



June 5, 2025

Delia Kaye

Natural Resources Director

Town of Concord Natural Resources Division

141 Keyes Road, Concord, MA 01742

**RE: BATHYMETRIC AND SEDIMENT THICKNESS MAPPING, WARNER'S POND
CONCORD, MA**

Dear Ms. Kaye,

CR Environmental, Inc. (CR), a small, certified WBE based in Falmouth, Massachusetts, conducted bathymetric and sediment thickness surveys of accessible portions of Warner's Pond in Concord, MA on May 20 and 21, 2025. Surveys were directed by a National Society of Professional Surveyors (NSPS) certified hydrographer and reviewed by Doucet Surveys, LLC now part of Survey and Mapping Services, LLC (SAM).

Survey methods and results are reported below.

1.0 VESSEL OPERATION AND NAVIGATION

The survey was conducted using CR's 12-foot survey skiff *Menidia*. The vessel was equipped with an instrument enclosure, side-mounted transducer pole, and 12-volt and 110-volt power supplies. Vessel positioning was accomplished using a Hemisphere VS-330 RTK GPS system. In fixed RTK mode GPS accuracy is approximately 1 cm horizontally and 2 cm vertically. The GPS and echo sounder were interfaced to a computer running HYPACK hydrographic surveying software. During the survey, this system calculated X and Y positions in the desired grid system (MA Mainland State Plane, NAD83, US ft), recorded the depth, water surface elevation

(inclusive of vessel settlement) and navigation data, and provided a steering display for the vessel captain. HYPACK depicted the progress of the survey using georeferenced files (e.g., orthophotos) as background files, ensuring that the survey area was adequately insonified.

CR occupied survey transects spaced 25 feet apart, perpendicular to the longitudinal axis of the pond. Additional crossline transects spaced 250 feet apart were occupied perpendicular to the mainstay transects to provide quality control and allow for statistical documentation of accuracy. Dense stands of aquatic were present over much of the pond and hindered or prevented vessel access (image below).



Typical vegetation density on May 20, 2025

2.0 METHODS

2.1 Bathymetric Survey Methods

2.1.1 Data Acquisition

Single-beam survey data were acquired using a Teledyne Odom, Inc. CV-100 echo sounder equipped with an 8-degree 200-kHz transducer. The echosounder draft was verified by comparing echosounder water depth measurements to staff measurements. These checks confirmed transducer draft to within 0.1 feet. An additional calibration was conducted *in situ* by collecting a water column profile of sound velocity using an AML-3 sound velocity profiler. The water column was well mixed and no corrections for sound velocity were required during processing. CR established temporary benchmarks (TBM) at two nearshore locations, recorded the RTK GPS position and elevation of these points and measured the height of the benchmarks above the water surface (Table 1, Figure 1). SAM, LLC subsequently surveyed each of the TBM points. The water surface elevation calculated using SAM's survey data were preferentially used during data processing.

In areas too shallow for acquisition of echo sounder data or with overwhelming vegetation density, CR occupied a grid of manual staff (depth) and probe (sediment thickness) points spaced approximately 150 feet apart.

2.1.2 Bathymetric Data Processing

Processing of sounding data was conducted using HYPACK software and consisted of the removal of outlying data points associated with water column interference (e.g., vegetation) and conversion of raw soundings to NAVD88 elevations based on RTK GPS observations. In many portions of the pond vegetation partially obscured the sediments surface. Where possible and defensible, CR digitized the sediment surface apparent on echograms (digital profile images) beneath the stands of vegetation.

The accuracy of processed bathymetric data was statistically computed by comparing differences between overlapping portions of mainstay (primary) transects and crossline transects. Processed echo sounder data were exported as an ASCII space-delimited file. Elevation corrected staff point data from 135 locations were merged with this acoustic database to allow construction of a gridded bathymetric surface extending as near to the shoreline as possible.

Bathymetric data were interpolated to generate a grid (raster) with a node separation of 10 feet x 10 feet. The resultant grid was used to generate digital contours and georeferenced bathymetric images of the survey area. All data has been delivered digitally. Data were projected to the Massachusetts Mainland State Plane, NAD83, US ft. Data are vertically referenced to NAVD88 using the SAM, LLC benchmark information. Layers include IDXYZSource point data, a 10-foot x 10-foot resolution raster grid in GeoTIFF format, a 3D representation of the sediment surface in GeoTIFF format and 1.0-foot contours in DXF and .shapefile formats suitable for analysis and plotting in CAD and GIS software. Digital data were provided to SAM for review and generation of a CAD drawing and delivery of two hard copies and .DWG and .XML digital files.

2.2 Sediment Thickness Mapping Methods

The thickness of sediments in Warner's Pond was determined by manually advancing a steel probe rod to refusal. Staff measurements of water depth, GPS locations, refusal depth and interpreted refusal substrate type were digitally recorded at each probe location. One hundred thirty-five probe locations were occupied. Tabular probe data have been digitally delivered. Data were used to generate a georeferenced map of estimated sediment thickness.

3.0 RESULTS

3.1 Bathymetric Results

The total length of survey transects was approximately 13.3 statute miles. Survey track lines are shown on Figure 1. Some littoral portions of the pond were too shallow for safe navigation.

Mapped elevations ranged from 107.2 feet NAVD88 to 119.6 feet NAVD88 (Figure 2, and Bathymetric Plan for CR Environmental, Inc. of Warner's Pond Concord, MA). The mean pond bed elevation was 115.5 feet NAVD88.

Bathymetric data were statistically analyzed to evaluate accuracy according to U. S. Army Corps of Engineers specifications (USACE, 2013). Crossline statistics for the bathymetric dataset yielded a negligible bias of -0.037 feet and a standard deviation of 0.206 feet, documenting the compliance with USACE hydrographic accuracy recommendations.

3.2 Sediment Thickness Mapping Results

Sediment thickness was measured as the difference between probe refusal depths and the manual staff measurements of water depth (Table 2 and Figure 3). Sediment thickness at the one hundred thirty-five probe stations ranged from 0.0 feet to 15.2 feet (mean = 4.2 feet). The subjectively assessed dominant refusal substrate texture was sand at 46% of the stations, followed by peat at 19%, gravel at 15%, mud or muddy sand at 13%, and rock at 7%.

REFERENCES

U.S. Army Corps of Engineers. 30 November 2013. *Engineering and Design. Hydrographic Surveying*. EM 1110-2-1003.

Sincerely,

CR Environmental, Inc.

Charlotte Cogswell, President

TABLES

TABLE 1

**TEMPORARY BENCHMARK LOCATION AND ELEVATION DATA
Warner's Pond
Concord, Massachusetts May 20 - 21, 2025
(Values in Feet)**

BENCHMARK INFORMATION					
<u>BM</u>	<u>X (Easting)</u>	<u>Y (Northing)</u>	<u>CR - NAVD88 EL</u>	<u>SAM - NAVD88 EL</u>	<u>EL DIFFERENCE</u>
BM Boat Ramp (9002)	683398.9	2993493.93	121.26	121.35	0.09
BM Park (9001)	683089.7	2994414.9	120.79	121.06	0.27

IN-SITU MEASUREMENT OF WATER SURFACE ELEVATION USING SAM DATA				
<u>BM ID</u>	<u>DATE</u>	<u>TIME</u>	<u>TOP OF BM STAKE TO WATER SURFACE</u>	<u>WS EL</u>
BM Boat Ramp (9002)	5/20/2025	10:04	1.84	119.51
		16:08	1.84	119.51
BM Park (9001)	5/20/2025	10:14	1.43	119.63
		16:00	1.42	119.64
		AVERAGE		119.57
<u>BM ID</u>	<u>DATE</u>	<u>TIME</u>	<u>TOP OF BM STAKE TO WATER SURFACE</u>	<u>WS EL</u>
BM Boat Ramp (9002)	5/21/2025	8:16	1.89	119.46
		15:58	1.89	119.46
BM Park (9001)	5/21/2025	8:04	1.46	119.60
		16:11	1.48	119.58
		AVERAGE		119.53

NOTES:

CR - CR Environmental, Inc. 639 Boxberry Hill Road, E. Falmouth, MA 02536

SAM - Survey and Mapping, LLC, 102 Kent Place, Newmarket, NH 03857

TABLE 2

WARNER'S POND STAFF AND PROBE MEASUREMENTS

Concord, Massachusetts

May 21, 2025

(Values in Feet)

POINT ID	DATE-TIME	X	Y	WATER DEPTH (FT)	BOTTOM EL NAVD88	REFUSAL DEPTH (FT)	REFUSAL EL NAVD88	REFUSAL TYPE	THICKNESS (FT)
P1	5/21/2025 8:57	682908.85	2994605.01	3.2	116.3	4.0	115.5	Gravel	0.8
P2	5/21/2025 8:59	682822.82	2994610.44	8.8	110.7	21.7	97.8	Mud	12.9
P3	5/21/2025 9:07	682689.86	2994599.77	11.2	108.3	22.2	97.3	Mud	11.0
P4	5/21/2025 9:09	682533.46	2994596.05	10.3	109.2	22.4	97.1	Mud	12.1
P5	5/21/2025 9:16	682389.12	2994592.6	6.0	113.5	15.4	104.1	Gravel	9.4
P6	5/21/2025 9:20	682387.06	2994437.1	5.9	113.6	21.1	98.4	Mud	15.2
P7	5/21/2025 9:24	682536.75	2994444.61	11.0	108.5	22.3	97.2	Mud	11.3
P8	5/21/2025 9:26	682684.21	2994449.35	12.2	107.3	22.4	97.1	Mud	10.2
P9	5/21/2025 9:30	682833.84	2994462.57	11.1	108.4	20.0	99.5	Mud	8.9
P10	5/21/2025 9:33	682996.26	2994320.98	5.7	113.8	15.5	104.0	Muddy Sand	9.8
P11	5/21/2025 9:38	682846.41	2994309.56	7.1	112.4	15.4	104.1	Muddy Sand	8.3
P12	5/21/2025 9:43	682697.22	2994305.28	4.7	114.8	12.3	107.2	Peat	7.6
P13	5/21/2025 9:46	682550.82	2994296.23	4.6	114.9	8.9	110.6	Peat	4.3
P14	5/21/2025 9:48	682399.33	2994287.63	4.7	114.8	13.6	105.9	Sand	8.9
P15	5/21/2025 9:52	682242.72	2994287.02	4.2	115.3	16.0	103.5	Mud	11.8
P16	5/21/2025 9:53	682174.22	2994281.32	3.8	115.7	7.7	111.8	Sand	3.9
P17	5/21/2025 9:57	682239.44	2994426.49	4.8	114.7	6.9	112.6	Peat	2.1
P18	5/21/2025 10:00	682244.43	2994577.2	4.6	114.9	9.0	110.5	Sand	4.4
P19	5/21/2025 10:03	682276.69	2994703.22	3.2	116.3	7.2	112.3	Sand	4.0
P20	5/21/2025 10:06	682368.17	2994733.14	4.0	115.5	15.0	104.5	Mud	11.0
P21	5/21/2025 10:09	682455.69	2994738.17	3.8	115.7	5.2	114.3	Sand	1.4
P22	5/21/2025 10:12	682523.37	2994723.63	3.9	115.6	4.3	115.2	Rock	0.4
P23	5/21/2025 10:14	682674.76	2994717.5	4.6	114.9	6.5	113.0	Gravel	1.9
P24	5/21/2025 10:17	682835.1	2994670.3	5.0	114.5	6.2	113.3	Gravel	1.2
P25	5/21/2025 10:21	682985.72	2994469.22	4.6	114.9	5.7	113.8	Sand	1.1
P26	5/21/2025 10:23	683141.11	2994328.16	4.3	115.2	5.5	114.0	Gravel	1.2
P27	5/21/2025 10:26	683526.35	2994192.71	3.3	116.2	3.3	116.2	Rock	0.0
P28	5/21/2025 10:27	683453.18	2994190.57	5.3	114.2	10.8	108.7	Peat	5.5
P29	5/21/2025 10:30	683298.62	2994182.9	5.3	114.2	15.5	104.0	Mud	10.2
P30	5/21/2025 10:32	683154.23	2994173.17	4.9	114.6	14.5	105.0	Mud	9.6
P31	5/21/2025 10:35	683002.84	2994168.02	6.0	113.5	15.0	104.5	Peat	9.0
P32	5/21/2025 10:39	682851.92	2994161.05	4.6	114.9	9.6	109.9	Peat	5.0
P33	5/21/2025 10:41	682710.39	2994150.1	4.5	115.0	9.3	110.2	Sand	4.8
P34	5/21/2025 10:45	682547.66	2994145.89	3.8	115.7	7.8	111.7	Peat	4.0
P35	5/21/2025 10:47	682402.04	2994136.61	4.1	115.4	7.9	111.6	Sand	3.8
P36	5/21/2025 10:51	682269.96	2994131.21	2.6	116.9	3.6	115.9	Sand/Gravel	1.0
P37	5/21/2025 10:55	682180.51	2994138.25	3.3	116.2	4.8	114.7	Sand	1.5
P38	5/21/2025 10:59	682407.59	2993989.13	3.5	116.0	7.5	112.0	Sand	4.0
P39	5/21/2025 11:02	682264.44	2993955.39	1.6	117.9	3.7	115.8	Sand	2.1
P40	5/21/2025 11:06	682105.15	2993955.77	2.0	117.5	6.7	112.8	Peat	4.7
P41	5/21/2025 11:10	681667.69	2993872.57	2.7	116.8	6.6	112.9	Sand	3.9
P42	5/21/2025 11:12	681766.2	2994014.11	2.1	117.4	5.9	113.6	Sand	3.8
P43	5/21/2025 11:14	681881.25	2993928.26	3.9	115.6	5.8	113.7	Sand	1.9
P44	5/21/2025 11:16	681844.73	2993859.47	2.4	117.1	4.5	115.0	Sand	2.1
P45	5/21/2025 11:17	681997.24	2993809.14	1.6	117.9	7.7	111.8	Peat	6.1
P46	5/21/2025 11:19	681968.57	2993894.86	2.3	117.2	6.1	113.4	Sand	3.8
P47	5/21/2025 11:22	682138.66	2993823.41	3.1	116.4	8.4	111.1	Peat	5.3
P48	5/21/2025 11:24	682267.12	2993831.55	2.4	117.1	6.9	112.6	Sand	4.5
P49	5/21/2025 11:26	682414.18	2993839.91	3.5	116.0	8.2	111.3	Sand	4.7
P50	5/21/2025 11:28	682556.55	2993994.38	5.6	113.9	7.9	111.6	Sand	2.3
P51	5/21/2025 11:30	682707.58	2994000.74	3.0	116.5	9.8	109.7	Sand	6.8
P52	5/21/2025 11:32	682860.99	2994009.69	4.1	115.4	10.5	109.0	Mud	6.4
P53	5/21/2025 11:35	683012.43	2994027.15	1.2	118.3	1.2	118.3	Rock	0.0
P54	5/21/2025 11:37	683150.7	2994038.4	3.4	116.1	4.4	115.1	Sand	1.0
P55	5/21/2025 11:38	683307.69	2994034.89	1.7	117.8	3.3	116.2	Sand	1.6
P56	5/21/2025 11:40	683460.11	2994043.38	5.3	114.2	9.5	110.0	Sand	4.2
P57	5/21/2025 11:42	683602.3	2994050.92	3.2	116.3	4.7	114.8	Sand	1.5
P58	5/21/2025 11:44	683557.31	2993898.44	4.3	115.2	6.0	113.5	Sand	1.7
P59	5/21/2025 11:46	683461.68	2993894.15	6.0	113.5	11.9	107.6	Muddy Sand	5.9
P60	5/21/2025 11:48	683313.1	2993886.35	5.3	114.2	14.3	105.2	Peat	9.0
P61	5/21/2025 11:51	683204.4	2993878.44	2.6	116.9	4.1	115.4	Gravel	1.5
P62	5/21/2025 12:11	682978.39	2993858.78	1.5	118.0	3.0	116.5	Gravel	1.5
P63	5/21/2025 12:14	682862.27	2993863.09	4.0	115.5	12.6	106.9	Mud	8.6
P64	5/21/2025 12:18	682722.15	2993853.71	3.8	115.7	10.1	109.4	Peat	6.3
P65	5/21/2025 12:20	682568.42	2993852.01	1.0	118.5	1.1	118.4	Rock	0.1
P66	5/21/2025 12:24	682335.93	2993676.43	1.5	118.0	4.2	115.3	Gravel	2.7
P67	5/21/2025 12:25	682272.91	2993682.87	3.7	115.8	8.2	111.3	Sand	4.5

POINT ID	DATE-TIME	X	Y	WATER DEPTH (FT)	BOTTOM EL NAVD88	REFUSAL DEPTH (FT)	REFUSAL EL NAVD88	REFUSAL TYPE	THICKNESS (FT)
P68	5/21/2025 12:29	682131.74	2993674.72	2.0	117.5	7.3	112.2	Sand	5.3
P69	5/21/2025 12:32	681952.92	2993514.14	3.4	116.1	6.7	112.8	Peat	3.3
P70	5/21/2025 12:34	682015.31	2993620.53	1.7	117.8	4.3	115.2	Sand	2.6
P71	5/21/2025 12:37	682138.34	2993526.99	1.9	117.6	7.2	112.3	Sand	5.3
P72	5/21/2025 12:39	682135.49	2993417.24	2.2	117.3	6.3	113.2	Peat	4.1
P73	5/21/2025 12:40	682060.98	2993441.82	2.5	117.0	8.4	111.1	Peat	5.9
P74	5/21/2025 12:43	682280.85	2993533.94	2.6	116.9	6.6	112.9	Sand	4.0
P75	5/21/2025 12:45	682378.55	2993543.79	1.9	117.6	5.3	114.2	Sand	3.4
P76	5/21/2025 12:48	682437.77	2993390.68	2.0	117.5	5.0	114.5	Sand	3.0
P77	5/21/2025 12:49	682363.78	2993384.94	1.0	118.5	3.9	115.6	Sand	2.9
P78	5/21/2025 12:52	682469.38	2993386.89	1.6	117.9	5.3	114.2	Sand	3.7
P79	5/21/2025 12:58	682861.2	2993711.23	1.4	118.1	3.6	115.9	Gravel	2.2
P80	5/21/2025 13:01	683028.61	2993716.19	4.6	114.9	11.5	108.0	Mud	6.9
P81	5/21/2025 13:05	683171.53	2993724.92	5.0	114.5	11.0	108.5	Peat	6.0
P82	5/21/2025 13:09	683324.2	2993729.19	4.2	115.3	13.8	105.7	Sand	9.6
P83	5/21/2025 13:11	683471.72	2993740.73	4.1	115.4	6.8	112.7	Sand	2.7
P84	5/21/2025 13:13	683539.87	2993744.7	2.3	117.2	4.1	115.4	Rock	1.8
P85	5/21/2025 13:16	683470.06	2993581.69	1.9	117.6	3.8	115.7	Sand	1.9
P86	5/21/2025 13:18	683325.05	2993586.86	4.4	115.1	8.9	110.6	Sand	4.5
P87	5/21/2025 13:20	683177.47	2993575.72	4.9	114.6	12.2	107.3	Sand	7.3
P88	5/21/2025 13:23	683030.47	2993572.84	4.3	115.2	9.2	110.3	Sand	4.9
P89	5/21/2025 13:25	682931.6	2993563.99	2.8	116.7	4.9	114.6	Gravel	2.1
P90	5/21/2025 13:28	682931.43	2993416.19	2.1	117.4	4.7	114.8	Sand	2.6
P91	5/21/2025 13:30	683035.11	2993417.37	4.3	115.2	7.9	111.6	Sand	3.6
P92	5/21/2025 13:34	683188.82	2993424.37	5.5	114.0	10.9	108.6	Sand	5.4
P93	5/21/2025 13:36	683333.37	2993419.16	2.1	117.4	5.7	113.8	Sand	3.6
P94	5/21/2025 13:39	683188.35	2993275.83	2.6	116.9	6.2	113.3	Sand	3.6
P95	5/21/2025 13:41	683051.7	2993266.38	6.2	113.3	9.7	109.8	Gravel	3.5
P96	5/21/2025 13:44	682952.59	2993218.72	1.2	118.3	4.7	114.8	Sand	3.5
P97	5/21/2025 13:47	682904.61	2993116.15	3.5	116.0	5.6	113.9	Sand	2.1
P98	5/21/2025 13:49	682759.97	2993100.1	1.4	118.1	6.3	113.2	Sand	4.9
P99	5/21/2025 13:52	682608.86	2993099.43	3.3	116.2	6.7	112.8	Sand	3.4
P100	5/21/2025 13:54	682455.6	2993091.32	2.5	117.0	6.2	113.3	Peat	3.7
P101	5/21/2025 13:56	682302.22	2993086.6	3.3	116.2	5.3	114.2	Peat	2.0
P102	5/21/2025 13:58	682158.45	2993075.52	2.9	116.6	4.9	114.6	Peat	2.0
P103	5/21/2025 14:00	682156.57	2993189.27	1.2	118.3	4.8	114.7	Peat	3.6
P104	5/21/2025 14:01	682293.83	2993231.27	2.6	116.9	4.7	114.8	Peat	2.1
P105	5/21/2025 14:03	682318.9	2993296.58	1.6	117.9	4.7	114.8	Peat	3.1
P106	5/21/2025 14:05	682446.62	2993239.34	2.3	117.2	5.8	113.7	Peat	3.5
P107	5/21/2025 14:07	682455.69	2992966.25	1.6	117.9	4.8	114.7	Sand	3.2
P108	5/21/2025 14:15	682310.02	2993019.9	1.9	117.6	5.8	113.7	Sand	3.9
P109	5/21/2025 14:16	682164.3	2992922.78	2.3	117.2	5.7	113.8	Peat	3.4
P110	5/21/2025 14:18	682093.19	2992923.36	2.3	117.2	6.2	113.3	Peat	3.9
P111	5/21/2025 14:22	682601.79	2992968.38	1.4	118.1	3.4	116.1	Rock	2.0
P112	5/21/2025 14:25	682757.87	2992963.14	3.3	116.2	5.3	114.2	Sand	2.0
P113	5/21/2025 14:27	682910.93	2992968.4	3.3	116.2	5.5	114.0	Sand	2.2
P114	5/21/2025 14:29	683052.18	2992965.9	1.6	117.9	5.4	114.1	Sand	3.8
P115	5/21/2025 14:31	683056.5	2993119.98	3.6	115.9	7.2	112.3	Sand	3.6
P116	5/21/2025 14:33	683202.22	2993125.99	5.2	114.3	10.3	109.2	Sand	5.1
P117	5/21/2025 14:35	683356.35	2993130.66	4.0	115.5	6.1	113.4	Sand	2.1
P118	5/21/2025 14:36	683343.2	2992983.94	2.5	117.0	5.8	113.7	Sand	3.3
P119	5/21/2025 14:41	683213.78	2992822.61	2.8	116.7	5.4	114.1	Sand	2.6
P120	5/21/2025 14:43	683372.58	2992831.8	1.6	117.9	4.0	115.5	Sand	2.4
P121	5/21/2025 14:45	683350.13	2992684.65	2.3	117.2	6.3	113.2	Gravel	4.0
P122	5/21/2025 14:46	683208.02	2992671.57	1.6	117.9	3.8	115.7	Gravel	2.2
P123	5/21/2025 14:48	683281.18	2992513.9	1.3	118.2	3.8	115.7	Gravel	2.5
P124	5/21/2025 14:52	683378.69	2992536.95	4.2	115.3	5.2	114.3	Gravel	1.0
P125	5/21/2025 14:55	683372	2992375.64	1.7	117.8	6.1	113.4	Sand	4.4
P126	5/21/2025 14:56	683494.34	2992394.43	2.2	117.3	5.3	114.2	Sand	3.1
P127	5/21/2025 14:58	683606.67	2992398.98	2.8	116.7	2.8	116.7	NR	0.0
P128	5/21/2025 14:59	683527.64	2992485.62	1.6	117.9	4.4	115.1	Rock	2.8
P129	5/21/2025 15:02	683549.56	2992245.35	1.1	118.4	3.3	116.2	Gravel	2.2
P130	5/21/2025 15:04	683707.67	2992242.68	4.4	115.1	4.4	115.1	Rock	0.0
P131	5/21/2025 15:06	683330.82	2992530.01	7.2	112.3	8.3	111.2	Gravel	1.1
P132	5/21/2025 15:08	683288.14	2992679.33	7.1	112.4	8.9	110.6	Rock	1.8
P133	5/21/2025 15:25	683284.63	2992826.77	8.0	111.5	8.4	111.1	Gravel	0.4
P134	5/21/2025 15:27	683270.58	2992968.56	2.0	117.5	5.2	114.3	Gravel	3.2
P135	5/21/2025 15:31	683270.39	2993123.08	3.8	115.7	7.7	111.8	Gravel	3.9

NOTES:

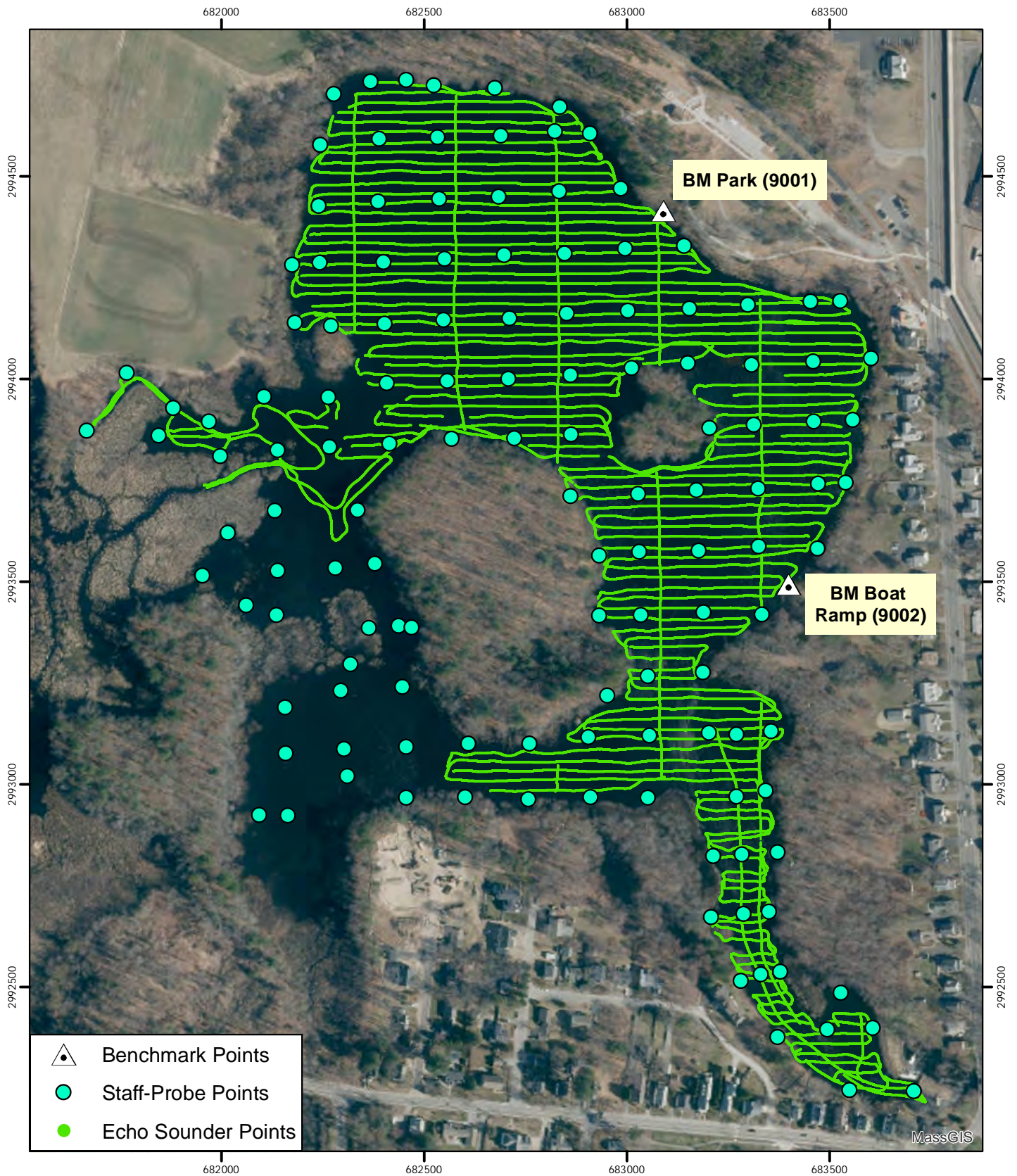
NR = Not Recorded

Sediment thickness = refusal depth - water depth

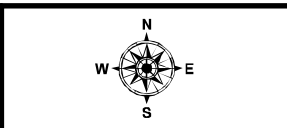
Pond bottom elevation = water surface elevation - water depth

Refusal elevation = pond bottom elevation - sediment thickness

FIGURES



SOUNDING DISTRIBUTION AND BENCHMARK LOCATIONS
Warners Pond
Concord, Massachusetts



NOTES:
1) Survey conducted May 20 - 21, 2025
2) Grid MA State Plane NAD 83 US Ft

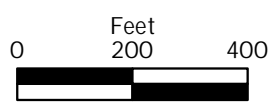
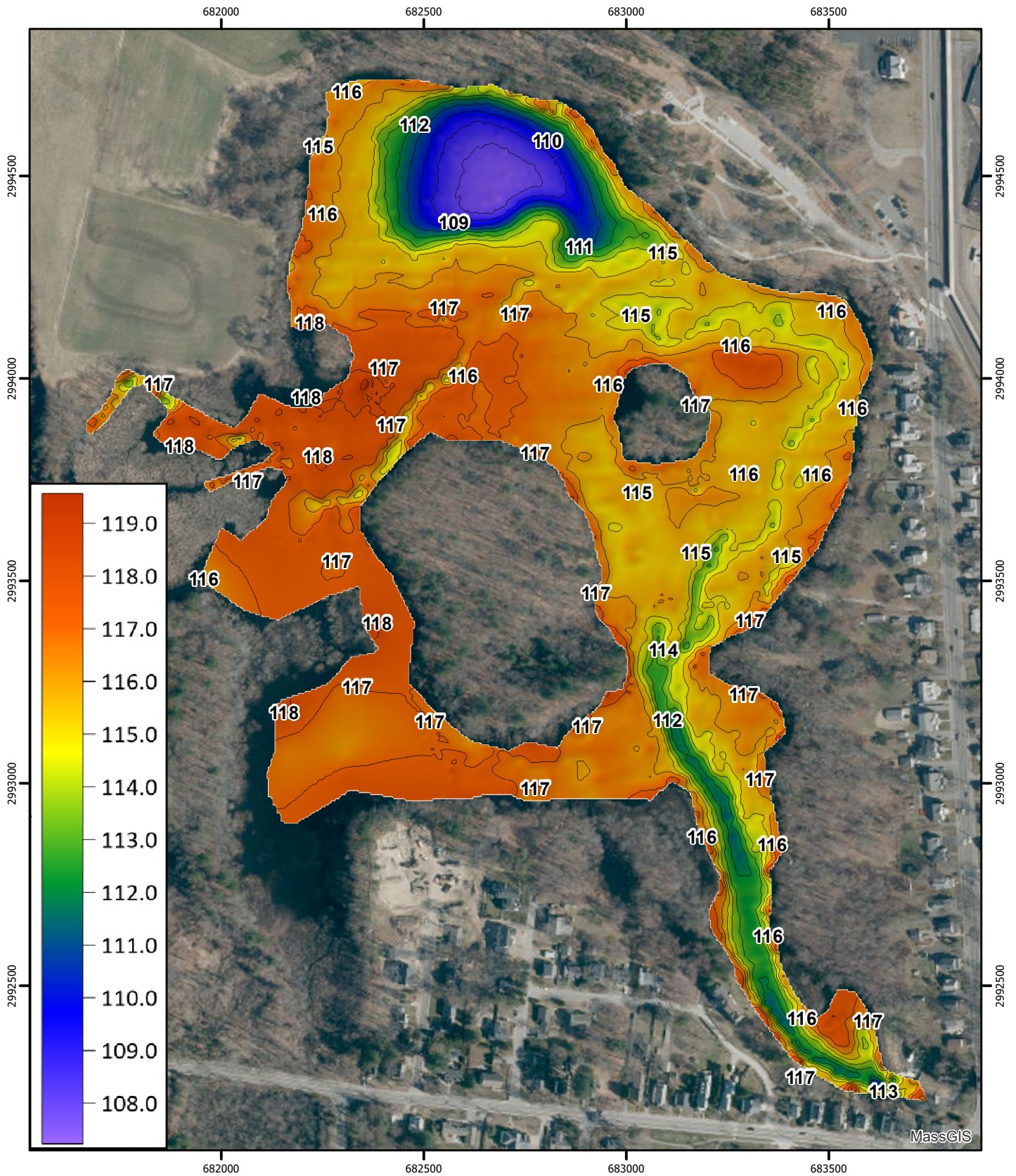



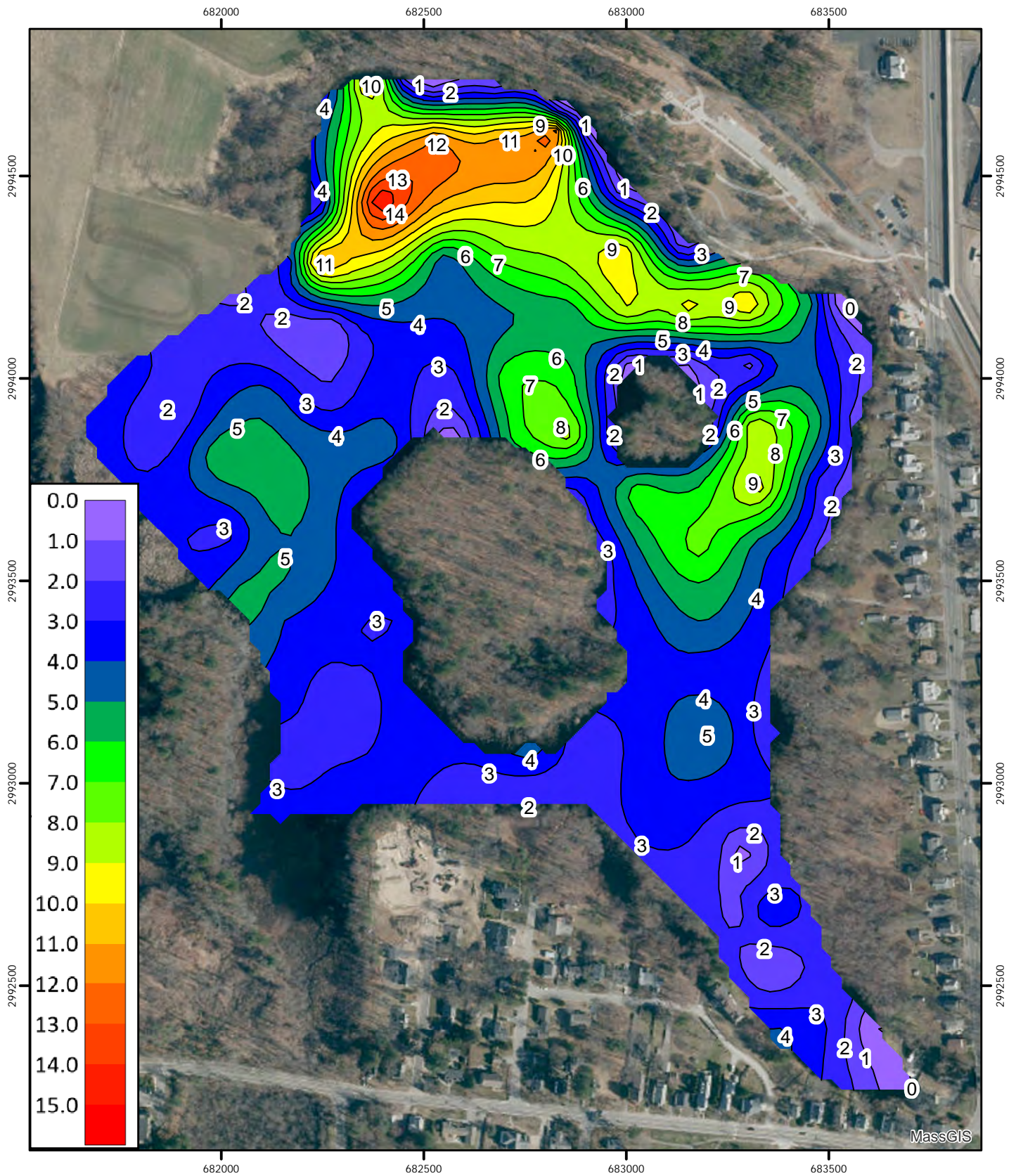


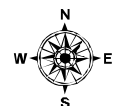
Figure 1



 www.crenvironmental.com	<p>NAVD88 BATHYMETRY - 1.0 FOOT CONTOUR INTERVAL Warner's Pond Concord, Massachusetts</p>	
	<p>NOTES: 1) Survey conducted May 20 - 21, 2025 2) Grid MA State Plane NAD 83 US Ft</p>	<p>0 200 400 Feet</p> 



SEDIMENT THICKNESS - 1.0 FOOT CONTOUR INTERVAL
 Warner's Pond
 Concord, Massachusetts



NOTES:
 1) Survey conducted May 20 - 21, 2025
 2) Grid MA State Plane NAD 83 US Ft

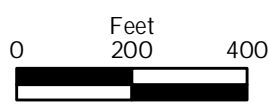
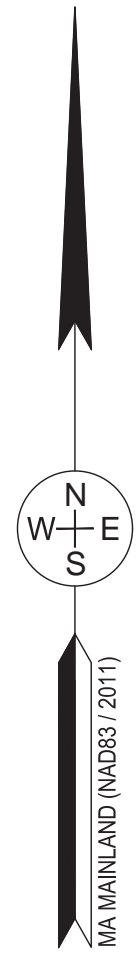


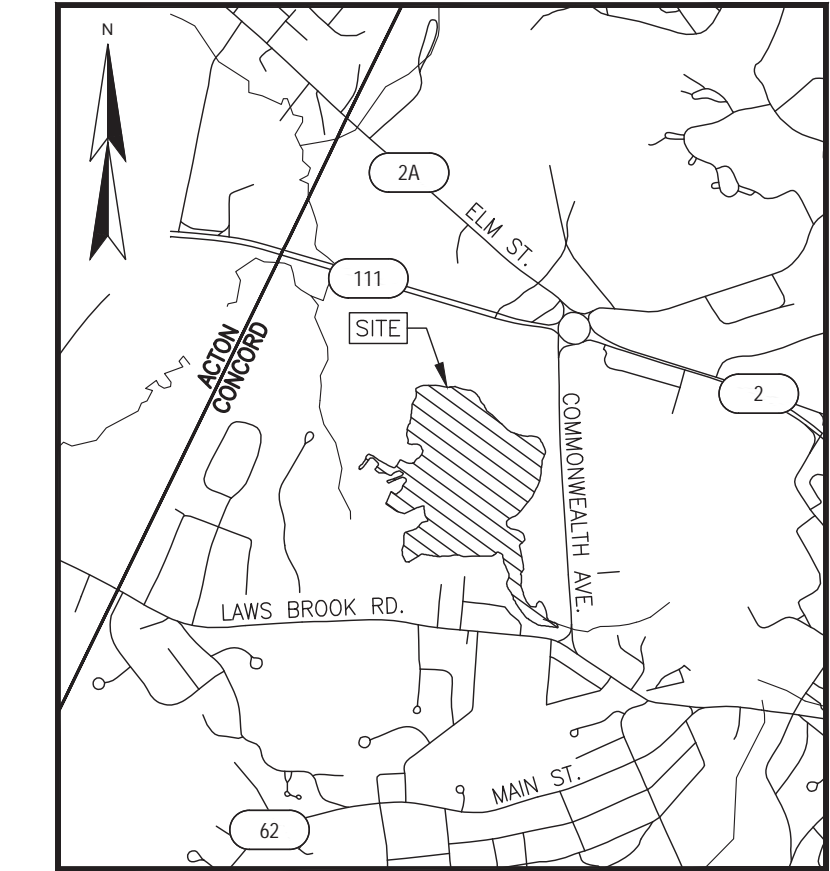
Figure 3

MassGIS

PLANS



KEY MAP (1"=200')



LOCATION MAP (1"=2000')

LEGEND

	ABUTTERS LOT LINE PER GIS
	MAJOR CONTOUR LINE
	MINOR CONTOUR LINE
	SPOT GRADE



**BATHYMETRIC PLAN
FOR
CR ENVIRONMENTAL, INC.
OF
WARNER'S POND
CONCORD, MASSACHUSETTS**

NOTES:

1. REFERENCE: WARNER'S POND
CONCORD, MASSACHUSETTS
2. BATHYMETRIC SURVEY PERFORMED BY CR ENVIRONMENTAL, INC. DURING MAY 2025 USING THE METHODOLOGY DESCRIBED BELOW:

SINGLE-BEAM SURVEY DATA WERE ACQUIRED USING A TELEDYNE ODOM, INC. CV-100 ECHO SOUNDER EQUIPPED WITH AN 8-DEGREE 200-KHZ TRANSDUCER. THE ECHOSOUNDER DRAFT WAS VERIFIED BY COMPARING ECHOSOUNDER WATER DEPTH MEASUREMENTS TO STAFF MEASUREMENTS. THESE CHECKS CONFIRMED TRANSDUCER DRAFT TO WITHIN 0.1 FEET. AN ADDITIONAL CALIBRATION WAS CONDUCTED IN SITU BY COLLECTING A WATER COLUMN PROFILE OF SOUND VELOCITY USING AN AML-3 SOUND VELOCITY PROFILER. THE WATER COLUMN WAS WELL MIXED AND NO CORRECTIONS FOR SOUND VELOCITY WERE REQUIRED DURING PROCESSING. CR ESTABLISHED TEMPORARY BENCHMARKS (TBM) POINT AT TWO NEARSHORE POINTS, RECORDED THE RTK GPS POSITION AND ELEVATION OF THESE POINTS AND MEASURED THE HEIGHT OF THE BENCHMARKS ABOVE THE WATER SURFACE (TABLE 1, FIGURE 1). SURVEYING AND MAPPING, LLC SUBSEQUENTLY SURVEYED EACH OF THE TBM POINTS. THE WATER SURFACE ELEVATION CALCULATED USING SURVEYOR'S DATA WAS PREFERENTIALLY USED DURING DATA PROCESSING.

IN AREAS TOO SHALLOW FOR ACQUISITION OF ECHO SOUNDER DATA OR WITH OVERWHELMING VEGETATION DENSITY, OR OCCUPIED A GRID OF MANUAL STAFF (DEPTH) AND PROBE (SEDIMENT THICKNESS) POINTS SPACED APPROXIMATELY 150 FT APART.
3. HORIZONTAL DATUM BASED ON NAD83(2011) MASSACHUSETTS STATE PLANE MAINLAND COORDINATE ZONE (2001) DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.
4. VERTICAL DATUM IS BASED ON APPROXIMATE NAVD88(GEOD18) (±.2') DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.
5. PARCEL BOUNDARIES (SHOWN FOR REFERENCE ONLY) ARE BASED ON GIS DATA FROM THE "BUREAU OF GEOGRAPHIC INFORMATION (MassGIS), COMMONWEALTH OF MASSACHUSETTS, EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY SERVICES".

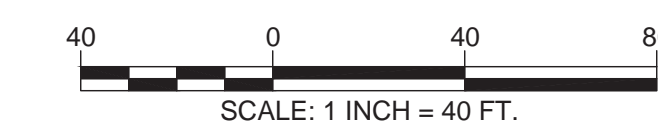
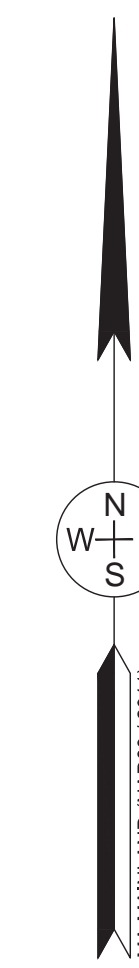
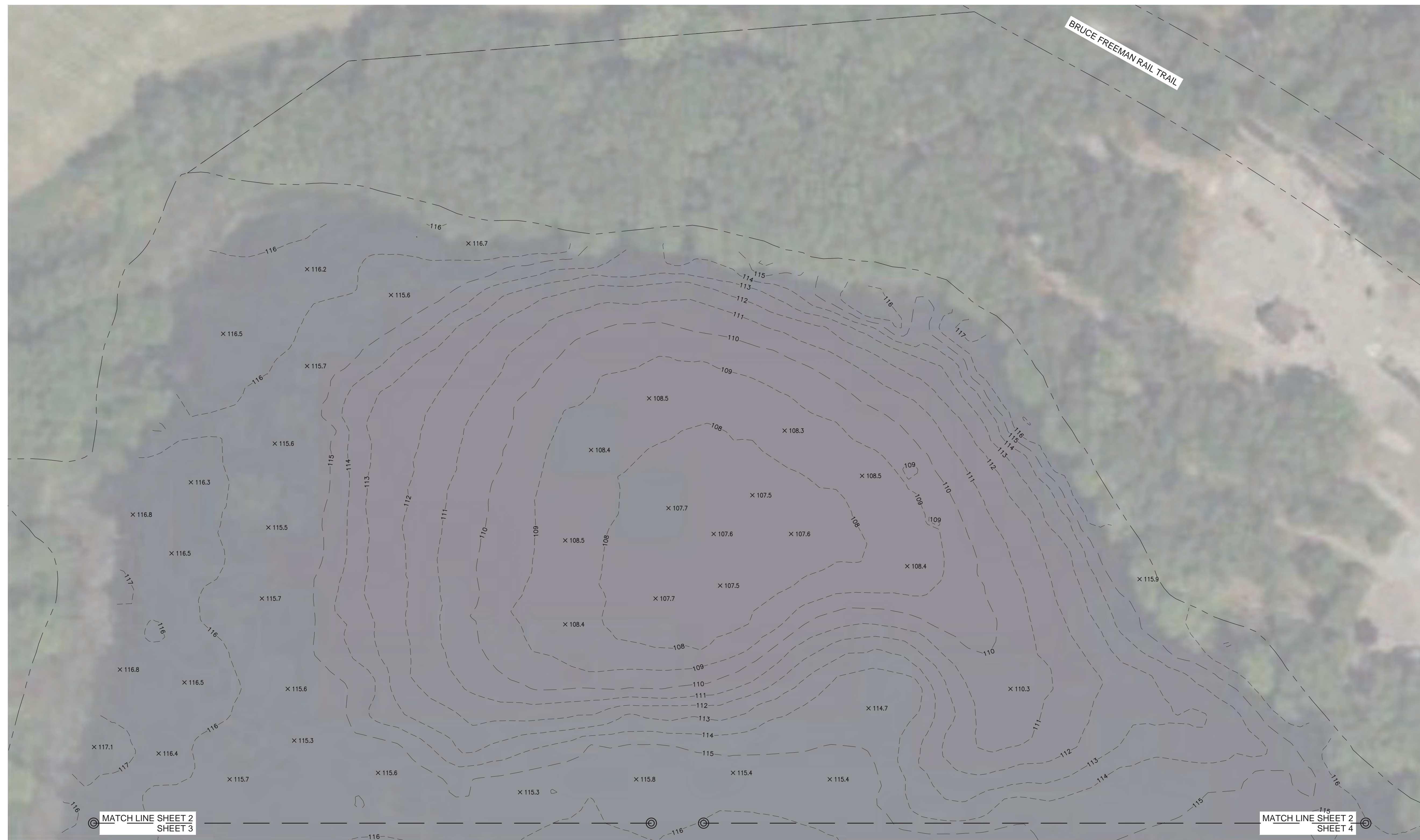
John F. Kaiser
6/5/25

NO.	DATE	DESCRIPTION	BY

DRAWN BY:	G.A.N.	DATE:	JUNE 3, 2025
CHECKED BY:	J.F.K.	DRAWING NO.	8869A
JOB NO.	8869	SHEET	1 OF 7

DOUCET SURVEY | A **SAM** Company
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 FOR
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 OF
 WARNER'S POND
 CONCORD, MASSACHUSETTS

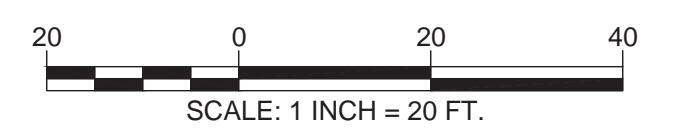
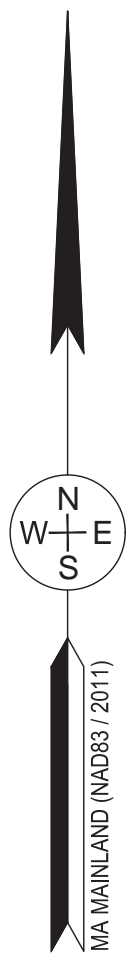
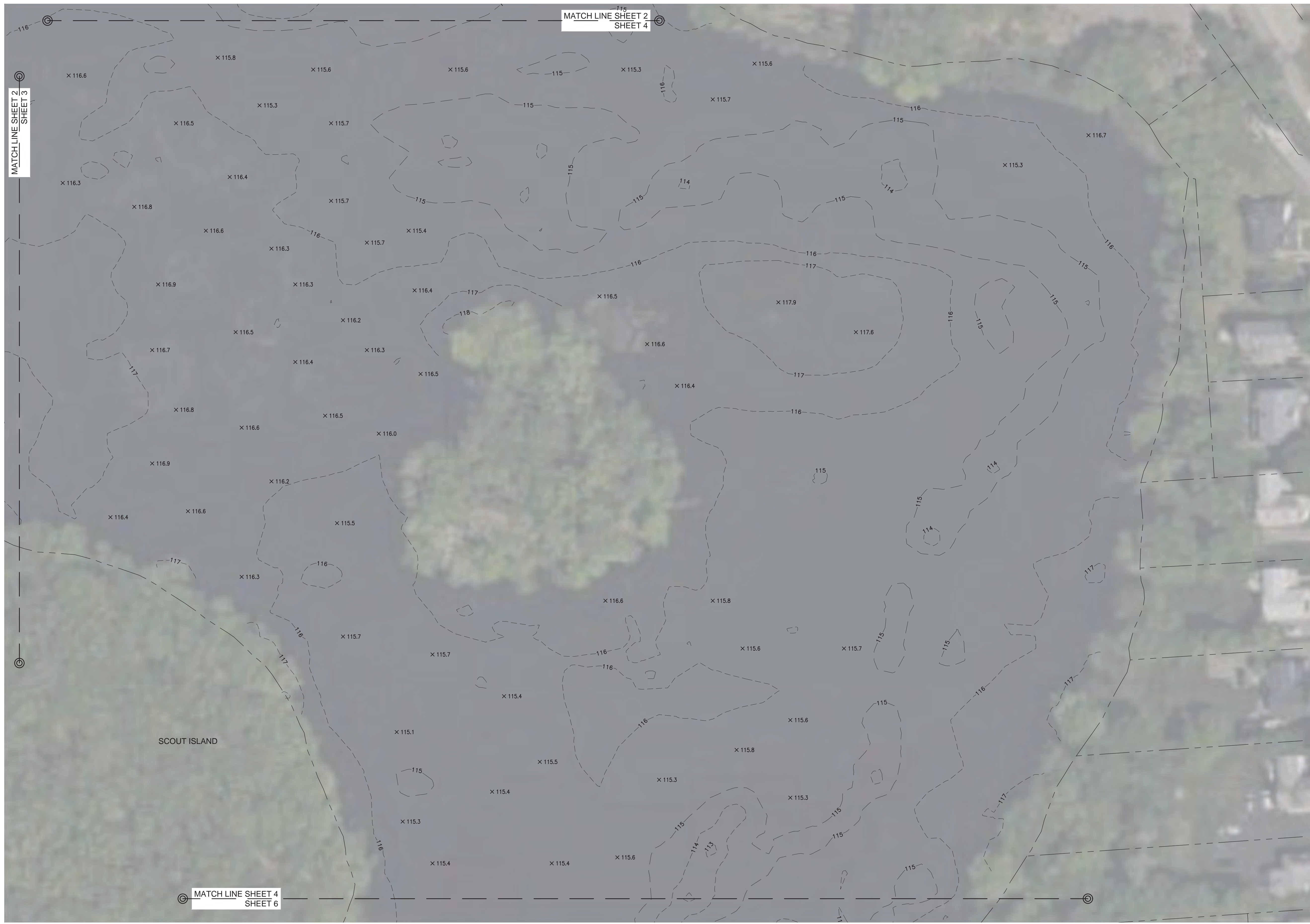
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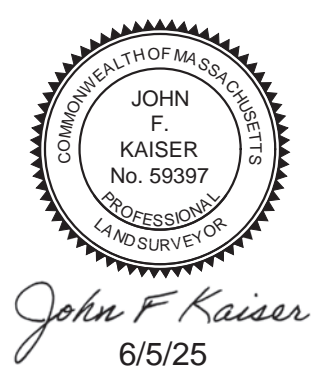
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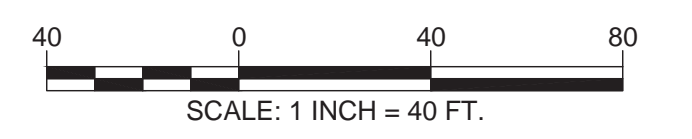
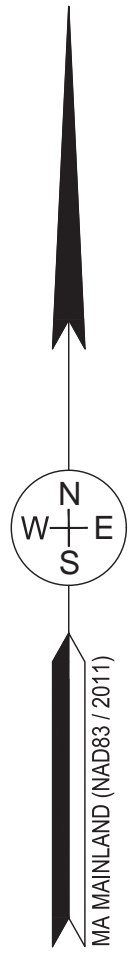
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MATCHLINE SHEET 3
SHEET 5

MATCHLINE SHEET 4
SHEET 5

SCOUT ISLAND



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CONCORD, MASSACHUSETTS

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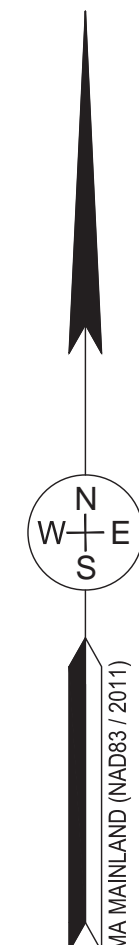
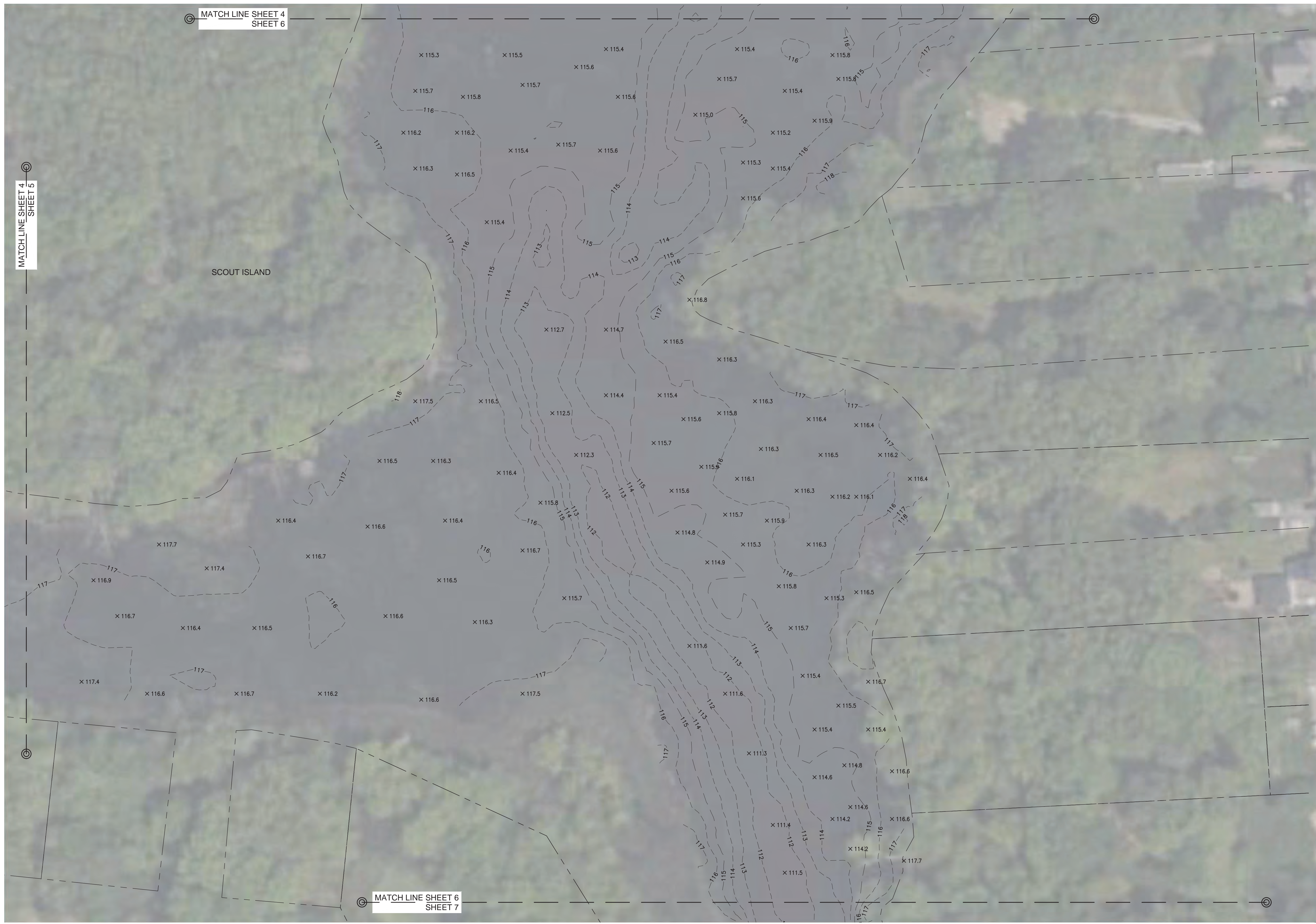
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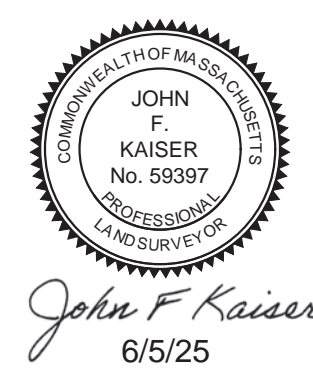
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