Hydrogeologic Evaluation

Tax Map D, Lots 50 & 70

NH Route 13

Brookline, New Hampshire

March 19, 2024

Terracon Project No. J1217029

Prepared for:

Tamposi Brothers Holdings, LLC

Hollis, New Hampshire

Prepared by:

Terracon Consultants, Inc.

Manchester, New Hampshire

Terracon

Nationwide

Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials

77 Sundial Ave, Ste 401W
Manchester, NH 03103-7236
P 603-647-9700
F 603-647-4432
Terracon.com

March 19, 2024

Tamposi Brothers Holdings, LLC
PO Box 847
Hollis, New Hampshire 03049
c/o
Fieldstone Land Consultants, PLLC
206 Elm Street
Milford, New Hampshire 03055

Attn: Mr. Chad Branon
M: 603-672-5456
E: cebranon@fieldstonelandconsultants.com

Re: Hydrogeologic Evaluation
Tax Map D, Lots 50 & 70 – NH Route 13
Brookline, New Hampshire
Terracon Project No. J1217029

Dear Mr. Branon:

This letter report summarizes a hydrogeologic evaluation conducted by Terracon Consultants, Inc. at the above-referenced site. The purpose of this study was to evaluate the potential availability of groundwater in the underlying bedrock aquifer, perform a groundwater mounding analysis and evaluate the potential impact the proposed development may have on the availability of groundwater in the local area. The details and results of this study are subject to the attached Limitations. Our work was conducted in general accordance with our February 27, 2021 proposal, and consisted of the following:

- Reviewing existing conceptual subdivision plans and test pit logs.
- Reviewing published geologic information from the United States Geological Survey (USGS) and the New Hampshire Department of Environmental Services (NHDES).
- Obtaining, reviewing, and analyzing local well records.
- Preparing a hydrogeologic budget for the subdivision.

We appreciate the opportunity to be of service to you on this project. If you have questions regarding this report, or if we may be of further assistance, please contact us.

Sincerely,
Terracon Consultants, Inc.

Sean D. Kennedy
Department Manager

David C. Del Marco, NH PG No. 888
Group Manager

Attachment

TABLE OF CONTENTS

HYDROGEOLOGIC EVALUATION
TAX MAP D, LOTS 50 & 70
NH ROUTE 13
BROOKLINE, NEW HAMPSHIRE

Terracon Project No. J1217029
March 19, 2024

1.0 INTRODUCTION

1.1 Proposed Site Development

The project site consists of approximately 68 acres within a 121.7-acre parcel located along NH Route 13 in Brookline, New Hampshire (Exhibit 1). The development within the proposed subdivision is planned for up to 58 elderly housing units within 14, 4-unit buildings and 1 duplex. The second phase of the development includes the construction of 40 units of workforce housing within 8, 5-unit buildings. The proposed buildings will be serviced by a private bedrock community well and 13 septic systems.

The proposed subdivision is primarily undeveloped and is generally comprised of low-lying vegetation or is wooded. Topography across the area of improvement within the subdivision is gently sloping and ranges in elevation from approximately 310 feet above the National Geodetic Vertical Datum (NGVD) along NH Route 13 to a high of approximately 460 feet in the northeastern portion of the development.

1.2 Hydrogeologic Setting

The site is located in the upper tributaries of the Nissitissit River drainage basin. The proposed subdivision is located east of NH Route 13. The area surrounding the proposed subdivision consists of residential properties and wooded land to the east. Areas to the north, west and south are developed with a mix of residential and commercial properties along NH Route 13. Scab Mill Brook is located approximately 0.3-miles west of the site. West Branch Village Brook is located approximately 0.75-miles to the southeast of the site.

The *Hillsborough County New Hampshire, Eastern Part Soil Survey*, (1981) maps published by the United States Department of Agriculture, Soil Conservation Service show the areas within the subdivision located east of NH Route 13 to generally consist of Chatfield-Hollis-Rock Outcrop and Hinckley loamy sand. The soils are generally described as 15 to 35 percent slopes and are usually found on hills or ridges. The soils generally have a moderately rapid to rapid permeability for the surface and subsoil layers, and generally a rapid to very rapid permeability in the substratum layers. The soils generally have a low water retention capacity. In our opinion, the soils within the proposed subdivision are conducive to moderate rates of groundwater recharge from precipitation.

Test pits completed by Fieldstone Land Consultants, PLLC (FLC) across the proposed subdivision were generally advanced to depths from 5.0 to 8.0 feet below ground surface (bgs). Soil conditions identified in the FLC test pits logs are consistent with glacial till deposits. Bedrock was encountered in 7 of the 33 test pits at depths ranging between 2.5 feet bgs and 5 feet bgs. Evidence of an estimated seasonal high water table was generally observed within the proposed subdivision at approximate depths of 2.0 to 3.0 feet within the central and northern portions of the development. The estimated seasonal high water table was generally observed at depths between 4.0 and 7.0 feet bgs within the southern portion of the development. We understand that wastewater discharge will be limited to residential septic systems, and that the septic systems will meet local and state design requirements.

According to the USGS *Water-Resources Investigations Report (WRIR) 86-4358 "Hydrogeology of Stratified-Drift Aquifers and Water Quality in the Nashua Regional Planning Commission Area, South-Central New Hampshire (1987),"* the regional overburden deposit within the proposed subdivision, east of NH Route 13, consists of glacial till, which is defined as a non-sorted, non-stratified sediment composed of boulders, gravel, sand, silt and clay mixed in various proportions. The area primarily west of NH Route 13 is identified as coarse-grained stratified drift, which is defined as medium sand to cobble gravel with approximately 10 to 40 feet thick of saturated material. Exhibit 3 depicts the USGS estimated boundaries for the glacial till and stratified-drift deposits, surface water drainage divide and water table contours.

According to the *Bedrock Geologic Map of New Hampshire* (1997), the bedrock beneath the site is mapped as a migmatite consisting of pink, foliated biotite granite intruding gneissic and granulose metasedimentary and metavolcanic rocks of the Merrimack Trough.

The USGS Open File Report 96-490 (1996) *Lineament Map of Area 2 of the New Hampshire Bedrock Aquifer Assessment, Southeastern New Hampshire* shows seven lineaments (photolinear features indicative of vertical or high-angle bedrock fractures) that exist beneath the boundaries of the proposed subdivision (Exhibit 4). Four of the seven lineaments are generally shown trending in a northeast-southwest orientation. Two of the lineaments are shown in an east-west orientation and one lineaments is depicted in a northwest-southeast orientation. Within an approximately 0.5-mile radius of the proposed subdivision, the majority of large lineaments are oriented in a general north-south direction.

Generally, the more fractures in the bedrock, the better the potential recharge and the greater the probability that higher yielding wells may be completed. Geologic mapping, geophysical surveys, and other site-specific activities would be necessary to confirm the existence of such fracture zones along these lineaments. Such field-scale studies were not conducted for this study.

According to the USGS *WRIR 86-4358*, the long-term (1951-1980) average annual mean precipitation in the Brookline area is 43.3 inches. The recharge rate for stratified drift, as reported in the USGS *WRIR 86-4358 Report*, is approximately 22 inches per year. Because the area east of NH Route 13 is mantled by glacial till, an additional 6.78 inches per year of precipitation is lost to runoff. To be conservative, the effective recharge rate for the entire proposed subdivision is considered to be 15.22 inches per year as opposed to 22 inches per year. The recharge rate of 15.22 inches per year is the equivalent of approximately 1,132 gallons per day (gpd)/acre or 76,976 gpd for the development. The sloping topography and soil associations summarized above allow for typical rates of groundwater recharge in an undeveloped setting. However, construction of houses and driveways will slightly reduce the amount of water that will be available to recharge the bedrock.

1.3 Potential Impacts to Existing Wells

The impact of the development on the overall water budget for the site can be approximated by hydrogeologic budget calculations. Recharge to bedrock aquifers generally occurs from infiltration of precipitation and subsurface flow into the aquifer system. Withdrawals from the bedrock aquifer include lateral outflow and consumptive withdrawals. Assuming steady state conditions, natural flow into the aquifer system would be negated by natural outflow, leaving infiltration and pumping as the principal components of recharge and withdrawal,

respectively.

For this evaluation, we have used the USGS values for mean annual precipitation of 43.3 inches and an effective recharge rate of 15.22 inches per year, or 1,132 gpd/acre. Therefore, approximately 28.08 inches of precipitation are lost to overland flow and evapotranspiration each year. As a safety factor, if we assume that only 50 percent of the effective recharge rate (15.22 inches per year) is available, the calculated recharge to the aquifer underlying the entire subdivision would be about 38,488 gpd (see attached Table 1). Using a conservative assumption that the domestic consumptive use of water for each household is 300 gpd, the estimated demand from the residences on the subdivision would be estimated at 29,400 gpd. As a result, a surplus of 9,088 gpd would be available to recharge the underlying bedrock aquifer.

The distribution and availability of groundwater in bedrock is very irregular, and field tests are usually employed to evaluate actual hydrogeologic connections between wells. For this study, however, we observed that the site is predominantly surrounded by sporadic development, and that existing wells appear to have sufficient yield to meet domestic needs. In that respect, the proposed project site is not considered a sensitive area with regard to groundwater availability.

2.0 GROUNDWATER MOUNDING ANALYSIS

2.1 Groundwater Mounding Analysis

We analyzed the wastewater treatment systems for a maximum design flow of 1,000 to 3,000 gpd. Analysis of mounding was performed using the computer program HANTAXIS developed by GeoHydrocycle, which implements the Hantush (1967) method and using the Glover (1964) solution to estimate long term mounding beneath rectangular wastewater disposal fields. The method is generally considered acceptable for long-term, low-dose systems such as wastewater treatment disposal fields.

Hantush's method requires the following input parameters to calculate the potential groundwater mound beneath each dispersal field:

- Application rate of wastewater (measured in feet/day of wastewater over the field)
- Duration of application

- Specific yield of the soil
- Hydraulic conductivity of the soil
- Saturated thickness of the underlying aquifer
- Length and width of the leachfield

In accordance with New Hampshire regulations, a minimum separation of 4 feet must be maintained between the bottom of the dispersal field bed and the design high groundwater level. The design high groundwater level is determined by adding the long-term (180 days) groundwater mound to the estimated seasonal high groundwater level.

Based on soil mottling observed within the test pits completed by FLC during December 2023 seasonal high groundwater levels were estimated for each proposed dispersal field. These high water table levels were estimated to range from approximately El 215 feet to El 227 feet in the proposed dispersal field areas.

2.2 Groundwater Mounding Results

The results of the mounding analyses for the groups of dispersal fields are presented in Appendix B and summarized on Table 2.

Based on the calculated mound heights of approximately 1.29 to 8.0 feet, the proposed design of the dispersal galleries appears suitable to infiltrate 46,500 gpd without an adverse effect to the hydrologic conditions of the site or surrounding properties. Modifications to several dispersal fields will be required with additional fill materials to maintain the minimum separation of 4 feet between the bottom of the dispersal field and the mounded groundwater elevation.

3.0 CONCLUSIONS

Based on the information collected and evaluated for this study, it is Terracon's opinion that there is reasonable documentary evidence to suggest that there is sufficient groundwater and recharge capacity required for the domestic needs of the proposed subdivision without an adverse impact on existing wells in the area.

Modifications to several dispersal fields will be required with additional fill materials to maintain the minimum separation of 4 feet between the bottom of the dispersal field and the mounded groundwater elevation.

Adverse impacts to the quality of the shallow groundwater and underlying bedrock

aquifer systems, surface water and wetland areas are not expected to occur as a result of the construction of the proposed development provided the septic designs are completed in accordance with State of New Hampshire regulations.

TABLES

TABLE 1

NH Route 13
Brookline, New Hampshire
Terracon Project No. J1217029

Groundwater Recharge Calculations

Given: Effective Recharge Rate = 15.22 inches/year
1 Foot = 12 inches
1 Acre = 43,560 square feet
1 Cubic Foot = 7.481 gallons
1 Year = 365 days

Total Annual Recharge:

15.2 in/year x 1 ft/12 in x 43,560 square ft x 1 acre x 7.481 gallons/ 1 cubic ft = 413,314 gallons per year per acre

Daily Recharge per Acre:

413,314 gallons per year per acre / 365 days per year = 1,132 gallons per day per acre

Daily Recharge per 68 acre development:

1,132 gallons per day per acre x 68 acres = 76,976 gallons per day

Recharge Safety Factor:

50% x 79,976 gallons per day = 38,488 gallons per day

TABLE 2

NH ROUTE 13

Brookline, New Hampshire

Terracon Project No. J1217029

Summary of Groundwater Hydrogeological Data

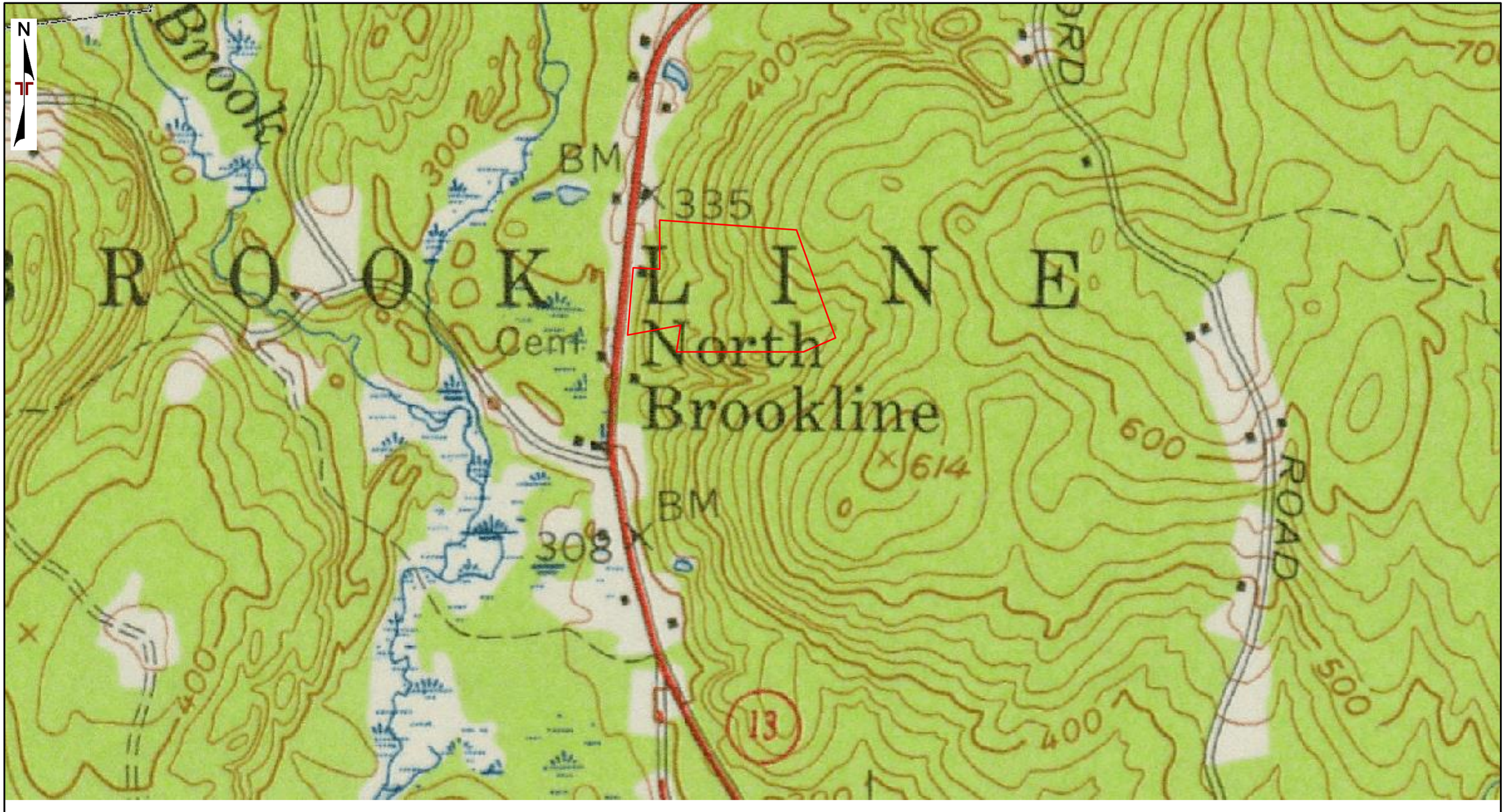
Location	Approximate Existing Grade (FT)	Estimated Elevation of Aquifer Bottom (FT)	Estimated Seasonal High Groundwater Table Elevation (FT)[#]	Approximate Saturated Thickness of Aquifer (FT)	Hydraulic Conductivity (FT/D)*	Total Proposed Flow (gallons)	Infiltration Field Dimensions (FT)		Area of Infiltration Field (FT^2)	Application Rate ($FT^3/D/FT^2$)	Modeled Mound Height (FT)	Calculated Mound Elevation (FT)	Minimum Elevation Required for Bottom of Dispersal Field Bed (FT)
							Length	Width					
Unit #1	340.00	334.00	337.25	3.25	10.00	1,500	100	13	1,300	0.1543	2.30	339.55	343.55
Unit #3	352.00	345.67	349.00	3.33	10.00	1,500	100	13	1,300	0.1543	2.25	351.25	355.25
Unit #4	350.00	343.67	347.00	3.33	10.00	1,500	100	13	1,300	0.1543	2.25	349.25	353.25
Unit #5	340.00	331.67	333.34	1.67	10.00	1,500	100	13	1,300	0.1543	3.84	337.18	341.18
Unit #6 & #7	378.00	371.00	372.58	1.58	10.00	3,000	100	15	1,500	0.2674	7.95	380.53	384.53
Unit #2 & #8	432.00	425.00	426.58	1.58	10.00	3,000	100	13	1,300	0.3085	8.00	434.58	438.58
Unit #9 & #10	360.00	354.40	357.00	2.60	10.00	3,000	100	15	1,500	0.2674	5.43	362.43	366.43
Unit #11 & #12	420.00	415.00	417.80	2.80	10.00	3,000	100	15	1,500	0.2674	5.13	422.93	426.93
Unit #13 & #14	392.00	386.00	389.50	3.50	10.00	1,000	75	15	1,125	0.1188	1.58	391.08	395.08
Unit #15 & #16	400.00	394.00	397.34	3.34	10.00	1,000	75	15	1,125	0.1188	1.65	398.99	402.99
Unit #17 & #18	454.00	447.40	451.58	4.18	10.00	1,000	75	15	1,125	0.1188	1.37	452.95	456.95
Unit #19 & #20	447.00	439.50	444.00	4.50	10.00	1,000	75	15	1,125	0.1188	1.29	445.29	449.29
Unit #21, #22 & #23	422.00	415.00	418.80	3.80	10.00	1,250	75	15	1,125	0.1485	1.85	420.65	424.65

[#] - Estimated Seasonal High Groundwater Table based on test pit data completed in December 2023

[*] - Hydraulic conductivity based on published values and prior explorations conducted within 3 miles of the site.

APPENDIX A

EXHIBITS



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: MILFORD, NH (1/1/1953).

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	SDK
Drawn by:	SDK
Checked by:	DCD
Approved by:	SDK

Project No.	J1217029
Scale:	AS SHOWN
File Name:	Exb 1
Date:	March 2024

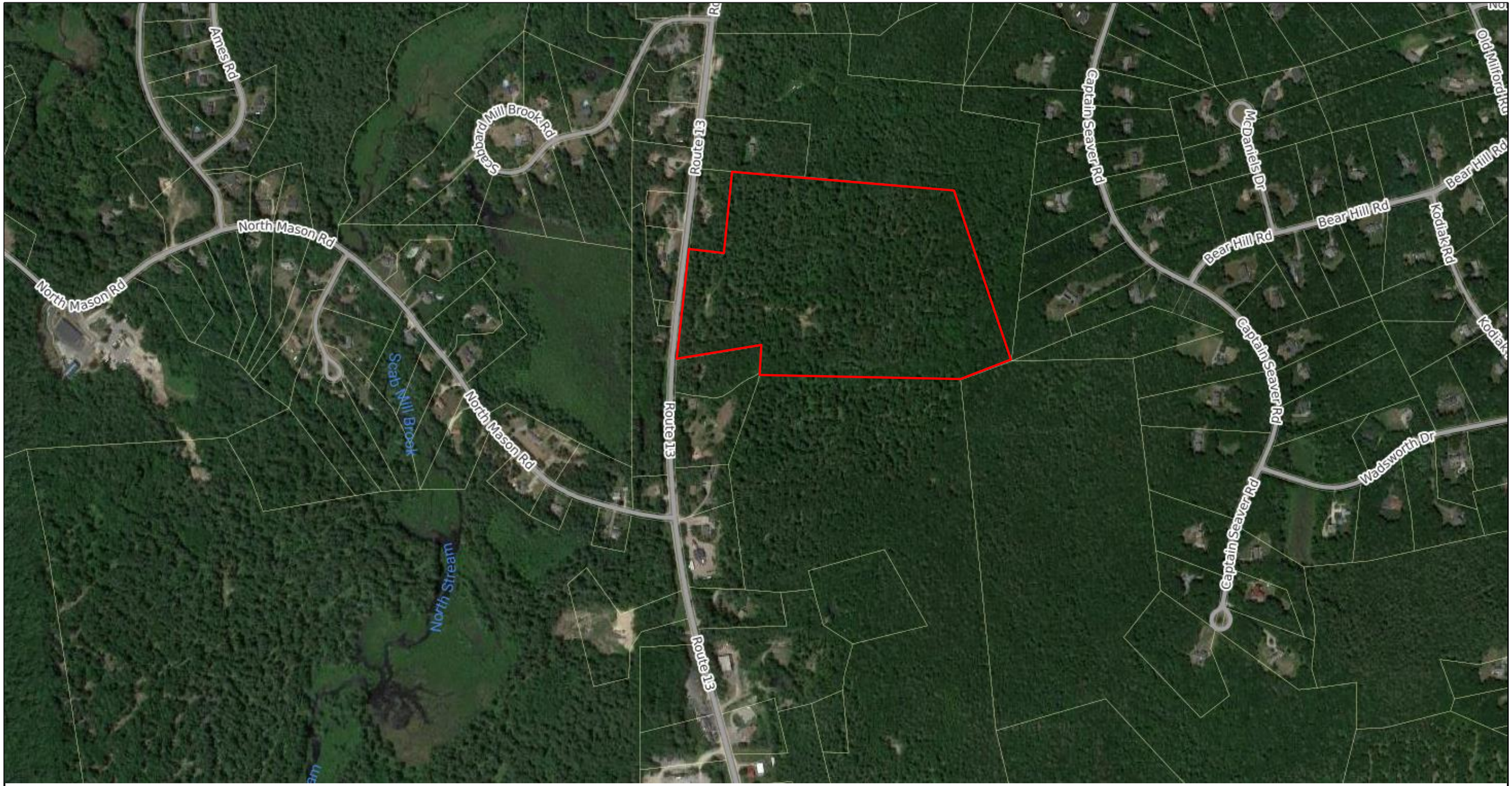
Terracon
77 Sundial Ave, Suite 401W
Manchester, New Hampshire

TOPOGRAPHIC MAP

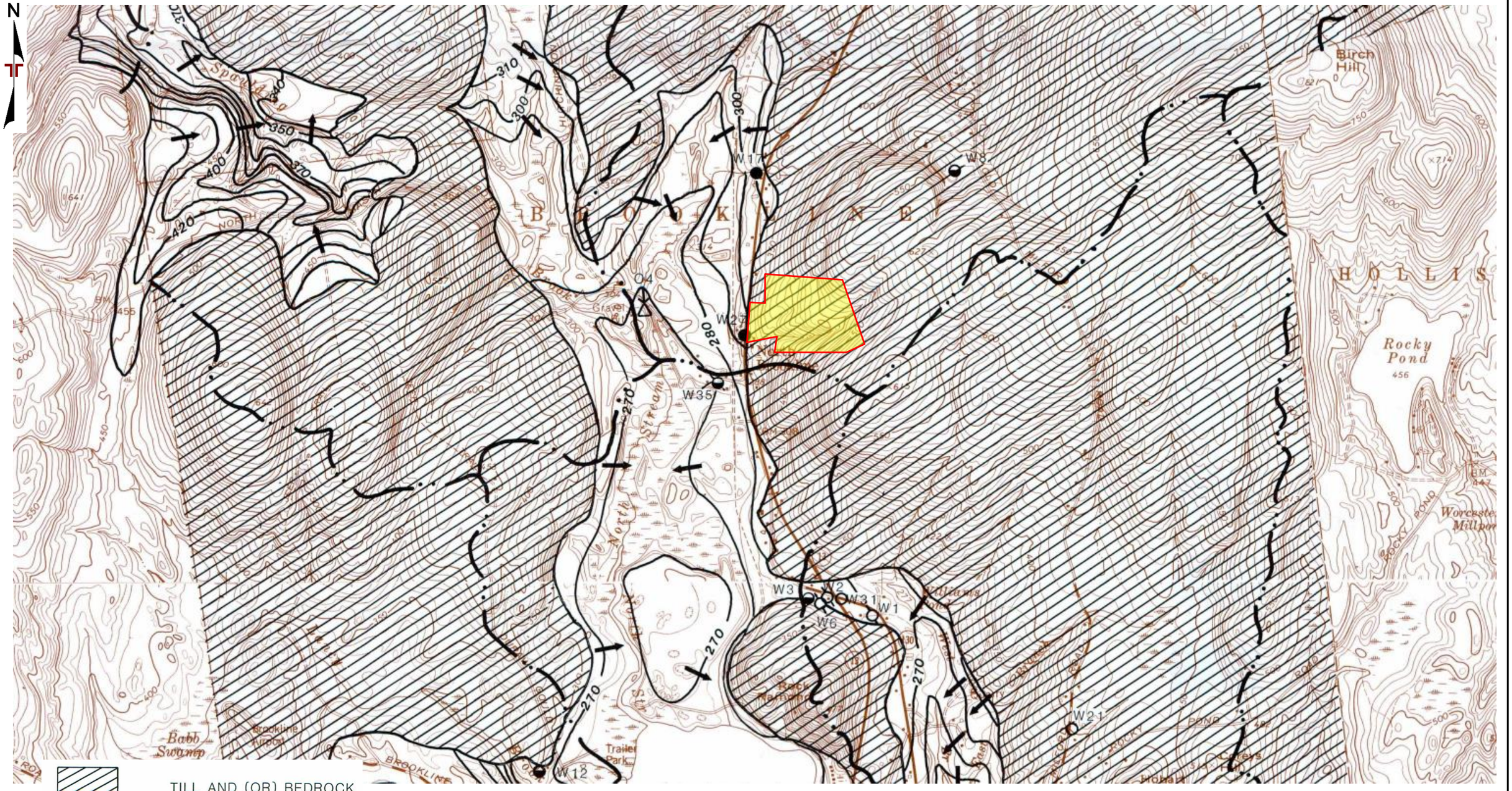
NH ROUTE 13
TAX MAP D – LOT 50
BROOKLINE, NEW HAMPSHIRE

Exhibit

1



Project Manager: SDK Drawn by: SDK Checked by: DCD Approved by: SDK	Project No. J1217029 Scale: AS SHOWN File Name: Exb 2 Date: March 2024	Terracon 77 Sundial Ave, Suite 401W Manchester, New Hampshire	PROPOSED SUBDIVISION PLAN NH ROUTE 13 TAX MAP D – LOT 50 BROOKLINE, NEW HAMPSHIRE	Exhibit 2



TILL AND (OR) BEDROCK

SURFACE-WATER DRAINAGE DIVIDE

300 — WATER-TABLE CONTOUR--Shows altitude of water table. Contour interval 10 feet. National Geodetic Vertical Datum of 1929. Arrows show generalized direction of ground-water flow.

Project Manager:	SDK
Drawn by:	SDK
Checked by:	DCD
Approved by:	SDK
Project No.	J1217029
Scale:	AS SHOWN
File Name:	Exb 3
Date:	March 2024

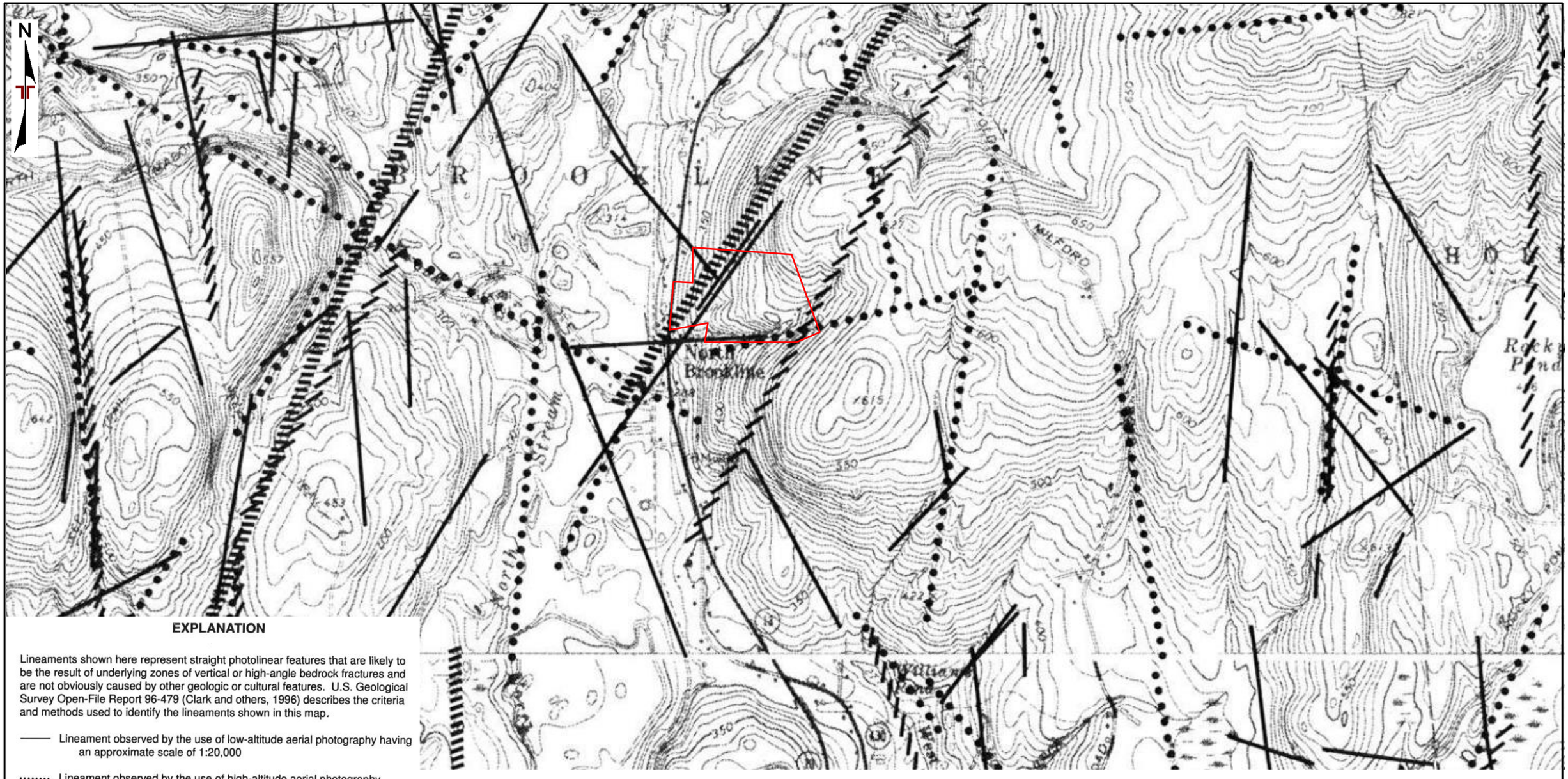
Terracon
77 Sundial Ave, Suite 401W
Manchester, New Hampshire

WRIR 86-4358 PLATE 1

NH ROUTE 13
TAX MAP D – LOT 50
BROOKLINE, NEW HAMPSHIRE

Exhibit

3



EXPLANATION

Lineaments shown here represent straight photolinear features that are likely to be the result of underlying zones of vertical or high-angle bedrock fractures and are not obviously caused by other geologic or cultural features. U.S. Geological Survey Open-File Report 96-479 (Clark and others, 1996) describes the criteria and methods used to identify the lineaments shown in this map.

——— Lineament observed by the use of low-altitude aerial photography having an approximate scale of 1:20,000

····· Lineament observed by the use of high-altitude aerial photography having an approximate scale of 1:80,000

~~~~~ Lineament observed by the use of 1:250,000-scale side-looking airborne radar imagery

wwwwww Lineament observed by the use of 1:1,000,000-scale Landsat imagery

Note: Additional lineaments that extend into this plate area will likely be identified as work progresses in adjacent map areas. These additions near plate boundaries will be included in future interpretive maps and Geographic Information Systems (GIS) coverages.

Project Manager:	SDK
Drawn by:	SDK
Checked by:	DCD
Approved by:	SDK

Project No.	J1217029
Scale:	AS SHOWN
File Name:	Exb 4
Date:	March 2024

Terracon
77 Sundial Ave, Suite 401W
Manchester, New Hampshire

USGS LINEAMENT MAP

NH ROUTE 13
TAX MAP D – LOT 50
BROOKLINE, NEW HAMPSHIRE

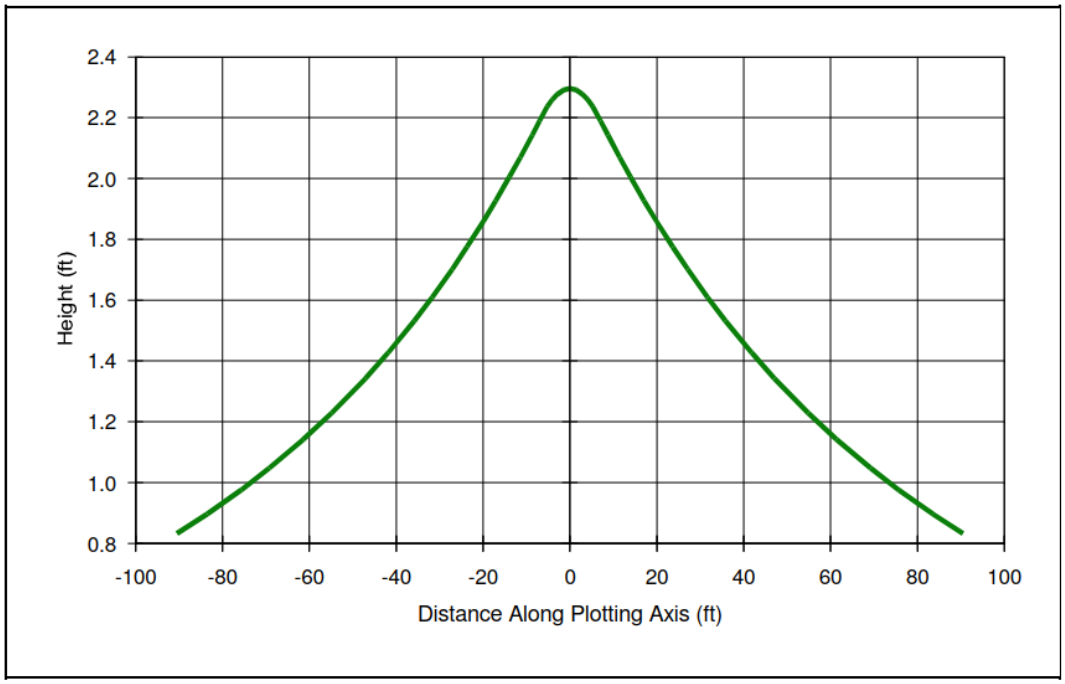
Exhibit

4
~~~~~

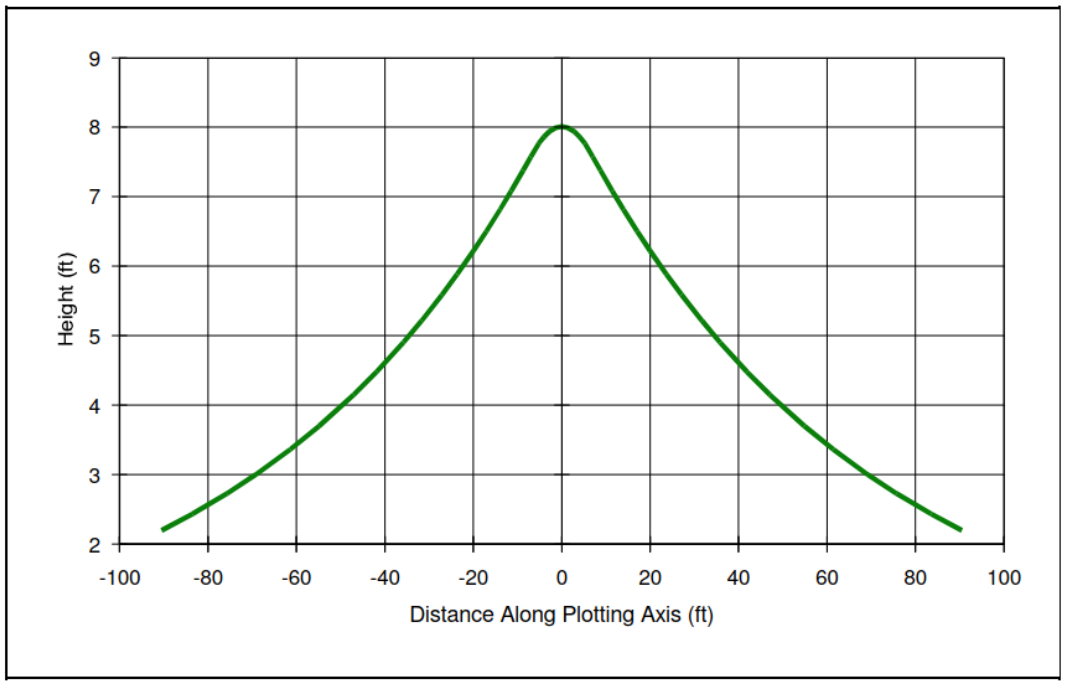
APPENDIX B

GROUNDWATER MOUNDING PLOTS

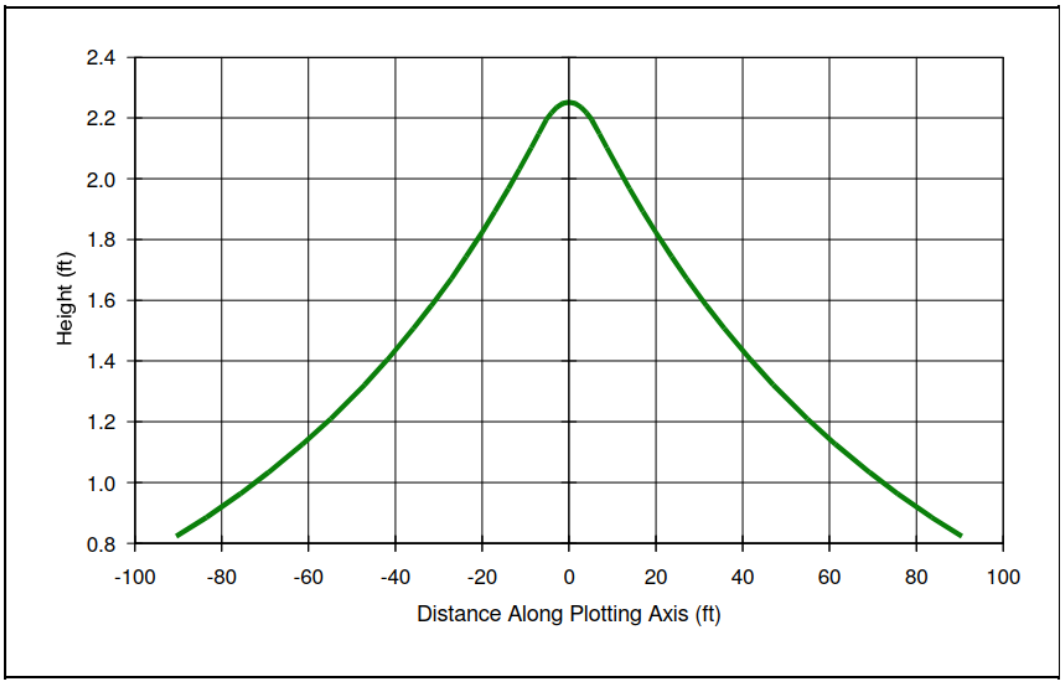
Groundwater Mounding Analysis - Unit 1



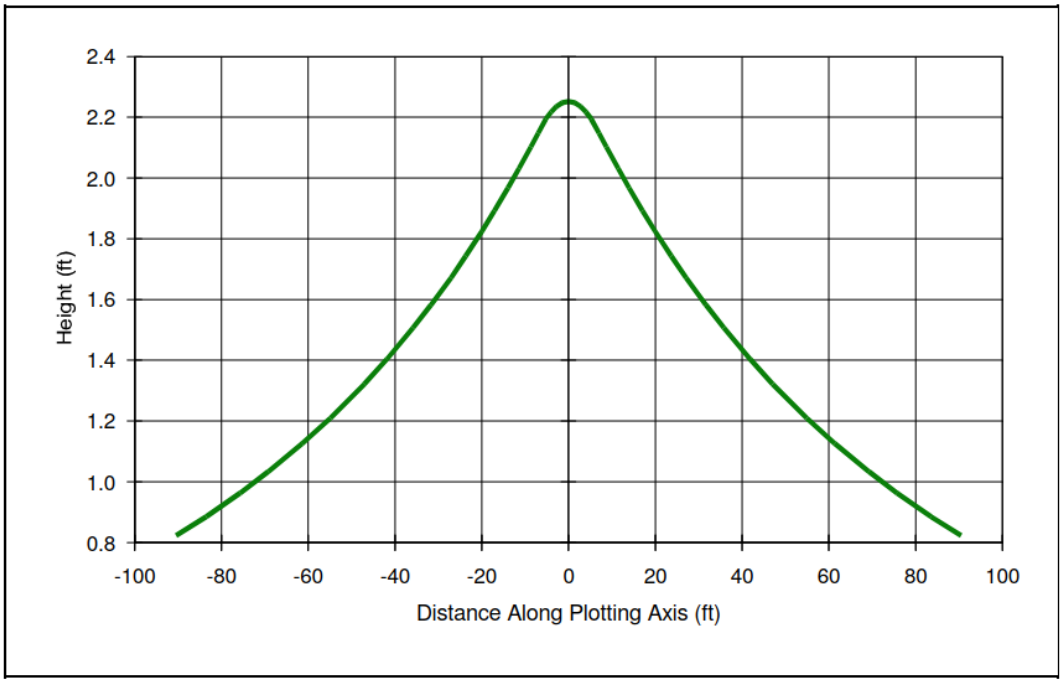
Groundwater Mounding Analysis Unit 2 & 8



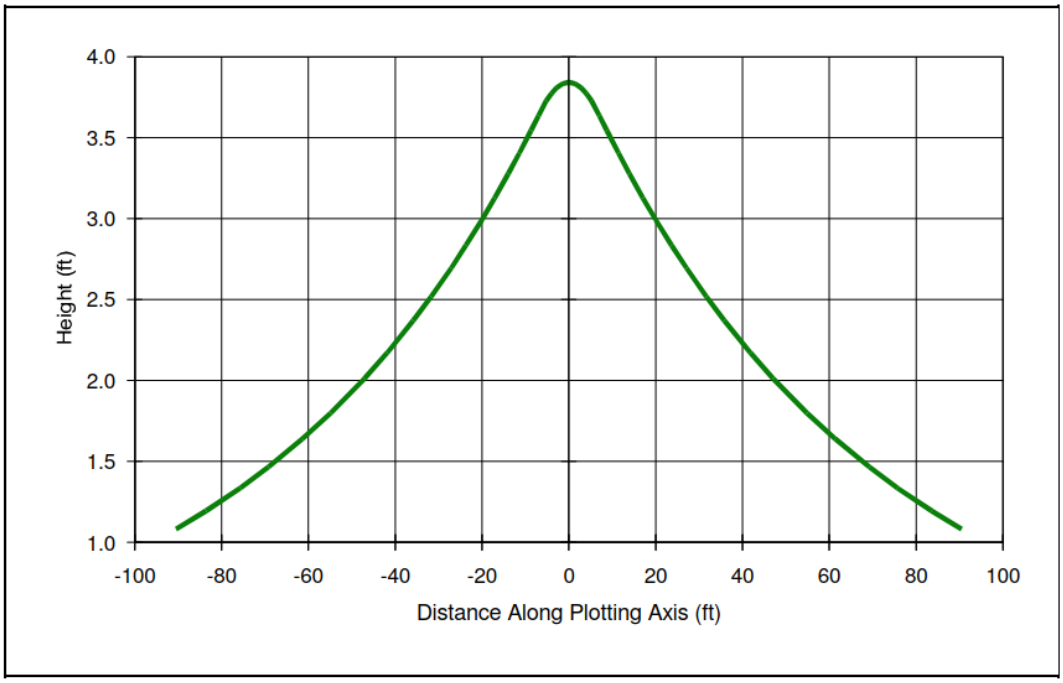
Groundwater Mounding Analysis - Unit 3



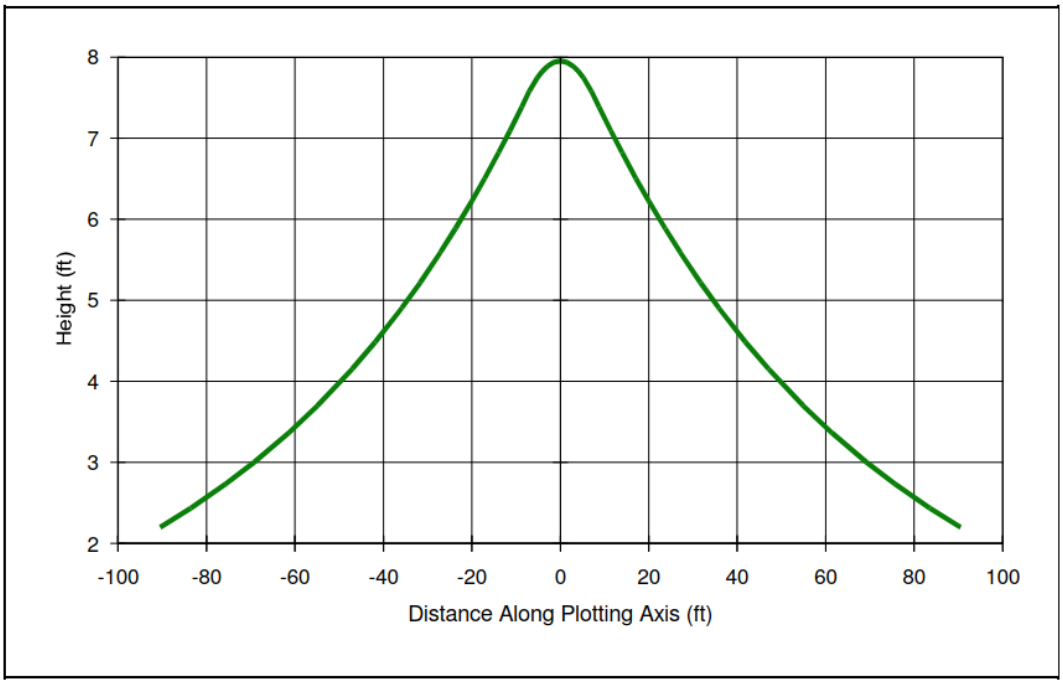
Groundwater Mounding Analysis - Unit 4



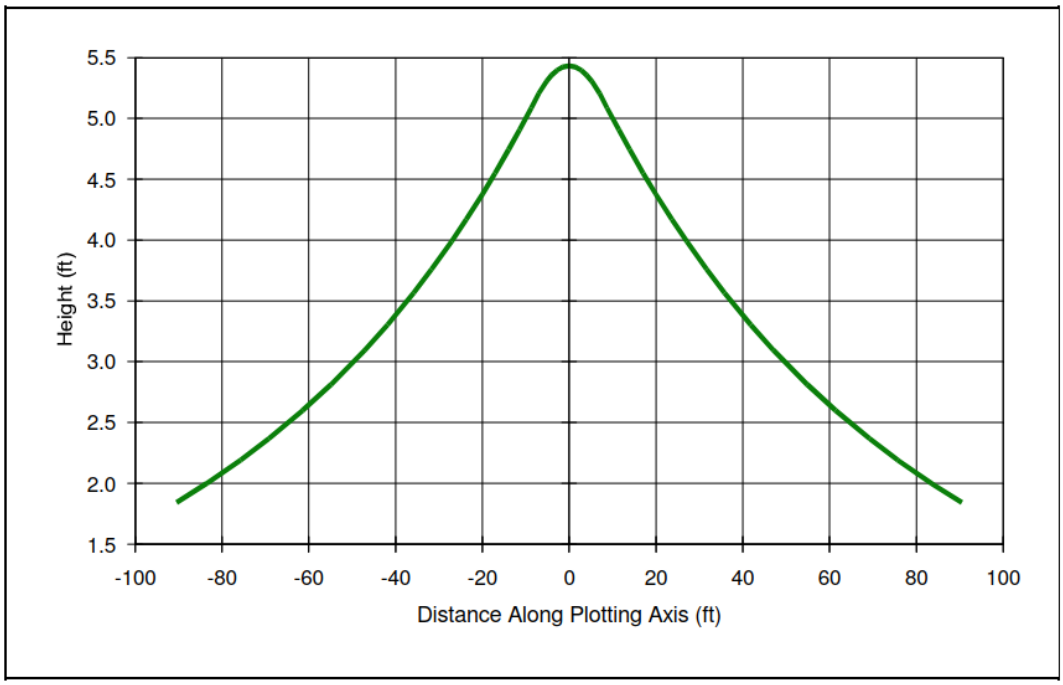
Groundwater Mounding Analysis - Unit 5



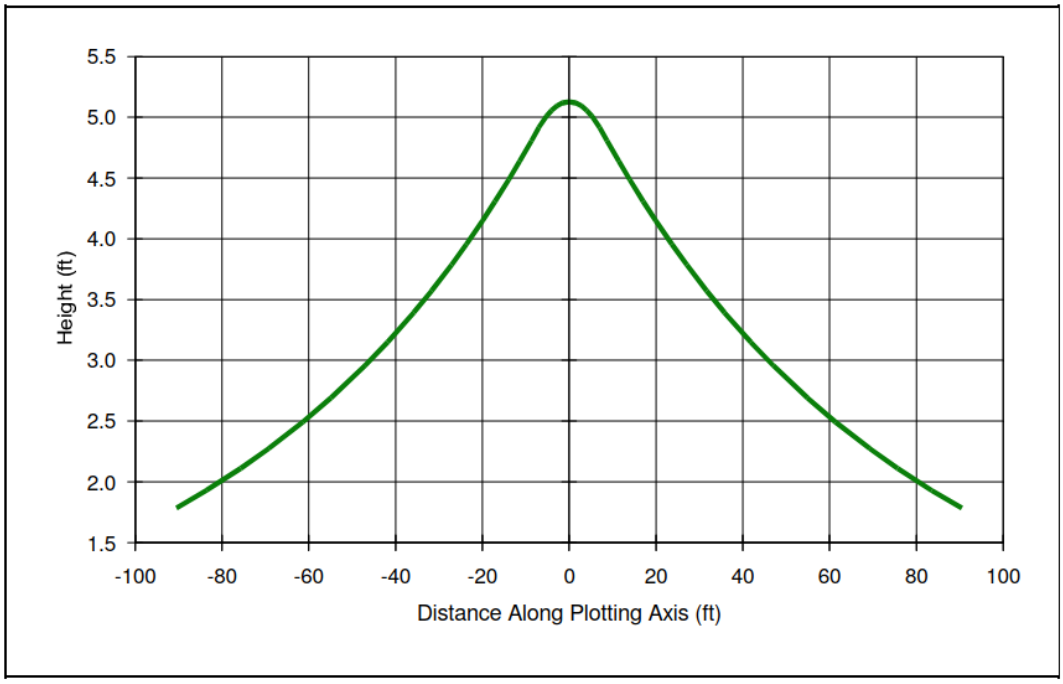
Groundwater Mounding Analysis - Unit 6 & 7



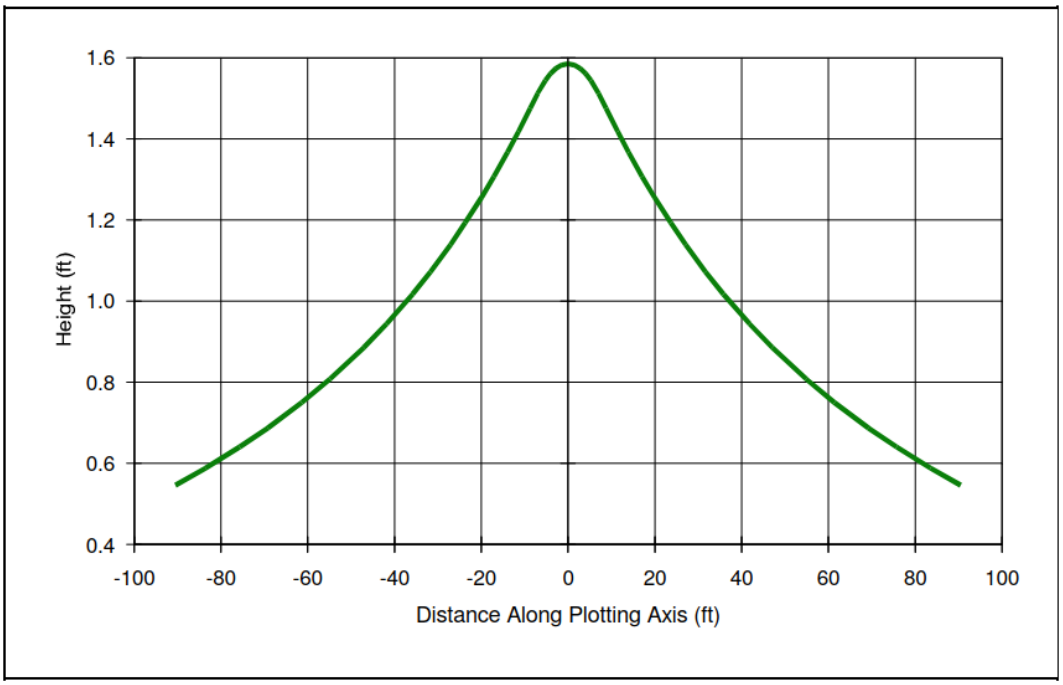
Groundwater Mounding Analysis - Unit 9 & 10



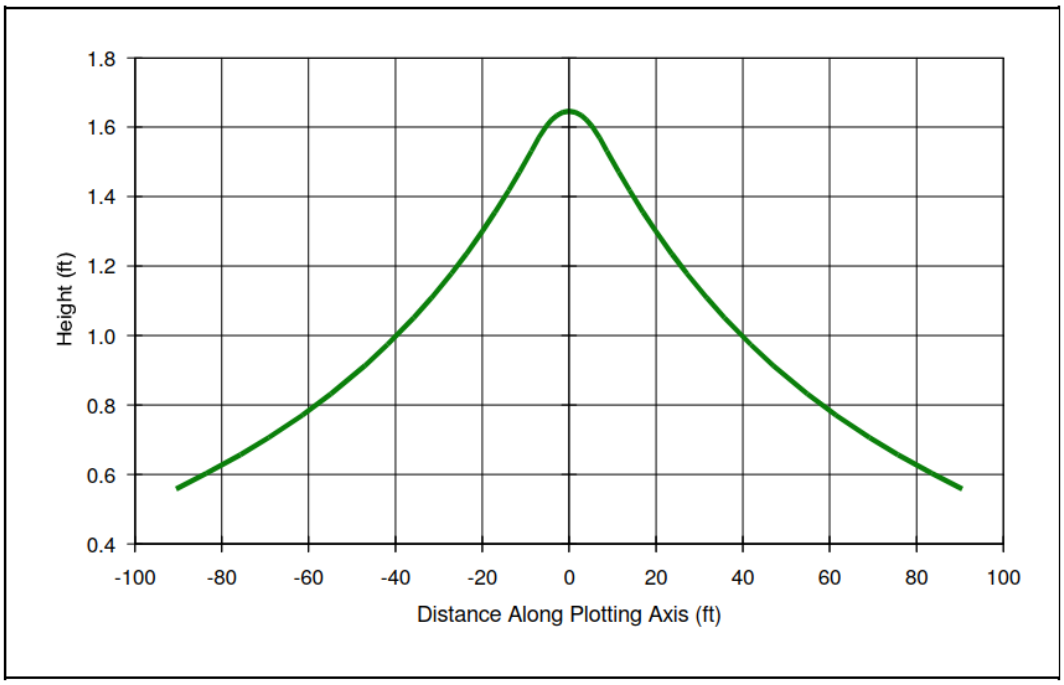
Groundwater Mounding Analysis - Unit 11 & 12



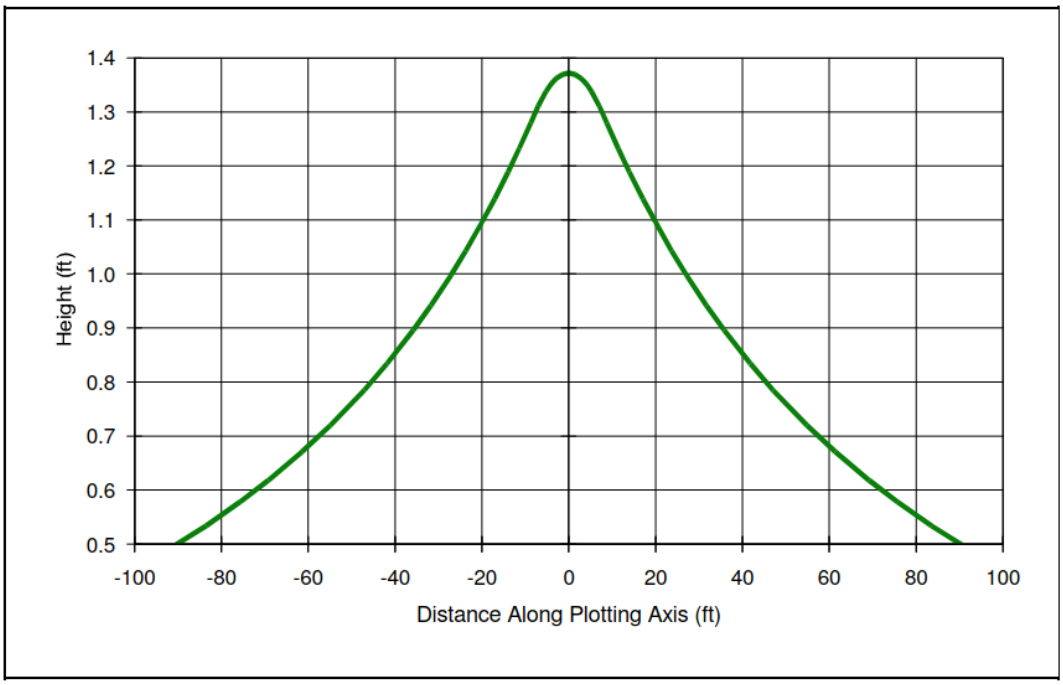
Groundwater Mounding Analysis - Unit 13 & 14



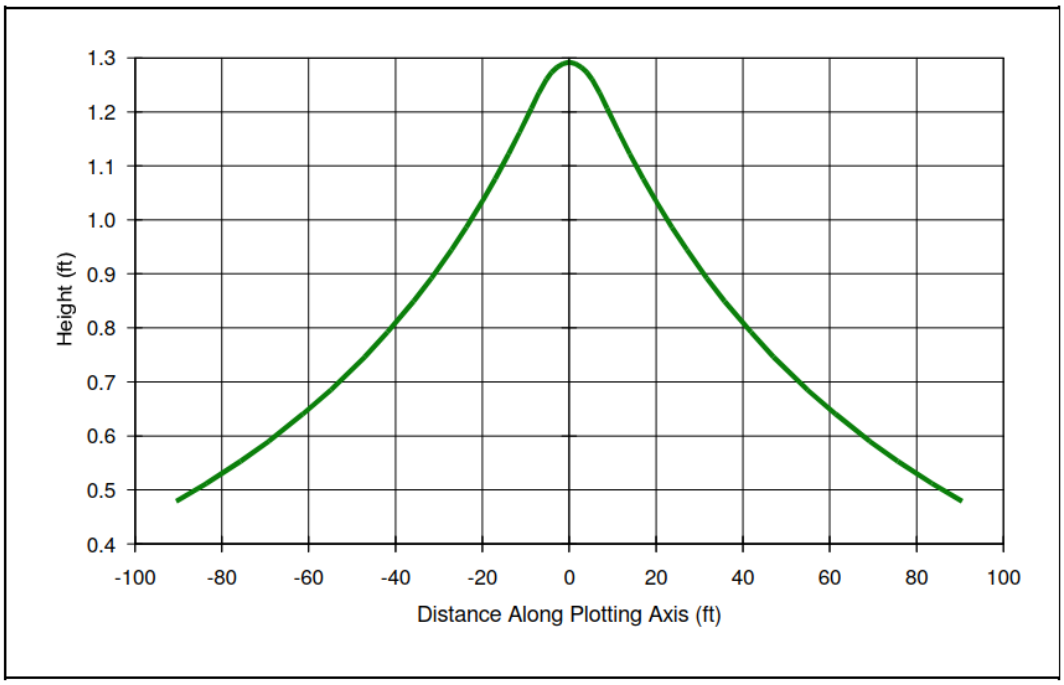
Groundwater Mounding Analysis - Unit 15 & 16



Groundwater Mounding Analysis - Unit 17 & 18



Groundwater Mounding Analysis Unit 19 & 20



Groundwater Mounding Analysis - Unit 21, 22 & 23