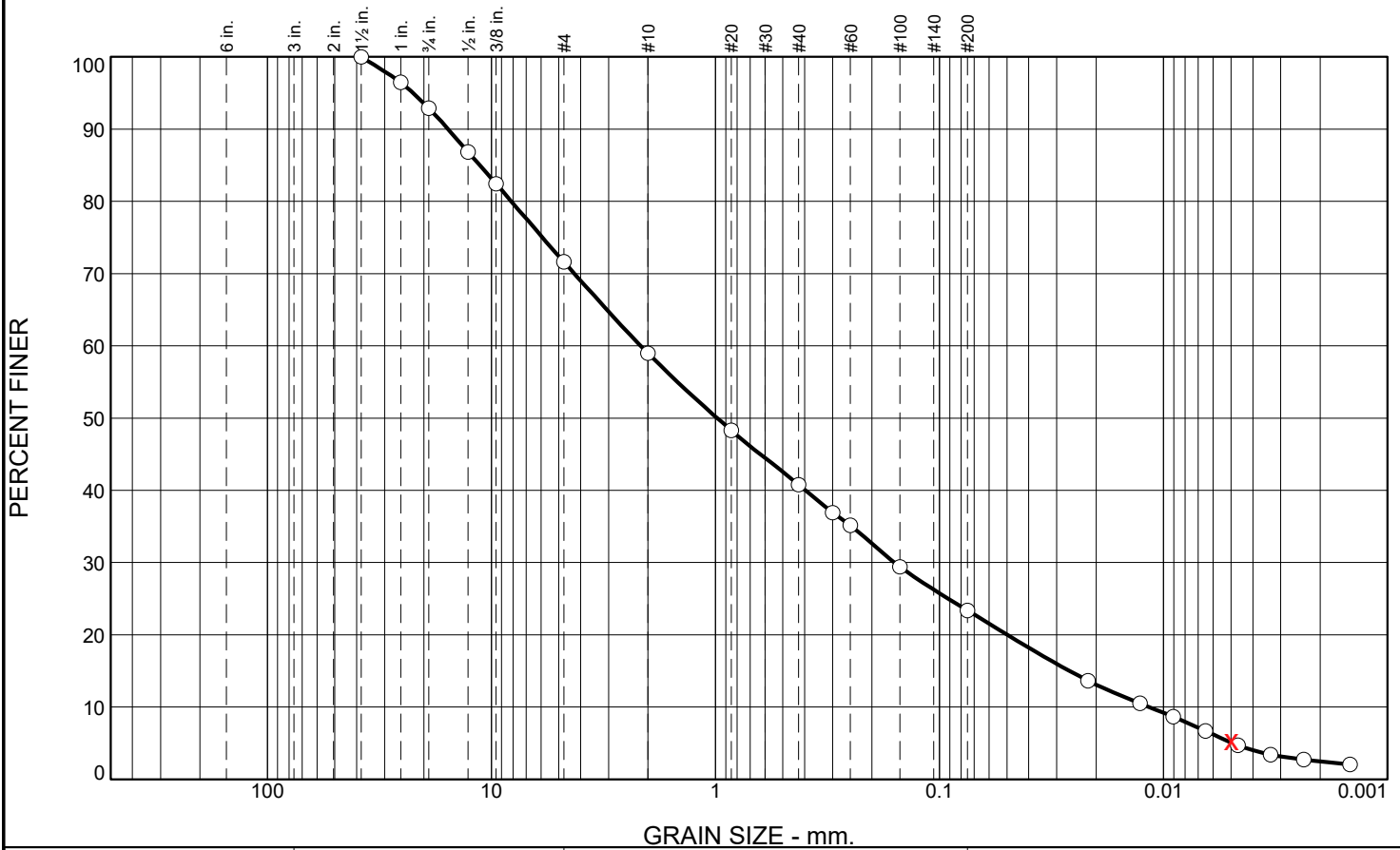**Location:** S-2 Sample   **Elev./Depth:** submitted

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
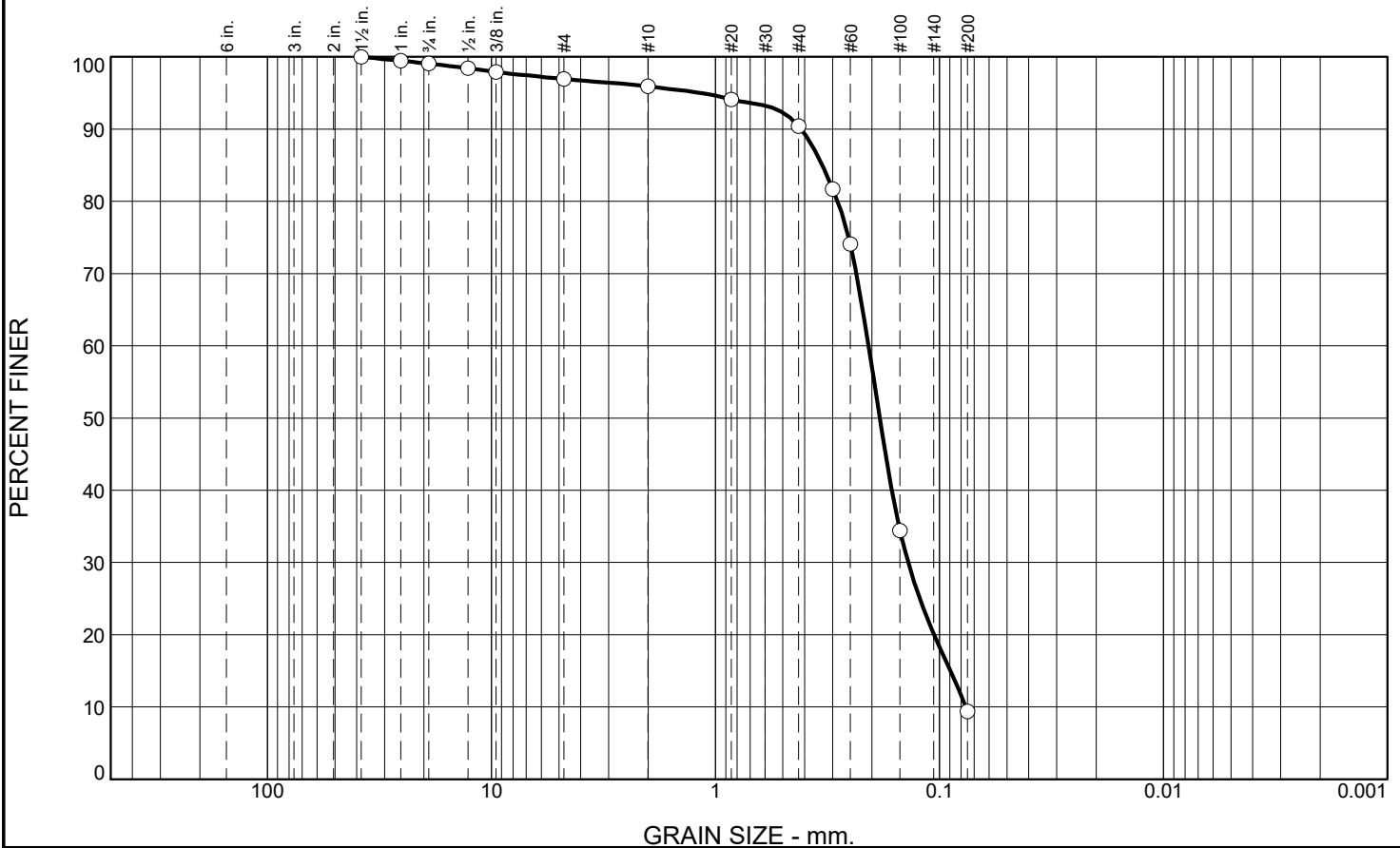
YANKEE ENGINEERING & TESTING, INC.

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
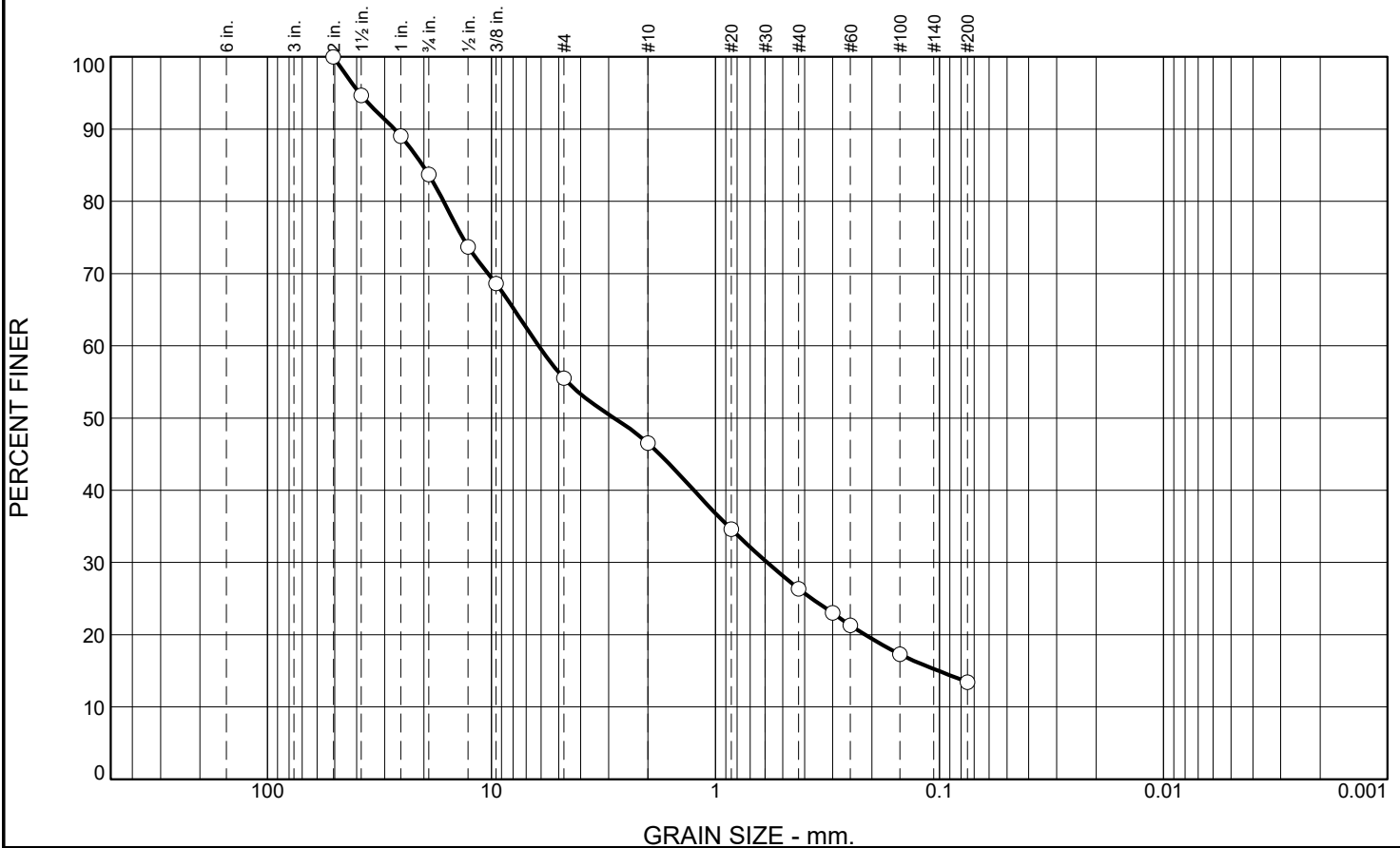**Location:** SB-1 Sample   **Elev./Depth:** submitted

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
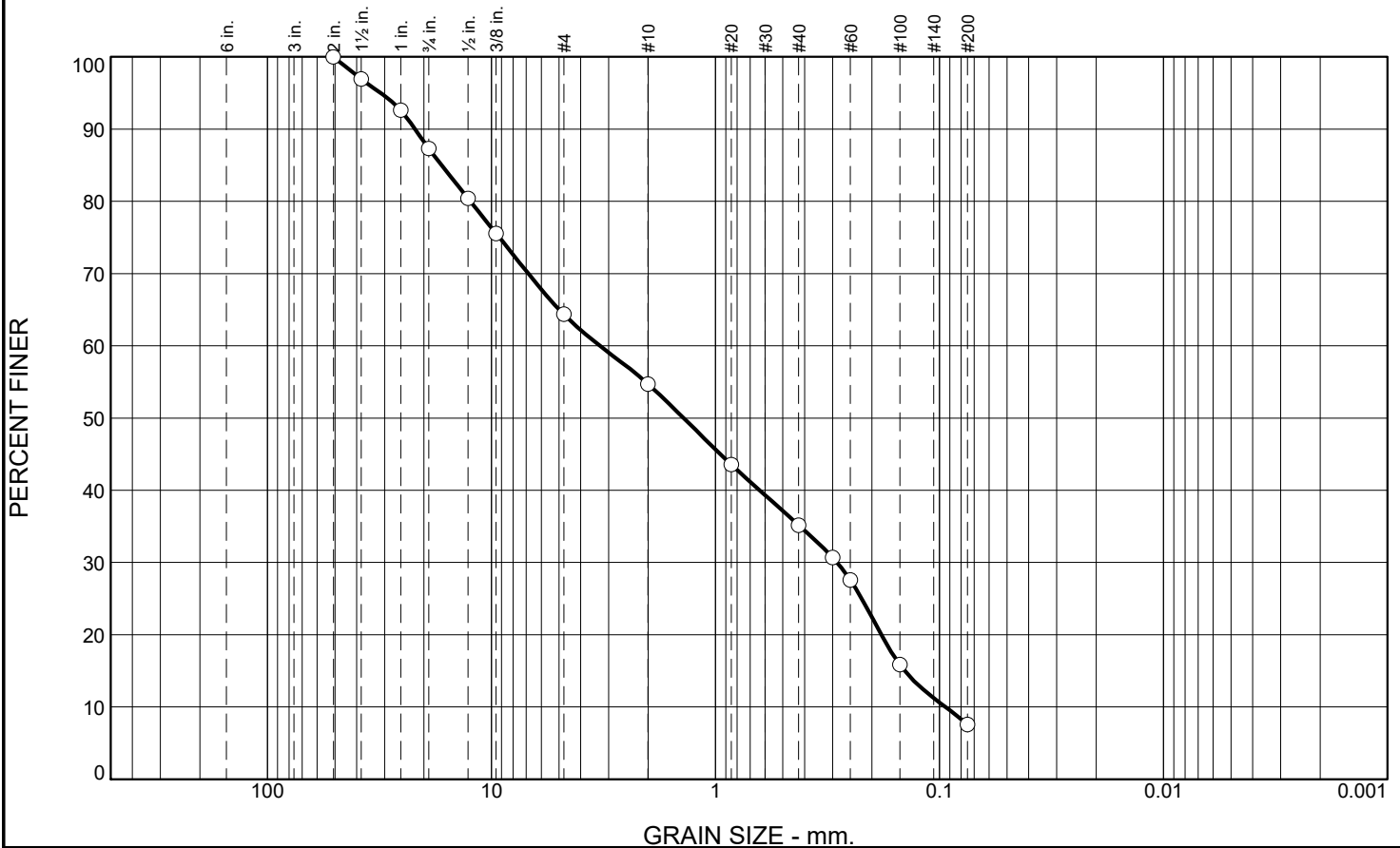**Location:** SB-2 Sample   **Elev./Depth:** submitted

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

GRAIN SIZE - mm.

% +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
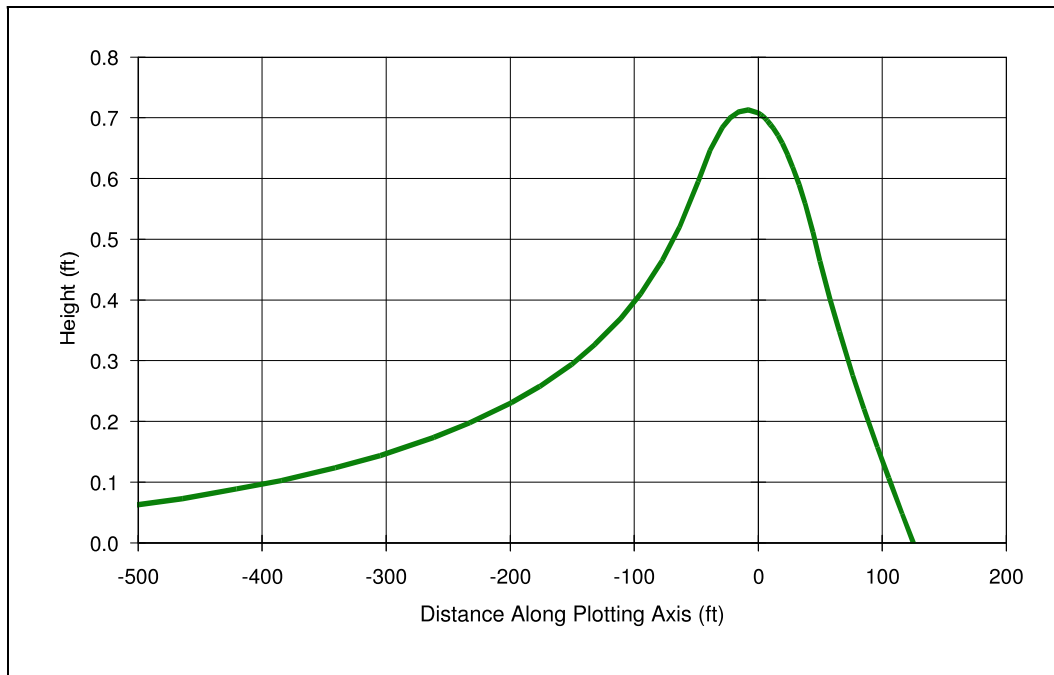
YANKEE ENGINEERING & TESTING, INC.

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
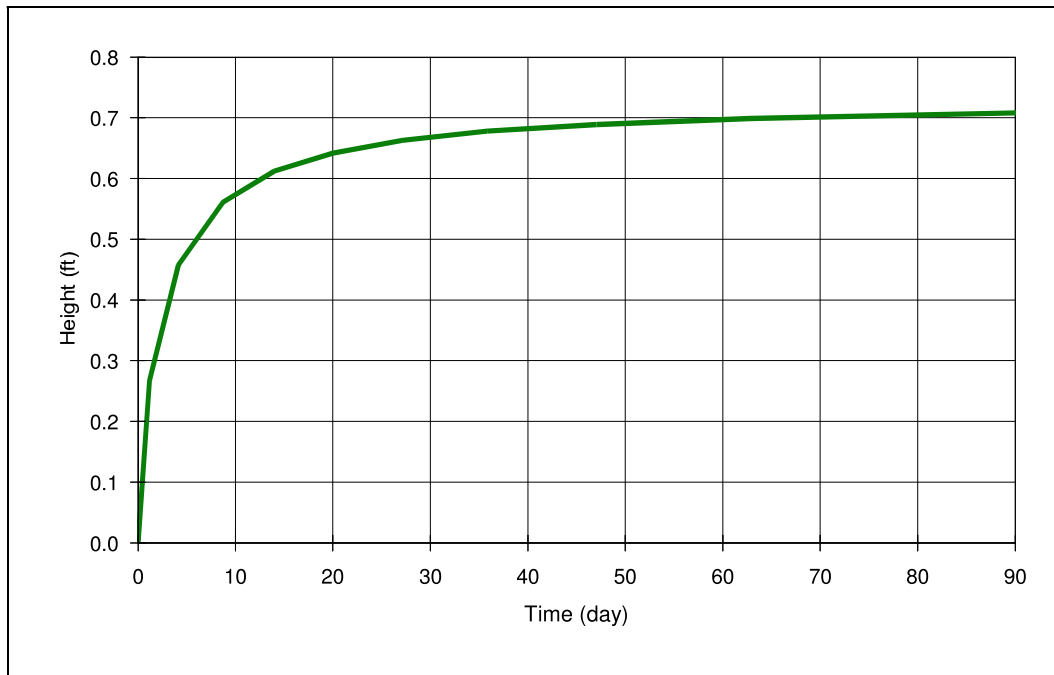Edge of recharge area:
positive X: 0 ft
positive Y: 46 ft
Total volume applied: 67896 c.ft

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
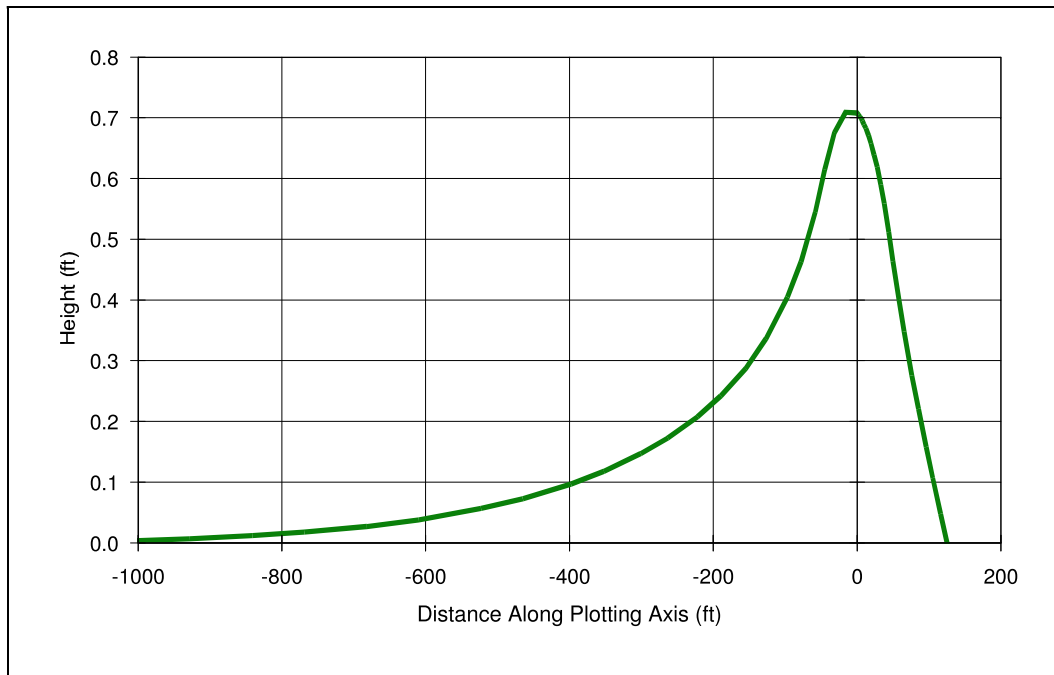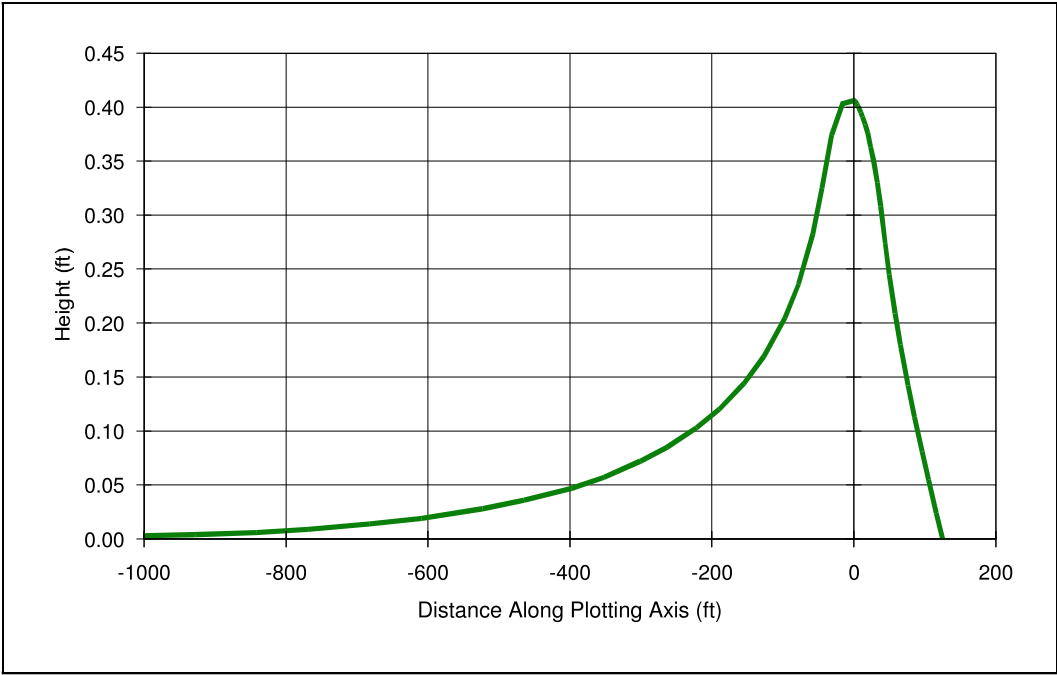Edge of recharge area:
positive X: 0 ft
positive Y: 46 ft
Total volume applied: 67896 c.ft

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)
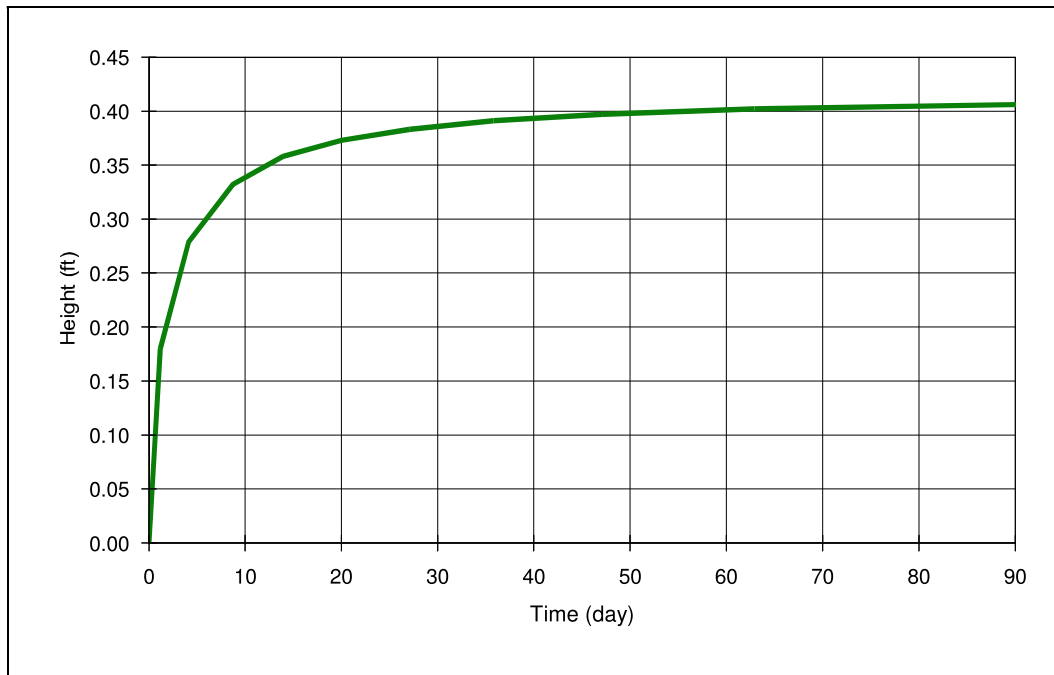
COMPANY: CLAWE

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
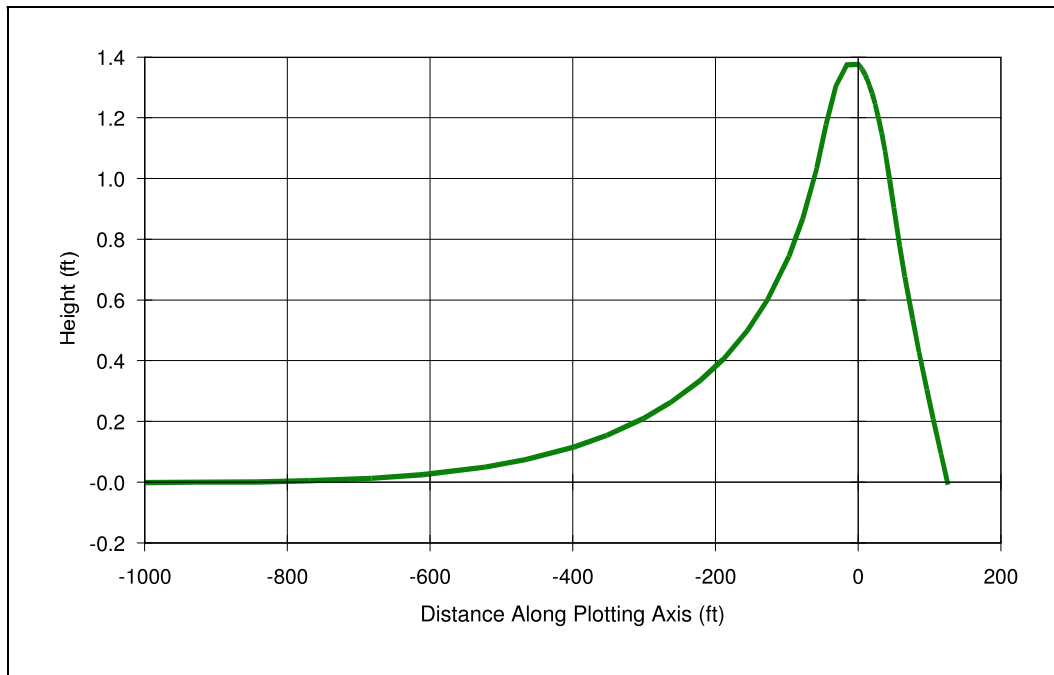Total volume applied: 33948 cft

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)

MODEL RESULTS

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

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

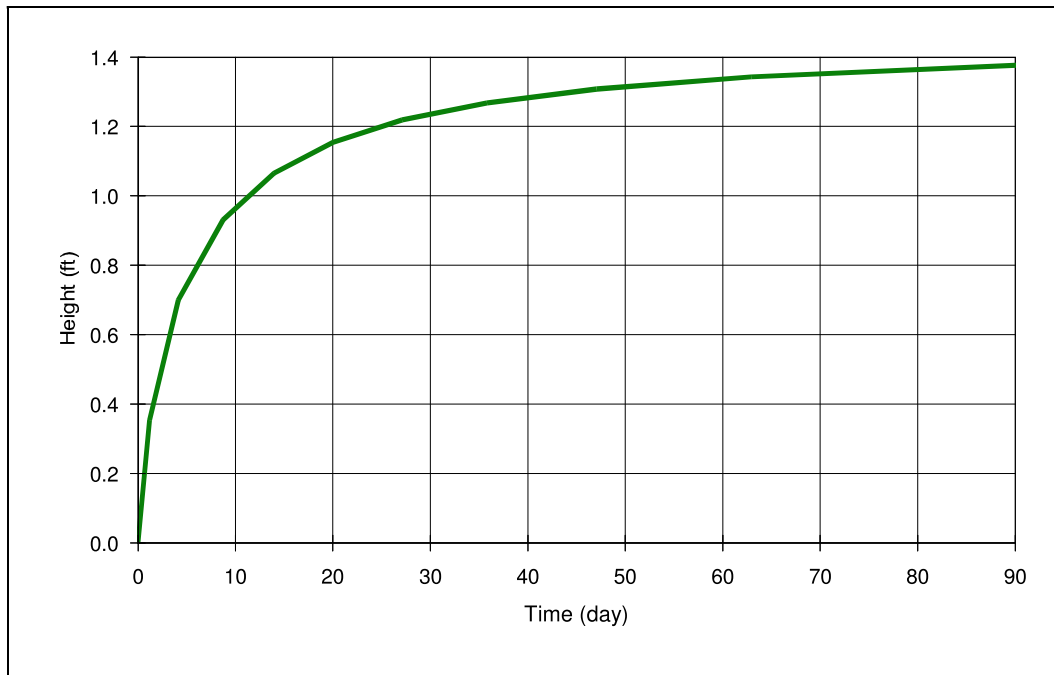DATE: 2/2/2024 TIME: 11:00:11 AM

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

Appendix G: Nitrogen Loading Analysis (to be added to the Hydrogeological Evaluation Report)

Under the existing condition, the property is draining from east to west. The proposed SAS is located in central west of the property about 108 ft from downgradient BVW, which is the closest receptor to the SAS. The SAS straddles about 175 ft across the broad mild valley consisting of thick very permeable soil (3-5 mpi percolation rates). The groundwater mounding analysis shows that plum will spread out 841 ft on each side of the SAS fields and will cover the entire western property line, which received ground water recharge from about 25.57 acres and 22.88 acres of land net for nitrogen loading excluding 53 and 55 Farm Road and including off site town conservation open space to the northeast. See USGS locus map and site plan for reference.

Based on our soil testing, the site in general has mixed ledge outcrops in the upper hill area and very permeable soil in the lower western part of the land. There will be four stormwater basins and exfiltration swales uniformly scattered through the site, which will provide better groundwater recharge. The existing man-dug farm pond takes contributing runoff and infiltrate groundwater entirely. The groundwater monitoring shows that this pond contributes to the west for groundwater flow.

There will be minimum lawn for the developed condition. No fertilizer will be allowed in any of the landscape areas or lawn.

Average precipitation in Sherborn area is 45.60 inches based on NATNWS of 163 years of record. The actual precipitation will likely increase based on the trend, which will further reduce nitrogen level.

Based on the basic site conditions described above, the general nitrogen loading and detailed nitrogen concentration at the downgradient reception line is analyzed. The results are presented in the following:

Section 15.214 of Title V (Nitrogen Loading Limitations) states that any new sewage system constructed within a Nitrogen Sensitive Area shall be designed to receive not more than 440 gallons per day (gpd) of design flow per 40,000 square feet (SF). With the proposed I/A system to treat the influent to 19 mg/l, the loading of sewer effluent can be increased to 660 gpd per 40, 000 SF. The total land area of 14 acres of land has a capacity of 10,062 gpd, which is 20% more than the proposed 8360 gpd.

As we can see above that the project site has provided adequate design to handle the nitrogen loading together with the overall uniformly distributed groundwater recharge facilities at the site. There will be more preserved forested open space of Town conservation land to provide even more groundwater recharge to lower the nitrogen level to the downgradient receptor. To further demonstrate the compliance to the most stringent standard, a detailed nitrogen budget analysis according to DEP Policy BRP/DWM/PeP-P99-7 is provided to confirm that the proposed SAS will comply with all required DEP standards for four site condition scenarios, see Table G2 for reference. The water budget was analyzed for both onsite area and including upgradient off site recharge area. See Figures G1 and G2. The results showed that nitrogen concentration at the downgradient receptor, BVW will be much less than 10 mg/l. The results are presented in Table G4.

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Table G 1. Nitrogen Source:					
Unit:	1 lb =	454000	mg		
Sewage		35	mg/l	Conventional septic	
Sewage		19	mg/l	with I/A	
Fertilizer		33	lbs/acre/yr		
Golf course fertilizer		3.5	lbs/acre		
Rain water		0.1	mg/l		
Runoff		1.5	mg/l		

Table G2. Input Scenarios for Nitrogen Budget Analysis

Scenario	Sewage flow	Effluent Nitrogen	Lawn fertilize	Off site Recharge	Assumptions for notrogen budget analysis
	GPD	mg/l	%		
1	8360	19	0	yes	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment
					2. Assume all lawn will not be fertilized
					3. Off site upgradient area recharge included.
2	8360	35	0	yes	1. Using Title 5 design daily flow for sewage nitrogen loading without I/A treatment.
					2. Assume all lawn will not be fertilized
					3. Off site upgradient area recharge included.
3	8360	19	0	no	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment
					2. Assume all lawn will not be fertilized
					3. Off site upgradient area recharge IS NOT included.
4	23271	19	40	yes	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment
					2. Assume all lawn will be fertilized
					3. Off site upgradient area recharge included.

Table G3. Output Nitrogen Concentration at downgradient Receptor- Budget Analysis

Scenario	Sewage flow	Effluent Nitrogen	Lawn fertilize	Off site Recharge	Calculated Nitrogen at Downgradient, mg/l	Assumptions for notrogen budget analysis
	GPD	mg/l	%			
1	8360	19	0	yes	3.89	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment
						2. Assume all lawn will not be fertilized
						3. Off site upgradient area recharge included.
2	8360	35	0	yes	6.95	1. Using Title 5 design daily flow for sewage nitrogen loading without I/A treatment.
						2. Assume all lawn will not be fertilized
						3. Off site upgradient area recharge included.
3	8360	19	0	no	5.6	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment
						2. Assume all lawn will not be fertilized
						3. Off site upgradient area recharge IS NOT included.
4	23271	19	40	yes	6.32	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment
						2. Assume all lawn will be fertilized
						3. Off site upgradient area recharge included.

Table G4. Nitrogen Loading Analysis

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

2. Area =25.57 ac	25.57
to the front	2.8
To the central	22.77
53 Farm rd	1.15
55 Farm rd	1.54
Net area	22.88

A.O.I

Figure G1 . Area of Impact plan
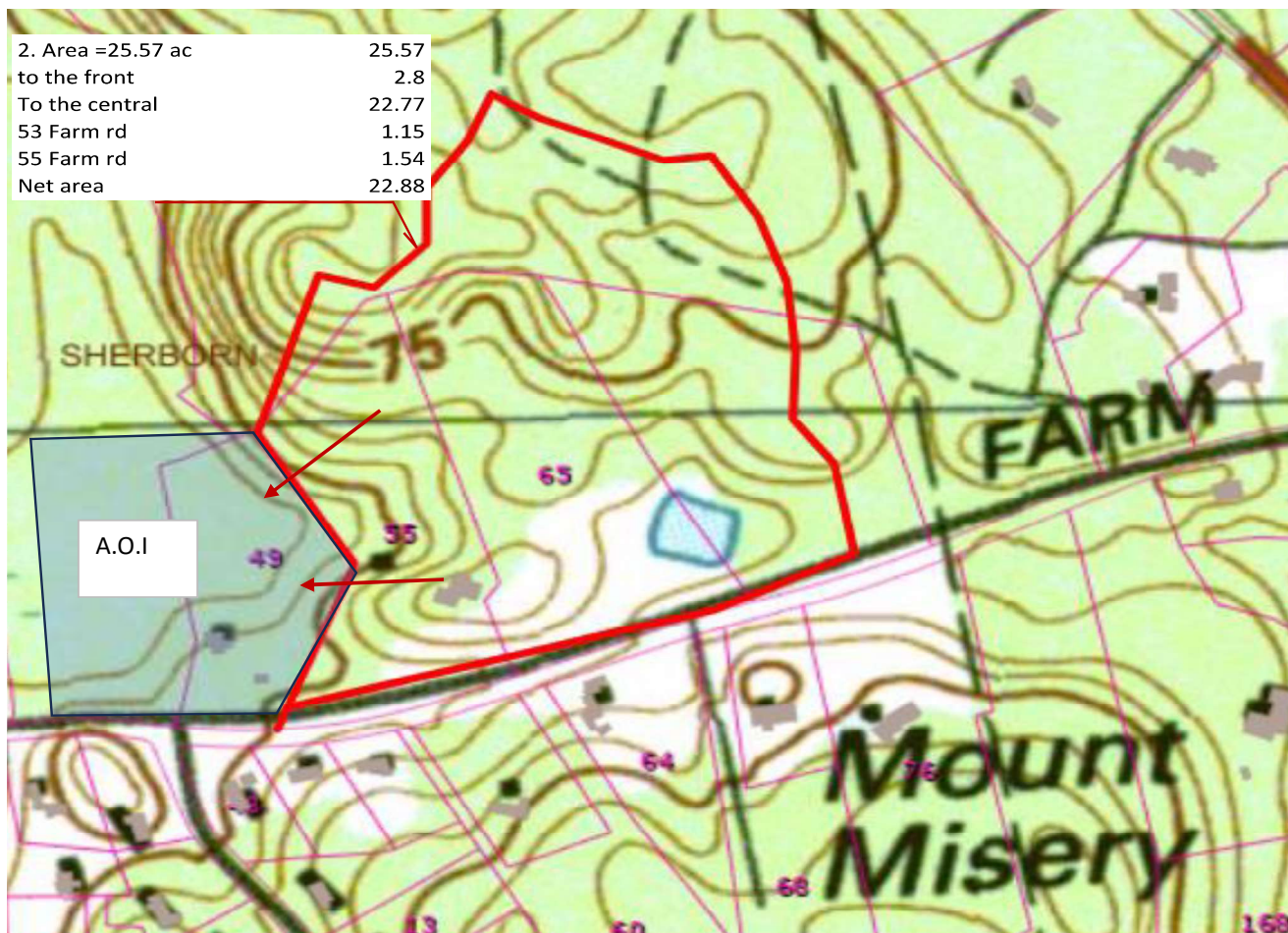
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Figure G2 : Water Budget - Proposed Conditions (with off site area)

Project: Homes at Farm Road
65 Farm Road
Sherborn, MA

User: DSW	Date: 02/03/24	Check:
Precip. (in): 45.60	Snowfall (in): 45	Lake evap. (in): 26.00
Wet-trans1: 2.00	Wet-trans2: 1.80	Open water: 1.00

Date:	
Runoff (in): 26.00	
Job: 269-12	
Sheet: 1 of 2	

Check: 26.00 | 26.00 | 1.00

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

WETLAND • SOIL GROUNDWATER • HYDROLOGY HYDRAULICS • 21E • STORMWATER • WASTEWATER • WILDLIFE HABITAT • FOUNDATION

Figure G3: Water Budget - Proposed Conditions no offsite area

Project:	Homes at Farm Road			User:	DSW	Date:	02/03/24	Check:		Date:	
	65 Farm Road			Precip. (in):	45.60	Snowfall (in):	45	Lake evap. (in):	26.00	Runoff (in):	26.00
	Sherborn, MA			Wet-trans1:	2.00	Wet-trans2:	1.80	Open water:	1.00	Job:	269-12
										Sheet:	1 of 2

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

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