

APPENDIX G

Groundwater Mounding Calculations

Groundwater Mounding Analysis Summary

LANGAN

Project Name: Belmont Hill School
 Project Number: 151021201
 Location: Belmont, MA
 Date: 3/13/2023
 Computed By: MPG
 Checked by: HH

	BASIN DRAIN TIME CALCULATIONS						GROUNDWATER MOUNDING							
SW BMP Location & Description	Storage Volume ¹	Bottom Surface Area	Infiltration Rate	Reference Test	Drain Time ²	< 72 hrs	BMP 1/2 Length	BMP 1/2 Width	Max GW Mounding	Groundwater Elevation ³	Reference Boring	BMP Bottom Elevation	Top Elev. of Mounding	BMP Bottom Elevation Higher than Top Elevation of Mounding?
	(cf)	(sf)	(in/hr)		(hrs)		(ft)	(ft)	(ft)	(ft)		(ft)	(ft)	
East Campus Parking Lot Porous Pavement A1	4,704	11,290	0.59	IT-7	8.5	YES	110	25.5	2.79	264.50	TP-7	268.17	267.29	YES
East Campus Parking Lot Porous Pavement B1	17,206	37,140	0.39	IT-8	14.2	YES	170	54.5	3.08	259.00	TP-1	263.42	262.08	YES
East Campus Parking Lot Porous Pavement B1 (Higher Infiltration Rate)	17,206	37,140	1.37	IT-8	4.1	YES	170	54.5	3.12	259.00	TP-1	263.42	262.12	YES
East Campus Maintenance Lot Chambers B3	5,663	1,989	0.80	IT-3	42.7	YES	36	13.8	11.49	245.00	LB-02	258.00	256.49	YES
East Campus Maintenance Lot Chambers B3 (Higher Infiltration Rate)	5,663	1,989	1.28	IT-3	26.7	YES	36	13.8	11.49	245.00	LB-02	258.00	256.49	YES
Permeable Pavement B4	1,873	6,600	0.80	IT-3	4.3	YES	127	13	1.89	245.00	LB-02	260.67	246.89	YES
Main Campus Jordan Parking Lot Permeable Pavement E3	5,706	13,000	0.18	IT-207	29.3	YES	170	19	2.92	242.50	TP-201	252.33	245.42	YES

Notes:

1. Storage Volume based on discarded exfiltration volume for 10-year, 24-hour storm.
2. Drain Time = Storage Volume/(Bottom Surface Infiltration Area x Design Permeability Rate).
3. Observed groundwater elevation or elevation of deepest excavation if no groundwater was encountered and there was no other indication of seasonal high water elevation observed.
4. BMP Bottom Elevation is the bottom elevation of stone reservoir or base. For sloping BMPs the lowest elevation was used.

Groundwater Mounding Analysis - A1

Project name: Belmont Hill School

Project Number:

Date: 3/13/2023

Computed By: MG

Checked By: HH

Input Values

0.59	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
0.59	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
110.000	x	1/2 length of basin (x direction, in feet)
25.500	y	1/2 width of basin (y direction, in feet)
8.50	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

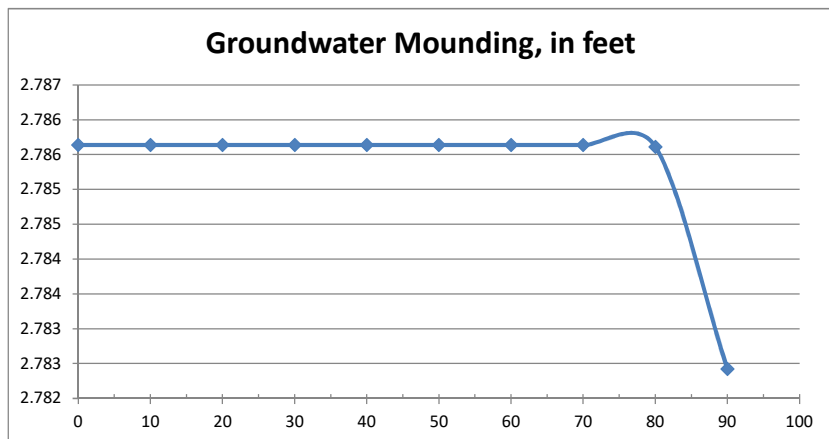
12.786	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
2.786	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

2.786	0
2.786	10
2.786	20
2.786	30
2.786	40
2.786	50
2.786	60
2.786	70
2.786	80
2.782	90



Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Groundwater Mounding Analysis - B1

Project name: Belmont Hill School

Project Number:

Date: 3/13/2023

Computed By: MG

Checked By: HH

Input Values

0.39	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
0.39	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
54.500	x	1/2 length of basin (x direction, in feet)
170.000	y	1/2 width of basin (y direction, in feet)
14.20	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

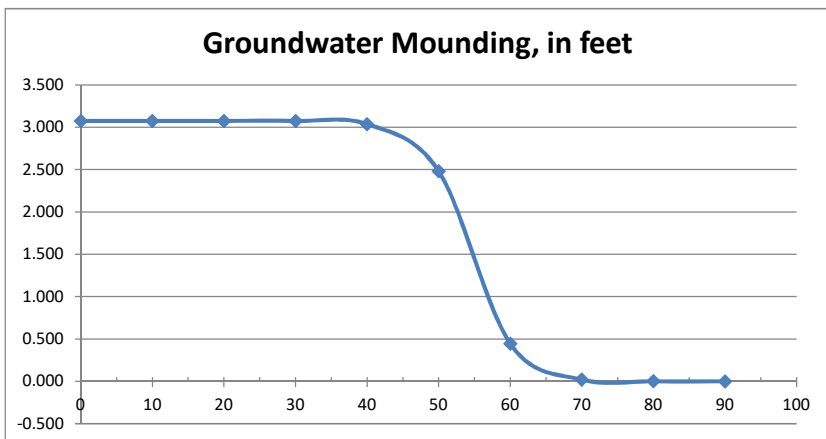
13.077	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
3.077	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

3.077	0
3.077	10
3.077	20
3.076	30
3.038	40
2.480	50
0.443	60
0.020	70
0.001	80
0.001	90



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Groundwater Mounding Analysis - B1 (with higher infiltration rate)

Project name: Belmont Hill School

Project Number:

Date: 3/13/2023

Computed By: MG

Checked By: HH

Input Values

1.37	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
1.37	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
54.500	x	1/2 length of basin (x direction, in feet)
170.000	y	1/2 width of basin (y direction, in feet)
4.10	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

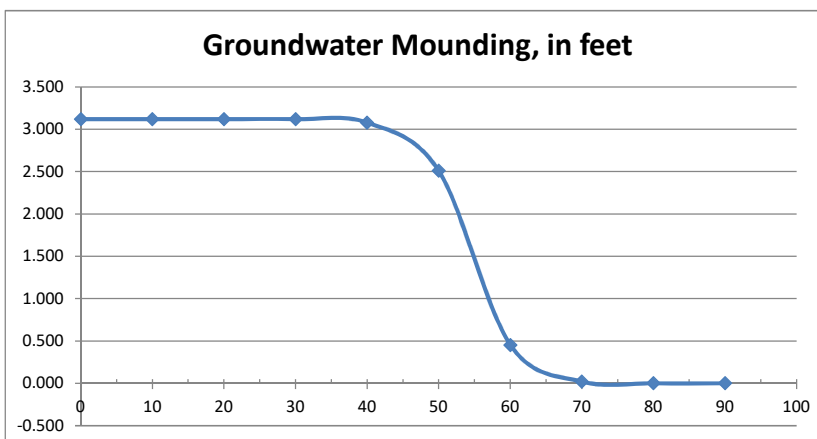
13.121	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
3.121	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

3.121	0
3.121	10
3.121	20
3.120	30
3.079	40
2.511	50
0.454	60
0.021	70
0.001	80
0.001	90



Re-Calculate Now



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Groundwater Mounding Analysis - B3

Project name: Belmont Hill School

Project Number:

Date: 3/2/2023

Computed By: MG

Checked By: HH

Input Values

0.80	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
0.80	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
36.000	x	1/2 length of basin (x direction, in feet)
13.800	y	1/2 width of basin (y direction, in feet)
42.70	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

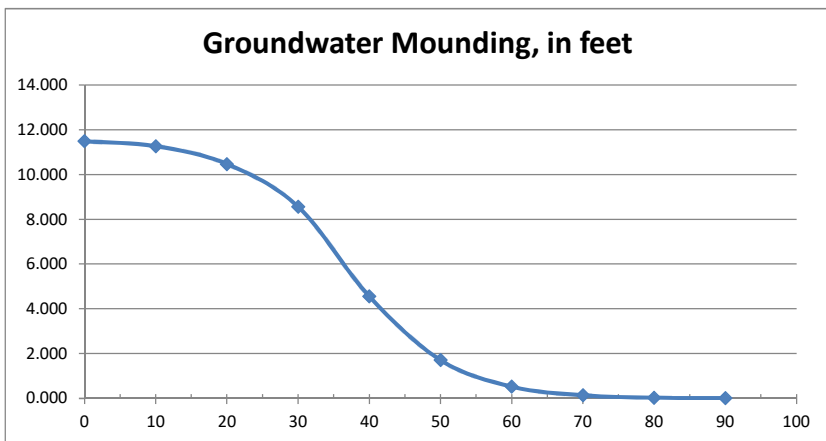
21.486	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
11.486	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

11.486	0
11.267	10
10.471	20
8.562	30
4.555	40
1.712	50
0.527	60
0.139	70
0.035	80
0.011	90



Re-Calculate Now



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Groundwater Mounding Analysis - B3 (with higher infiltration rate)

Project name: Belmont Hill School

Project Number:

Date: 3/2/2023

Computed By: MG

Checked By: HH

Input Values

1.28	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
1.28	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
36.000	x	1/2 length of basin (x direction, in feet)
13.800	y	1/2 width of basin (y direction, in feet)
26.70	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

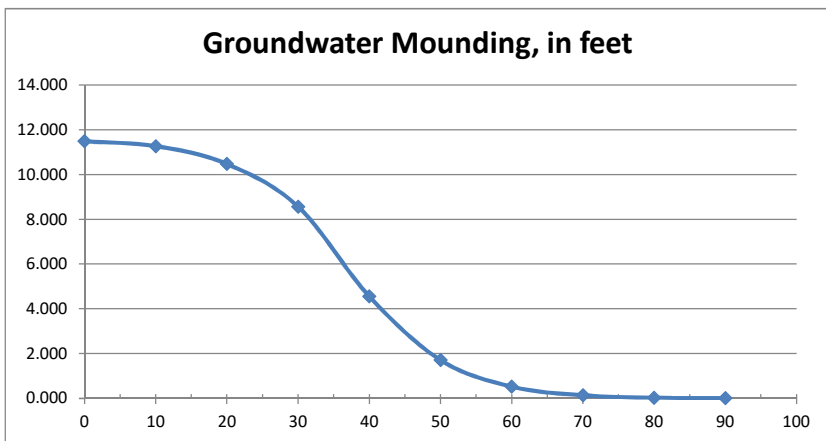
21.489	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
11.489	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

11.489	0
11.270	10
10.473	20
8.564	30
4.556	40
1.713	50
0.528	60
0.140	70
0.035	80
0.011	90



Re-Calculate Now



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Groundwater Mounding Analysis - B4

Project name: Belmont Hill School

Project Number:

Date: 3/13/2023

Computed By: MG

Checked By: HH

Input Values

0.80	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
0.80	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
127.000	x	1/2 length of basin (x direction, in feet)
13.000	y	1/2 width of basin (y direction, in feet)
4.30	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

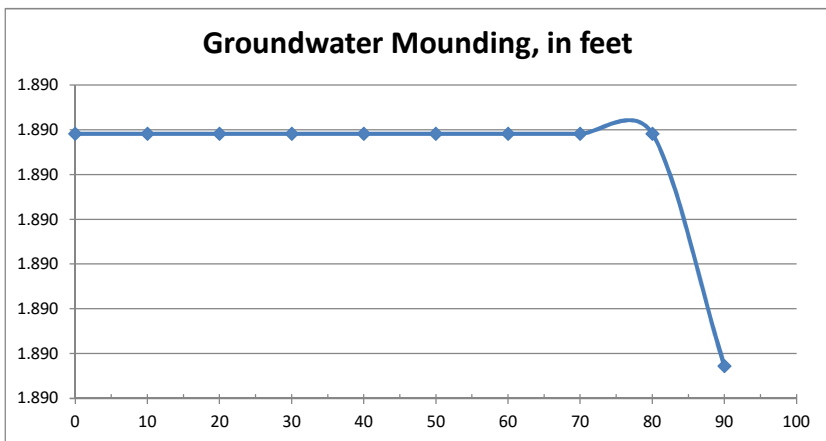
11.890	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.890	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

1.890	0
1.890	10
1.890	20
1.890	30
1.890	40
1.890	50
1.890	60
1.890	70
1.890	80
1.890	90



Re-Calculate Now



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Groundwater Mounding Analysis - E3

Project name: Belmont Hill School

Project Number:

Date: 3/13/2023

Computed By: MG

Checked By: HH

Input Values

0.18	R	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
0.18	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
19.000	x	1/2 length of basin (x direction, in feet)
170.000	y	1/2 width of basin (y direction, in feet)
29.30	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

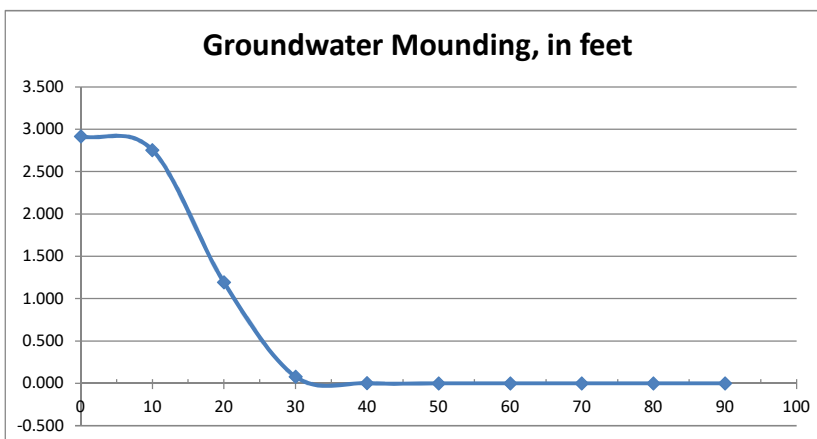
12.917	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
2.917	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
Ground-water center of basin in x
Mounding, in feet direction, in feet

2.917	0
2.754	10
1.192	20
0.080	30
0.002	40
0.001	50
0.001	60
0.001	70
0.001	80
0.001	90



Re-Calculate Now



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