Creative
LAND & WATER
Engineering, LLC

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August 16, 2020
Revised November 9, 2020

To: Chris D'Antonio, Windsor Place LLC
73 Pelham Island Road
Wayland, MA 01778

From: Desheng Wang, Ph.D., P.E.
Creative Land & Water Engineering, LLC

Re: 24 School Street, Wayland, MA , DEP file # 322-0897

Plans to develop the property at 24 School Street include 12 residential units under state statute Chapter 40B. Wastewater from the development is estimated to be 2,860 gallons per day and will be discharged to groundwater under Title 5 regulations. Site storm water will be collected and a portion of which will be discharged to groundwater by way of a storm water infiltration basin. See site plan for location reference.

During the Wayland Conservation review process, questions were raised concerning groundwater mounding for Site wastewater and storm water. On February 28, 2018 CLAWE submitted a report to Wayland presenting groundwater mounding calculations for both wastewater and storm water. The Town of Wayland Consecration Commission hired consultant agreed with CLAWE's analysis after some minor adjustment in parameters. Board of Health has approved the onsite septic plans. However, the Wayland Conservation Commission had denied the project citing with the abutters concerning impact to wetland and demanding a groundwater analysis using USGS model MODFLOW. The applicant appealed the decision to DEP for a superseding Order of Conditions and then to an adjudicatory hearing. During the meeting with DEP, the applicant and DEP reached an agreement to conduct a MODFLOW analysis of the groundwater mounding. The parties also agreed to use all the existing testing data in soil and ground water including groundwater monitoring wells, hydraulic conductivity, deep hole soil test pits and the approved wetland border as general site condition. At the request of CLAWE through Dr. Wang, GeoHydroCycle, Inc. (HGC) was retained to conduct a Groundwater Mounding Analyses using MODFLOW, a finite difference groundwater computer model, and the most widely used groundwater computer model in the world.

The goals for GHC's analysis were to:

1. ***Simulate groundwater mounding for discharge to the proposed effluent disposal area; and***
2. ***Simulate groundwater mounding from the discharge of a 100-year storm event for the proposed stormwater infiltration basin.***
3. ***Accumulative effects of the two systems in groundwater mounding height for SAS design and impact evaluation on stormwater infiltration trench.***

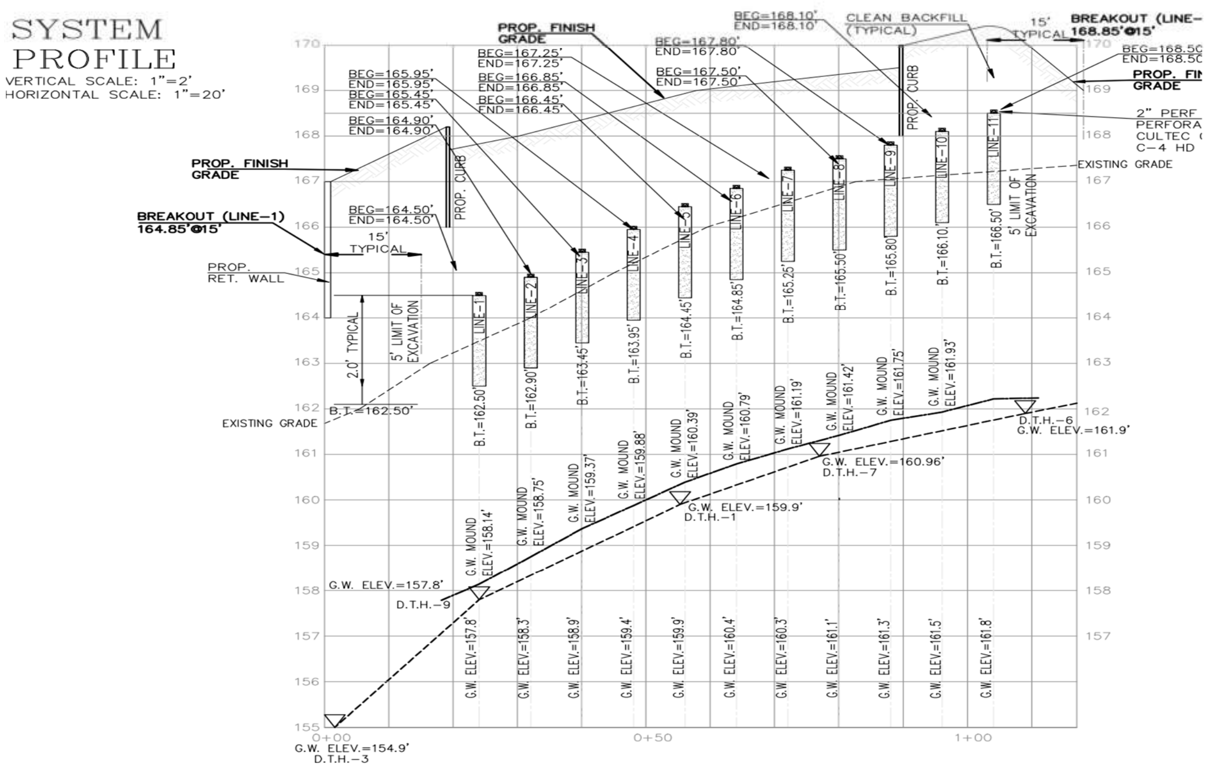
HGC's modeling results had more detailed spatial distribution of groundwater mounding while the maximum mounding heights in similar or slightly lower than CLAWE's results. In some area, HGC's analysis showed a lightly higher mounded groundwater in the western 1/3 of the leaching area. The septic leaching trenches (Line-1, Line 2, Line-3, and Line-4) needs to be raised 0.08 ft to 0.67 ft. The septic plan will be updated with these elevation changes. However, it will not impact the surface grading as enough fill depth in this area can accommodate the new trench elevations. The HGC's analysis also confirmed that stormwater infiltration trench will be adequately dewatered as the previously analysis done by CLAWE. The detailed comparison of septic leaching field is summarized in the following. Detailed analysis can be referred to GHC's report.

24 School Street, Wayland, MA - Groundwater Mounding using Soil Mottling
by Creative Land & Water Engineering, LLC
Date: 11/29/2018 updated: 2/27/2019 4/24/2019 8/16/2020

Trench	Dist from SW CNR, ft	Stormw M, ft	SAS M GW ft	Modflow Combined, ft	Required Bottom Elev., ft	Diff, ft	HGW, ft	Groundwater Mound, ft	M. GW, ft	Hantushi Method: Required Bottom of Trench, ft	Previous Bottom of Trench, ft	Difference, ft	Min. raise of trench bottom elev., ft	Updated Bottom of Trench meeting BOH required, ft	Actual Raise of bottom Elev, ft
Line-1	5	0.340	158.83	159.168	**163.17**	-0.67	157.8	0.38	158.18	162.18	162.5	0.32	good, 0	**162.5**	0
Line-2	13	0.325	159.18	159.503	**163.50**	-0.60	158.3	0.49	158.79	162.79	162.9	0.11	good, 0	**162.9**	0
Line-3	21	0.309	159.52	159.830	**163.83**	-0.38	158.9	0.51	159.41	163.41	163.3	-0.11	raise 0.07 ft	**163.45**	0.15
Line-4	29	0.293	159.73	160.027	**164.03**	-0.08	159.4	0.52	159.92	163.92	163.7	-0.22	raise 0.18 ft	**163.95**	0.25
Line-5	37	0.278	159.95	160.225	**164.22**	0.23	159.9	0.53	160.43	164.43	164.1	-0.33	raise 0.29 ft	**164.45**	0.35
Line-6	45	0.262	160.18	160.439	**164.44**	0.41	160.3	0.53	160.83	164.83	164.5	-0.33	raise 0.29 ft	**164.85**	0.35
Line-7	53	0.246	160.41	160.658	**164.66**	0.59	160.7	0.53	161.23	165.23	164.9	-0.33	raise 0.29 ft	**165.25**	0.35
Line-8	61	0.231	160.57	160.804	**164.80**	0.70	160.96	0.5	161.46	165.46	165.3	-0.16	raise 0.12 ft	**165.5**	0.2
Line-9	69	0.215	160.69	160.906	**164.91**	0.89	161.3	0.49	161.79	165.79	165.7	-0.09	raise 0.05 ft	**165.8**	0.1
Line-10	77	0.200	160.81	161.008	**165.01**	1.09	161.5	0.47	161.97	165.97	166.1	0.13	good, 0	**166.1**	0
Line-11	85	0.184	160.93	161.110	**165.11**	1.39	161.8	0.45	162.25	166.25	166.5	0.25	good, 0	**166.5**	0

Note: 1. The groundwater mounding height is calcualted in Scenairo #3 using soil mottling elevations by Metrowest Eng.
2. Hantushi Groundwater mounding analysis had been taken from Creative Land & Water Eng, LLC report dated 6/12/2018.
3. This trench bottom elevation adjustments were done per the Wayland Board of Health request
4. MODFLOW groundwater mounding analysis by GHC
5. Difference (-) indicate bottom of the trench need to be raised; (+) no change or can be lowered.

file map wayland in main directly

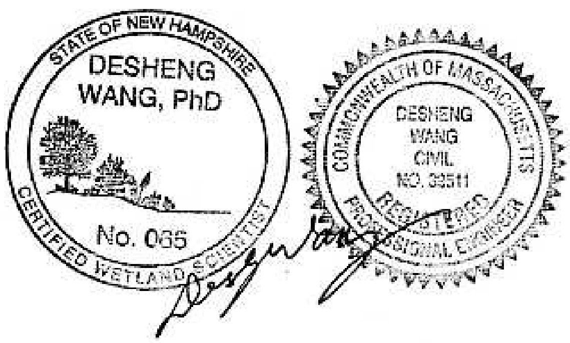


If you have any questions, please feel free to contact me.

Sincerely,

Creative Land & Water Engineering, LLC

By



Desheng Wang, Ph.D., P.E.
Certified Wetland Scientist and Hydraulic Engineer

Cc: **Michelle N. O'Brien,** PIERCE ATWOOD LLP, 100 Summer Street, 22nd Floor Boston, MA 02110
DEP, NERO, Wetland Program, Wilmington, MA 01887
Conservation Commission, Wayland Town Hall, 41 Cochituate Road, Wayland, MA 01778
Mark Kablack
Brian Nelson, MWE
Steve Smith, GHC

GeoHydroCycle, Inc.

Wastewater Disposal
Water Supply

Assessment
Analyses
Permitting
Modeling
Software

July 23, 2020

Desheng Wang, Ph.D., P.E.
Creative Land & Water Engineering, LLC
PO Box 584
Southborough, MA 01772

re: Groundwater Mounding Analyses
24 School Street
Wayland, MA 01778
GHC #20005

Dear Dr. Wang:

GeoHydroCycle, Inc. (GHC) is pleased to present this letter report describing the work that Dr. Desheng Wang of Creative Land & Water Engineering, LLC (CLAWE) requested to conduct a Groundwater Mounding Analyses using MODFLOW for the property located at 24 School Street, Wayland, MA 01778 (the Site). Figure 1 presents a Locus of the property and Figure 2 presents a plan view of the Site Features.

In performing this analyses GHC conducted a field reconnaissance on June 26, 2020 to observe surface water and wetland conditions, but did not conduct any field testing. For our work, GHC relied on project information and data provided by CLAWE, including:

- An AutoCAD file entitled PROP_SITE_3_R11.dwg dated 5/28/20 and prepared by MetroWest Engineering, Inc.
- Three Site data tables prepared by CLAWE. See Enclosure 2.

Introduction

Plans to develop the property at 24 School Street include 12 residential units under state statute Chapter 40B. Wastewater from the development is estimated to be 2,860 gallons per day and will be discharged to groundwater under Title 5 regulations. Site storm water will be collected and a portion of which will be discharged to groundwater by way of a storm water infiltration basin. Figure 2 presents proposed locations for the wastewater and storm water discharges.

5 Madison Avenue
Newton, Massachusetts
02460

(617) 527-8074 (v)

GeoHydroCycle, Inc.

During the Wayland review process, questions were raised concerning groundwater mounding for Site wastewater and storm water. On February 28, 2018 CLAWE submitted a report to Wayland presenting groundwater mounding calculations for both wastewater and storm water. Based on subsequent reviews and discussions of the CLAWE report, additional groundwater mounding calculations were requested, and GeoHydroCycle, Inc. was retained to conduct a Groundwater Mounding Analyses using MODFLOW.

As requested, to conduct a Groundwater Mounding Analyses, GHC used the groundwater model entitled MODFLOW, a finite difference groundwater computer model, and the most widely used groundwater computer model in the world.

In applying MODFLOW, using similar model parameters to those employed by CLAWE, the goals for GHC's analysis were to:

1. Simulate groundwater mounding for discharge to the proposed effluent disposal area;
2. Simulate groundwater mounding from the discharge of a 100-year storm event for the proposed infiltration basin; and
3. Using the predicted wastewater and storm water mounding, assess the cumulative effects.

Groundwater Modeling

Groundwater mounding modeling requires the input of parameters that are representative of the aquifer being simulated, including hydraulic conductivity, saturated thickness, and the nearby Snake Brook tributary and wetland. For mounding simulations the model requires the characteristics of the discharge area, including its physical location, area and proposed discharge rate. Model timing is set by Massachusetts guidelines[1] for land disposal of wastewater and was set at 90 days. For the discharge of storm water the model timing was set to 1 day for the 100-year storm plus additional time to allow observation of the storm aftereffects, including the 3 days after the storm. As requested, GHC used two aquifer hydraulic conductivity values in the model.

Groundwater mounding for both wastewater and storm water is required to be done starting with groundwater at a seasonal high elevation. Based on data presented in CLAWE's tables and the layout of Site Features as shown in the AutoCAD file, GHC prepared Figure 3 showing groundwater contours. Data for that map included groundwater levels from the three Site monitoring wells, seasonal high groundwater levels (soil mottling) from three Site test pits, and high surface water levels from the adjacent Snake Brook tributary and wetland to the west.

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[1] *Massachusetts DEP. July 2018. Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal.*

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Groundwater data used in preparing the map were from the three test pits and the wetlands represent seasonal high groundwater levels, and the three well groundwater levels were taken on March 12, 2018, during the time of the year when groundwater levels are at annual highs. As such, the groundwater contours shown in Figure 3 represent seasonal high groundwater for the Site.

<u>Conceptual Model</u>

In developing the groundwater model to predict Wastewater and Storm Water mounding, GHC prepared a conceptual model of the aquifer. Features of the conceptual model include:

1. The model is a two layer model with the upper layer representing only the Infiltration Basin, all other nodes in the upper layer are inactive. The lower layer represents the aquifer beneath the Site, and is unconfined with the water table as the upper surface.
2. The hydraulic conductivity of the Infiltration Basin upper layer nodes is set at 50,000 ft/day to simulate an open water condition[2] typical of a storm water basin during a storm event.
3. The Snake Brook tributary and wetland to the west is the local groundwater discharge area.
4. Aquifer properties are set at values similar to those used by CLAWE.
5. The simulation can be achieved by modeling the proposed discharges on a flat water table with the resulting groundwater mound superimposed onto the seasonal high groundwater.

The following Table 1 presents aquifer properties used in the groundwater mounding model.

Table 1. MODFLOW Aquifer Parameters.

Parameter	Value	Unit
Hydraulic Conductivity - North:	31.09	feet per day
Hydraulic Conductivity - South:	16.24	feet per day
Hydraulic Conductivity - Infiltration Basin	50,000	feet per day
Saturated Thickness:	15.1	feet

[2] Eggleston, J.R., Carlson, C.S., Fairchild, G.M. and P.J. Zarriello. *Simulation of Groundwater and Surface-Water Interaction and Effects of Pumping in a Complex Glacial-Sediment Aquifer, East Central Massachusetts.* 2012. Scientific Investigations Report 2012-5172.

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Figure 4A presents the distribution of hydraulic conductivity for the model, and Figure 4B presents a Schematic Cross-Section of the model. Table 2 presents the wastewater and storm water discharge amounts used in the model.

Table 2. MODFLOW Wastewater and Storm Water Parameters.

Parameter	Value	Unit
Wastewater Discharge:	2,860	gallons per day
100-Year Storm Water Discharge:	4,344	cubic feet per day

Figure 5 presents a plan view of the wastewater and storm water discharge areas in the model.

MODFLOW Mounding Results

Wastewater

Results of the MODFLOW groundwater mounding simulation for the proposed wastewater discharge are shown in Figure 6, which indicates that the increase in groundwater levels would be 0.44 feet beneath the effluent disposal area. Superimposing the Figure 6 mounding onto the Figure 3 Seasonal High Groundwater elevations yields Figure 7 showing mounded seasonal high groundwater elevation contours. This figure demonstrates that the highest mounded seasonal high groundwater elevation at the Site beneath the effluent disposal area will be 160.9 feet, MSL at the southeast corner.

Storm Water

Results of the MODFLOW groundwater mounding simulation for the 100-Year Storm Water discharge to the Infiltration Basin are shown in Figure 8 and indicate that 3 days after the storm the residual groundwater mound would be 0.36 feet beneath the Infiltration Basin. This value is less than the 2 foot design separation distance, showing that the basin has fully drained in 3 days.

To asses the effects of the storm water mounding GHC prepared Figure 9 showing model graphs of the mound development over time at the four corners of the effluent disposal area. As Figure 9 shows the storm water mounding at the corners of the effluent disposal area varies between 0.08 and 0.35 feet, with the largest mounding occurring at the southern corners closest to the infiltration basin.

In summary, GHC's MODFLOW groundwater mounding for both wastewater and storm water discharges has shown similar groundwater mounding heights to those calculated by CLAWE.

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GEOHYDROCYCLE, INC.

If you have any questions, please call me.

Sincerely,
GeoHydroCycle, Inc.

Stephen W. Smith, P.E., P.HGW.

Enclosures: 1 - Figures
2 - CLAWE References

cc: Chris D'Antonio, Chadwick Properties, LLC

School Street Report.lwp

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02460

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Enclosure 1 - Figures

0 2,000

Scale in feet

N

Figure 1. Site Locus.

Base Map: MassGIS Quads.

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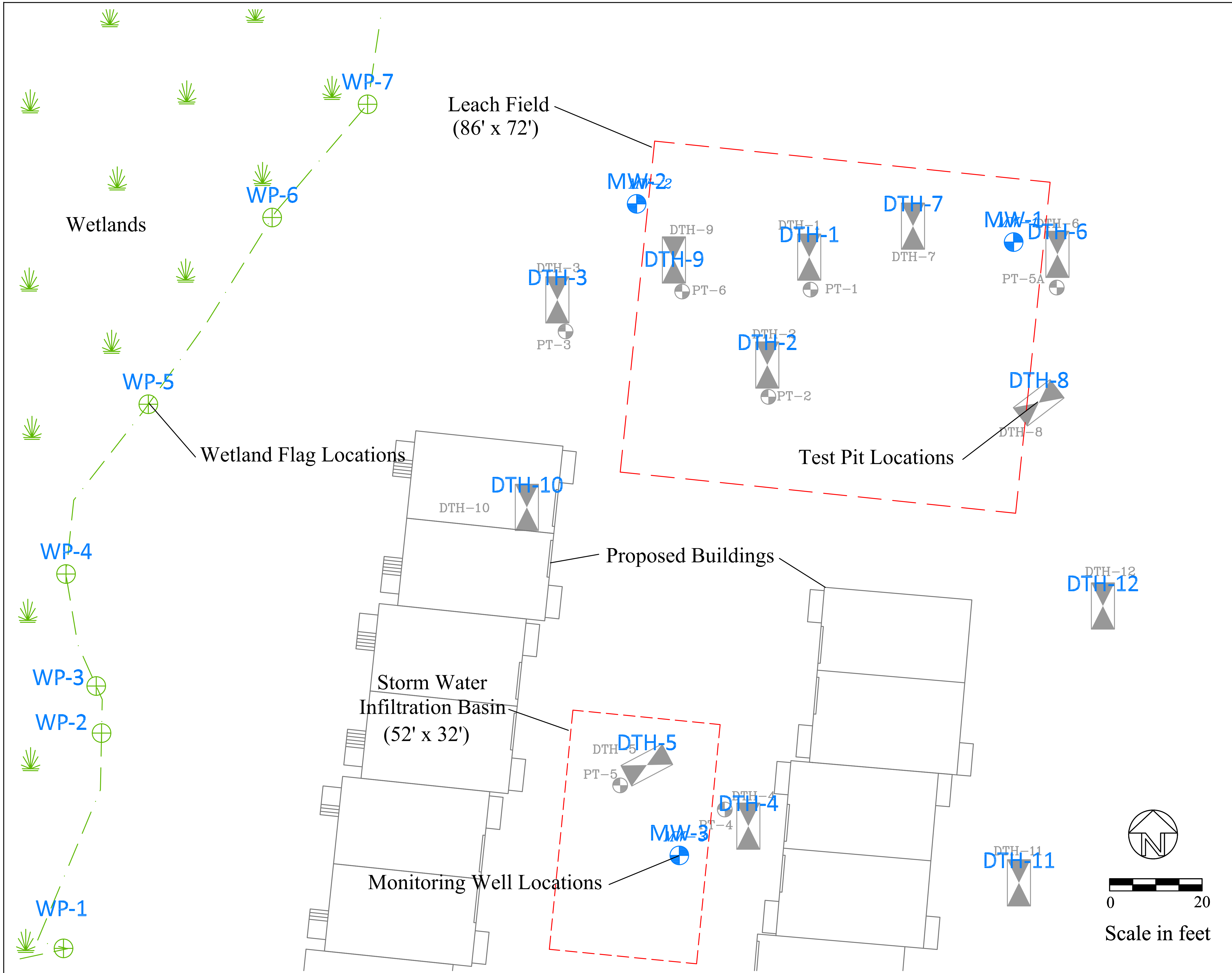
Project No. GHC #20005

Drafted SWS

Date 6/25/20 Rev

Groundwater Modeling
24 School Street
Wayland, MA



Groundwater Modeling
24 School Street
Wayland, MA

Figure 2. Site Features.

Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 06/25/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

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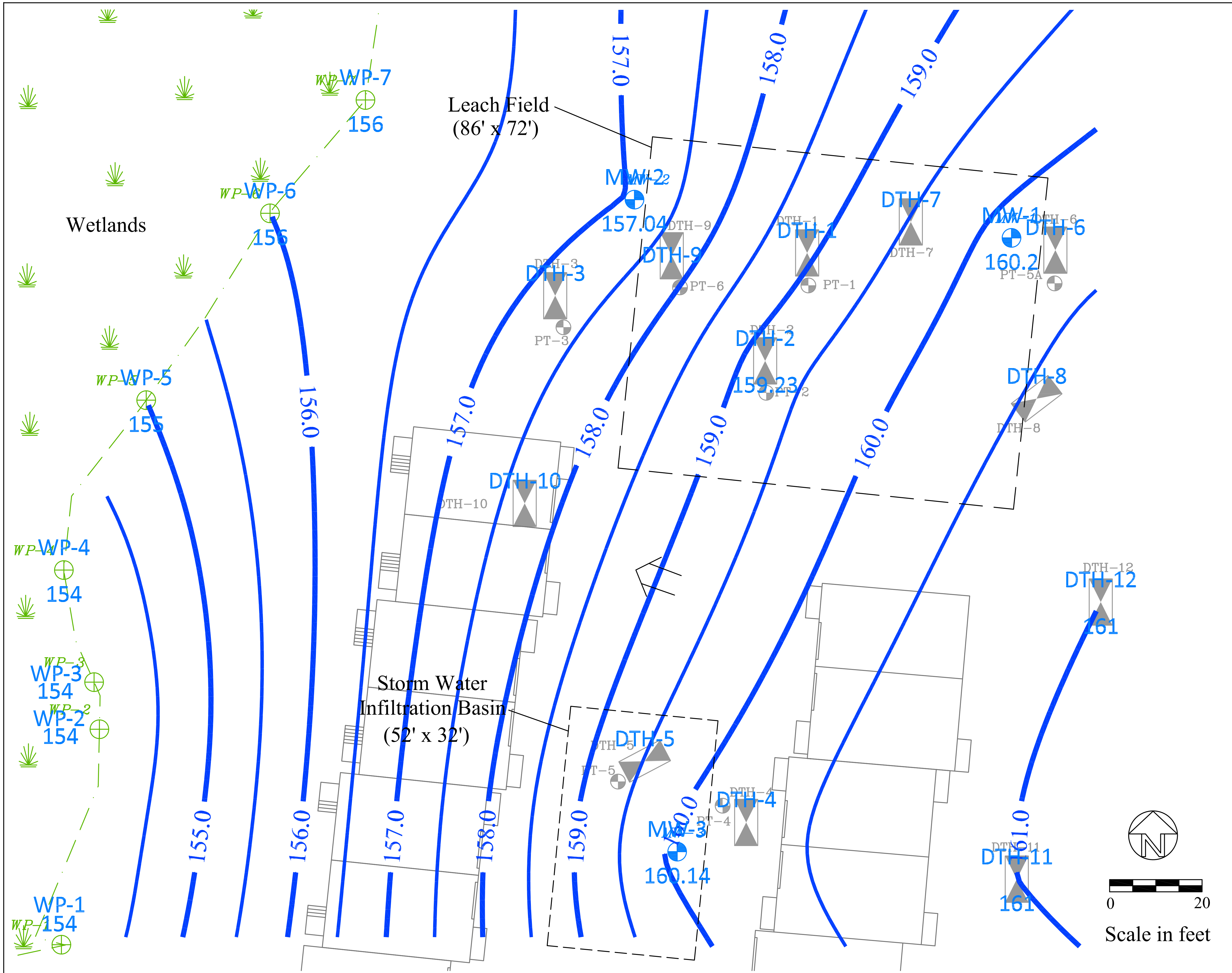


Groundwater Modeling
24 School Street
Wayland, MA

Figure 3. Estimated Seasonal High Groundwater Based on 3/12/18 Data.

LEGEND:

306 — Groundwater Elevation Contours. Interval = 0.5 foot.

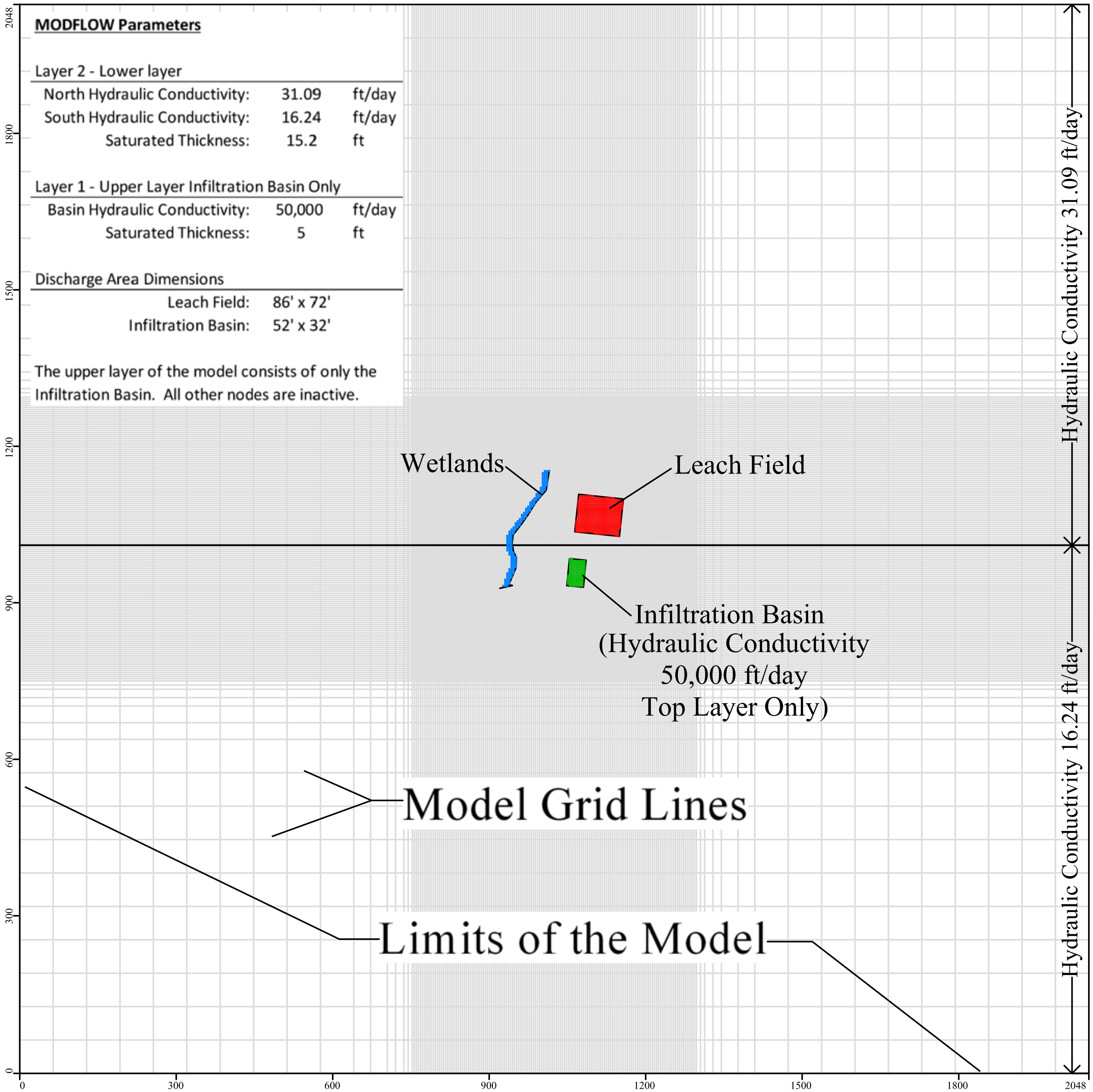
Inferred Groundwater Flow Direction.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. Groundwater contours are based on widely spaced well locations and may not reflect actual groundwater elevations.
3. Groundwater contours are presented for the purposes of this report only.
4. See Figure 2 for more information.

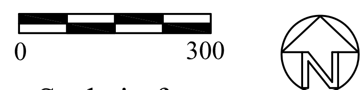
Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 7/1/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

GeoHydroCycle, Inc.



Groundwater Modeling
24 School Street
Wayland, MA

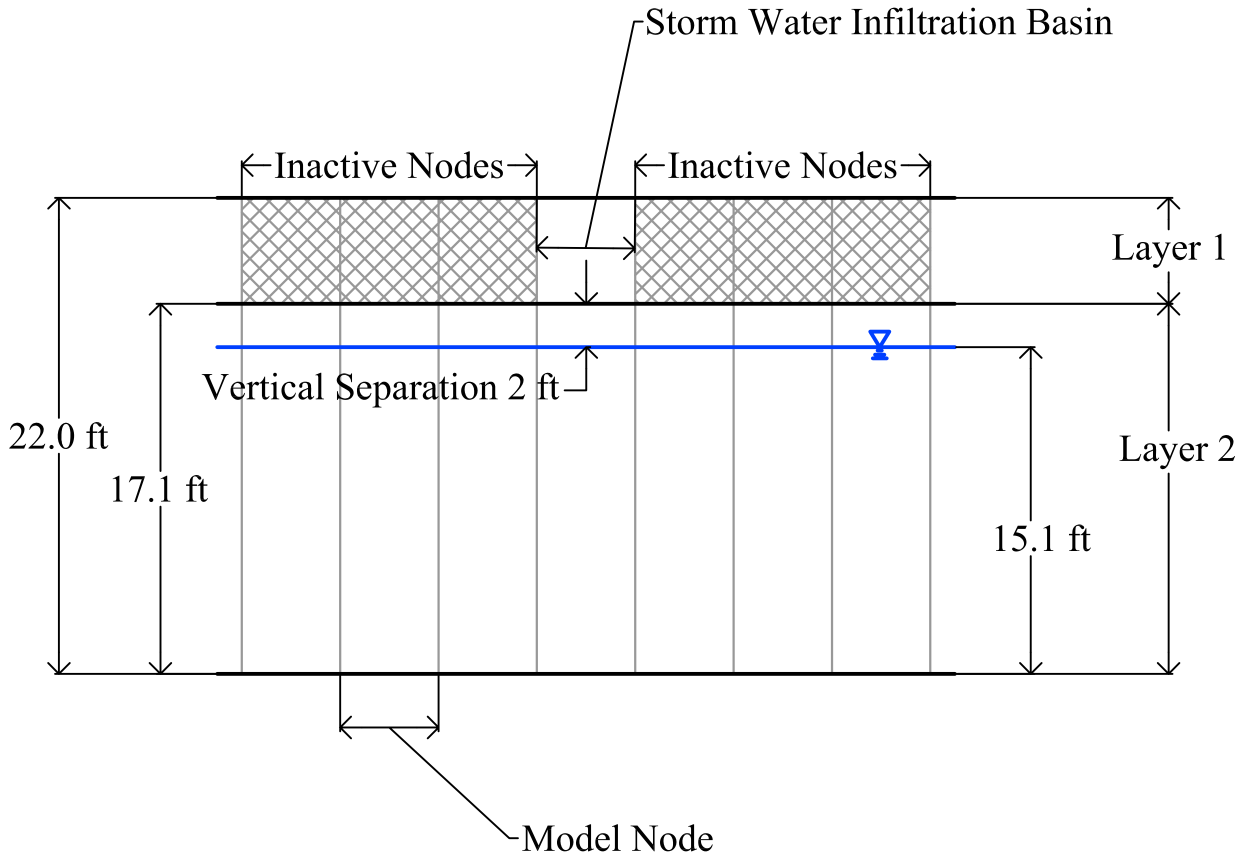
Figure 4A. MODFLOW Plan View Layout.



Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 06/25/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

GeoHydroCycle, Inc.

Groundwater Modeling
24 School Street
Wayland, MA



Not to Scale

Figure 4B. Schematic Model Cross-Section.

Project No. GHC#20005
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Date 07/7/20 Rev
Base Map: None.

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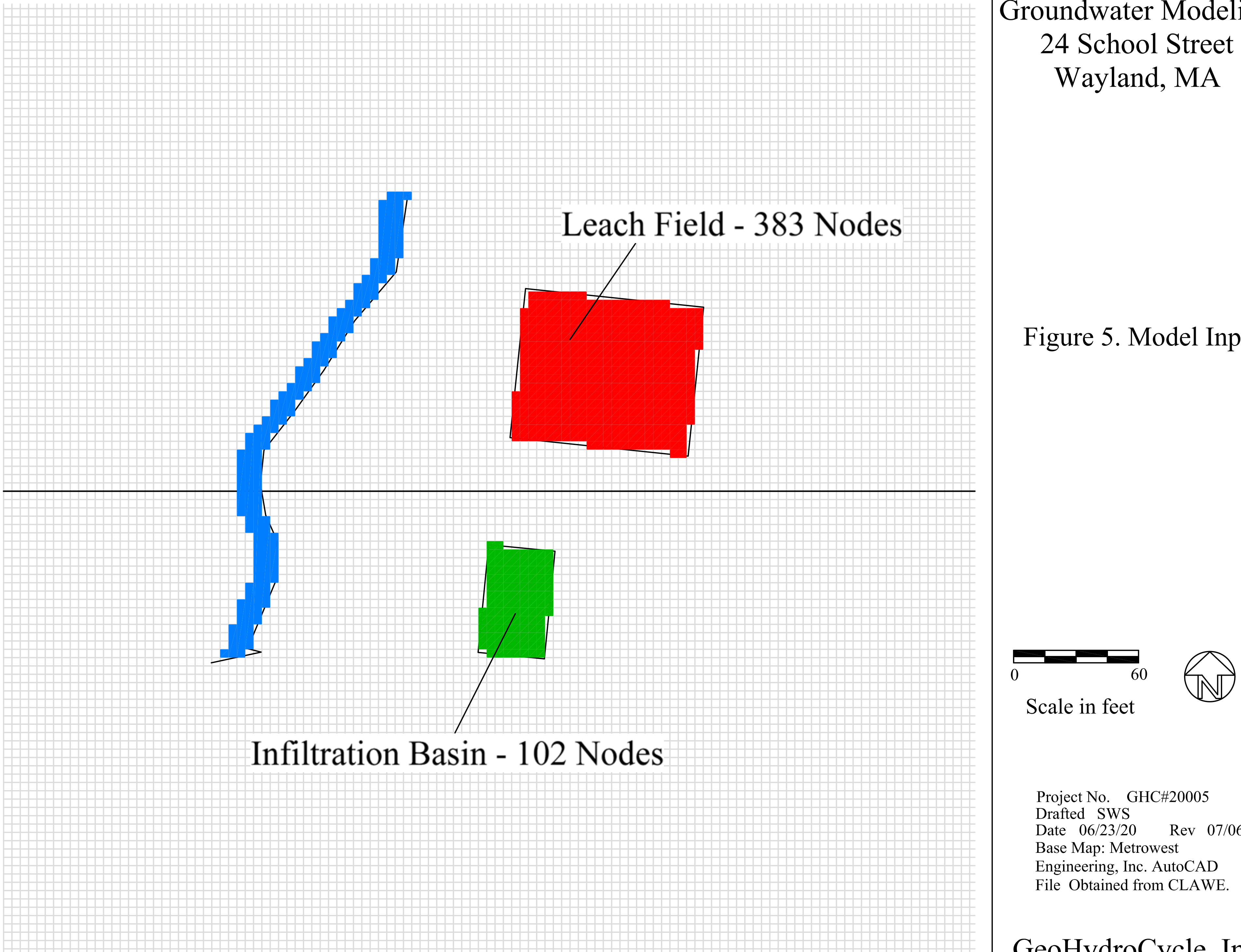

Groundwater Modeling
24 School Street
Wayland, MA

Figure 5. Model Input.

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Drafted SWS
Date 06/23/20 Rev 07/06/20
Base Map: Metrowest
Engineering, Inc. AutoCAD
File Obtained from CLAWE.

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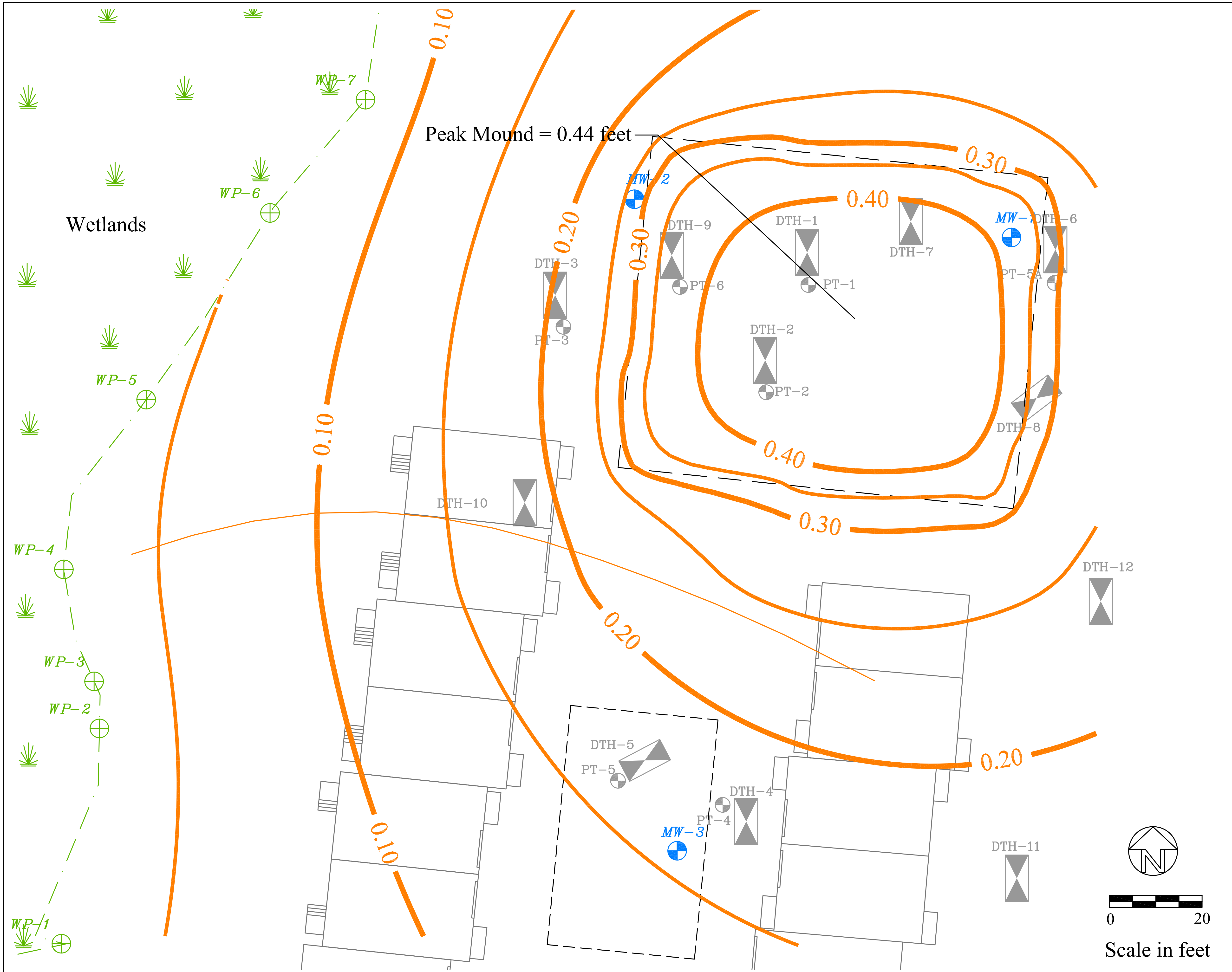

Groundwater Modeling
24 School Street
Wayland, MA

Figure 6. Simulated Groundwater Mound Height Contours for Effluent Discharge of 2,680 GPD Into 6,192 SF.

LEGEND:

1.0 Groundwater Mound Height Contours. Interval = 0.05 foot.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. Treated wastewater discharge = 2,680 gallons per day.
3. Total Leach Field footprint = 6,192 square feet.
4. See Figure 2 for more information.

Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 7/23/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

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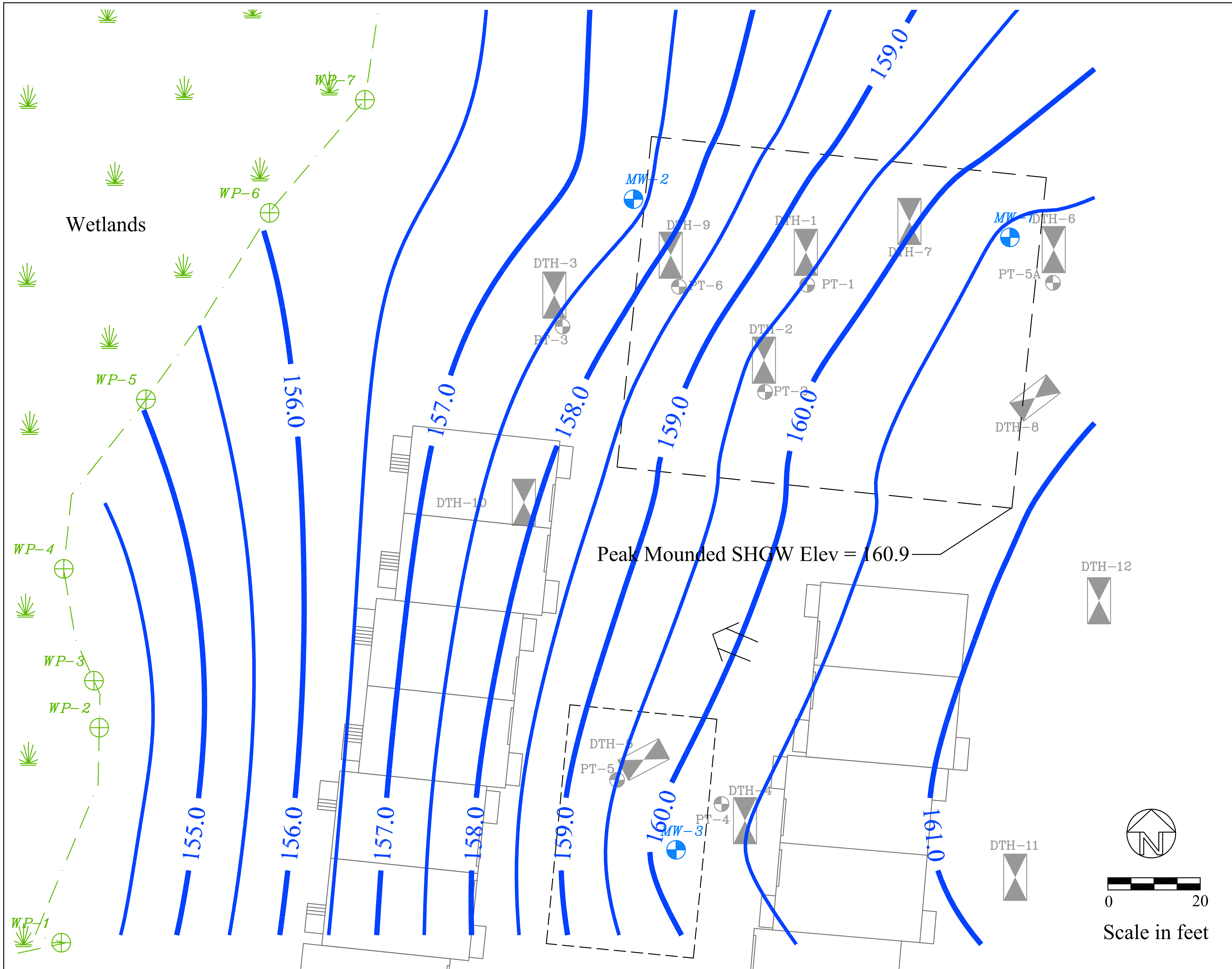


Groundwater Modeling
24 School Street
Wayland, MA

Figure 7. Simulated Groundwater Elevation Contours for Effluent Discharge of 2,680 GPD Into 6,192 SF.

LEGEND:

160 Groundwater Elevation Contours. Interval = 0.5 foot.

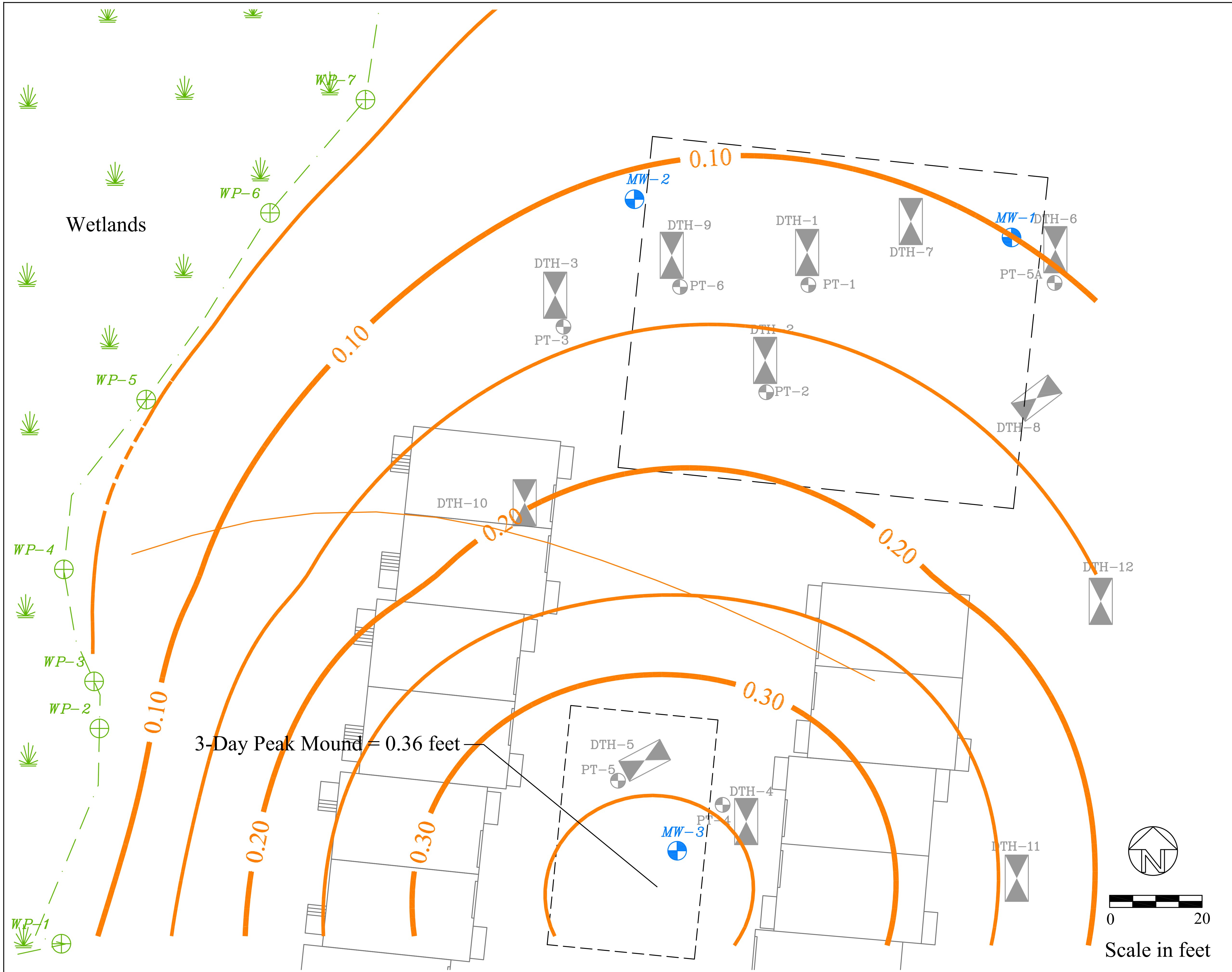
Inferred Groundwater Flow Direction.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. Treated wastewater discharge = 2,680 gallons per day.
3. Total SAS footprint = 6,192 square feet.
4. Groundwater contours are presented for the purposes of this report only.
5. See Figure 2 for more information.

Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 7/1/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

GeoHydroCycle, Inc.



Groundwater Modeling
24 School Street
Wayland, MA

Figure 8. Simulated Groundwater Mound Height Contours at 3 Days for 100-Year Storm Water Discharge Into 1,664 SF Infiltration Basin.

LEGEND:

1.0 Groundwater Mound Height Contours. Interval = 0.05 foot.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. 100-Year Storm volume = 4,344 cubic feet.
3. Total Infiltration Basin footprint = 1,664 square feet.
4. See Figure2 for more information.

Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 7/23/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

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Summary Table.

Corner	Max (ft)
SW	0.35
SE	0.18
NW	0.10
NE	0.08

Groundwater Modeling
24 School Street
Wayland, MA

Figure 9. Simulated Groundwater Mound Height Time Series of 100-Year Storm Effects at Corners of Leach Field.

NOTES:

1. Groundwater mounding data are calculated and interpreted as described in the text.
2. 100-Year Storm volume = 4,344 cubic feet.
3. Total Infiltration Basin footprint = 1,664 square feet.
4. See Figure2 for more information.

Project No. GHC#20005
Drafted SWS
Date 06/23/20 Rev 7/6/20
Base Map: Metrowest Engineering, Inc. AutoCAD File Obtained from CLAWE.

GeoHydroCycle, Inc.

Enclosure 2 - CLAWE References

Table 1. Water Table Monitoring (revised 6/15/2018, 5/4/2019)

Monitoring well	Top of case, ft	Top of well, ft	Bottom of well	Ground elev., ft	Depth to water from TOW, ft							Difference
					12/4/2017	1/10/2018	1/29/2018	2/9/2018	3/12/2018	5/3/2019	5/9/2019	ft
MW 1	170.18	169.97	142.7	167.7	11.9	14.12	11.81	12.02	9.77	10.87	11.64	4.35
MW 2	166.13	165.69	146.2	164.2	9.57	11.12	9.67	9.8	8.65	9.62	9.79	2.47
MW 3	165.08	164.91	148.1	163.1	6.76	8.85	6.07	6.19	4.77	5.95	6.85	4.08
Average												3.63

Monitoring well	Top of case, ft	Top of well, ft	Bottom of well	Ground elev., ft	Water Table Elev, ft							
					12/4/2017	1/10/2018	1/29/2018	2/9/2018	3/12/2018	5/3/2019	5/9/2019	K, ft/day
MW 1	170.18	169.97	142.7	167.7	158.07	155.85	158.16	157.95	160.2	159.1	158.33	25.97
MW 2	166.13	165.69	146.2	164.2	156.12	154.57	156.02	155.89	157.04	156.07	155.9	31.09
MW 3	165.08	164.91	148.1	163.1	158.15	156.06	158.84	158.72	160.14	158.96	158.06	6.51

Monitoring well	Top of case, ft	Top of well, ft	Bottom of well	Ground elev., ft	Depth to water from GS, ft						
					12/4/2017	1/10/2018	1/29/2018	2/9/2018	3/12/2018	5/3/2019	5/9/2019
MW 1	170.18	169.97	142.7	167.7	9.63	11.85	9.54	9.75	7.5	8.6	9.37
MW 2	166.13	165.69	146.2	164.2	8.08	9.63	8.18	8.31	7.16	8.13	8.3
MW 3	165.08	164.91	148.1	163.1	4.95	7.04	4.26	4.38	2.96	4.14	5.04

Table 1a. Soil Evaluation Estimated High Groundwater - MetroWest v.s. MW measurements
Revised 6-10-2018

Test Pit	GSE, ft		EHGW	Location	Measured from MW		Use for Mounding
DTH-1	165.7		159.87	CN SAS			
DTH-2	165.9		159.23	CS SAS	(MW1+ MW2)/2	158.62	**159.55**
DTH-3	161.7		154.87	CW SAS			
DTH-4	164.1		<154	Center STM Infil			
DTH-5	162.6		156.6	NW STM infil	MW 3	160.14	160.14
DTH-6	167.7		161.87	NE SAS	MW 1	160.2	
DTH-7	166.8		<157.3	NE SAS			
DTH-8	168.2		161.53	SE SAS			
DTH-9	163		157.8	NW SAS	MW 2	157.04	
DTH-10	160.75		155.08	SW off SAS			
DTH-11	166		161	E off STM Infil			
DTH-12	168.2		161	SE off SAS			

* SAS used average water table of DTH-1 and DTH-2 for mounding analysis

Table 3. Summary of Updated Mounding Analysis, revsied 6-11-2018, 7-2-2018 8/15/2018

Parameters	Long-Term	100-year Storm	Wastewater				
Recharge area	Infiltration- LT	Infiltration-cons	SAS, K1	SAS, K1,2,3, WT DTH1,2	SAS - K1,3, WT DTH 1,2	SAS, K1,2,3, WT MW1,2	SAS - K1,3, WT MW 1,2
Scenarios	Inf-sys	Inf - sys	SCN 1	SCN 2	SCN 3	SCN4	SCN 5
Dimension, ft	32x52	32x52	86 x 72	86 x 72	86 x 72	86 x 72	86 x 72
Area, sq. ft	1664	1664	6192	6192	6192	6192	6192
Recharge Vol. Cu ft (per day or event)	804	4344	358.24	358.24	358.24	358.24	358.24
Duration, day	1	1	90	90	90	90	90
Recharge rate, cu ft/day/sq. ft	0.48	2.61	0.0579	0.0579	0.0579	0.0579	0.0579
Dewater time, day	3	3	90	90	90	90	90
GW Separation, ft	2.11	2.11	4	4	4	4	4
Maximum mounding height, ft	1.13	6.17	0.27	0.38	0.49	0.4	0.52
Estimated effective Max MH, ft	**1.14**	**2.962**	**0.31**	**0.42**	**0.53**	**0.44**	**0.56**
Impact mounding height by other systems, ft	**0.01**	**0.2**	0.04	0.04	0.04	0.04	0.04
Combined Mound height, ft	**1.14**	**6.37**	**0.31**	**0.42**	**0.53**	**0.44**	**0.56**
3-day residual height, ft	0.3	1.75					
5-day residual height, ft	**0.18**	**0.93**					
Estimated effective 3d MH, ft	**0.3**	**1.75**					
Estimated effective 5d MH, ft	**0.18**	**0.93**					
Bottom of stones, ft	**162.25**	**162.25**	**163.25 to 166**	**163.25 to 166**	**163.25 to 166**	**163.25 to 166**	**163.25 to 166**
Top of stones, ft							
EHGW, ft	**160.14** **MW#3**	**160.14** **MW#3**	**156.12 to 158.16** **160**	**(DTH 1+DTH2)/2** **159.55**	**(DTH 1+DTH2)/2** **159.55**	**(MW1+MW2)/2** **158.62**	**(MW1+MW2)/2** **158.62**
Bottom aquifer, ft	**148.1**	**148.1**	**142.7**	**144.45**	**144.45**	**144.45**	**144.45**
3 day elevation, ft	**160.22**	**160.22**					
Flood routing elev, ft	**161.28**	**163.10**					
Top of grade, ft	167	167					
Aquafer depth, ft	12.04	12.04	17.3	15.1	15.1	14.17	14.17
Hydraulic Conductivity, ft/day	6.51, MW#3	6.51, MW#3	25.97 Min(MW#1, MW#2)	21.19 (MW#1+2+3)/3	16.24 (MW#1+3)/2	21.19 (MW#1+2+3)/3	16.24 (MW#1+3)/2
Distance to Const. head boundary from center of field, ft	126				121		

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

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Effective, Affordable, and Sustainable Solutions for Land & Water Environment

February 28, 2018
Revised March 1, 2018
2nd Revision May 7. 2018

Slug Test and Groundwater Mounding Analysis Report
24 School Street, Wayland, MA

A 12-unit 40B residential development is under review with Wayland ZBA and Wayland Conservation Commission. The project will use an on-site wastewater septic system and stormwater subsurface infiltration. The project will generate a daily design flow of 2860 gpd to the septic system under Title 5 310 CMR15.00. The Town expressed concern about the possible mutual impact between the stormwater infiltration system and the septic system. At public hearings and in their staff review comments, Wayland Conservation Commission requested that the applicant provide a detailed groundwater mounding analysis to assess and mitigate the mounding impact if any for septic leaching field and the stormwater subsurface infiltration area. This report provides the mounding analysis and supporting field testing data. Our goals are as follows:

1. Analyze the groundwater mounding distribution under both systems using reasonable and conservative parameters based on in-situ hydrogeological evaluation and testing.
2. Recommend modifications for the siting of the septic and stormwater systems if needed to avoid any impact to each system and to the environment.

The work includes field evaluation of the underlying aquifer and soil hydraulic conductivity; computer modeling of the groundwater mounding height and distribution in space and in time for design sewage flow and up to 100-year stormwater runoff recharge events. This analysis is updated to address the comments dated March 9, 2018 and to incorporate the recommendations from the working phone conference with the Town Consultant Nover-Armstrong Associates, Inc. (NAA). The results are presented in the following.

Hydrogeological Evaluation

On December 4, 2017, three borings were sunk to monitor the water table and to conduct slug tests to determine the hydraulic conductivity of soil under the proposed septic leaching field and the stormwater infiltration area. On January 10, 2018 staff of Creative Land & Water Engineering, LLC performed slug tests in three monitoring wells, namely MW1 to MW3, to collect hydraulic conductivity data. The drilling and well and soil logs are attached for reference. The locations of drilling and monitoring wells are presented in the attached monitoring well plan.

Technical Drilling Services, Inc. drilled and installed the three wells using hollow stemmed auger mounted on a track ATV. See Figure 1 for location of the wells. In general, the diameter of the boring measures 6 inches, and the wells 2 inches. Bedrock or refusal was encountered from 15 feet to 25 feet. The soils are very sandy outwash material, except at the bottom of MW 3, where finer till material was observed. Details of the well profile are attached to the end of the report[1]. The NRCS soil map showed the site has Hinckley loam and Narragansett silt loam soil, which are rated as hydrological group A soils, very permeable soils. This is consistent with our onsite evaluation. See attached NRCS soil report for reference. The water tables in the three monitoring wells was monitored and presented in Table 1. On March 12, 2018, the site had the highest ground water table, which is consistent with soil evaluation information or higher than soil mottling at Well 3. We will use data from this testing for our mounding analysis. Given the topography, the aquifer bottom would be more likely as presented at MW 1. As MW 3 is located in the stormwater infiltration area, the shallower aquifer depth at MW 3 at the limit of drilling is also used for the mounding analysis for stormwater infiltration area as a conservative checking.

Table 1. Water Table Monitoring

Monitoring well	Top of case, ft	Top of well, ft	Bottom of well	Ground elev., ft	Depth to water from TOW, ft				
					12/4/2017	1/10/2018	1/29/2018	2/9/2018	3/12/2018
MW 1	170.18	169.97	142.7	167.7	11.9	14.12	11.81	12.02	9.77
MW 2	166.13	165.69	146.2	164.2	9.57	11.12	9.67	9.8	8.65
MW 3	165.08	164.91	148.1	163.1	6.76	8.85	6.07	6.19	4.77

Monitoring well	Top of case, ft	Top of well, ft	Bottom of well	Ground elev., ft	Water Table Elev, ft				
					12/4/2017	1/10/2018	1/29/2018	2/9/2018	3/12/2018
MW 1	170.18	169.97	142.7	167.7	158.07	155.85	158.16	157.95	160.2
MW 2	166.13	165.69	146.2	164.2	156.12	154.57	156.02	155.89	157.04
MW 3	165.08	164.91	148.1	163.1	158.15	156.06	158.84	158.72	160.14

Monitoring well	Top of case, ft	Top of well, ft	Bottom of well	Ground elev., ft	Depth to water from GS, ft				
					12/4/2017	1/10/2018	1/29/2018	2/9/2018	3/12/2018
MW 1	170.18	169.97	142.7	167.7	9.63	11.85	9.54	9.75	7.5
MW 2	166.13	165.69	146.2	164.2	8.08	9.63	8.18	8.31	7.16
MW 3	165.08	164.91	148.1	163.1	4.95	7.04	4.26	4.38	2.96

The monitored groundwater table is also compared with the soil evaluation results based on soil morphology by Metrowest Engineering (MWE). The comparison is presented in Table 1a, which shows that the water table measured on March 12, 2018 will be more conservative to use for the

[1] Based on the drill log, it appears that some large boulders or refusal were hit at MW 2 and MW 3 prior to each the bedrock.

mounding analysis.

Table 1a. Soil Evaluation Estimated High Groundwater - MetroWest v.s. MW measurements

Test Pit	GSE, ft	EHGW	Location	Measured from MW		Used for Mounding
DTH-1	165.7	159.87	CN SAS			
DTH-2	165.9	159.23	CS SAS	(MW1+ MW2)/2	158.62	160
DTH-3	161.7	154.87	CW SAS			
DTH-4	164.1	<154	Center STM Infil			
DTH-5	162.6	156.6	NW STM infil	MW 3	160.14	160.14
DTH-6	167.7	161.87	NE SAS	MW 1	160.2	
DTH-7	166.8	<157.3	NE SAS			
DTH-8	168.2	161.53	SE SAS			
DTH-9	163	157.8	NW SAS	MW 2	157.04	
DTH-10	160.75	155.08	SW off SAS			
DTH-11	166	161	E off STM Infil			
DTH-12	168.2	161	SE off SAS			

There was no significant precipitation three days prior to the testing of hydraulic conductivity, to allow relative stable water table. A level TROLL was used to log data following standard test method ASTM 4044. In general, the following procedures were followed:

- Measure the initial water table;
- Slowly submerge the level TROLL until at least 1 foot below the water surface;
- Wait 5-10 minutes for the water level to stable; and
- Start logging, quickly drop into the well a metal rod or about 300 ml of water.

The data were then analyzed using the method presented in ASTM D5912 (Bouwer and Rice method). The data and detailed calculation sheets are in the Appendix. Table 2 is a summary of the results.

Table 2. Slug test summary

	Well Profile				*Slug used*	*Hydraulic Conductivity (ft/s)*
	Depth to bottom (ft)	*Depth to Water Table (ft)*	*Depth of Aquifer (ft)*	*Length of Screen (ft)*		
MW 1	25	14.12	13.15	20	Metal	3.01x10^{-4}
MW 2	18	11.12	8.37	15	Metal	3.60x10^{-4}
*MW 3**	15	8.85	7.96	10	Metal	7.54x10^{-5}

Note Only the screened length under water was used for analysis. *MW3 might be impacted by the limited drilling depth.
Soil logs at each monitoring well is presented in the attachment for reference.

Groundwater Mounding Analysis

Given that the onsite septic system has a daily design flow of 2860 gpd, per 310 CMR 15.202 (4) (g) and as required by the Town Board of Health and Conservation Commission, we calculated the groundwater mounding heights for the septic system leaching field (SAS area) in accordance with DEP technical guidance. A Hydrogeocycle Computer model using Hantush (1967) method was used to analyze the ground water mounding height and distribution under the SAS area and stormwater management infiltration area. Given that MA DEP requires 3 day dewatering of stormwater detention and infiltration area, we calculated the maximum and residual groundwater mounding heights 100-year storm events for the stormwater infiltration system. The goals of the analysis are

1) to show the bottom of SAS area will have at least 4 feet groundwater separation from the mounded groundwater table;

2) to show that the stormwater infiltration system will meet the DEP stormwater guidelines for the hydrogeological requirements under the following conditions:

    1. The stormwater infiltration shall have a minimum of 2 ft groundwater separation from the existing high groundwater
    2. The system will dewater in less than 72 hours (3 days) for up to 100-year storm events (i.e. the 3-day residual mounding height will be less than 2 ft). The maximum height is only a reference and does not need to be considered as it will be temporally stored in the infiltration chambers.
    3. As the 100-year storm is the worst condition, it would be adequate for smaller storm condition if the infiltration storage chambers can be dewatered in less than 3 days for a 100-year storm checked, i.e. below the bottom of the infiltration galley.
    4. If the above requirement has been met, the design for stormwater management is considered to satisfy the DEP stormwater management guidelines for the hydrogeological requirements.

The saturated aquifer parameters based on the boring and testing and the results of the analyses are presented in Tables 3 and detailed in the attached printouts. As we also know, the real mounding heights would be even smaller as we used the lowest hydraulic conductivity value tested and assumed that the water table is flat. Under a sloped water table condition, groundwater mounding would be lowered.

The updated groundwater mounding analysis renders the following conclusions:

1. The maximum mounding height under the SAS area is 0.27 ft and the extension of impact to the stormwater infiltration area will be about 0.12 ft while the impact of the stormwater infiltration mounding on the SAS will be very little 0.04 ft.

2. The stormwater infiltration will be dewatered in 3 days for up to 100year storm. For 2-year storm event, all runoff will be recharged. For 100-year storm, some water will be bypassed through overflow to prevent surcharge breakout.

3. Under 100-year storm condition, groundwater mounding would go above the proposed grade without adequate storage and overflow provided. As the observed high ground water table in this area is at 160.14 ft, therefore, the infiltration system bottom has been raised approximately 3 ft from 159 ft to 162.25 ft and spread over in a larger area to reduce the surcharge. The stormwater infiltration area is revised to 52 ft by 32 ft. The effective mounding height and 3-day residual mounding height was recalculated using the new dimensions as 2.95 ft and 1.75 ft under the worst assumption, respectively.

4. As we discussed above, the aquifer bottom would be likely as at the upgradient monitoring well MW 1. The more conservative shallower aquifer bottom is also used to confirm the mounding impact in the stormwater infiltration area. Both cases showed that the stormwater infiltration area will have 3-day residual mounding height less than 2 ft of the required groundwater separation in the DEP Stormwater Management guidelines for up to a 100-year storm event. Other grading and access way have been revised to reflect the new mounding height. See Table 3 for detailed information.

Table 3. Summary of Updated Mounding Analysis

Parameters	100-year Storm		Wastewater
Recharge area	Infiltration-Norm	Infiltration-cons	SAS
Dimension, ft	32x52	32x52	86 x 72
Area, sq. ft	1664	1664	6192
Recharge Vol. Cu ft (per day or event)	4344	4344	358.24
Duration, day	1	1	90
Recharge rate, cu ft/day/sq. ft	2.61	2.61	0.0579
Dewater time, day	3	3	90
GW Separation, ft	2.11	2.11	4
Maximum mounding height, ft	5.18	6.17	0.27
Estimated effective Max MH, ft	**2.748**	**2.946**	**0.31**
Impact mounding height by other systems, ft	**0.12**	**0.12**	0.04
Combined Mound height, ft	**5.3**	**6.29**	**0.31**
3-day residual height, ft	1.24	1.75	
5-day residual height, ft	**0.65**	**0.93**	
Estimated effective 3d MH, ft	**1.24**	**1.75**	
Estimated effective 5d MH, ft	**0.65**	**0.93**	**0.24**
Bottom of stones, ft	**162.25**	**162.25**	**163.25 to 166**
Top of stones, ft			
EHGW, ft	**160.14**	**160.14**	**156.12 to 158.16** **160**
Bottom aquifer, ft	**142.7**	**148.1**	**142.7**
3 day elevation, ft	**158.25**	**160.22**	
Flood routing elev, ft	**162.888**	**163.09**	
Top of grade, ft	167	167	
Aquafer depth, ft	17.44	12.04	17.3

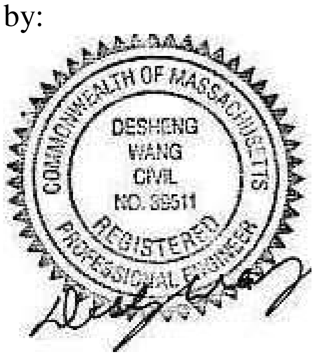
Summary and Conclusions

1. Three boring holes were drilled and monitoring wells installed for collection of aquifer and soil data.
2. Saturated hydraulic conductivity was tested in each well.
3. Using the collected soil and water table data, the groundwater mounding under the SAS area and the infiltration area were analyzed.
4. The mounding analysis shows that the SAS area is adequately sized with adequate groundwater separation above the mounded groundwater for proper treatment.
5. The stormwater infiltration area was raised about 3 ft with a recharge area of 32 ft wide by 52 ft long. The infiltration area will have a dewatering time less than 72 hours (about 59 hours) that meets the DEP stormwater dewatering requirement of 72 hours.

If you have any questions regarding this study, please feel free to contact us.

Sincerely,

Creative Land & Water Engineering, LLC
by:



Desheng Wang, Ph.D., P.E.
Hydrogeological Engineer and,
Wetland Scientist

Soil Log

Project #: J315-5
Date: 12/4/2017

Project: Windsor Place
Location: 24 School Street, Wayland, MA

Driller: T & K Drilling, Inc.

Drilling Method: Hallow Stem Auger

Boring: 1 MW 1

Depth, ft	Soil texture	Note	Blow count
0	gravelly sand		
5			
7	gravelly Loamy sand		60 for 2"
10	f. m. sand		45-28-40-41
12			
		water at 10'	11-23-31-49
15	fine m. sand		
17			
20	fine silty sand		12-60/3"
22			
25			60/2"
25.33	refusal		

Soil Log

Project #: J315-5 Project: Windsor Place
Date: 12/4/2017 Location: 24 School Street, Wayland, MA

Driller: T & K Drilling, Inc. Drilling Method: Hallow Stem Auger

Boring: 2 MW 2

Depth, ft	Soil texture	Note	Blow count
0	loam		
2			
5	m. gr. Sand		
		water at 8'	
10	f. m. sand		18-37-38-42
12			
15	fine m. sand		
17	fine silty sand		
18	refusal		60/2"

Soil Log

Project #: J315-5
Date: 12/4/2017

Project: Windsor Place
Location: 24 School Street, Wayland, MA

Driller: T & K Drilling, Inc.

Drilling Method: Hallow Stem Auger

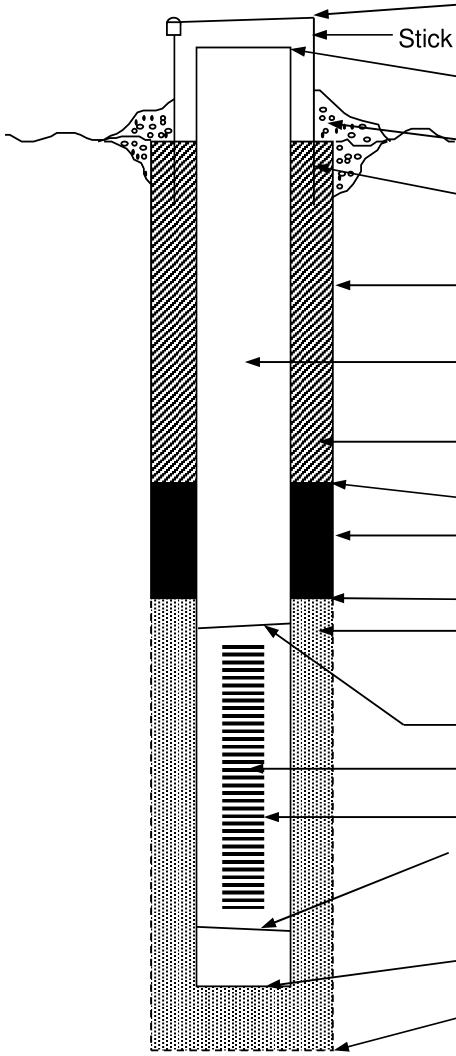
Boring: 3 MW 3

Depth, ft	Soil texture	Note	Blow count
0	loam		
2			
5	fine m sand		
		water at 5'	
10	f. sil sand		29-21-28-27
12			
15	refusal		

MONITORING WELL PROFILE

Project #:	J315-5	Project:	Windsor Place
Date:	12/4/2017	Location:	24 School Street, Wayland, MA
Driller:	T & K Drilling, Inc.	Drilling Method:	Hallow Stem Auger

Boring: 1



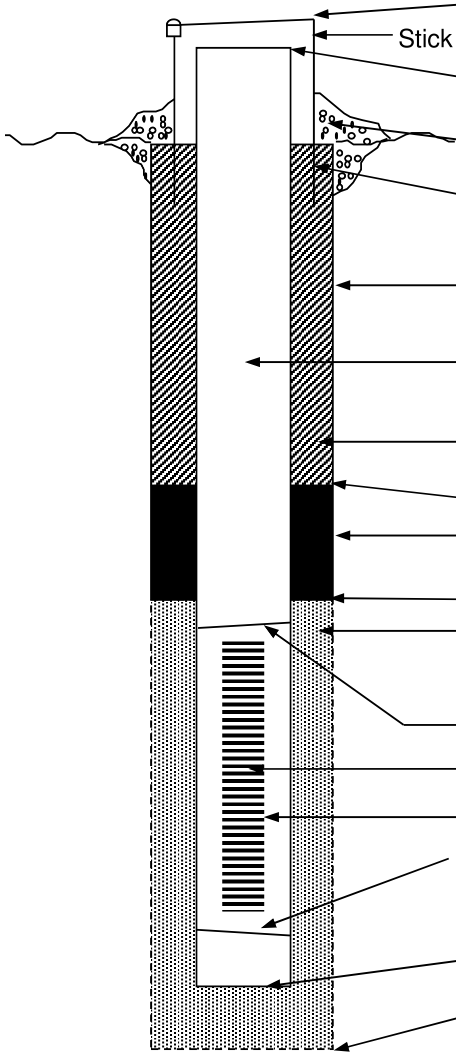
Elevation of Top of Surface Casing:	170.18	ft.
Stick up of Casing Above Ground Surface:	2.48	ft.
Elevation at Top of Riser:	169.97	ft.
Type of Surface Seal:	concrete	
I.D. of Surface Casing:	4	in.
Diameter of Hole:	6	in.
I.D. of Riser Pipe:	2	in.
Type of Riser Pipe:	PVC	
Type of Backfill:	native	
Elevation/Depth to Top of Seal:	165.2/2.5	ft.
Type of Seal:	bentonite	
Elevation/Depth to Top of Sand:	163.2/4.5	ft.
Type of Sand Pack:	#1	
Elevation/Depth to Top of Screen:	162.7/5	ft.
Type of Screen:	PVC	
Screen Slot Size x Length:	10x10	ft.
I.D. of Screen:	2	in.
Elevation/Depth to Bottom of Screen:	142.9/24.8	ft.
Sediment Sump with Plug:	n/a	
Elevation/Depth to Bottom of Hole:	142.7/25.00	ft.

MONITORING WELL PROFILE

Project #: J315-5
Date: 12/4/2017
Project: Windsor Place
Location: 24 School Street, Wayland, MA

Driller: T & K Drilling, Inc.
Drilling Method: Hallow Stem Auger

Boring: 2



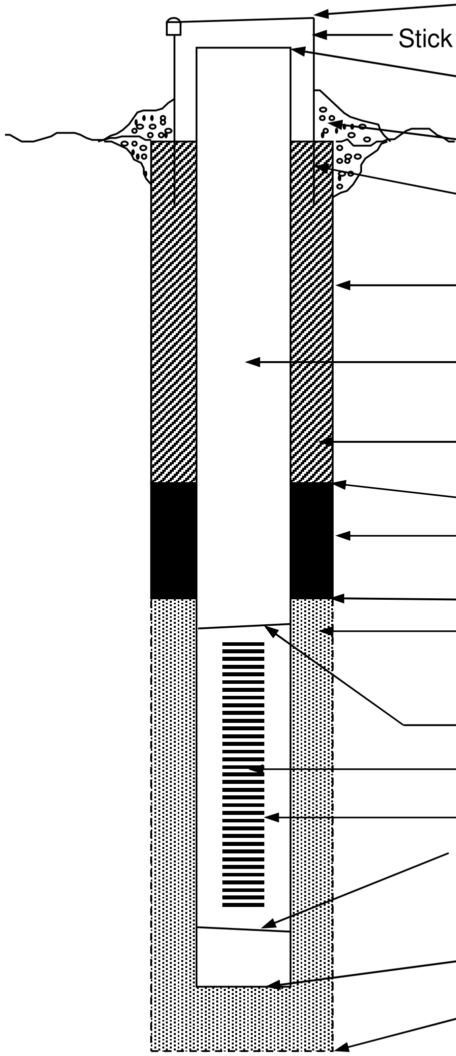
Elevation of Top of Surface Casing:	166.13	ft.
Stick up of Casing Above Ground Surface:	1.93	ft.
Elevation at Top of Riser:	165.69	ft.
Type of Surface Seal:	concrete	
I.D. of Surface Casing:	4	in.
Diameter of Hole:	6	in.
I.D. of Riser Pipe:	2	in.
Type of Riser Pipe:	PVC	
Type of Backfill:	native	
Elevation/Depth to Top of Seal:	163.2/1	ft.
Type of Seal:	bentonite	
Elevation/Depth to Top of Sand:	161.7/2.5	ft.
Type of Sand Pack:	#1	
Elevation/Depth to Top of Screen:	161.2/3.0	ft.
Type of Screen:	PVC	
Screen Slot Size x Length:	10x6	ft.
I.D. of Screen:	2	in.
Elevation/Depth to Bottom of Screen:	146.4/17.8	ft.
Sediment Sump with Plug:	n/a	
Elevation/Depth to Bottom of Hole:	146.2/18	ft.

MONITORING WELL PROFILE

Project #: J315-5
Date: 12/4/2017
Project: Windsor Place
Location: 24 School Street, Wayland, MA

Driller: T & K Drilling, Inc.
Drilling Method: Hallow Stem Auger

Boring: 3



Elevation of Top of Surface Casing:	165.08	ft.
Stick up of Casing Above Ground Surface:	1.98	ft.
Elevation at Top of Riser:	164.91	ft.
Type of Surface Seal:	concrete	
I.D. of Surface Casing:	4	in.
Diameter of Hole:	6	in.
I.D. of Riser Pipe:	2	in.
Type of Riser Pipe:	PVC	
Type of Backfill:	native	
Elevation/Depth to Top of Seal:	160.6/2.5	ft.
Type of Seal:	bentonite	
Elevation/Depth to Top of Sand:	158.6/4.5	ft.
Type of Sand Pack:	#1	
Elevation/Depth to Top of Screen:	158.1/5	ft.
Type of Screen:	PVC	
Screen Slot Size x Length:	10x4	ft.
I.D. of Screen:	2	in.
Elevation/Depth to Bottom of Screen:	148.3/14.8	ft.
Sediment Sump with Plug:	n/a	
Elevation/Depth to Bottom of Hole:	148.1/15	ft.

Calculation Sheet for Hydraulic Conductivity using Bouwer & Rice 1976 Method

MW 1 (B1)

Site: 24 School Street, Wayland, MA
Date: 1/10/2018
Performed by: wjc Checked by: dsw 2/5/2018

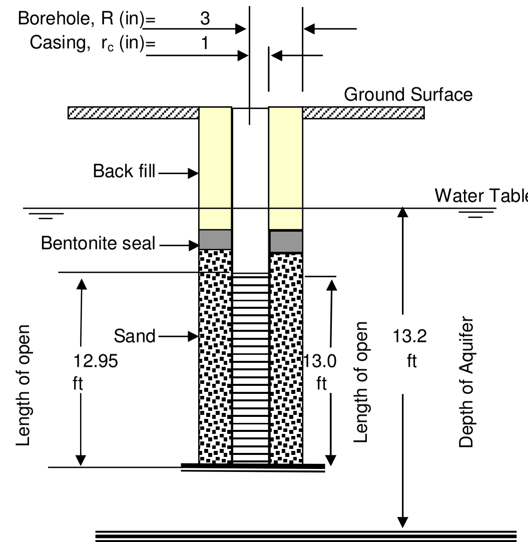
$K = r_c^2 \ln(Re/R)/(2Le)\ (1/t)\ \ln(H0/Ht)$

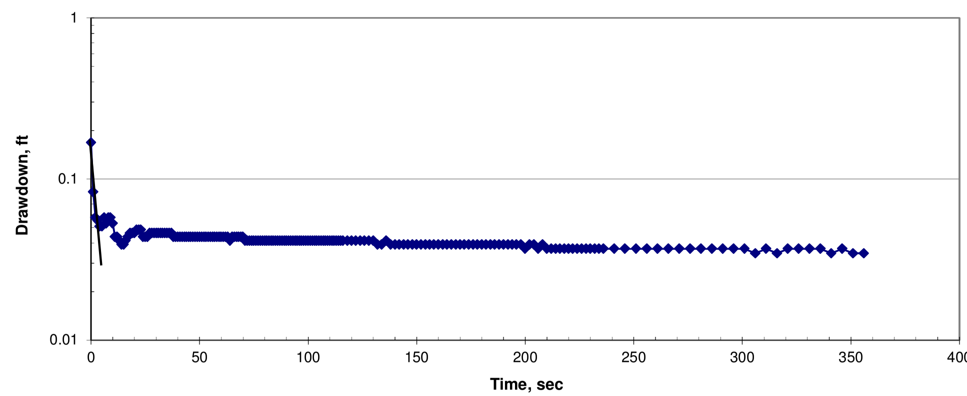
$r_c = [(1-n)r_a^2 + n\ R^2]^{0.5}$

where,

n is the short-term specific yield of the filter pack=	0.2	
r_a is uncorrected well casing radius=	0.083	ft
R is borehole radius=	0.25	ft
Ls is the total length of well screen =	12.95	ft
Le is length of open aquifer =	12.95	ft
Lw is depth of aquifer=	13.15	ft
Re is the effective radial distance over which head is dissipated		
r_c is corrected casing radius =	0.083	ft
Le/R =	51.8	
*Dimensionless number, C=	2.75	
$\ln(Re/R)=(1.1/\ln(Lw/R)+C/(Le/R))^{-1}$ =	3.02	
t1=	0	sec
t2=	3	sec
H1=	0.1684	ft
H2=	0.05537	ft
(1/t)ln(H0/Ht) = (1/(t2-t1)ln(H1/H2)=	0.3708	

Hydraulic Conductivity, K= 3.01E-04 ft/s
25.97 ft/day





References:
1. Applied Hydrogeology, C.W. Fetter, 3rd Edition.
2. ASTM Standard Test Method for (Analytical Procedure) Determining Hydraulic Conductivity of an Unconfined Aquifer by Overdamped Well Response to Instantaneous Change in Head (Slug), D5912-96
3. ASTM Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers, D4044-96

Calculation Sheet for Hydraulic Conductivity using Bouwer & Rice 1976 Method

MW 2 (B2)

Site:	24 School Street, Wayland, MA			
Date:	1/10/2018			
Performed by: wjc		Checked by:	dsw	2/5/2018

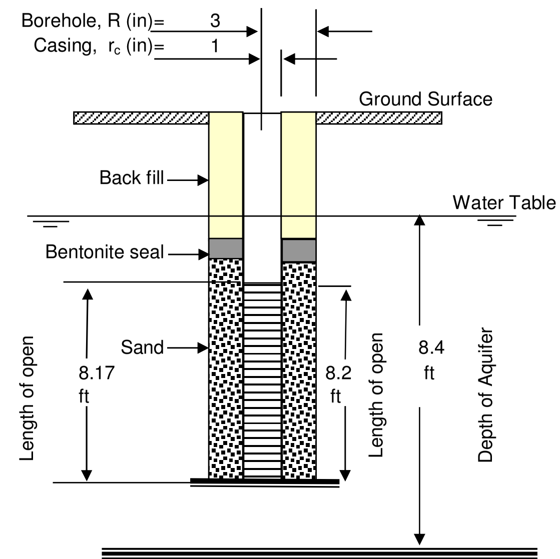
$K = r_c^2 \ln(Re/R)/(2Le)\ (1/t)\ \ln(H0/Ht)$

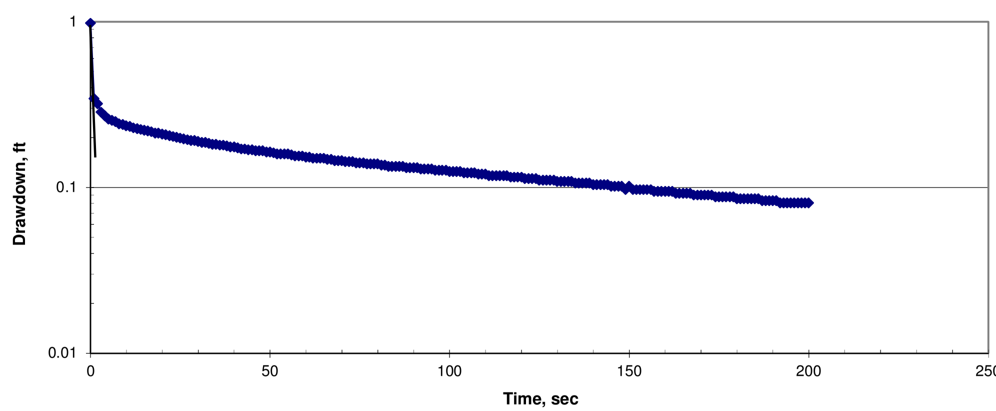
$r_c = [(1-n)r_a^2 + n\ R^2]^{0.5}$

where,

n is the short-term specific yield of the filter pack=	0.2
r_a is uncorrected well casing radius=	0.083 ft
R is borehole radius=	0.25 ft
Ls is the total length of well screen =	8.17 ft
Le is length of open aquifer =	8.17 ft
Lw is depth of aquifer=	8.37 ft
Re is the effective radial distance over which head is dissipated	
r_c is corrected casing radius =	0.083 ft
Le/R =	32.68
*Dimensionless number, C=	2.18
$\ln(Re/R)=(1.1/\ln(Lw/R)+C/(Le/R))^{-1}$ =	2.63
t1=	0 sec
t2=	4 sec
H1=	0.978 ft
H2=	0.27 ft
(1/t)ln(H0/Ht) = (1/(t2-t1)ln(H1/H2)=	0.3218

Hydraulic Conductivity, K= **3.60E-04 ft/s**
31.09 ft/day





References:
1. Applied Hydrogeology, C.W. Fetter, 3rd Edition.
2. ASTM Standard Test Method for (Analytical Procedure) Determining Hydraulic Conductivity of an Unconfined Aquifer by Overdamped Well Response to Instantaneous Change in Head (Slug), D5912-96
3. ASTM Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers, D4044-96

Calculation Sheet for Hydraulic Conductivity using Bouwer & Rice 1976 Method

MW 3 (B3)

Site: 24 School Street, Wayland, MA

Date: 1/10/2018

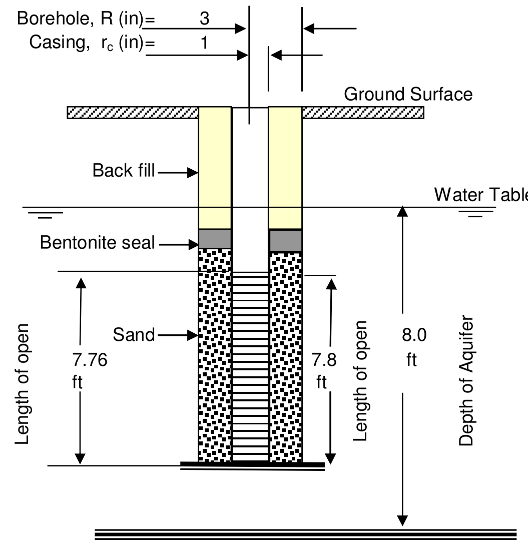
Performed by: wjc   Checked by: dsw   2/5/2018

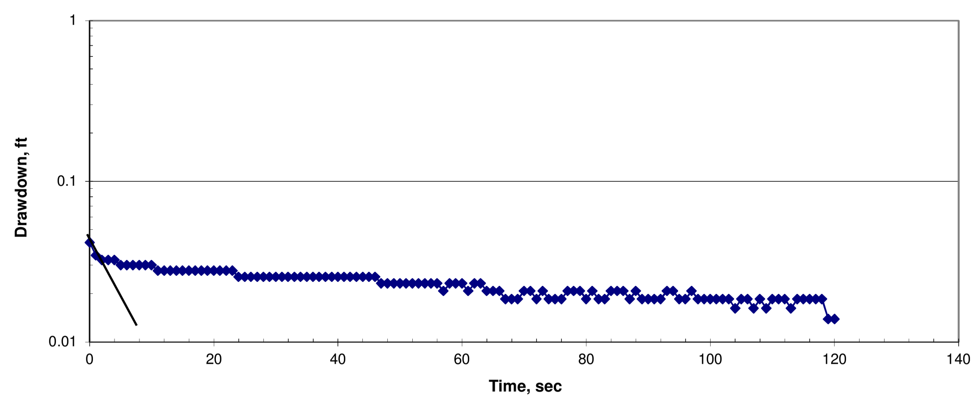
$K = r_c^2 \ln(Re/R)/(2Le)\ (1/t)\ \ln(H0/Ht)$

$r_c = [(1-n)r_a^2 + n\ R^2]^{0.5}$

where,

n is the short-term specific yield of the filter pack=	0.2	
r_a is uncorrected well casing radius=	0.083	ft
R is borehole radius=	0.25	ft
Ls is the total length of well screen =	7.76	ft
Le is length of open aquifer =	7.76	ft
Lw is depth of aquifer=	7.96	ft
Re is the effective radial distance over which head is dissipated		
r_c is corrected casing radius =	0.083	ft
Le/R =	31.04	
*Dimensionless number, C=	2.13	
$\ln(Re/R)=(1.1/\ln(Lw/R)+C/(Le/R))^{-1}$ =	2.59	
t1=	0	sec
t2=	5	sec
H1=	0.041526	ft
H2=	0.02999	ft
(1/t)ln(H0/Ht) = (1/(t2-t1)ln(H1/H2)=	0.0651	
Hydraulic Conductivity, K=	**7.54E-05**	**ft/s**
	6.51	ft/day

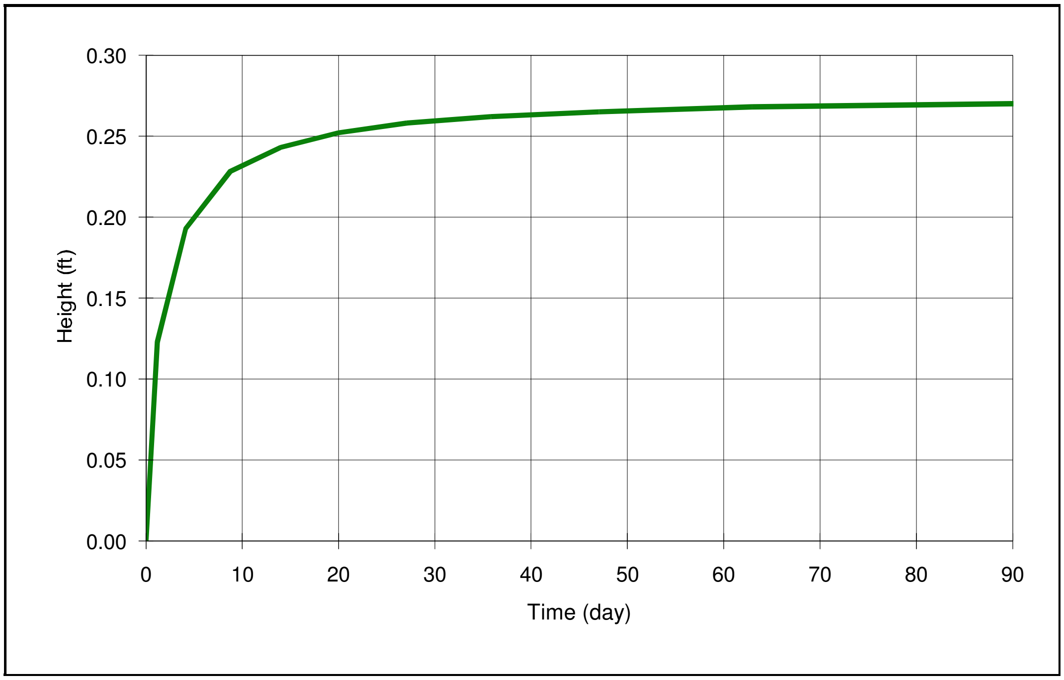




References:

1. Applied Hydrogeology, C.W. Fetter, 3rd Edition.
2. ASTM Standard Test Method for (Analytical Procedure) Determining Hydraulic Conductivity of an Unconfined Aquifer by Overdamped Well Response to Instantaneous Change in Head (Slug), D5912-96
3. ASTM Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers, D4044-96

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS

ANALYST: Desheng Wang

DATE: 5/6/2018 TIME: 9:52:19 PM

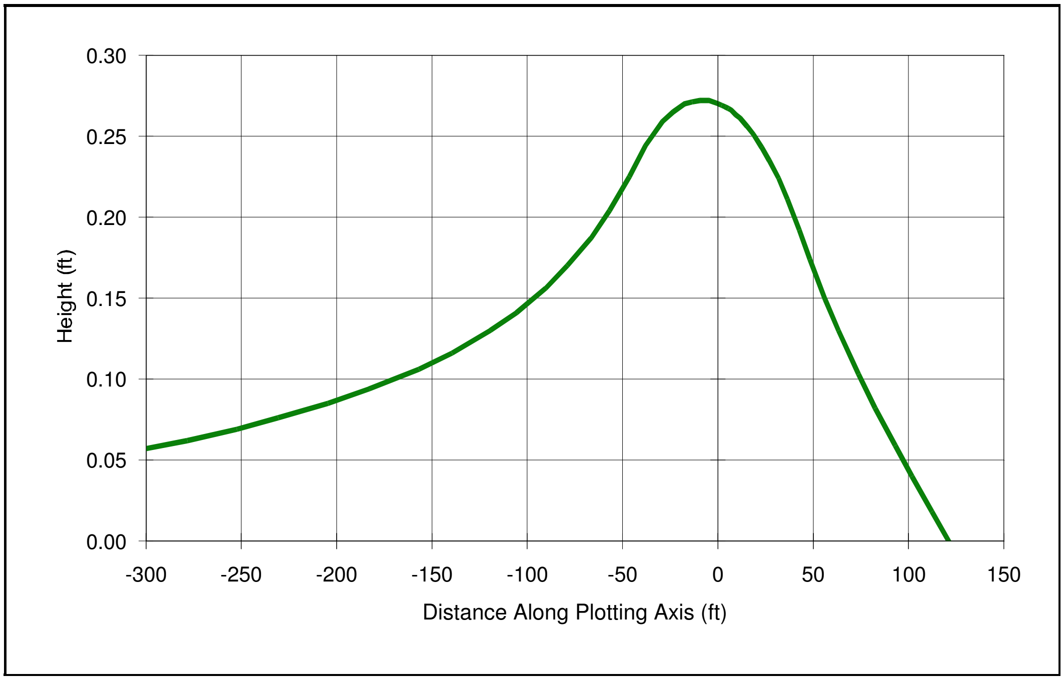
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 25.97 ft/day
Initial saturated thickness: 17.3 ft
Length of application area: 86 ft
Width of application area: 72 ft
Constant head boundary used at: 121 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 32266.51 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.12
4	0.19
9	0.23
14	0.24
20	0.25
27	0.26
36	0.26
47	0.26
63	0.27
90	0.27

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS

ANALYST: Desheng Wang

DATE: 5/6/2018 TIME: 9:53:18 PM

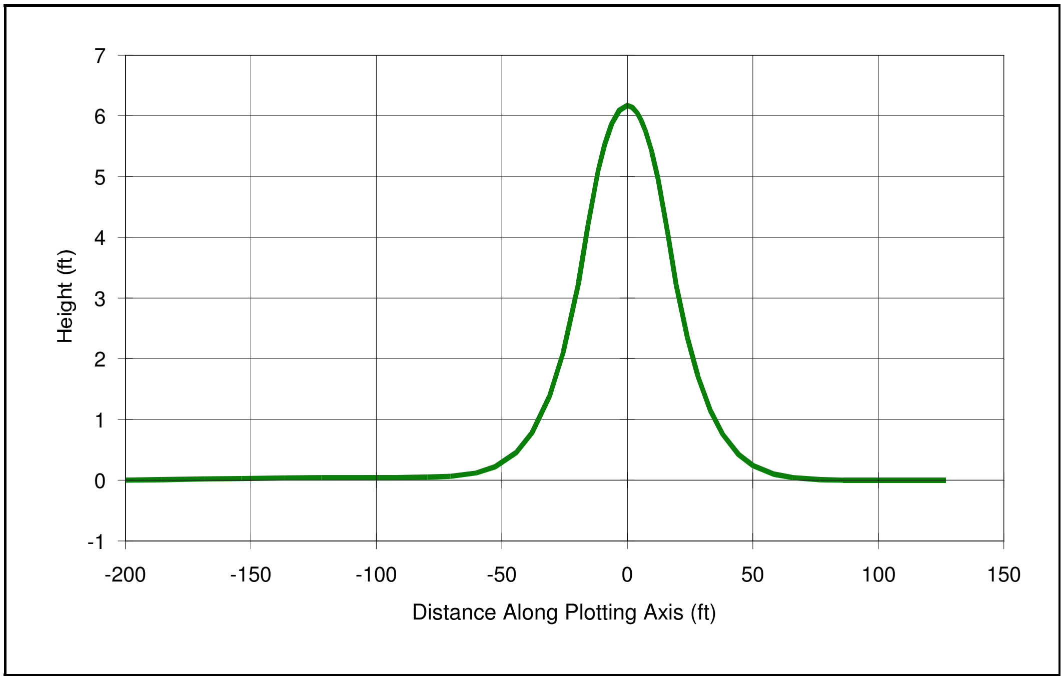
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 25.97 ft/day
Initial saturated thickness: 17.3 ft
Length of application area: 86 ft
Width of application area: 72 ft
Constant head boundary used at: 121 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 43 ft
Total volume applied: 32266.51 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-300	-300	0.06
0	-252.3	-252	0.07
0	-204.6	-205	0.08
0	-156.9	-157	0.11
0	-119.4	-119	0.13
0	-90.3	-90	0.16
0	-66.5	-67	0.19
0	-46.5	-46	0.22
0	-29.1	-29	0.26
0	-17.4	-17	0.27
0	-9.4	-9	0.27
0	0	0	0.27
0	3.8	4	0.27
0	7	7	0.27
0	11.7	12	0.26
0	18.7	19	0.25
0	26.8	27	0.24
0	36.4	36	0.21
0	48.1	48	0.17
0	63.3	63	0.13
0	82.5	83	0.08
0	101.8	102	0.04
0	121	121	0

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM 100yr -rev 2

ANALYST: Desheng Wang

DATE: 5/6/2018 TIME: 10:04:54 PM

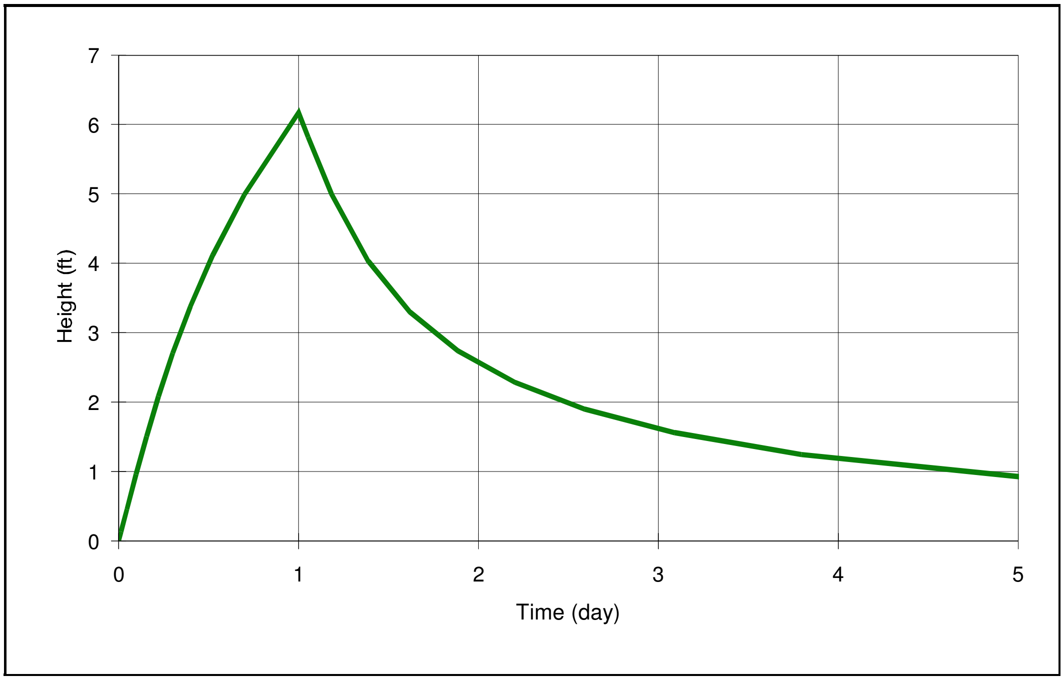
INPUT PARAMETERS

Application rate: 2.61 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 12.04 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 16 ft
positive Y: 0 ft
Total volume applied: 4343.04 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-200	0	-200	0
-168.2	0	-168	0.02
-136.4	0	-136	0.04
-104.6	0	-105	0.04
-79.6	0	-80	0.05
-60.2	0	-60	0.12
-44.4	0	-44	0.45
-31	0	-31	1.38
-19.4	0	-19	3.26
-11.6	0	-12	5.1
-6.3	0	-6	5.86
0	0	0	6.17
4	0	4	6.04
7.3	0	7	5.75
12.2	0	12	4.97
19.5	0	20	3.22
27.9	0	28	1.73
37.9	0	38	0.76
50.1	0	50	0.24
65.9	0	66	0.04
85.9	0	86	0
106	0	106	0
126	0	126	0

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM 100yr -rev 2

ANALYST: Desheng Wang

DATE: 5/6/2018 TIME: 10:10:24 PM

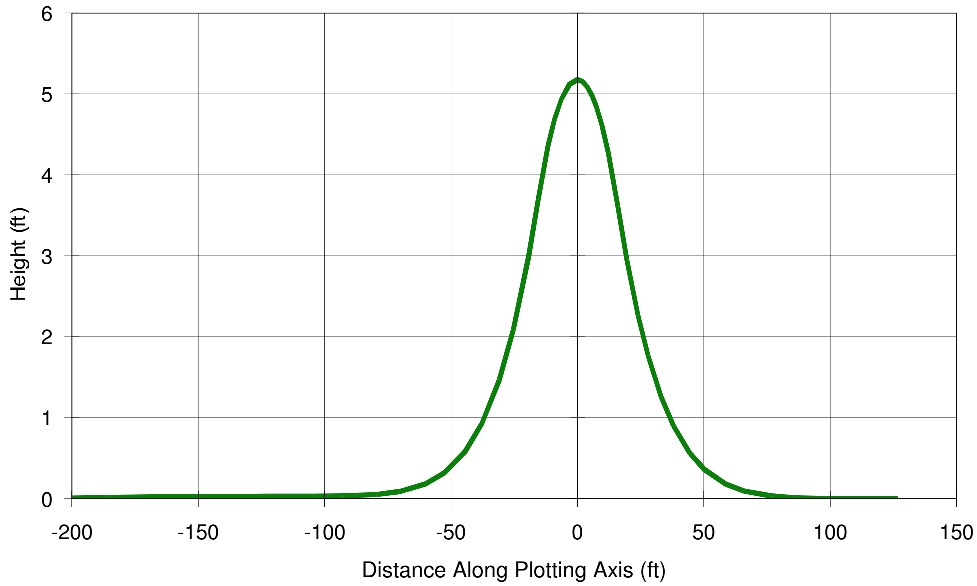
INPUT PARAMETERS

Application rate: 2.61 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 12.04 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 4343.04 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.13
0	0.46
0.1	0.96
0.2	1.51
0.2	2.08
0.3	2.7
0.4	3.37
0.5	4.12
0.7	4.99
1	6.17
1.1	5.82
1.2	5
1.4	4.03
1.6	3.3
1.9	2.74
2.2	2.28
2.6	1.9
3.1	1.56
3.8	1.25
5	0.93

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM 100yr -rev 2 D

ANALYST: Desheng Wang

DATE: 5/6/2018 TIME: 10:14:43 PM

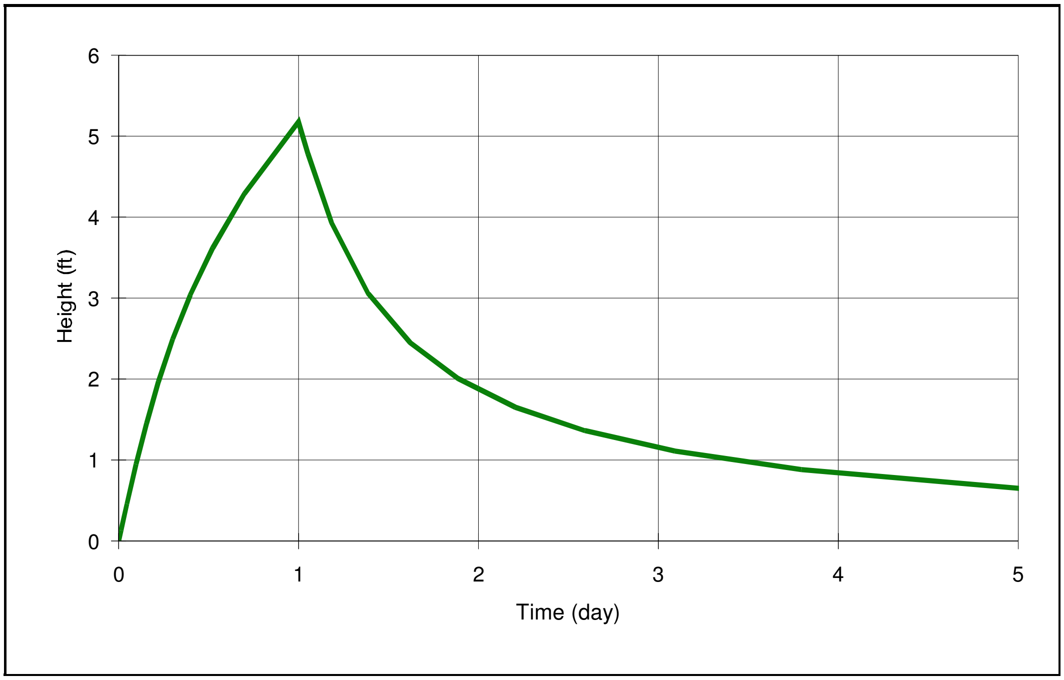
INPUT PARAMETERS

Application rate: 2.61 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 17.44 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 16 ft
positive Y: 0 ft
Total volume applied: 4343.04 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-200	0	-200	0.01
-168.2	0	-168	0.02
-136.4	0	-136	0.03
-104.6	0	-105	0.03
-79.6	0	-80	0.05
-60.2	0	-60	0.18
-44.4	0	-44	0.59
-31	0	-31	1.46
-19.4	0	-19	2.98
-11.6	0	-12	4.37
-6.3	0	-6	4.94
0	0	0	5.18
4	0	4	5.08
7.3	0	7	4.86
12.2	0	12	4.27
19.5	0	20	2.95
27.9	0	28	1.76
37.9	0	38	0.9
50.1	0	50	0.36
65.9	0	66	0.1
85.9	0	86	0.01
106	0	106	0
126	0	126	0

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM 100yr -rev 2 D

ANALYST: Desheng Wang

DATE: 5/6/2018 TIME: 10:15:22 PM

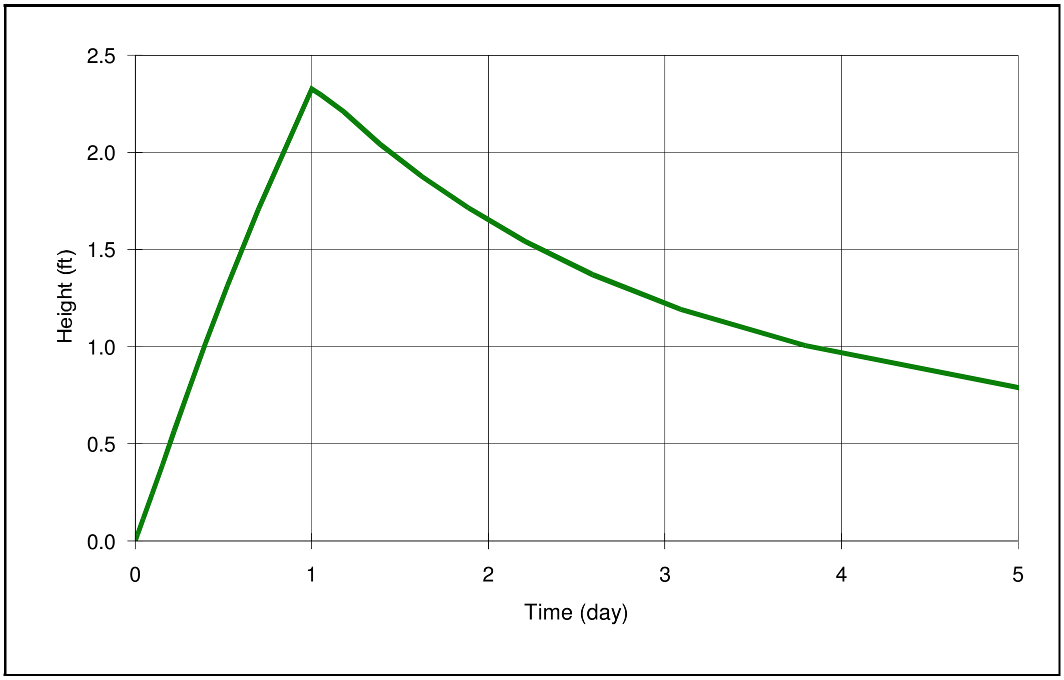
INPUT PARAMETERS

Application rate: 2.61 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 17.44 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 4343.04 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.13
0	0.46
0.1	0.95
0.2	1.45
0.2	1.97
0.3	2.5
0.4	3.04
0.5	3.62
0.7	4.29
1	5.18
1.1	4.78
1.2	3.93
1.4	3.05
1.6	2.45
1.9	2
2.2	1.65
2.6	1.36
3.1	1.11
3.8	0.88
5	0.65

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM 100yr -rev 2

ANALYST: Desheng Wang

DATE: 5/7/2018 TIME: 11:57:08 AM

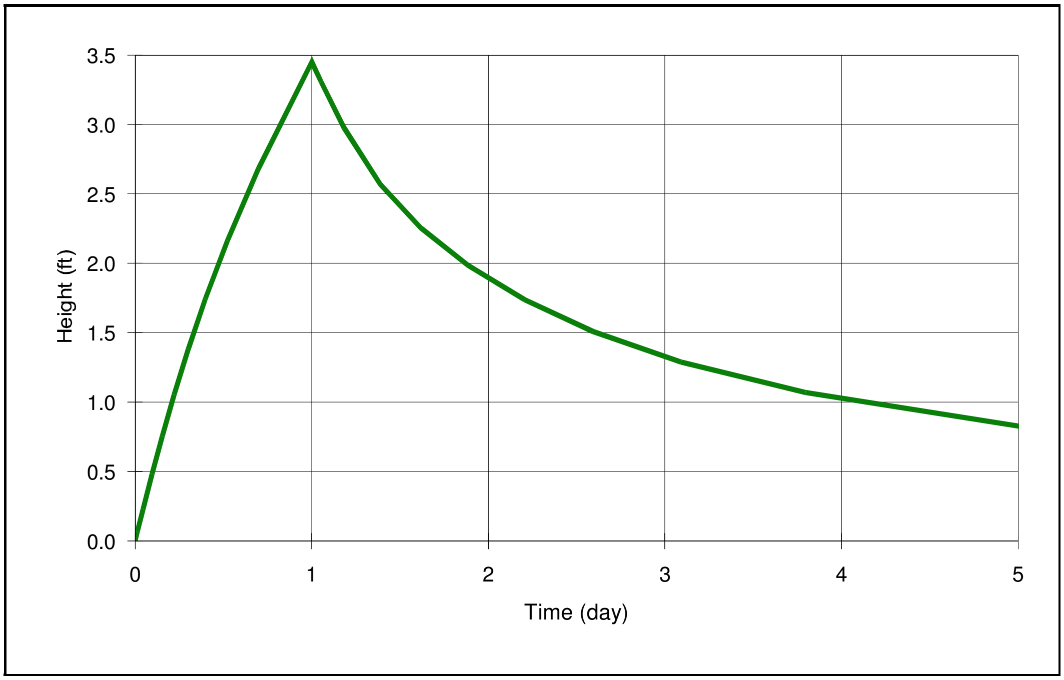
INPUT PARAMETERS

Application rate: 2.61 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 12.04 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Groundwater mounding @
X coordinate: 15.99 ft at corner
Y coordinate: 25.99 ft
Total volume applied: 4343.04 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.03
0	0.12
0.1	0.24
0.2	0.39
0.2	0.57
0.3	0.77
0.4	1.02
0.5	1.31
0.7	1.71
1	2.33
1.1	2.3
1.2	2.21
1.4	2.04
1.6	1.88
1.9	1.71
2.2	1.54
2.6	1.37
3.1	1.19
3.8	1
5	0.79

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM 100yr -rev 2

ANALYST: Desheng Wang

DATE: 5/7/2018 TIME: 12:09:40 PM

INPUT PARAMETERS

Application rate: 2.61 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 12.04 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 25.99 ft at long axis edge
Total volume applied: 4343.04 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.07
0	0.23
0.1	0.48
0.2	0.76
0.2	1.05
0.3	1.38
0.4	1.74
0.5	2.16
0.7	2.68
1	3.45
1.1	3.31
1.2	2.98
1.4	2.57
1.6	2.25
1.9	1.98
2.2	1.74
2.6	1.51
3.1	1.29
3.8	1.07
5	0.83

United States Department of Agriculture

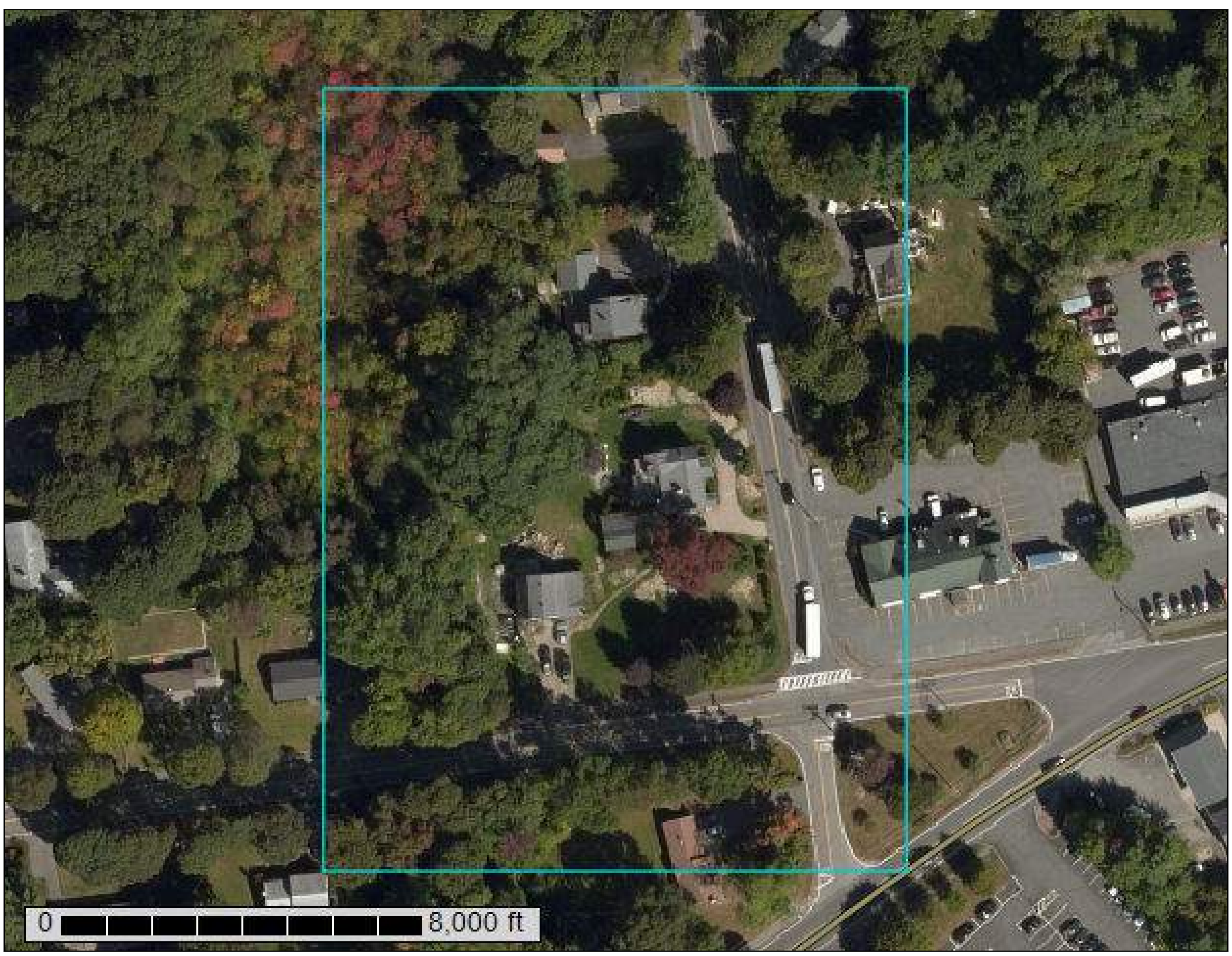
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Middlesex County, Massachusetts

24 School Street, Wayland, MA



February 28, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:957 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 10, 20, 40, 60

Feet: 0, 45, 90, 180, 270

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 17, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	1.3	25.7%
52A	Freetown muck, 0 to 1 percent slopes	0.1	2.2%
251B	Haven silt loam, 3 to 8 percent slopes	0.1	1.3%
253C	Hinckley loamy sand, 8 to 15 percent slopes	0.9	18.9%
415B	Narragansett silt loam, 3 to 8 percent slopes	2.1	41.6%
602	Urban land	0.2	4.1%
624B	Haven-Urban land complex, 0 to 8 percent slopes	0.3	6.0%
Totals for Area of Interest		**5.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Swansea and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Bogs, depressions, depressions, kettles, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Bogs, depressions, depressions, kettles, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

251B—Haven silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 990d
Elevation: 100 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Haven and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haven

Setting

Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 2 inches: silt loam
H2 - 2 to 20 inches: silt loam
H3 - 20 to 32 inches: very fine sandy loam
H4 - 32 to 65 inches: stratified coarse sand to sand to fine sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 36 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 9 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Scio

Percent of map unit: 5 percent
Landform: Depressions, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent

253C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Eskers, kames, kame terraces, outwash plains, outwash terraces, moraines, outwash deltas
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, riser
Down-slope shape: Convex, concave, linear
Across-slope shape: Concave, linear, convex
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Eskers, kames, outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, head slope, nose slope, crest, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Eskers, kames, kame terraces, outwash plains, outwash terraces, moraines, outwash deltas
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, concave, linear
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Kame terraces, outwash plains, outwash terraces, moraines, outwash deltas
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread

Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

415B—Narragansett silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vqrp
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Narragansett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Narragansett

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits and/or friable silty eolian deposits over loose sandy glaciofluvial deposits derived from metamorphic rock and/or friable sandy basal till derived from metamorphic rock

Typical profile

H1 - 0 to 2 inches: slightly decomposed plant material
H2 - 2 to 7 inches: silt loam
H3 - 7 to 35 inches: silt loam
H4 - 35 to 60 inches: very gravelly loamy sand
H5 - 60 to 65 inches: very gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 35 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Haven

Percent of map unit: 10 percent
Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

602—Urban land

Map Unit Setting

National map unit symbol: 9950
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

624B—Haven-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9956
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Haven and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haven

Setting

Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 2 inches: silt loam
H2 - 2 to 20 inches: silt loam
H3 - 20 to 32 inches: very fine sandy loam
H4 - 32 to 65 inches: stratified coarse sand to sand to fine sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 18 to 36 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Tisbury

Percent of map unit: 10 percent
Landform: Terraces, plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Eskers, ridges, terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

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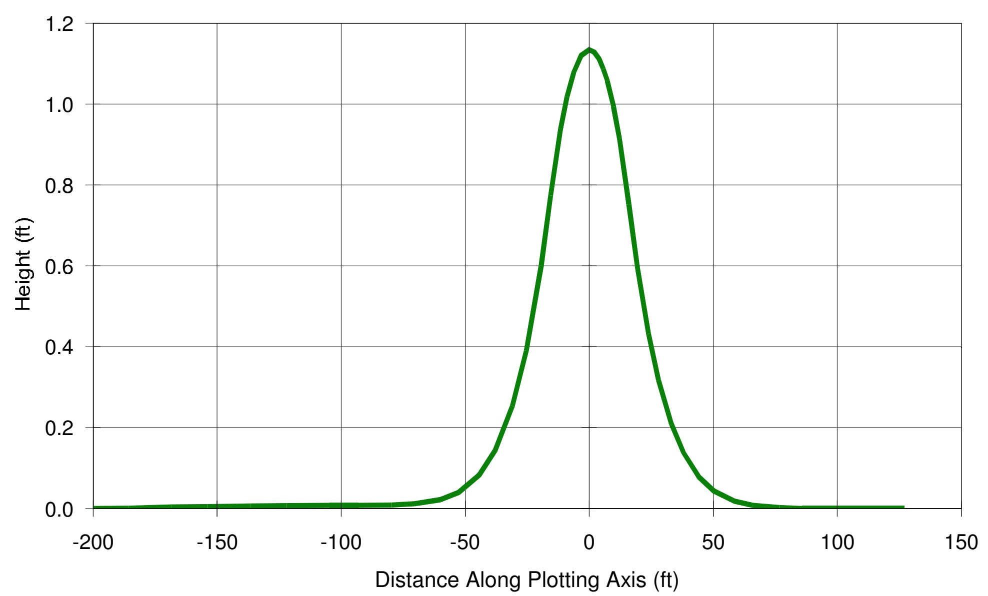
Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM Long-Term

ANALYST: Desheng Wang

DATE: 8/15/2018 TIME: 9:50:43 PM

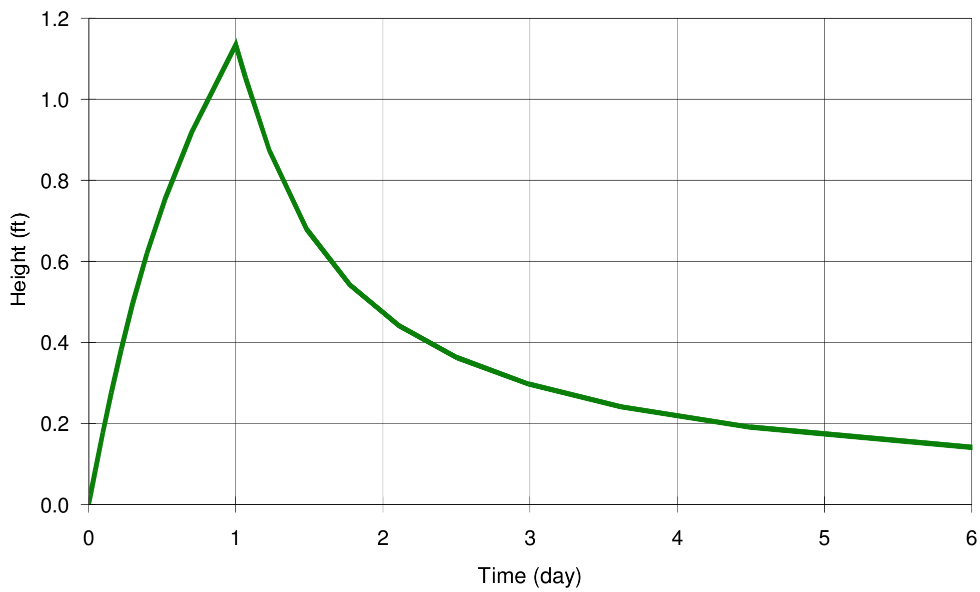
INPUT PARAMETERS

Application rate: 0.48 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 12.04 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 16 ft
positive Y: 0 ft
Total volume applied: 798.72 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-200	0	-200	0
-168.2	0	-168	0
-136.4	0	-136	0.01
-104.6	0	-105	0.01
-79.6	0	-80	0.01
-60.2	0	-60	0.02
-44.4	0	-44	0.08
-31	0	-31	0.25
-19.4	0	-19	0.6
-11.6	0	-12	0.94
-6.3	0	-6	1.08
0	0	0	1.13
4	0	4	1.11
7.3	0	7	1.06
12.2	0	12	0.92
19.5	0	20	0.59
27.9	0	28	0.32
37.9	0	38	0.14
50.1	0	50	0.04
65.9	0	66	0.01
85.9	0	86	0
106	0	106	0
126	0	126	0

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



COMPANY: CLAWE

PROJECT: 24 School St Wayland- STM Long-Term

ANALYST: Desheng Wang

DATE: 8/15/2018 TIME: 9:51:25 PM

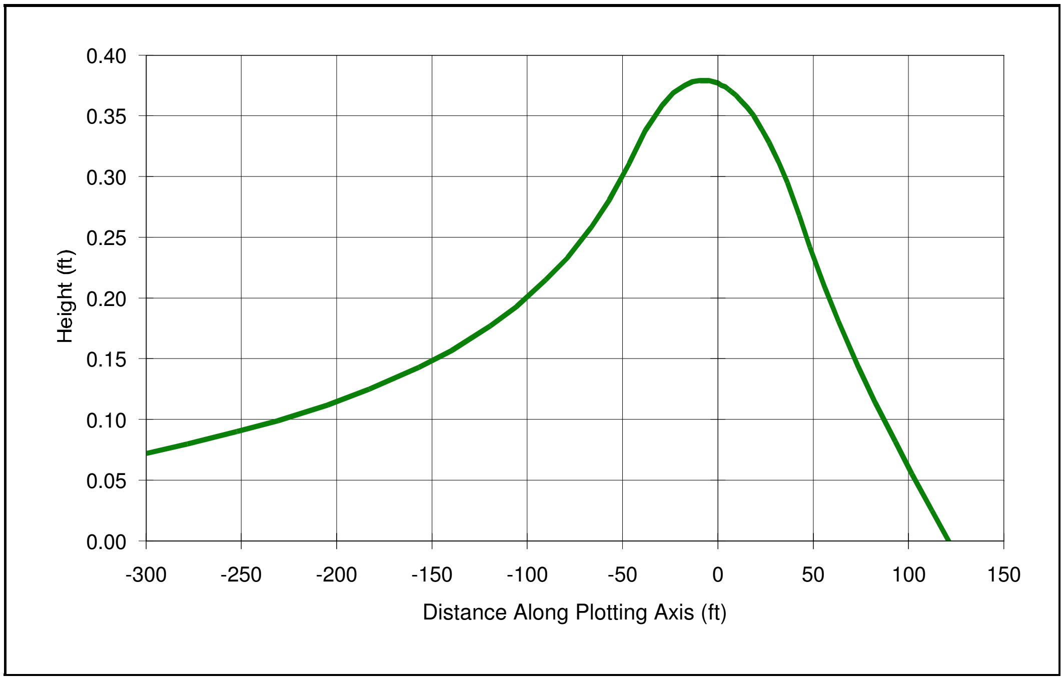
INPUT PARAMETERS

Application rate: 0.48 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 6 day
Fillable porosity: 0.26
Hydraulic conductivity: 6.51 ft/day
Initial saturated thickness: 12.04 ft
Length of application area: 52 ft
Width of application area: 32 ft
Constant head boundary used at: 126 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 798.72 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.02
0	0.08
0.1	0.18
0.2	0.28
0.2	0.38
0.3	0.5
0.4	0.62
0.5	0.76
0.7	0.92
1	1.13
1.1	1.05
1.2	0.87
1.5	0.68
1.8	0.54
2.1	0.44
2.5	0.36
3	0.3
3.6	0.24
4.5	0.19
6	0.14

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS K1,2,3

ANALYST: Desheng Wang

DATE: 6/10/2018 TIME: 10:44:44 PM

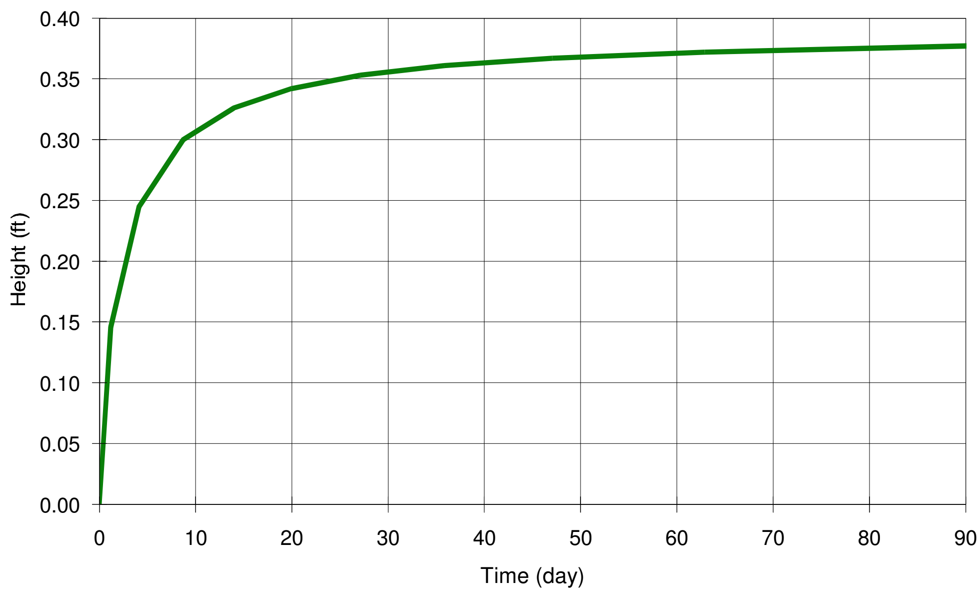
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 21.19 ft/day
Initial saturated thickness: 15.1 ft
Length of application area: 72 ft
Width of application area: 86 ft
Constant head boundary used at: 121 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 43 ft
positive Y: 0 ft
Total volume applied: 32266.51 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-300	0	-300	0.07
-252.3	0	-252	0.09
-204.6	0	-205	0.11
-156.9	0	-157	0.14
-119.4	0	-119	0.18
-90.3	0	-90	0.22
-66.5	0	-67	0.26
-46.5	0	-46	0.31
-29.1	0	-29	0.36
-17.4	0	-17	0.38
-9.4	0	-9	0.38
0	0	0	0.38
3.8	0	4	0.37
7	0	7	0.37
11.7	0	12	0.36
18.7	0	19	0.35
26.8	0	27	0.33
36.4	0	36	0.3
48.1	0	48	0.24
63.3	0	63	0.18
82.5	0	83	0.11
101.8	0	102	0.06
121	0	121	0

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS K1,2,3

ANALYST: Desheng Wang

DATE: 6/10/2018 TIME: 10:45:51 PM

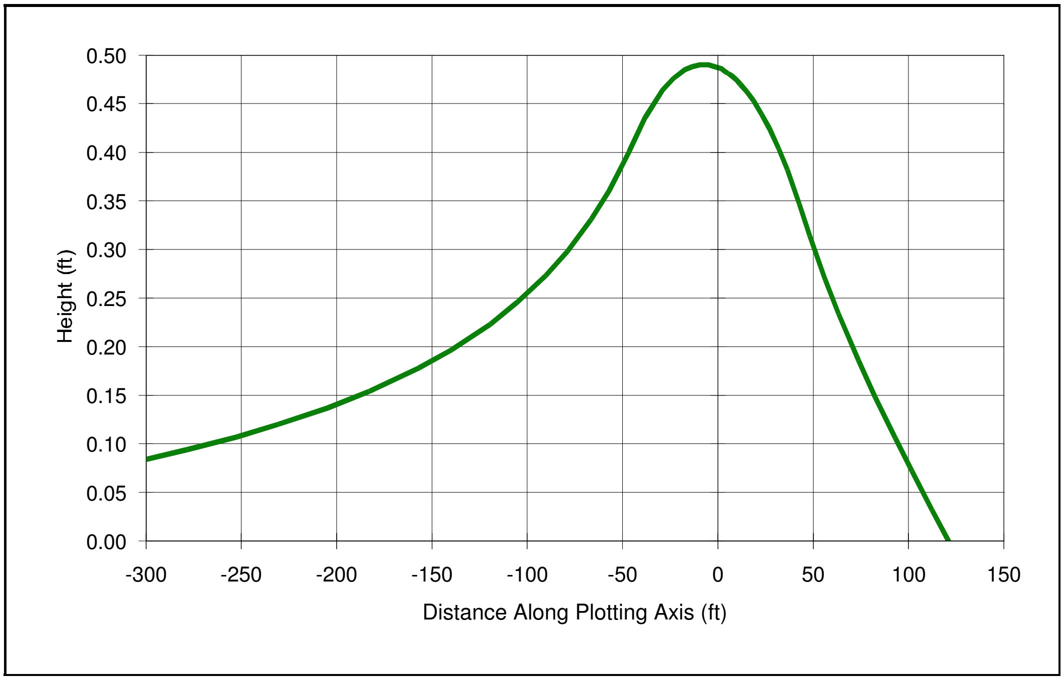
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 21.19 ft/day
Initial saturated thickness: 15.1 ft
Length of application area: 72 ft
Width of application area: 86 ft
Constant head boundary used at: 121 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 32266.51 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.15
4	0.24
9	0.3
14	0.33
20	0.34
27	0.35
36	0.36
47	0.37
63	0.37
90	0.38

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS, K1,3

ANALYST: Desheng Wang

DATE: 6/10/2018 TIME: 10:57:34 PM

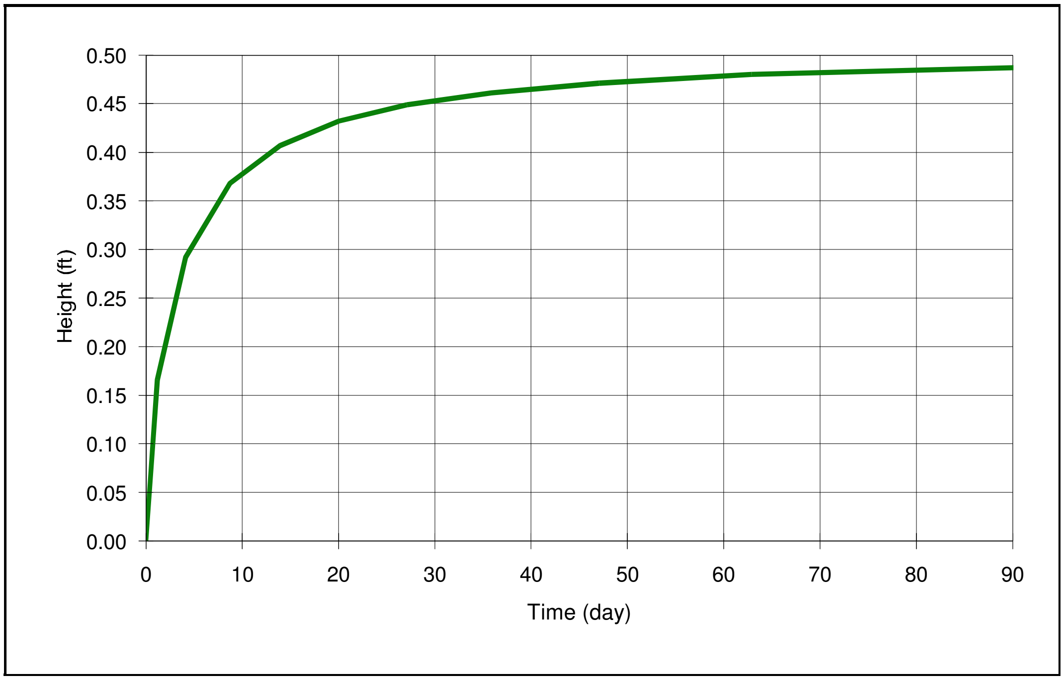
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 16.24 ft/day
Initial saturated thickness: 15.1 ft
Length of application area: 72 ft
Width of application area: 86 ft
Constant head boundary used at: 121 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 43 ft
positive Y: 0 ft
Total volume applied: 32266.51 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-300	0	-300	0.08
-252.3	0	-252	0.11
-204.6	0	-205	0.14
-156.9	0	-157	0.18
-119.4	0	-119	0.22
-90.3	0	-90	0.27
-66.5	0	-67	0.33
-46.5	0	-46	0.4
-29.1	0	-29	0.46
-17.4	0	-17	0.48
-9.4	0	-9	0.49
0	0	0	0.49
3.8	0	4	0.48
7	0	7	0.48
11.7	0	12	0.47
18.7	0	19	0.45
26.8	0	27	0.42
36.4	0	36	0.38
48.1	0	48	0.31
63.3	0	63	0.23
82.5	0	83	0.15
101.8	0	102	0.07
121	0	121	0

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS, K1,3

ANALYST: Desheng Wang

DATE: 6/10/2018 TIME: 10:58:34 PM

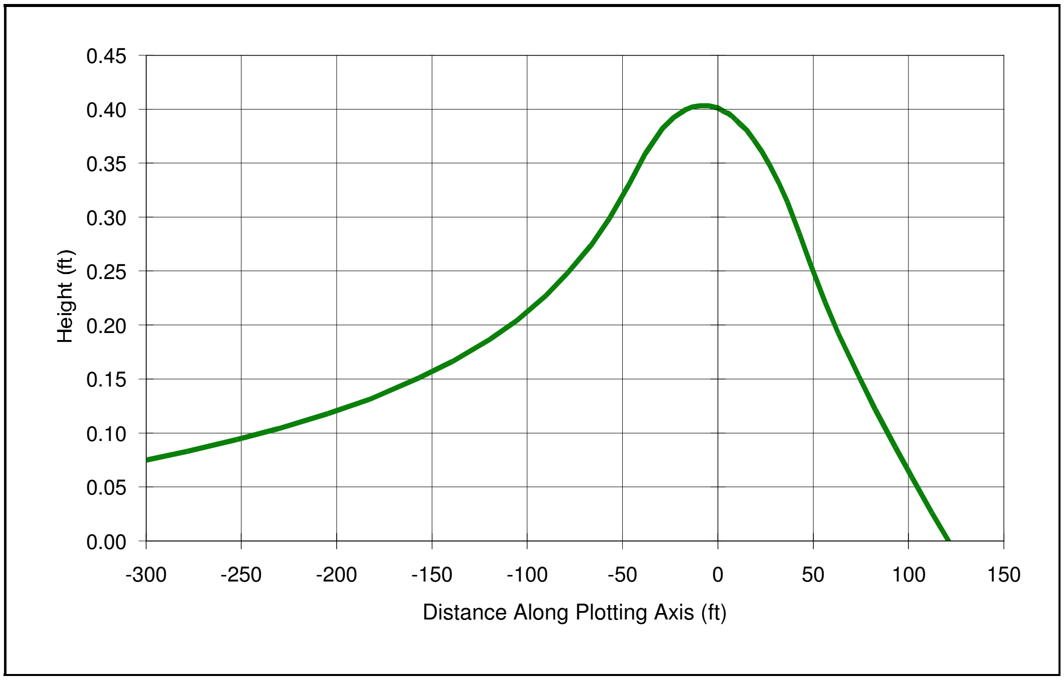
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 16.24 ft/day
Initial saturated thickness: 15.1 ft
Length of application area: 72 ft
Width of application area: 86 ft
Constant head boundary used at: 121 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 32266.51 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.17
4	0.29
9	0.37
14	0.41
20	0.43
27	0.45
36	0.46
47	0.47
63	0.48
90	0.49

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS K1,2,3 WT1,2

ANALYST: Desheng Wang

DATE: 6/10/2018 TIME: 11:26:08 PM

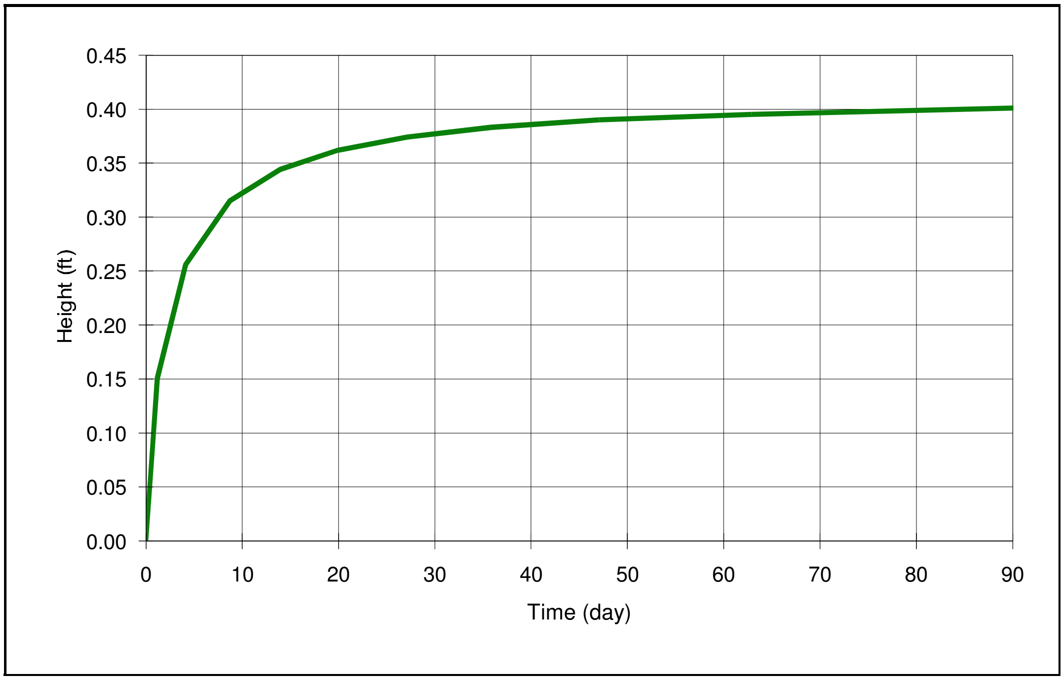
INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 days
Fillable porosity: 0.26
Hydraulic conductivity: 21.19 ft/day
Initial saturated thickness: 14.17 ft
Length of application area: 72 ft
Width of application area: 86 ft
Constant head boundary used at: 121 ft
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 43 ft
positive Y: 0 ft
Total volume applied: 32266.51 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-300	0	-300	0.08
-252.3	0	-252	0.09
-204.6	0	-205	0.12
-156.9	0	-157	0.15
-119.4	0	-119	0.19
-90.3	0	-90	0.23
-66.5	0	-67	0.27
-46.5	0	-46	0.33
-29.1	0	-29	0.38
-17.4	0	-17	0.4
-9.4	0	-9	0.4
0	0	0	0.4
3.8	0	4	0.4
7	0	7	0.39
11.7	0	12	0.39
18.7	0	19	0.37
26.8	0	27	0.35
36.4	0	36	0.31
48.1	0	48	0.26
63.3	0	63	0.19
82.5	0	83	0.12
101.8	0	102	0.06
121	0	121	0

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



COMPANY: CLAWE

PROJECT: 24 School Street - SAS K1,2,3 WT1,2

ANALYST: Desheng Wang

DATE: 6/10/2018 TIME: 11:26:37 PM

INPUT PARAMETERS

Application rate: 0.0579 c.ft/day/sq. ft
Duration of application: 90 day
Total simulation time: 90 day
Fillable porosity: 0.26
Hydraulic conductivity: 21.19 ft/day
Initial saturated thickness: 14.17 ft
Length of application area: 72 ft
Width of application area: 86 ft
Constant head boundary used at: 121 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 32266.51 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
1	0.15
4	0.26
9	0.32
14	0.34
20	0.36
27	0.37
36	0.38
47	0.39
63	0.4
90	0.4