

Horsley Witten Group

Sustainable Environmental Solutions

90 Route 6A, Unit 1 • Sandwich, MA • 02563

Phone - 508-833-6600 • Fax - 508-833-3150 • www.horsleywitten.com



Chop Chaque Bogs Restoration Conceptual Feasibility Assessment

Mashpee, Massachusetts

October 2021



Prepared for:
Mashpee Conservation Commission
16 Great Neck Road North
Mashpee, MA 02649

Prepared by:
Horsley Witten Group, Inc.



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Path: H:\Projects\2021\21073 Chop Chaque Mashpee\GIS\PDF\Project Site

Legend

● Control Structure

Datums:
Horizontal - NAD83 feet
Vertical - NAVD88 feet



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Project Site
Chop Chaque Bogs
Mashpee, MA

Date: 8/3/2021

Figure 1



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: H:\Projects\2021\21073 Chop Chaque Mashpee\GIS\Maps\Soil Map.mxd

Map Unit Symbol	Map Unit Name	Percent Slopes	Hydrologic Group
1	Water		
55A	Freetown coarse sand, sanded surface	0-3	B/D
252D	Carver coarse sand	8-15	A
254B	Merrimac fine sandy loam	0-3	A
254C	Merrimac fine sandy loam	8-15	A

Datums:

Horizontal - NAD83 feet
Vertical - NAVD88 feet



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Soil Classification
Chop Chaque Bogs
Mashpee, MA

Date: 8/3/2021




Figure 3





Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: H:\Projects\2021\21073 Chop Chaque Mashpee\GISMaps\Existing Constraints.mxd

Legend

-  Zone II Wellhead Protection Area
-  NHESP Priority Habitats of Rare Species
-  NHESP Estimated Habitats of Rare Wildlife

MassDEP Wetlands:

-  Cranberry Bog
-  Open Water



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**Existing Constraints
 Chop Chaque Bogs
 Mashpee, MA**

Datums:
 Horizontal - NAD83 feet
 Vertical - NAVD88 feet

The Site is not located in a FEMA National Flood Hazard area.
 The Site does not contain any MassDEP Hazardous Waste sites.



Date: 10/7/2021

Figure 4



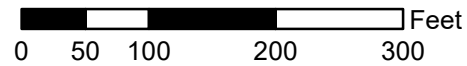
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Legend

-  Elevation Contours - 2'
-  Elevation Contours - 10'

Datums:

Horizontal - NAD83 feet
 Vertical - NAVD88 feet



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Topography
 Chop Chaque Bogs
 Mashpee, MA

Date: 10/8/2021

Figure 5



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Path: H:\Projects\2021\21073 Chop Chaque Mashpee\GISMaps\GPS Points Map.mxd

Legend

- Staff Gauge
- Well

Point ID	Northing	Easting	Elevation (ft)
CCB-MW1	2701562.83	942014.90	43.74
CCB-MW1 PVC	2701562.73	942015.04	45.21
CCB-MW2	2701319.64	941697.64	43.04
CCB-MW2 PVC	2701319.64	941697.57	45.18
CCB-MW3	2701170.83	942044.36	43.60
CCB-MW3 PVC	2701170.89	942044.12	44.21

Point ID	Northing	Easting	Elevation (ft)
CCB-SG1	2701513.46	941832.11	41.86
CCB-SG1 TOP	2701513.60	941832.16	43.97
CCB-SG2	2701473.60	941780.71	42.00
CCB-SG2 POST	2701473.69	941780.22	44.44
CCB-SG3	2701211.52	942088.92	42.06
CCB-SG3 POST	2701211.49	942088.62	44.83
CULVERT/CCB-SG4	2701191.04	941348.68	46.75
CCB-SG5	2701133.22	941339.12	40.39
CCB-SG5 PVC	2701133.09	941339.18	44.55

Datums:
 Horizontal - NAD83 feet
 Vertical - NAVD88 feet



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Data Collection Locations
 Chop Chaque Bogs
 Mashpee, MA

Date: 8/3/2021

Figure 6

Figure 7. Chop Chaque Bog Complex - Entire Monitoring Period

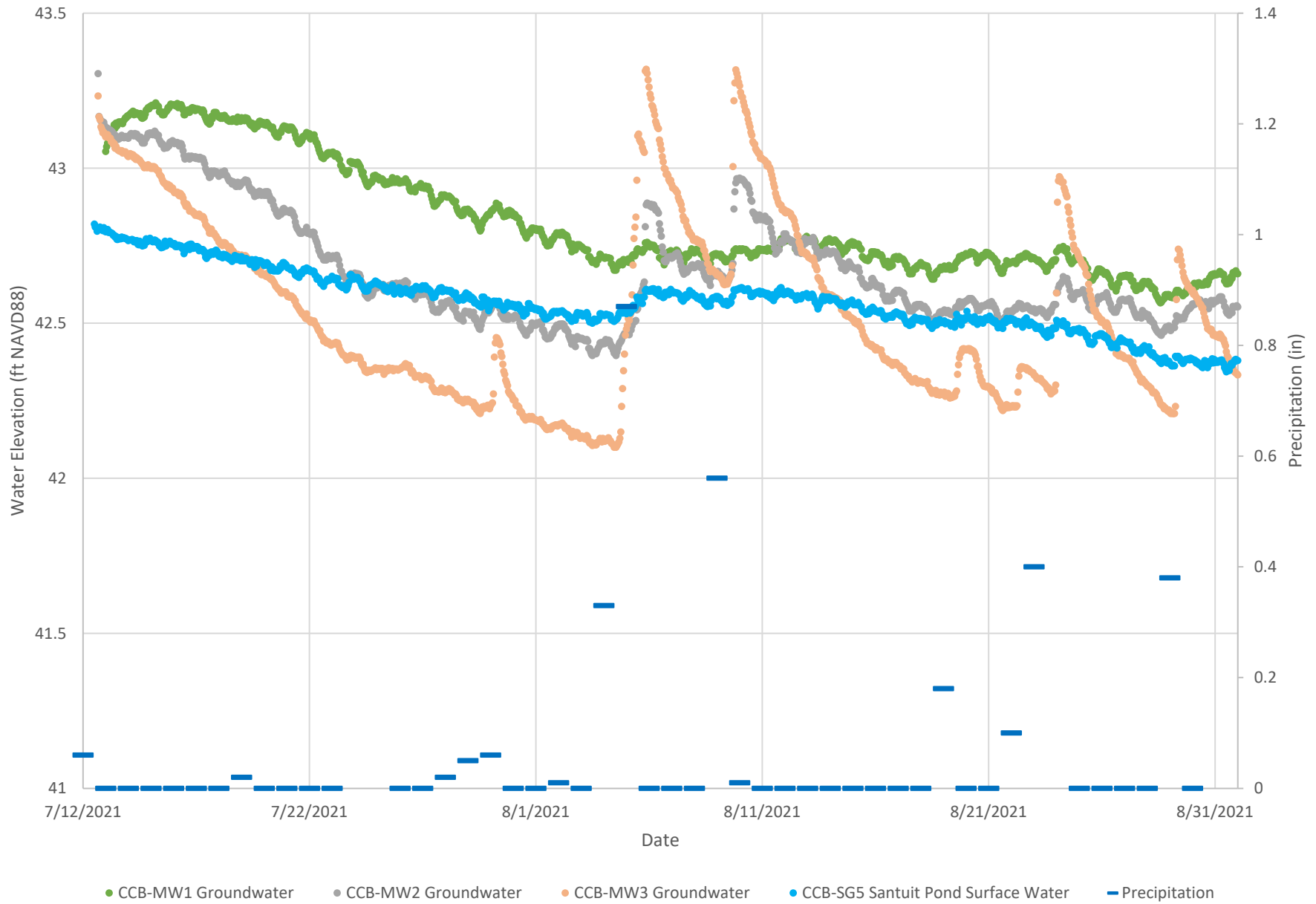
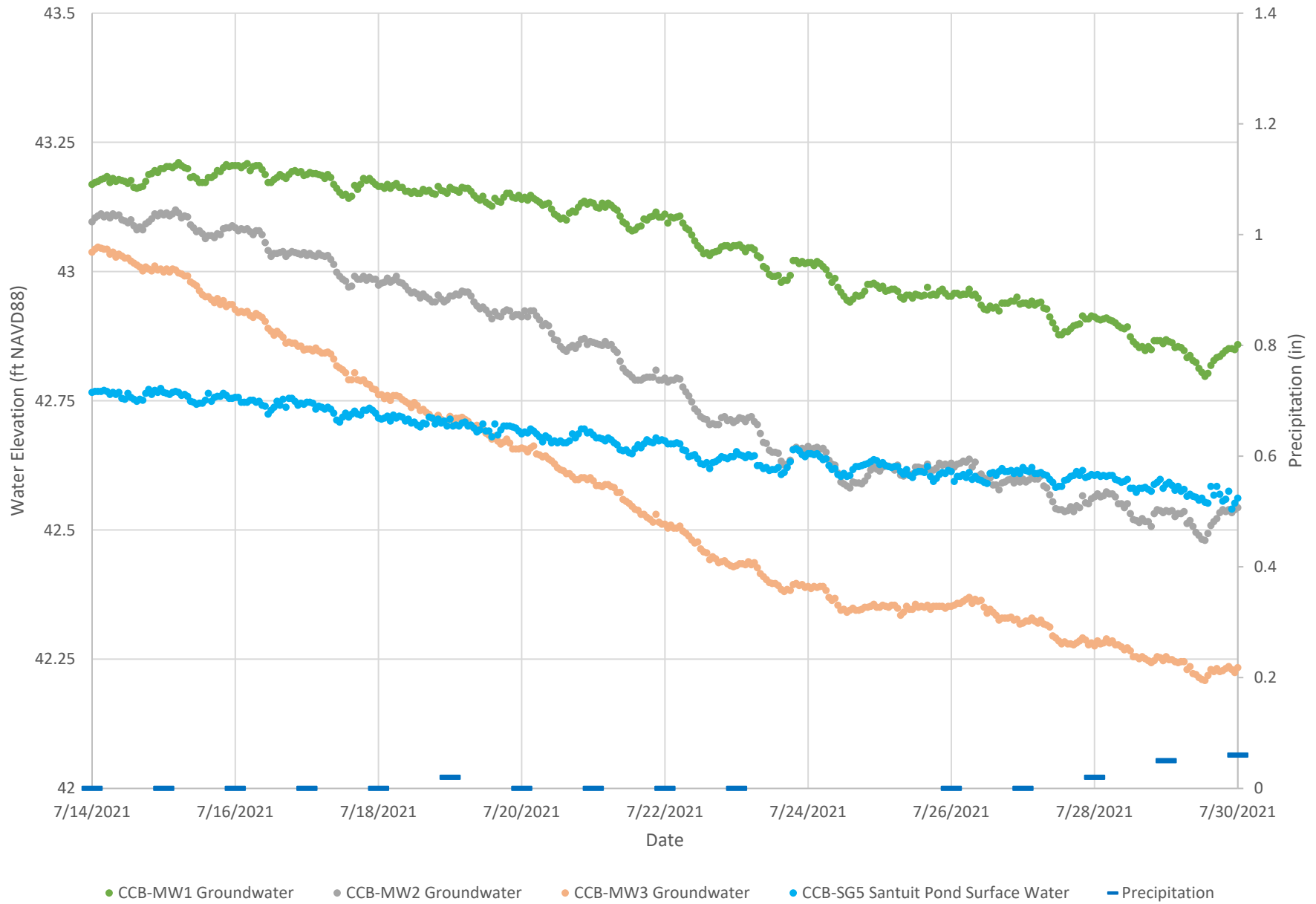
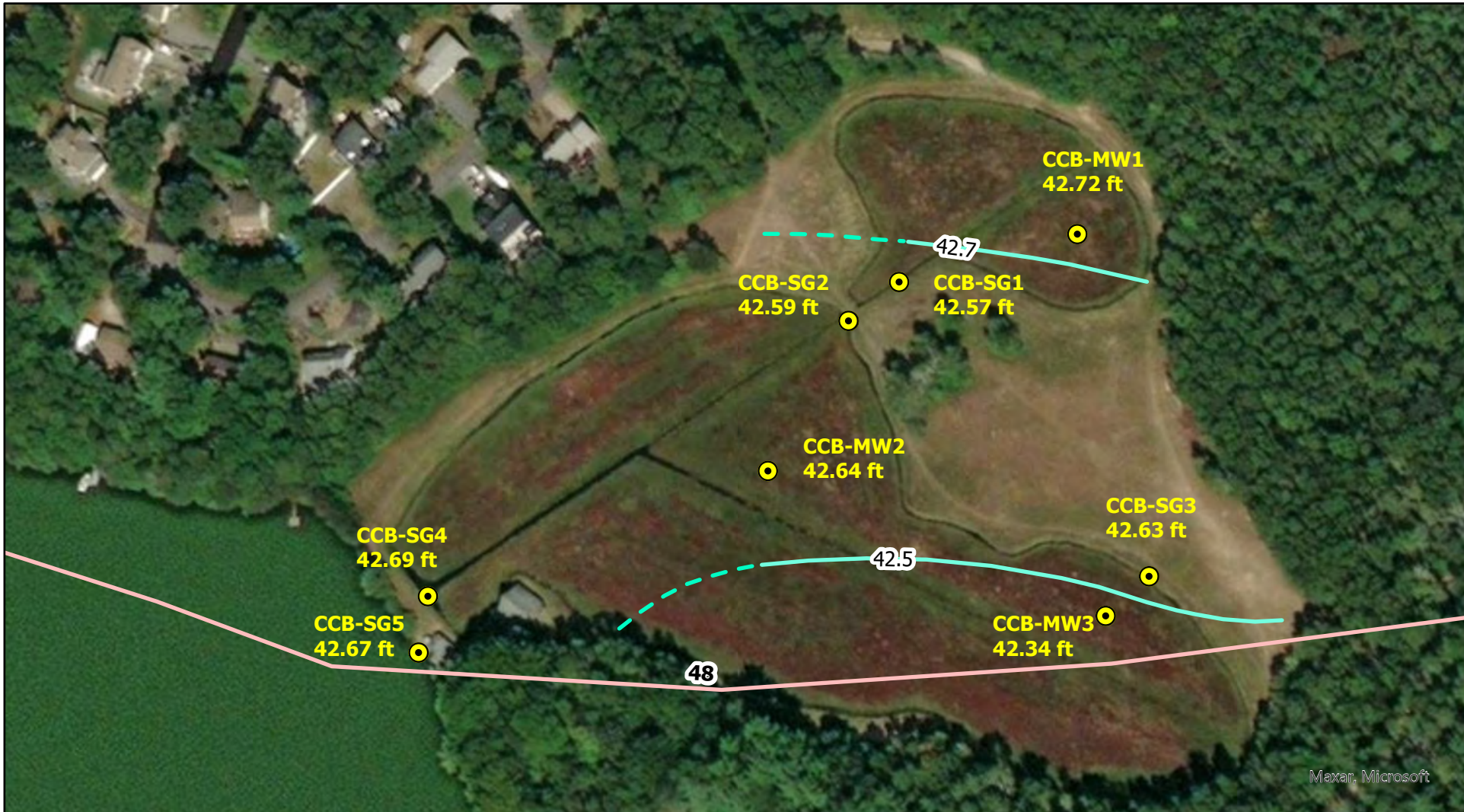


Figure 8. Chop Chaque Bog Complex - July Monitoring Period





Path: H:\Projects\2021\21073 Chop Chaque Mashpee\GIS\ChopChaqueBog\ChopChaqueBog.aprx

Legend

- Cape Cod Commission Water Table Contours (2 Foot Intervals)
- Field Data Locations
- 8/13/21 Water Table Contours (0.2 Foot Intervals)

Datums:

Horizontal - NAD83 feet
Vertical - NAVD88 feet



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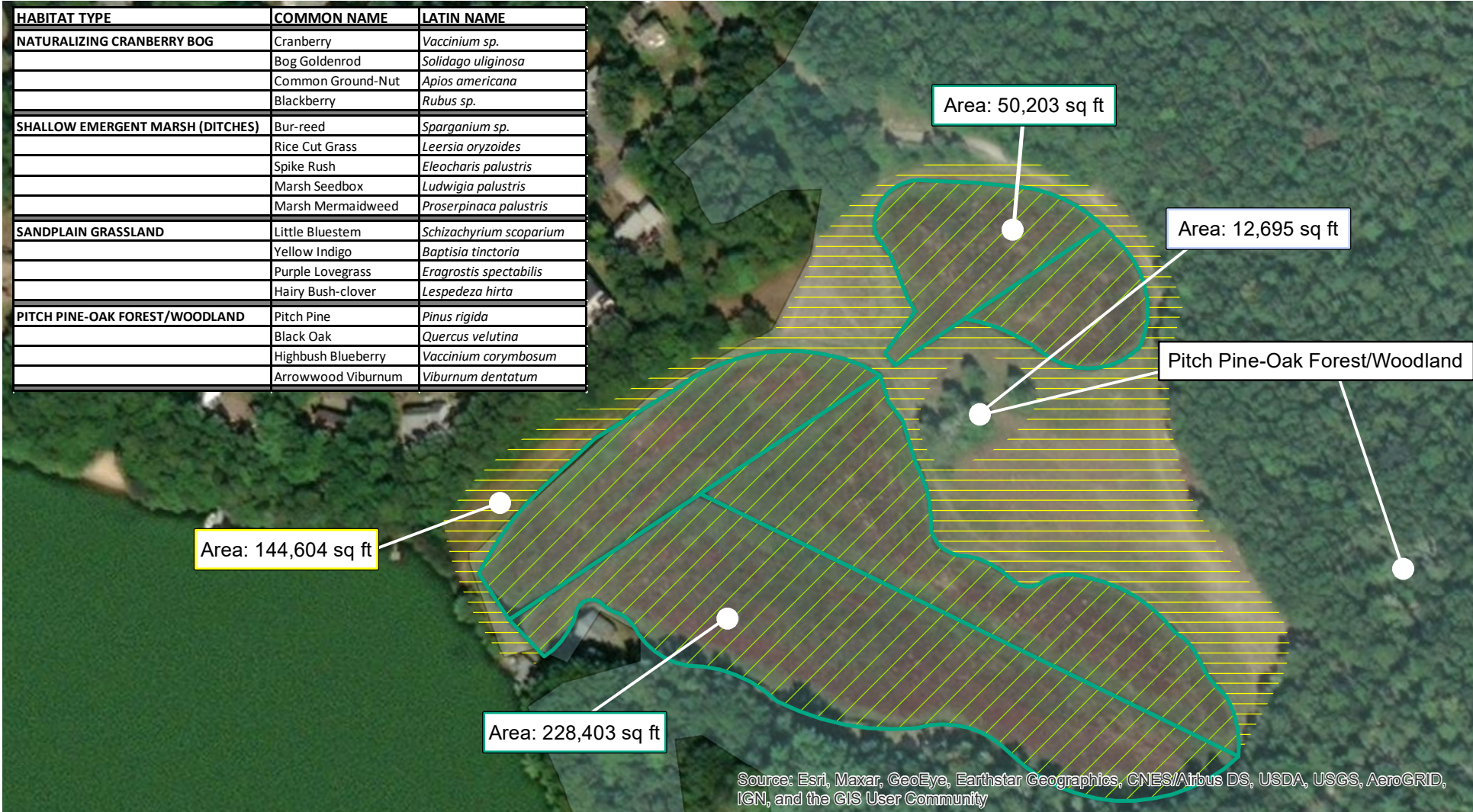


Chop Chaque Bogs
Water Table Contours
August 13th, 2021

Date: 10/13/2021

Figure 9

HABITAT TYPE	COMMON NAME	LATIN NAME
NATURALIZING CRANBERRY BOG	Cranberry	<i>Vaccinium sp.</i>
	Bog Goldenrod	<i>Solidago uliginosa</i>
	Common Ground-Nut	<i>Apios americana</i>
	Blackberry	<i>Rubus sp.</i>
SHALLOW EMERGENT MARSH (DITCHES)	Bur-reed	<i>Sparganium sp.</i>
	Rice Cut Grass	<i>Leersia oryzoides</i>
	Spike Rush	<i>Eleocharis palustris</i>
	Marsh Seedbox	<i>Ludwigia palustris</i>
	Marsh Mermaidweed	<i>Proserpinaca palustris</i>
SANDPLAIN GRASSLAND	Little Bluestem	<i>Schizachyrium scoparium</i>
	Yellow Indigo	<i>Baptisia tinctoria</i>
	Purple Lovegrass	<i>Eragrostis spectabilis</i>
	Hairy Bush-clover	<i>Lespedeza hirta</i>
PITCH PINE-OAK FOREST/WOODLAND	Pitch Pine	<i>Pinus rigida</i>
	Black Oak	<i>Quercus velutina</i>
	Highbush Blueberry	<i>Vaccinium corymbosum</i>
	Arrowwood Viburnum	<i>Viburnum dentatum</i>



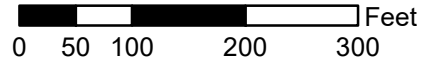
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: H:\Projects\2021\21073 Chop Chaque Mashpee\GIS\Maps\Habitat Diagram.mxd

Legend

- Bog Area
- Sandplain Grassland
- NHESP Estimated Habitats of Rare Wildlife
- Shallow Emergent Marsh

Datums:
 Horizontal - NAD1983
 Vertical - NAVD88



No FEMA Flood Hazard Areas in project area.

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**Vegetation Habitat Types
 Chop Chaque Bogs
 Mashpee, MA**



LEGEND:

GENERAL	SYMBOLS
--- 44 ---	PEAT THICKNESS CONTOUR - MINOR
--- 45 ---	PEAT THICKNESS CONTOUR - MAJOR
— — — — —	PROFILE CENTERLINE
— — — — —	BUILDING
— — — — —	HEADWALL
— — — — —	UTILITIES
— — — — —	DRAIN PIPE
○	MONITORING WELL
●	SOIL PROBING LOCATION
○	STAFF GAGE



Revisions

Rev.	Date	By	Appr.	Description
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Town: OCTOBER 2021
 Designed By: JWP
 Drawn By: JWP
 Checked By: PAC

Plan Set:
CHOP CHAQUE BOGS RESTORATION
CONCEPTUAL DESIGN
MASHPEE, MASSACHUSETTS

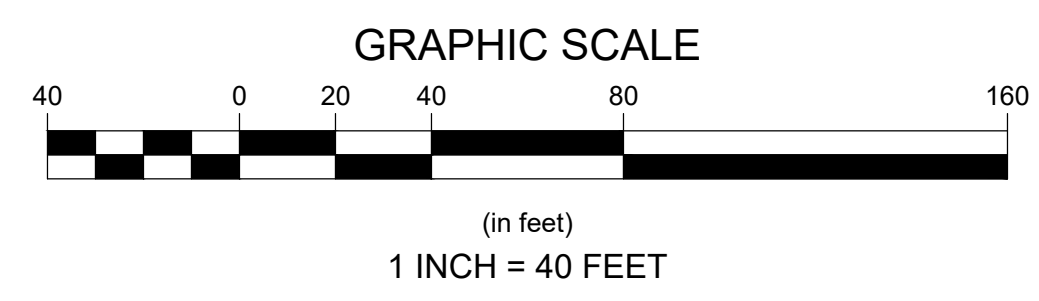
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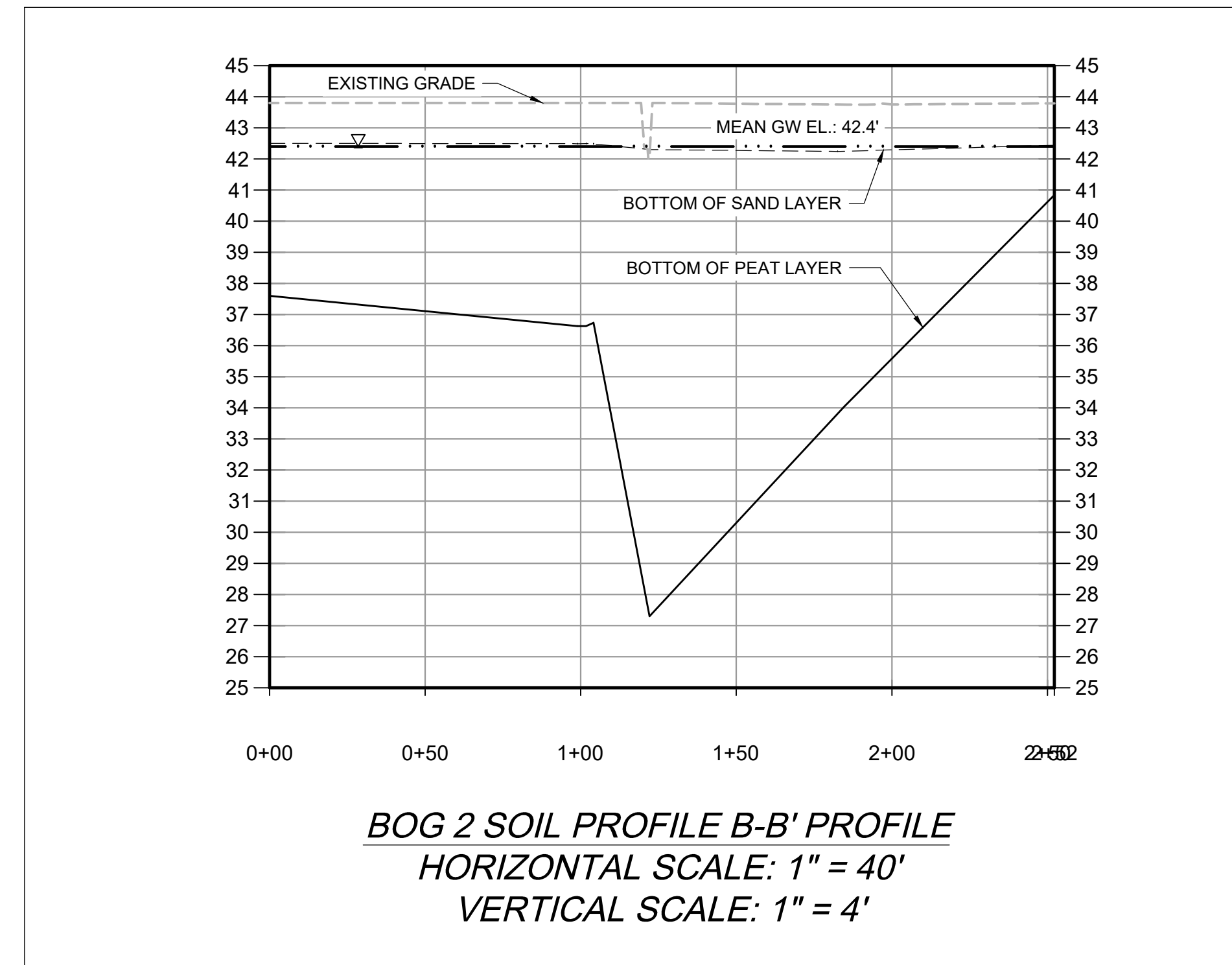
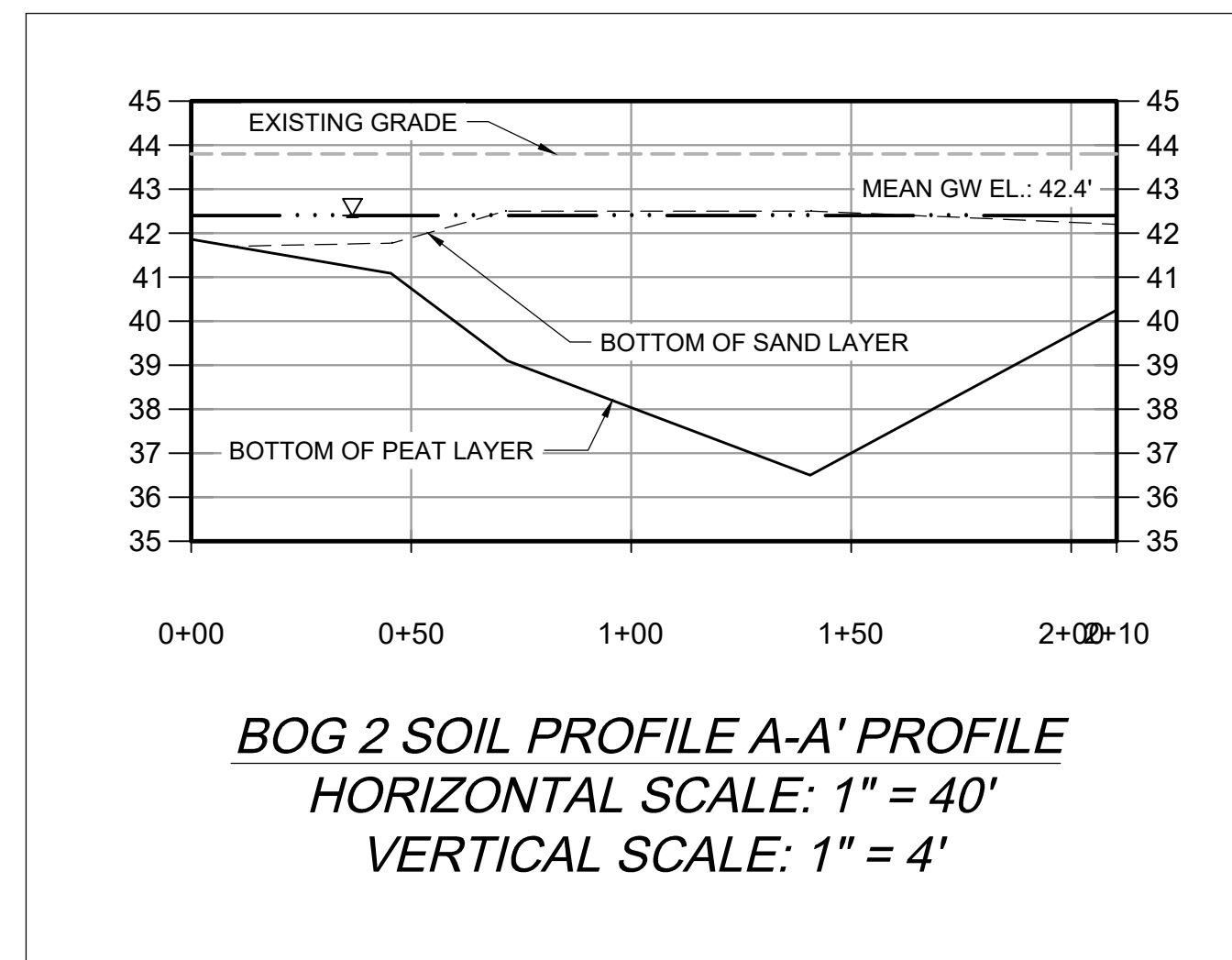
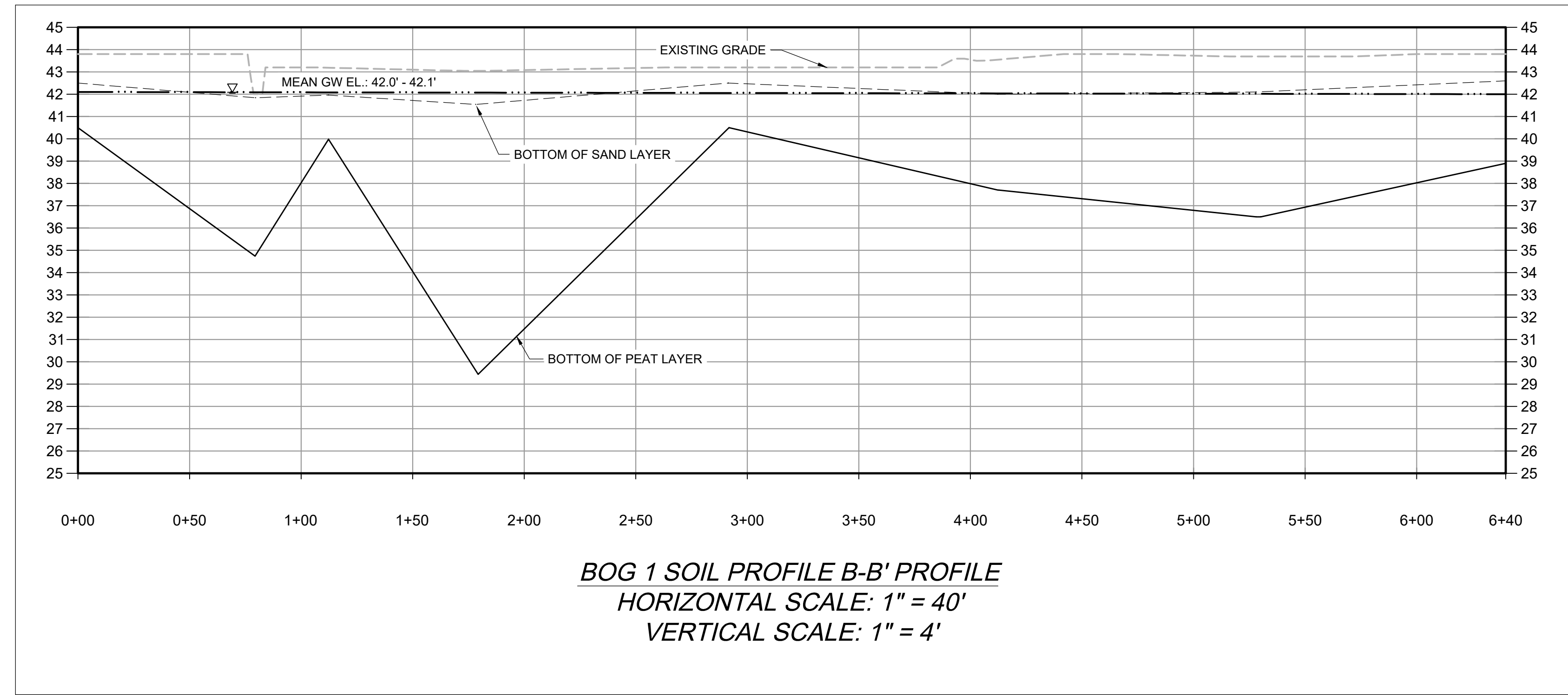
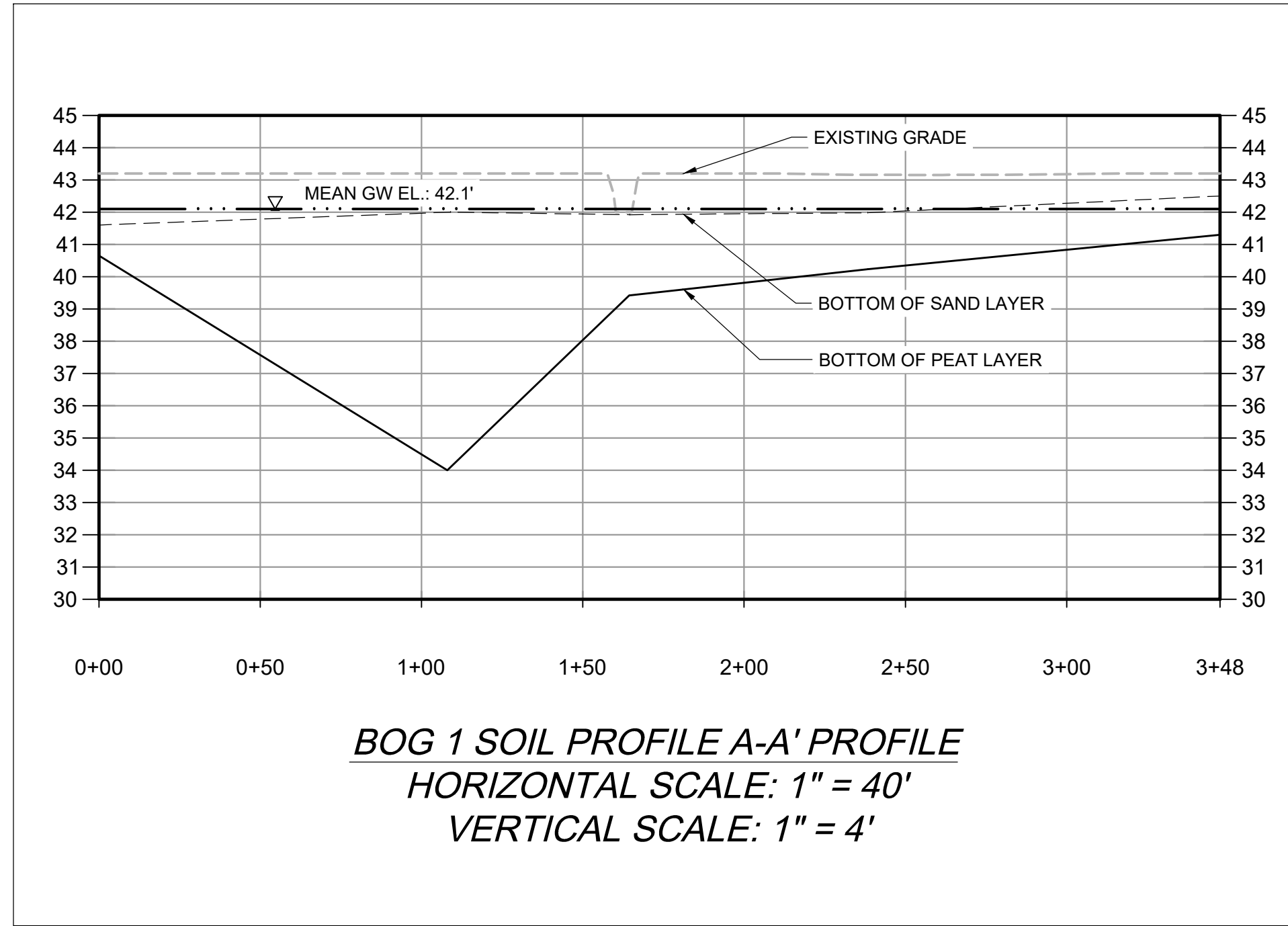
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Registration:
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 CONSTRUCTION

Project Number: 21073
 Figure: 11 of 12
 Sheet Number:





Revisions

Rev.	Date	By	Appr.	Description
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 Designated By: JWP
 Domain By: JWP
 Checked By: PAC
 Date: OCTOBER 2021

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Plan Set:
CHOP CHAQUE BOGS RESTORATION
CONCEPTUAL DESIGN
MASHPEE, MASSACHUSETTS

Plan Title:
SOIL PROFILES

Survey Provided By:
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 Fax: ---

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ATTACHMENT 1 – SOIL BORINGS LOG

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BORING LOG CCB-MW1

Project: Chop Chaque Cranberry Bog Restoration Client: Town of Mashpee Installer: J. Procton, M. Guerzon Boring Equipment: Hand Auger	Date: 7/12/2021 Completion Depth: 6' Elevation: Inspector: N. Price
--	--

Proportions Used:

		<u>Color</u>	<u>Misc.</u>		<u>Size</u>
trace (tr)	0 - 10%	Blue (Bl)	Fragments (frag.)	Fine = (f)	Fine to Coarse = (f-c)
little (li)	10 - 20%	Red (R)	Cement (cem.)	Medium = (m)	Very = (v)
some (so)	20 - 35%	Light (lt)	Well-Graded Sand (SW)	Coarse = (c)	More/Less = (+/-)
and	35 - 50%	Dark (dk)	Poorly-Graded Sand (SP)	Dark = (dk)	
		Rust (Ru)	Well-Graded Gravel (GW)		
		Tan (T)	Poorly-Graded Gravel (GP)		
		Brown (Br)	Below Land Surface (BLS)		
			Not Available (N/A)		

Bold indicates soil sample submitted for laboratory analysis.

Depth Feet	Description	Penetration (in)	Recovery (in)	PID	Comments
0-0.75	T m-c SAND, so f sand	9	9	NA	
0.75-1.5	T m-c SAND, so f sand	9	9	NA	Wet
1.5-2.75	Br SILT, with clay	15	15	NA	
2.75-6.0	Br SILT, with clay	39	0	NA	Peat, refusal at 6.0'

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BORING LOG CCB-MW2

Project: Chop Chaque Cranberry Bog Restoration	Date: 7/12/2021
Client: Town of Mashpee	Completion Depth: 7.5'
Installer: J. Procton, M. Guerzon	Elevation:
Boring Equipment: Hand Auger	Inspector: N. Price

Proportions Used:

	<u>Color</u>	<u>Misc.</u>	<u>Size</u>
trace (tr)	0 - 10%	Blue (Bl)	Fragments (frag.)
little (li)	10 - 20%	Red (R)	Cement (cem.)
some (so)	20 - 35%	Light (lt)	Well-Graded Sand (SW)
and	35 - 50%	Dark (dk)	Poorly-Graded Sand (SP)
		Rust (Ru)	Well-Graded Gravel (GW)
		Tan (T)	Poorly-Graded Gravel (GP)
		Brown (Br)	Below Land Surface (BLS)
			Not Available (N/A)

Fine = (f) **Fine to Coarse = (f-c)**
Medium = (m) **Very = (v)**
Coarse = (c) **More/Less = (+/-)**
Dark = (dk)

Bold indicates soil sample submitted for laboratory analysis.

Depth Feet	Description	Penetration (in)	Recovery (in)	PID	Comments
0-0.75	T m-c SAND, so f sand	9	9	NA	
0.75-1.5	T SILT (at 15"), and m-c sand	9	9	NA	Wet, peat
1.5-2.75	Br SILT (at 22") with clay	15	15	NA	Peat
2.75-4.0	Br/R SILT and clay	15	15	NA	Peat
4.0-4.92	Br SILT and clay	11	11	NA	Peat
4.92-7.5	Br SILT and clay	43	0	NA	Peat, refusal at 7.5'

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BORING LOG CCB-MW3

<p>Project: Chop Chaque Cranberry Bog Restoration</p> <p>Client: Town of Mashpee</p> <p>Installer: J. Procton, M. Guerzon</p> <p>Boring Equipment: Hand Auger</p>	<p>Date: 7/12/2021</p> <p>Completion Depth: 5.0'</p> <p>Elevation:</p> <p>Inspector: N. Price</p>
---	---

Proportions Used:					
		<u>Color</u>	<u>Misc.</u>		<u>Size</u>
trace (tr)	0 - 10%	Blue (Bl)	Fragments (frag.)	Fine = (f)	Fine to Coarse = (f-c)
little (li)	10 - 20%	Red (R)	Cement (cem.)	Medium = (m)	Very = (v)
some (so)	20 - 35%	Light (lt)	Well-Graded Sand (SW)	Coarse = (c)	More/Less = (+/-)
and	35 - 50%	Dark (dk)	Poorly-Graded Sand (SP)	Dark = (dk)	
		Rust (Ru)	Well-Graded Gravel (GW)		
		Tan (T)	Poorly-Graded Gravel (GP)		
		Brown (Br)	Below Land Surface (BLS)		
			Not Available (N/A)		

Bold indicates soil sample submitted for laboratory analysis.

Depth Feet	Description	Penetration (in)	Recovery (in)	PID	Comments
0-0.75	T m-c SAND, so f sand	9	9	NA	Wet at 4"
0.75-1.83	T m-c SAND, so f sand, tr gravel	13	13	NA	
1.83-2.67	Br SILT, so clay	10	10	NA	Peat
2.67-5.0	Br SILT, so clay	28	0	NA	Peat, refusal at 5.0'

ATTACHMENT 2 – CONCEPT-LEVEL DESIGN
PLANS

last modified: 10/14/21 printed: 10/14/21 by jp H:\Projects\2021\121073 Chop Chaque Mashpee\Drawings\21073 EX.dwg



LEGEND:

GENERAL	SYMBOLS
--- 44 ---	CONTOUR - MINOR
--- 45 ---	CONTOUR - MAJOR
—	PROFILE CENTERLINE
—	BUILDING
—	HEADWALL
—	UTILITIES
—	DRAIN PIPE
—	PROFILES
—	EXISTING GRADE
—	BOTTOM OF SAND LAYER
—	BOTTOM OF PEAT LAYER
—	ESTIMATED SEASONAL AVERAGE GROUNDWATER ELEVATION
(Symbol: Circle with crosshair)	MONITORING WELL
(Symbol: Circle with dot)	SOIL PROBING LOCATION
(Symbol: Circle)	STAFF GAGE

Revisions

Rev	Date	By	Appr	Description
1				
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Checked By: JAC
 Drawn By: JNP
 Designated By: JNP
 Date: OCTOBER 2021

CHOP CHAQUE BOGS RESTORATION
CONCEPTUAL DESIGN
MASHPEE, MASSACHUSETTS

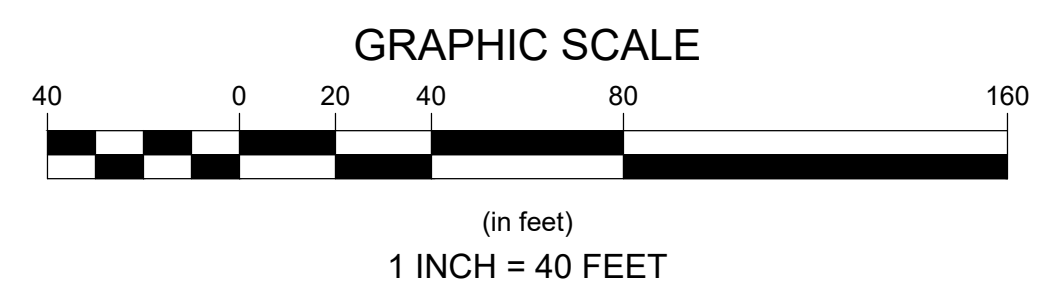
Plan Set:
EXISTING CONDITIONS PLAN

Prepared For:
Town of Mashpee
 16 Great Neck Road North
 Mashpee, MA 02563
 Phone: (508) 539-1400
 Fax: ---

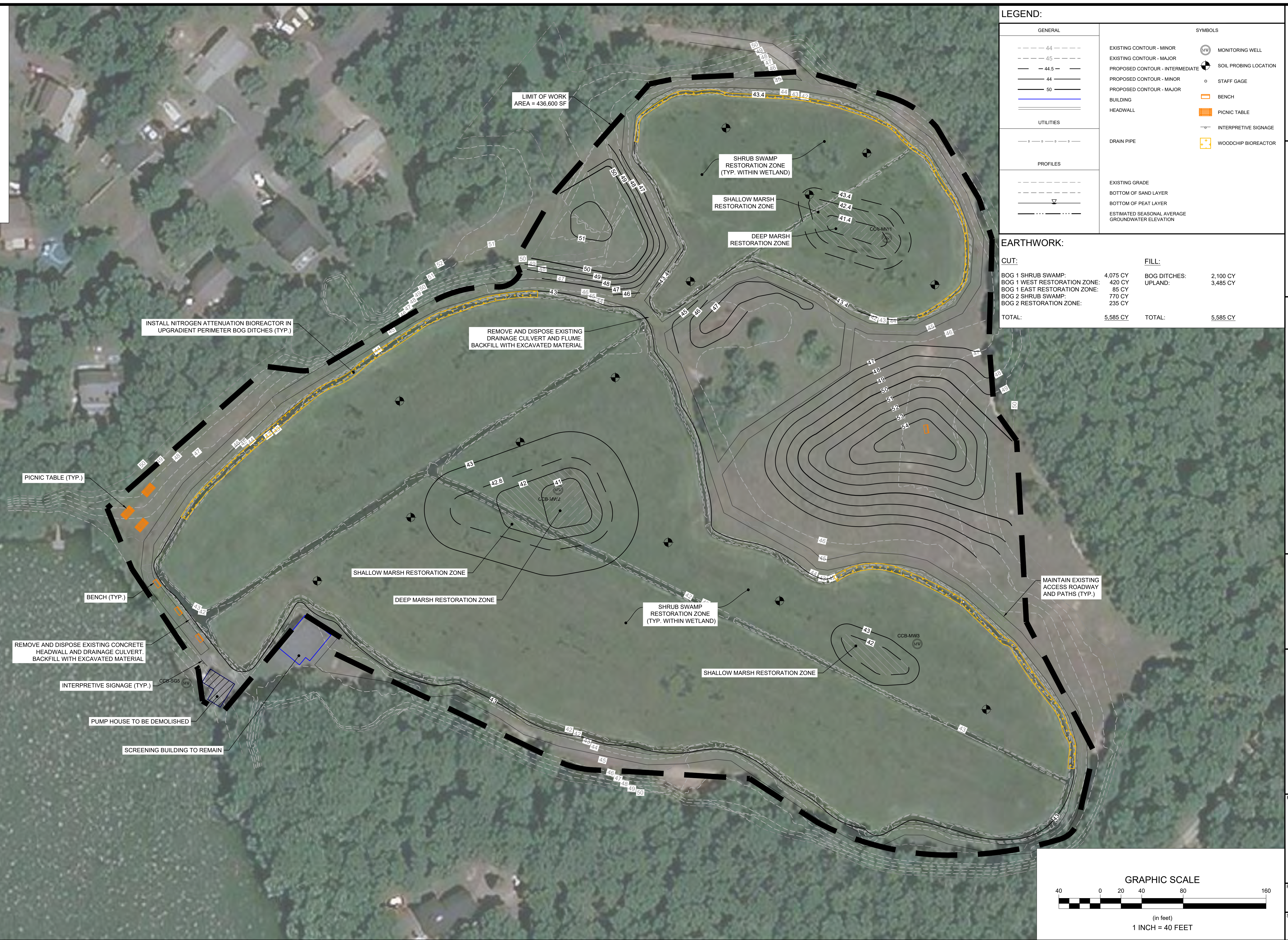
Survey Provided By:
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 Dated: OCTOBER 2021

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Project Number: 21073
 Sheet: 1 of 2
 Sheet Number: C-1



last modified: 10/14/21 printed: 10/14/21 by jp H:\Projects\2021\121073 Chop Chaque Mashpee\Drawings\21073 GD.dwg

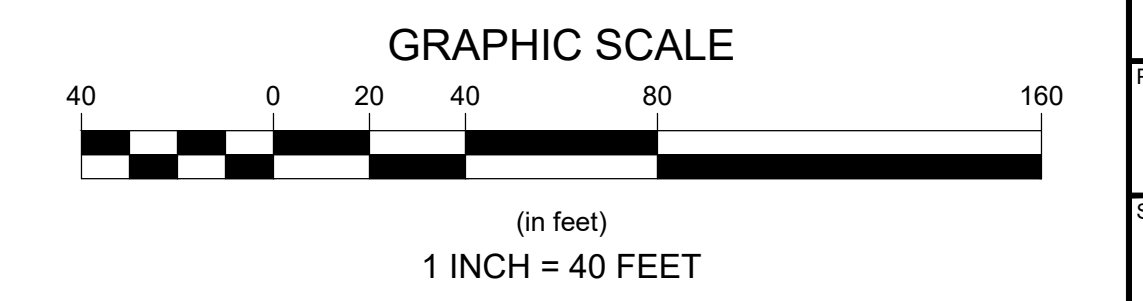


LEGEND:

GENERAL	SYMBOLS
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--- 45 ---	EXISTING CONTOUR - MAJOR
- - - 44 - - -	PROPOSED CONTOUR - INTERMEDIATE
--- 44 ---	PROPOSED CONTOUR - MINOR
--- 50 ---	PROPOSED CONTOUR - MAJOR
=====	BUILDING
=====	HEADWALL
-----o-----	UTILITIES
-----o-----	DRAIN PIPE
-----o-----	PROFILES
-----o-----	EXISTING GRADE
-----o-----	BOTTOM OF SAND LAYER
-----o-----	BOTTOM OF PEAT LAYER
-----o-----	ESTIMATED SEASONAL AVERAGE GROUNDWATER ELEVATION
○	MONITORING WELL
⊙	SOIL PROBING LOCATION
○	STAFF GAGE
□	BENCH
□	PICNIC TABLE
⊙	INTERPRETIVE SIGNAGE
⊕	WOODCHIP BIOREACTOR

EARTHWORK:

CUT:	FILL:
BOG 1 SHRUB SWAMP: 4,075 CY	BOG DITCHES: 2,100 CY
BOG 1 WEST RESTORATION ZONE: 420 CY	UPLAND: 3,485 CY
BOG 1 EAST RESTORATION ZONE: 85 CY	
BOG 2 SHRUB SWAMP: 770 CY	
BOG 2 RESTORATION ZONE: 235 CY	
TOTAL: 5,585 CY	TOTAL: 5,585 CY



<p>Revisions</p> <table border="1"> <thead> <tr> <th>Rev</th> <th>Date</th> <th>By</th> <th>Appr</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>		Rev	Date	By	Appr	Description					
Rev	Date	By	Appr	Description							
<p>Horsley Witten Group, Inc. Sustainable Environmental Solutions 90 Route 6A Sandwich, MA 02563 Phone: (508) 833-3150 Fax: (508) 833-3150 508-833-6600 voice 508-833-3150 fax</p>											
<p>Prepared For: Town of Mashpee 16 Great Neck Road North Mashpee, MA 02563 Phone: (508) 539-1400 Fax: ---</p>	<p>Survey Provided By: Horsley Witten Group, Inc. 90 Route 6A Sandwich, MA 02563 Phone: (508) 833-3150 Fax: (508) 833-3150 Dated: OCTOBER 2021</p>										
<p>Project Number: 21073 Sheet: 2 of 2</p> <p>Sheet Number: C-2</p>											
<p>DRAFT NOT FOR CONSTRUCTION</p>											
<p>CHOP CHAQUE BOGS RESTORATION CONCEPTUAL DESIGN MASHPEE, MASSACHUSETTS</p>											
<p>GRADING AND RESTORATION PLAN</p>											

ATTACHMENT 3 – CONCEPTUAL OPINION OF
PROBABLE COSTS



Project: Chop Chaque Cranberry Bogs Restoration
Location: Mashpee, Massachusetts

Submission: 10% Cost Estimate
Date: 10/14/2021

Estimator: JPM **Checked By:** NP

GENERAL SITEWORK	Unit	Quantity	Unit Cost	Total Cost
SITE PREPARATION & CLEARING				
Site Mobilization / Demobilization	LS	1	\$ 10,000.00	\$ 10,000.00
Building Demo	SF	575	\$ 20.00	\$ 11,500.00
Remove and Dispose Existing Drainage Structure	EA	2	\$ 2,000.00	\$ 4,000.00
Subtotal Site Preparation & Clearing			\$ 25,500.00	
WETLAND RESTORATION				
Dewatering	LS	1	\$ 10,000.00	\$ 10,000.00
Excavation	CY	5,585	\$ 50.00	\$ 279,250.00
Fill Excavated Material	CY	5,585	\$ 40.00	\$ 223,400.00
Seeding of Fill Areas	SY	5,800	\$ 2.25	\$ 13,050.00
Wetland Seed Mix	SY	32,020	\$ 2.25	\$ 72,045.00
Woodchip Bioreactor	CY	56	\$ 180.00	\$ 10,080.00
Subtotal Wetland Restoration			\$ 607,825.00	
SITE FEATURES				
Interpretive Signage	EA	2	\$ 5,000.00	\$ 10,000.00
Bench	EA	4	\$ 2,500.00	\$ 10,000.00
Picnic Table	EA	3	\$ 4,000.00	\$ 12,000.00
Subtotal Site Features			\$ 32,000.00	
TOTAL GENERAL SITE			\$ 665,325.00	

TOTAL ESTIMATED CONSTRUCTION COST		\$ 665,325.00
CONTIGENCY	50%	332,670.00
TOTAL ESTIMATED COST		\$ 997,995.00

Qualifications:

The following items are not included in the scope of work:

Erosion Controls and Tree Protection
Contaminated Soil
Sheeting / Earth Support

Quantities provided are based on conceptual plans "Chop Chaque Bogs Restoration, Conceptual Design, Mashpee, MA" October 2021, prepared by Horsley Witten Group.

Unit prices provided are based upon typical 2021 construction costs and data. Unit prices are subject to change due to adjustments to material and labor costs, site conditions and inflation.