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FEBRUARY 28, 2024

Town of Arlington Conservation Commission
c/o Mr. Ryan Clapp, Conservation Administrator
Robbins Memorial Town Hall
730 Massachusetts Avenue
Arlington, Massachusetts 02476

RE: Response to Additional Peer Review Comments and Questions from the Commission
Thorndike Place Stormwater Peer Review

Dear Members of the Arlington Conservation Commission,

On behalf of the Applicant, Arlington Land Realty, LLC, BSC Group, Inc. (BSC) is pleased to submit this response to peer review comments provided by Hatch Associates Consultants, Inc. (Hatch) and questions from the Commission relative to the Thorndike Place residential development (the Project) to be located off of Dorothy Road in the Town of Arlington. We have previously provided responses to Hatch's peer reviews in letters dated January 24, 2024, and February 13, 2024. This letter will provide responses to the items included in Hatch's *Executive Summary to the Conservation Commission* in their most recent memorandum dated 2024-02-14. In addition, we are providing responses to questions from the Commission included in an email from Mr. Ryan Clapp, Conservation Administrator dated February 16, 2024, and an email from Mr. Ross Mullen, PE, CFM of Hatch dated February 22, 2024. For each item, we have restated the original comment in standard text and provided our response in *italics*. We have divided the response into sections for Hatch's memo and the emails from Mr. Clapp and Mr. Mullen.

Hatch's Executive Summary to the Conservation Commission

After review of the proposed Thorndike Place stormwater site design relative to the Massachusetts Stormwater Handbook, Hatch has determined the project is in compliance with the following conditions:

1. Permanent establishment of vegetation on the south side of the senior living complex prior to runoff from the roof discharging to the wetland and verification of non-erosive velocities from this discharge.

   As stated during the February 15, 2024, public hearing on the project, the outlet protection for this pipe will be constructed prior to any discharge. In addition, we are proposing a temporary settling basin at the outlet of this roof drain to be maintained until permanent vegetation is established in the emergency access way. This basin will be 6-inches deep and approximately 3,000 sft. for a volume of approximately 1,500 cft. The temporary settling basin will reduce the velocity of this discharge even further prior to it overflowing towards the wetlands. It should be noted that the roof drain in question is approximately 150-feet from the nearest wetland over relatively flat terrain (approximately 1.3% slope). In addition to the reduction in velocity from the outlet protection, this discharge is not expected to result in erosive velocities. In our previous response to Hatch's review dated February 13, 2024, we provided calculations demonstrating that the discharge from this pipe outlet protection during the 100-year storm event will have a velocity of 1.71 fps, which is a non-erosive velocity.

2. Applicant verifies that at least ten feet of separation is provided between the R-Tank^{XD} features and the townhome basement foundations.

The R-Tank^{XD} systems are Subsurface Structures as detailed in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook. Subsurface Structures do not have a minimum setback from foundations (please refer to Volume 2, Chapter 2 section on Subsurface Structures). These systems are less than 10-feet at their closest to the townhome foundations. As previously stated in public hearings and previous responses to reviews, the basements will be adequately waterproofed to ensure that groundwater and/or infiltration from these systems does not impact the basements.

3. Review and, if necessary, resubmission of groundwater mounding analysis of the Stormtrap ST1 infiltration feature to demonstrate compliance. Provide a defensible basis for the selected horizontal conductivity and duration of infiltration period. Verify adequate separation is provided between the senior living complex and the mounded groundwater table.

   The groundwater mounding analysis of the Stormtrap ST1 infiltration has been reviewed and confirmed as appropriate. The horizontal hydraulic conductivity selected is a typical value for silty materials converted from 3.65x10^{-6} meters per second to feet per day. The duration of infiltration was determined using the time necessary for the required recharge volume to infiltrate in the HydroCAD model of the system. First, the portion of the required recharge volume that is routed to this system was determined (51,555 sft impervious surface resulting in 0.025 acre-feet required recharge volume). Then, a storm event was determined that resulted in this volume being infiltrated through the StormTrap system. Infiltration through the system is routed to the "discarded" outlet. As included in the Stormwater Report, infiltration ("discarded") in this storm event begins at 12.13 hours and ends at 13.35 hours. As this is the only time that stormwater is infiltrating through the system, this duration (1.22 hours) is used in the groundwater mounding analysis. This is the same methodology previously peer reviewed and accepted on behalf of the Town by BETA Group, Inc. during the Comprehensive Permit process. It must be noted that the Stormwater Handbook does not specify or require that mounding analyses be performed for a 24-hour period or that mounding analyses be performed for each design storm. In Volume 3, Chapter 1, the Stormwater Handbook states, "Mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four (4) feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm (e.g., 10-year, 25-year, 50-year, or 100-year 24-hour storm). In such cases, the mounding analysis must demonstrate that the Required Recharge Volume (e.g., infiltration basin storage) is fully dewatered within 72 hours (so the next storm can be stored for exfiltration). The mounding analysis must also show that the groundwater mound that forms under the recharge system will not break out above the land or water surface of a wetland (e.g., it doesn't increase the water sheet elevation in a Bordering Vegetated Wetland, Salt Marsh, or Land Under Water within the 72-hour evaluation period)." We have demonstrated through our calculations that the infiltration system will dewater within 72-hours (see drawdown calculations in the Stormwater Report) and that the groundwater mound will not break out above the land or water surface of a wetland, thus demonstrating compliance with the requirements of Standard 3.

4. If the applicant uses asphalt shingles on the townhomes, to manage loose grit from the shingles:
   a. The roof drains shall remain disconnected from the Stormtrap ST1 infiltration system until after construction is substantially complete and connected prior to occupancy or
   b. The R-Tank^{XD} systems shall be inspected, and loose grit removed prior to occupancy.

   As stated in our January 24, 2024, response and again during the public hearings, we have no objection to this requirement and request that it be included as a project specific condition by the Conservation Commission.

Separately from the Massachusetts Stormwater Handbook, our peer review also included review of the project with respect to the floodplain rules within the Code of Federal Regulations (CFR) and stormwater engineering best practices. These comments are provided to inform the Conservation Commission of the concerns Hatch has with respect to the CFR and stormwater engineering best practices:

- The window of uncertainty based on the determined groundwater elevations is only 0.02-feet for the proposed design to meet the Massachusetts Stormwater Handbook Standards 3 and 4. Infiltration within fill soils and proximal to a wetland is atypical for stormwater site design because these soils are typically saturated and not conducive to infiltration.

  The required 2-feet of separation to groundwater is being provided. As previously stated on numerous occasions, test pits were performed in May 2023 following coordination with the Town of Arlington and observation and review by the Town's peer reviewer, Whitestone Associates. All groundwater elevations determined by BSC were validated by Whitestone. Observed elevations are shown in in the table below. Actual peer reviewed groundwater elevations under the large infiltration system serving the multifamily apartments were observed at 2.50 and -0.24. Actual peer reviewed groundwater elevations at locations of five small infiltration systems varied from 0.71 to 3.98. Out of an abundance of conservatism, we chose to design ALL infiltration systems as if groundwater had been observed at the highest elevation that was observed in just one test pit (TP-5) at the location of one small infiltration system. Thus, while BSC could have designed the StormTrap infiltration system based on the elevations determined by the two test pits within the area of that infiltration system, BSC instead utilized the most conservative elevation sitewide. Therefore, while Hatch's concern is noted, we stand by our statements that the systems have been designed in a conservative manner to comply with the Stormwater Standards. In addition, infiltration proximal to a wetland is not only typical, but is required by the Stormwater Standards of the Wetlands Protection Act and that the infiltration systems are all over 100-feet from the nearest wetland.

Test Pit	Existing Grade	Total Depth (in.)	Depth Fill (in.)	Depth Observed GW (in.)	Depth to Redox (in.)	ESHGW
TP-1	10.66	120	90	108	n/a	1.66
TP-2	8.79	104	83	97	n/a	0.71
TP-3	7.88	87	27	82	51	3.63
TP-4	7.08	96	64	68	n/a	1.41
TP-5	7.98	74	33	60	48	3.98
TP-6	6.87	132	30	110	64	1.54
TP-7	8.92	114	108	110	n/a	-0.24
TP-8	11.83	120	120	112	n/a	2.50

- The project should be sequenced so as to comply with the Code of Federal Regulations §60.3 and applicable FEMA floodplain regulations, including, if necessary, completion of a LOMR-F and/or seepage analysis to determine the structure is reasonable safe from flooding. As a member community of the National Flood Insurance Program (NFIP), the Town of Arlington is required to follow the regulatory standards of the NFIP.

  As previously stated, the project will comply with all applicable FEMA regulations and requirements.

- As an industry best practice, dry and/or wet flood proofing of the townhome basements should be secondary to good stormwater and drainage design that limits opportunities for surface and groundwater intrusion into structures. Hatch remains very concerned about both the lateral proximity and vertical offset of the infiltration basins to the townhomes and potential for groundwater intrusion into these structures from both the Stormtrap ST1 and R-TankXD features. The Town of Arlington Zoning Bylaws §5.8.6.A(2), which were subject to comment during the Comprehensive Permit, are based on similar flood prevention principles and require four feet of separation between the seasonal high groundwater elevation and the low floor.

As previously stated, all work proposed on this project is typical of projects throughout Massachusetts and Arlington. The review of the stormwater system before the Commission is to confirm compliance with the stormwater standards under the WPA. Further, it is not uncommon or undesirable industry practice to provide both appropriately designed underground infiltration systems together with waterproofing of structures as proposed by this project. Please refer to the memorandum prepared by McPhail Associates and submitted separately for additional information pertaining to groundwater impacts to the basements.

Ryan Clapp February 16, 2024, Email

1. Have applicant provide information on why less than a 24-hour storm was used for the duration of the mounding analysis.

   Please see our response to Hatch's Comment 3 above.

2. Have applicant perform monitoring on well(s) (existing or new) within the area proposed for the large infiltration unit(s) which is where existing test pits 7/8 are located. Monitoring to begin in March 2024, and Commission would like monitoring data for 2-3 months (reach out to Town Engineering Department to determine appropriate timeline) and have applicant compare data to data from USGS index wells per Stormwater Handbook. Ensure stormwater standards are met even during heavy rains (particularly Standard 8) - will need review from Hatch.

   As previously stated on numerous occasions, test pits were performed in May 2023 following coordination with the Town of Arlington and observation and review by the Town's peer reviewer, Whitestone Associates. All groundwater elevations determined by BSC were validated by Whitestone in accordance with standards promulgated by the Massachusetts Wetlands Protection Act and the DEP's Stormwater Handbook. Therefore, the Applicant does not agree to perform the additional monitoring requested as we stand by the information provided and that the groundwater data used for all design is conservative because it is the highest elevation found on site. The installed test pits were installed during the high groundwater season and in accordance with the specific conditioning of the Comprehensive Permit that was included at the direction of the Town's peer reviewers at BETA and with the input of this Commission. Further, the test pits were installed with the Town's selected representative at Whitestone overseeing the process. As previously stated, BSC stands behind its opinion that the stormwater system for the project has been designed employing a conservative approach and one that is appropriate for use on this site. Within the Commission's review of an abutting parcel, the designed stormwater system on such land has relied upon significantly lower groundwater elevations based upon observed groundwater only. To our knowledge, the Commission has not sought additional monitoring to verify the accuracy of such readings.

   On February 15, 2024, BSC performed groundwater measurements at the three wells installed on site. In each location, groundwater elevations were measured to be lower than observed in May 2023. Elevations from both May 2023 and February 15, 2024, are included in the table below.

Test Pit	Observed GW Elevation May 2023	Observed GW Elevation February 15, 2024
TP-1	1.66	1.28
TP-6	1.54	1.07
TP-7	-0.24	-0.20

3. Have applicant provide elevation of redox feature first observed at test pit 7.

   The redox features noted in Test Pit 7 were observed by Whitestone Associates, the Town's peer reviewer, approximately between elevations 4.4 and 5.6, but appropriately disregarded by Whitestone in determining the groundwater elevation in their June 28, 2023, review. As previously noted during the public hearing, as these redox features do not continue below elevation 4.4 through the bottom of the test pit (approximately

elevation -0.58), it is not indicative of a seasonal high groundwater table. This is noted in the Town's review engineer's (Whitestone) memorandum, which noted that the estimated seasonal high water table (ESHWT) depth to be 9.3 feet below grade, or an elevation of approximately -0.3, validating BSC's estimate of -0.5.

4. Have applicant respond to Hatch's February 14, 2024 letter, the June 28, 2023 Whitestone review, and to David Kaplan's question and Scott Horsley's response re: normalizing groundwater test well results to account for variation of precipitation and groundwater over several years.

   Please see our above responses to Hatch's February 14, 2024, letter. There are no comments in Whitestone's June 28, 2023, letter.

   The "normalizing groundwater test well results" referenced is commonly performed by a Frimpter analysis. In accordance with the DEP Stormwater Handbook (Volume 3, Chapter 1), "Depth to seasonal high groundwater may be identified based on redox features in the soil (see Fletcher and Venneman listed in References)." As stated above, BSC's design utilized the highest elevation of redox features found on the entire site as the groundwater elevation for all infiltration locations. However, in response to the Commission's request, a Frimpter analysis for all test pits in which redox features were not found is attached. The results show probable high water elevations below elevation 4 for each of these test pits. As such we affirm our previous estimate for seasonal high groundwater at elevation 4 remains an appropriate representation of the site.

Ross Mullen February 22, 2024, Email

In addition to the items below, Commissioner Kaplan asked Hatch to investigate if the project would continue to meet the regulatory TSS removal standards if the primary infiltration device (StormTrap) was assumed to be backwatered/filled up due to groundwater mounding.

If the primary infiltration device was filled up due to groundwater mounding, the applicant would most likely not meet Standard 4 as the runoff (inflow) to the chamber would discharge over the designed overflow, thereby bypassing the infiltration and treatment, with only minor settling of TSS in the filled infiltration device basin.

Please see our responses regarding groundwater mounding above. As the mounding analysis demonstrates that groundwater does not impede the system's ability to infiltrate in accordance with the Standard 3 requirements, the system maintains its TSS removal capabilities and compliance with Standard 4.

We believe that these responses fully respond to all open comments from the stormwater peer review. We look forward to discussing this project with you further at the upcoming public hearings on the project. Please feel free to contact me at (617) 896-4386 or drinaldi@bscgroup.com should you have any questions on the information in this report.

Sincerely,
BSC GROUP, INC.

Dominic Rinaldi, PE
Senior Associate

Attachments: Frimpter Analysis

USGS METHODOLOGY FOR ESTIMATING DEPTH TO SEASONAL HIGH WATER TABLE

BSC GROUP

Project No.	23407.02	**Calc By**	C.Thomas
Subject	Groundwater Adjustment (Frimpter)	**Date**	2/20/2024
Location	Thorndike Place, Arlington	**Checked by**	D.Rinaldi
		Date	2/27/24

$S_h = S_c - (S_r / OW_r) * (OW_c - OW_{max})$

S_h = estimated depth to probable high water level
S_c = measured depth to water at the site
S_r = range of water level where site is located (from Figure 10-4)
OW_r = recorded upper limit of annual range of water level at observation well, which is used to correlate with the water levels at the site (from USGS)
OW_c = measured depth to water in the observation well, which is used to correlate with the water levels at the site (from USGS)
OW_{max} = depth to recorded maximum water level at the observation well, which is used to correlate with the water levels at the site (from USGS)

TP-1 Index Well: MA-LTW 104, Lexington, MA

Owmax	-0.05 ft
Owr =	3.81 ft
Owc =	2 ft
Sr=	4.2 ft
Sc=	9 ft

		Sh (ft)	6.74015748
Ground elevation	10.66	Sh (in)	80.88188976

Probable high water elevation	(Ground elevation - Sh)
3.91984252	

TP-2 Index Well: MA-LTW 104, Lexington, MA

Owmax	-0.05 ft
Owr =	3.81 ft
Owc =	2 ft
Sr=	4.2 ft
Sc=	8.08 ft

		Sh (ft)	5.82015748
Ground elevation	8.79	Sh (in)	69.84188976

Probable high water elevation	(Ground elevation - Sh)
2.96984252	

TP-4 Index Well: MA-LTW 104, Lexington, MA

Owmax	-0.05 ft
Owr =	3.81 ft
Owc =	2 ft
Sr=	4.2 ft
Sc=	5.67 ft

		Sh (ft)	3.41015748
Ground elevation	7.08	Sh (in)	40.92188976

Probable high water elevation	(Ground elevation - Sh)
3.66984252	

TP-7 Index Well: MA-LTW 104, Lexington, MA

Owmax	-0.05 ft
Owr =	3.81 ft
Owc =	2 ft
Sr=	4.2 ft
Sc=	9.17 ft

		Sh (ft)	6.91015748
Ground elevation	8.92	Sh (in)	82.92188976

Probable high water elevation	(Ground elevation - Sh)
2.00984252	

TP-8 Index Well: MA-LTW 104, Lexington, MA

Owmax	-0.05 ft
Owr =	3.81 ft
Owc =	2.5 ft
Sr=	2 ft
Sc=	9.33 ft

		Sh (ft)	7.991417323
Ground elevation	11.83	Sh (in)	95.89700787

Probable high water elevation	(Ground elevation - Sh)
3.838582677	

SANDS AND GRAVELS IN VALLEY FLATS

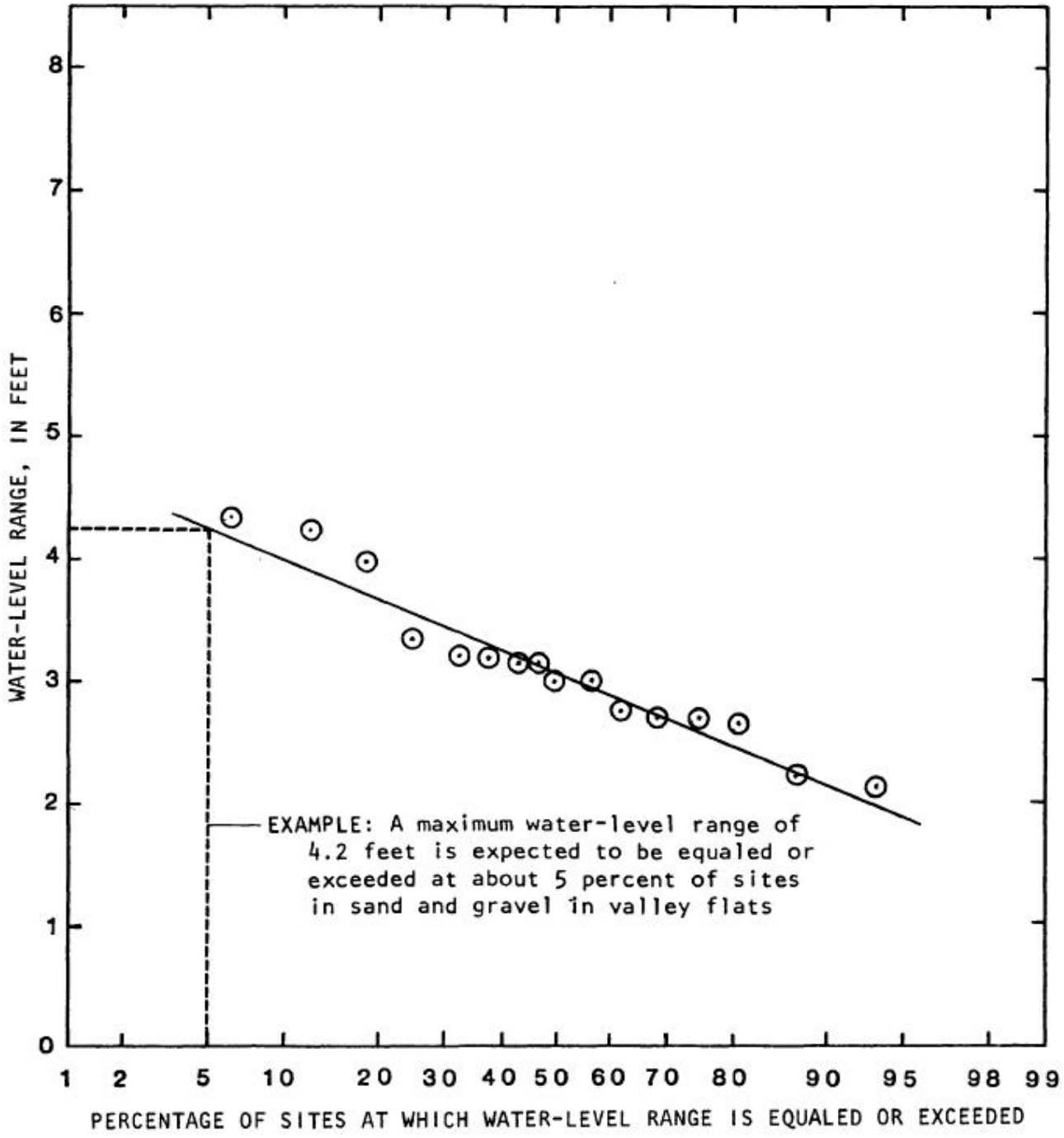

Figure 10-4. Probability of water-level range in sands and gravels in valley flats. (source: Frimpter, 1981)

(https://www.usgs.gov/)

About This Information

The Massachusetts Department of Environmental Protection is in the process of revising the procedures for the “Frimpter Method” for estimating high groundwater levels based on the recent report (https://doi.org/10.3133/sir20205036) “Updating Data Inputs, Assessing Trends, and Evaluating a Method To Estimate Probable High Groundwater Levels in Selected Areas of Massachusetts.” On Cape Cod, the Cape Cod Commission uses a slightly different method (https://www.capecodcommission.org/our-work/estimating-high-groundwater-levels/) to estimate high groundwater levels.

During the transition to the new method, the statistics for the current methodology for estimating high groundwater levels have been updated until the new methodology is approved and released. The map and table on this web page provide information on wells in the Massachusetts Observation-Well Network which have been used as index wells in the calculation of high groundwater levels. Values of highest groundwater level (OWmax), lowest groundwater level, and maximum annual range (OWr) are based on monthly and daily measurements from the beginning of the record through **September 30, 2022**. The values of OWmax and OWr are used in conjunction with Probable High Ground-Water Levels in Massachusetts, USGS Open-File Report, 80-1205 (https://doi.org/10.3133/ofr801205) to estimate probable high groundwater levels at sites in Massachusetts.

Map

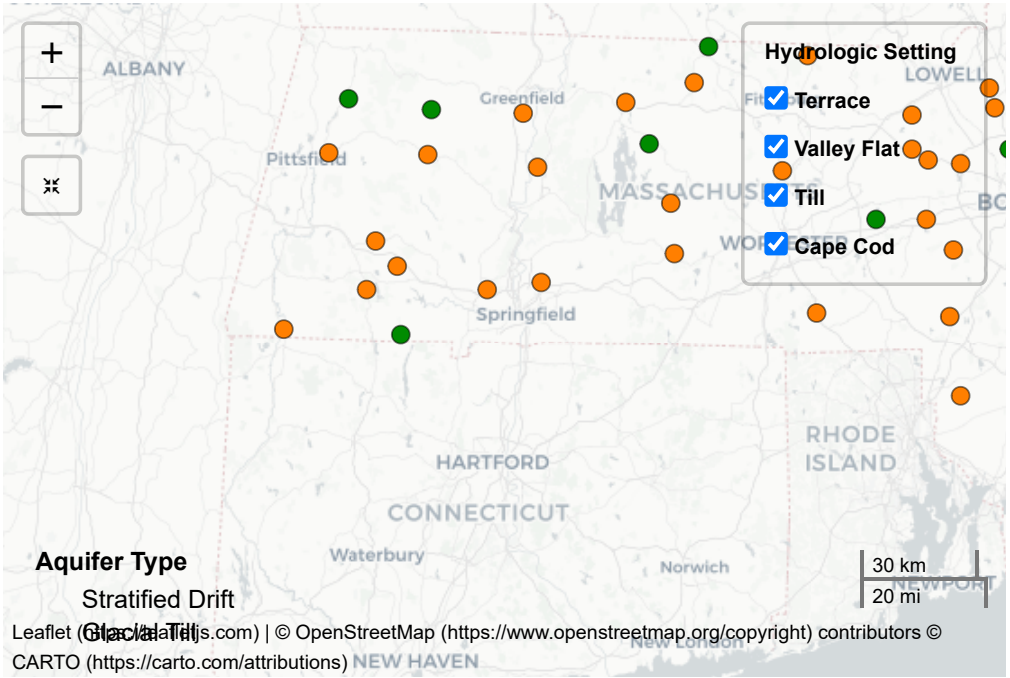

Table with values for the Frimpter method

Copy Excel

Search:

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

Site_Number	Station Name	Setting	Aquifer Type	Start date	Start Date (daily data)		Lowest water level	OwMax	OWr
422627071154002	MA-LTW 104 LEXINGTON, MA	Valley Flat	Stratified Drift	1964-12-01	2023-04-07	4.35	-0.05	3.81	https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=422627071154002 (https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=422627071154002)

413525070291904	MA-MIW 29 MASHPEE, MA	*	Stratified Drift	1976-02-04	2022-09-15	10.03	5.53	3.66	https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=413525070291904 (https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=413525070291904)
415433070583302	MA-MTW 82 MIDDLEBORO, MA	Till	Glacial Till	1964-12-01		17.58	1.5	15.49	https://nwis.waterdata.usgs.gov/ma/nwis/gwlevels?site_no=415433070583302&agency_cd=USGS&format (https://nwis.waterdata.usgs.gov/ma/nwis/gwlevels?site_no=415433070583302&agency_cd=USGS&format
411555070021901	MA-NBW 228 NANTUCKET, MA	*	Stratified Drift	1976-03-04	2022-03-31	27.9	20.51	4.7	https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=411555070021901 (https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=411555070021901)
424520070562401	MA-NIW 27 NEWBURY, MA	Till	Glacial Till	1959-07-01	1984-10-17	12.68	1	10.2	https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=424520070562401 (https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=424520070562401)
									https://waterdata.usgs.gov/nwis/dv?