ALLEN & MAJOR ASSOCIATES, INC.

Project No.	1362-25	**Sheet**	1 of 1
Project Description	6 Forge Parkway		
	Franklin, MA		
Calculated By	MM	**Date**	07/22/24
Checked By	MAM	**Date**	

The Frimpter Method analysis is typically utilized if test pits were not performed during the months where high groundwater is anticipated (March-April) and an adjustment to observed groundwater outside this period is required.

The Frimpter Method was performed for GEO-TP-102 in accordance with the calculations outlined within "The Probable High Ground-Water Levels in Massachusetts", written by Michael H. Frimpter and the information provided Massachusetts Department of Environmental Protection to demonstrate:

The index well selected for correlation was USGS well No. 421438071165601 - Dover, MA. The index well is near the Site and is in a similar landform as GEO-TP-102. Given the location of GEO-TP-102 within the middle of the site and the location along a plateau, a terrace landform has been used for this calculation. Figure 12 from the Frimpter Report identifies that Sites in Massachusetts with sand and gravel on terraces approximately 5% of Sites containing sand and gravel on terraces have water level ranges that exceed 10.0-feet (SR=10.0). (Figure 12 from the Frimpter Report is attached).

The Frimpter Method utilizes the following equation and variables to determine the probable highwater level at the Site (SH):

$$S_H = S_C - (S_R / OW_R) \times (OW_C - OW_{MAX})$$

Where:

S_H = Probable high water level at the Site

S_C = Measured depth to water at the Site

S_C = 132 inches 11 feet GEO-TP-102

S_R = Range of water level where the Site is located.

S_R = 10

OW_R = Recorded upper limit of annual range of water level at the observation well which is used to correlate with water levels at the Site.

OW_R = 5.65 (USGS well No. 421438071165601 - Dover, MA)

OW_C = Measured depth to water in the observation well which is used to correlate with water levels at the Site.

OW_C = 31.71 (USGS well No. 421438071165601 - Dover, MA on 05/28/2024)

OW_{MAX} = Depth to recorded maximum water level at the observation well which is used to correlate with the water levels at the Site.

OW_{MAX} = 28.92 (USGS well No. 421438071165601 - Dover, MA)

To estimate the depth of probable high-water level within GEO-TP-102, the SR value from Figure 12, "Probability of water level range in sand and gravel on terraces" was utilized, yielding a SR value of 10

$$S_H = S_C - (S_R / OW_R) \times (OW_C - OW_{MAX})$$

11 - (10.0 / 5.7) x (31.7 - 28.9) = 6.1 Feet

Based upon evalucation of the adjusted probable high water elevation, it appears to be inconsistant with the Redox features found in similar test pits within the footprint of the proposed stormwater system. Based on this evaluation, the summary below averages the ESHWT elevation of data where redox was observed and those which are adjusted utilizing the Frimpter method.

ESHWT @ GEO-TP-102 (adjusted):	275 ft	-	6.1 ft	=	268.9 ft	(Frimpter method adjustment)
ESHWT @ GEO-TP-103	269 ft	-	10.5 ft	=	258.5 ft	(Redox)
ESHWT @ GEO-TP-5	272 ft	-	9.0 ft	=	263.0 ft	(Redox)

Average ESHWT = 263.5 ft

generally less than the difference between OW_{max} and the lowest groundwater elevation value on record because the most extreme values are deleted from the tabulation. Values for OW_{max} and OW_r can be obtained from the USGS website. If the observation well was installed many years ago, the OW_{max} and OW_r values will not change much from one year to another. If the well installation was more recent it is imperative that the values of these parameters are obtained from the most current data on the USGS website.

The value of OW_c reflects the groundwater elevation in the observation well during the same month that the groundwater level at the proposed groundwater discharge site is determined. Select the appropriate month from the USGS website. Values for OW_c are the monthly well readings that are available in the monthly data table.

SANDS AND GRAVELS ON TERRACES

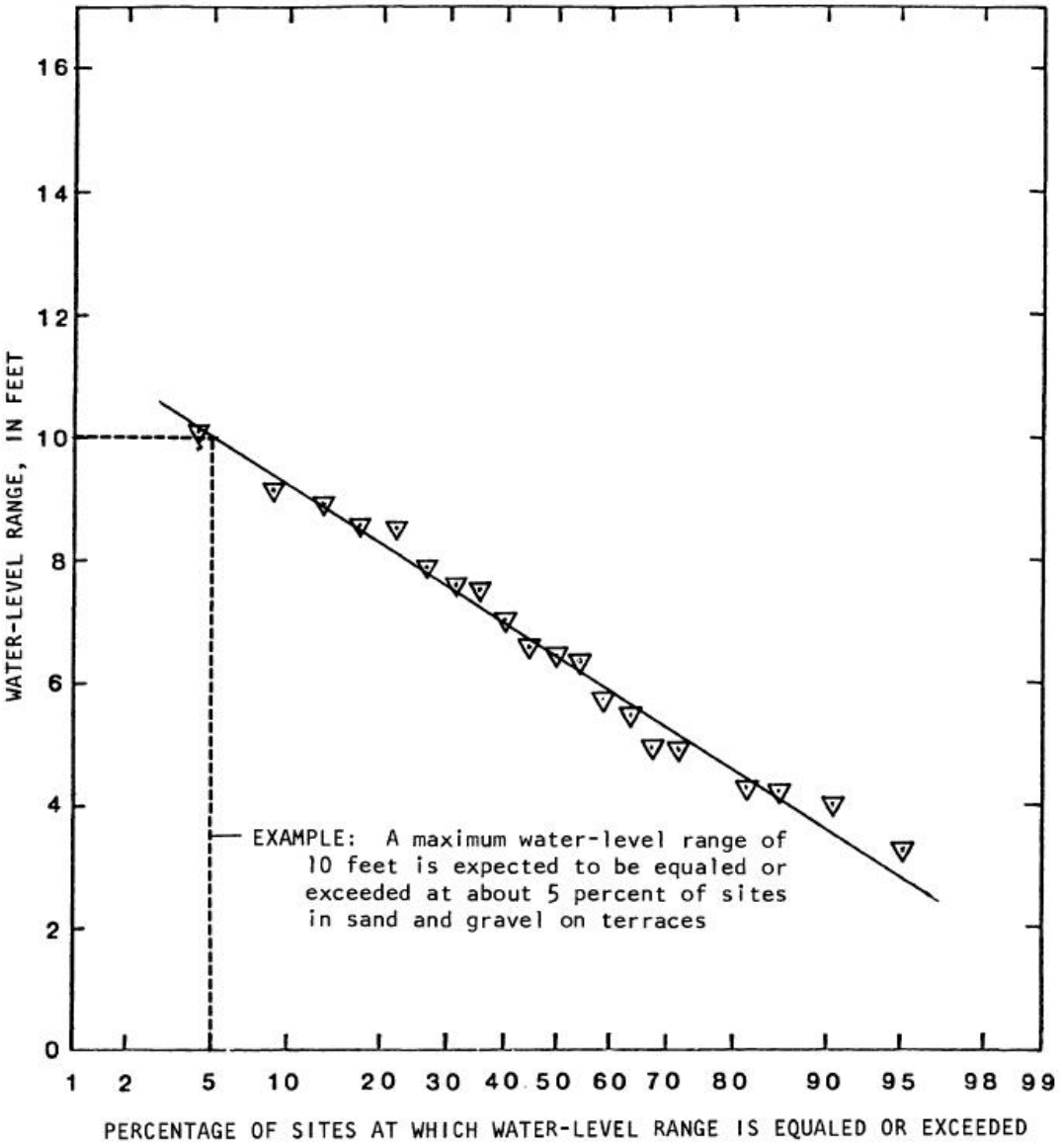

Figure 10-2. Probability of water-level range in sands and gravels on terraces (source: Frimpter, 1981)

Deep Observation Hole

GeoEngineers USA

Site Location: Franklin, MA
Site Address: 6 Forge Parkway
Project No.: 27167-001-00

Date: 5/28/24
Time: 8:15 AM
Weather: 70s, Overcast

Boring ID: GEO-TP-102
Ground Surface Elev. (ft.): 275 +/-

Logged by: S. Ring
Massachusetts Licensed Soil Evaluator #: SE14818

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth (in)	Color	Percent		Gravel	Cobbles			
0 - 20	Ap	10YR3/3	_____	_____	_____	Sandy loam	10-15	10-15	Massive	Friable	Frequent Roots
20 - 36	Bw	10YR4/6	_____	_____	_____	Sandy loam	5-10	<5	Massive	Friable	Frequent Roots
36 - 132	C	2.5Y6/3	_____	_____	_____	Loamy sand	5-10	<5	Massive	Friable	

Test Pit Termination Depth (in.): 132 **Reason for Termination:** Excavator Reach

Groundwater Observations:

Depth to water weeping from pit face (in.):	132		
Depth to standing water in hole (in.):	132	Stabilization Time:	15 Minutes
Depth to estimated seasonal high groundwater [ESHGW] (in.):	132	Basis for ESHGW:	Weeping

In-Situ Testing:

Percolation Test:	NT	Depth (in.):	NA
Permeameter Test:	NT	Depth (in.):	NA
Falling Head Test:	NT	Depth (in.):	NA
Other Test:	NT	Depth (in.):	NA

Additional Notes:
Groundsurface elevations reference the North American Vertical Datum of 1988 (NAVD88) and are approximate.
NT = not tested
NA = not applicable

Table with values for the Frimpter method

Copy Excel

MA-DVW 10R DOVER, MA Se

Statistics for use in estimation of high groundwater levels, [Values in feet below land surface datum, OwMax, highest measured groundwater level; OWr, maximum annual range. *, site on Cape

Site_Number	Station Name	Setting	Aquifer Type	Start date	Start Date (daily data)	Lowest water level	OwMax	OWr	Link to Data
421438071165601	MA-DVW 10R DOVER, MA	Terrace	Stratified Drift	1964-11-01	2021-02-25	36.77	28.92	5.65	https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=421438071165601