March 13, 2009

Erin Mosley, P.E.
Project Manager
CH2M Hill
25 New Chardon Street
Suite 300
Boston, MA 02114-4770

RE: Bathymetric and Sediment Mapping Surveys, Vibracore Sampling, and River Stage/Flow Measurements at the Noroton River and Holly Pond, Stamford, CT

Dear Ms. Mosley:

CR Environmental, Inc. (CR) under contract to CH2MHill performed bathymetry, sediment thickness, push/piston core, grab, and preliminary benthic community sampling operations in Holly Pond the estuary of the Noroton River in Stamford and Darien, Connecticut. In addition, water level, velocity, and water quality samples were taken in a reach of the Noroton River upstream of the I-95 Bridge. The sampling and surveys were designed to support CH2MHill's assessment of sedimentation and volumetric analysis in the pond for potential dredging, water quality and habitat improvements. This report summarizes the methods used for data acquisition and the results obtained. Geophysical and hydrographic survey uncertainties and limitations are provided in Attachment 1.

1.0 TASK 1 - SITE RECONNAISSANCE

On May 7, 2008, Christopher Wright, Senior Scientist at CR Environmental, and CH2MHill personnel conducted a reconnaissance of the Holly Pond and Noroton River Site. The purpose of the reconnaissance was to identify a launching area for CR's survey and sampling boat in Holly Pond, a suitable location for installation of the water level recorder for bathymetric operations, and general observations on the amount of exposed shoreline substrate and water depth in the pond, particularly in the northern extent (i.e. the Noroton River inlet to Holly Pond). Tide measurements were collected from a temporary benchmark in Holly Pond and compared to the NOAA tidal data for Stamford. These data revealed that the water depth at the northern extent of Holly Pond at high tide was approximately 3 feet, therefore, only a very shallow draft boat could be used for the survey and sampling operations.

2.0 TASK 2 - BATHYMETRIC AND SEDIMENT THICKNESS SURVEYS

In November 2008, bathymetric and sediment thickness surveys were conducted by CR on Holly Pond and the Noroton inlet to Holly Pond, respectively. An acoustic sub-bottom survey was

considered to estimate sediment thickness in the Noroton inlet to Holly Pond, but the shallow conditions precluded the usefulness of this acoustic technology. Acoustic multiples from shallow water depths would confound interpretation of the sub-bottom record, therefore, manual probing to refusal was substituted.

2.1 Vessel Operations

Boat operations were performed from a 12-ft aluminum skiff with an instrument enclosure, custom transducer and antennae mounts, and a 4 stroke outboard power. The boat was launched from the eastern shore at the northern end of the pond, and survey operations were performed in less than one foot of water (Plate 1).

2.2 Navigation

Navigation for each aspect of the survey was accomplished using a Trimble AgGPS 132 12-channel Differential Global Positioning System (DGPS) system capable of receiving the U.S. Coast Guard (USCG) Beacon corrections, and OmniStar subscription-based satellite differential corrections. The system achieved sub-meter horizontal position accuracy throughout the survey. Data have been projected to the Connecticut State Plane, NAD-83, U.S. Survey Feet or NAD-83 Geographic.

2.3 Bathymetric Data Acquisition and Processing

On November 12, 2008, CR personnel conducted a bathymetric survey of Holly Pond. The bathymetric data acquisition system consisted of a laptop computer running HYPACK MAX hydrographic survey software, a precision single-beam echosounder and a Trimble DGPS. The echosounder and DGPS were interfaced to the survey computer via RS-232 serial ports. Depth measurements were collected using a SyQwest, Inc. Bathy500MF precision echosounder equipped with an 8-degree 200-kHz transducer. The echosounder accurately digitized and recorded the pond bottom and exported depth values to the HYPACK data acquisition software. Dynamic adjustments to signal gain and range were made as necessary to ensure high quality data. The echosounder transducer was mounted to the rail of the survey vessel amidships using a high-strength adjustable boom. The DGPS antenna was attached to the top of the transducer boom, eliminating the need to account for horizontal offsets. The transducer depth below water surface was measured and recorded at the start and end of the survey.

The accuracy of the Bathy500MF is approximately 0.1% of the water depth with a resolution of 0.1 ft. System accuracy was checked at the start and end of the survey day by comparing echosounder water depth measurements to known water depths obtained using the “bar check” method in which a metal plate is lowered beneath the echosounder’s transducer to several known distances below the water surface. Based on these comparisons, the system was calibrated for shallow water conditions. “Bar-check” calibrations were consistently accurate to within 0.1 ft throughout the survey.

Additional calibrations were conducted in-situ by collecting water column profiles of sound velocity. Sound velocity in water can be determined based on measurements of temperature and salinity. Measurements of water column temperature and salinity were performed using YSI Model 85 water quality profiler. Profile data were entered into HYPACK and used to adjust raw soundings.

Vertical control for the survey was accomplished by installing an InSitu, Inc. LevelTroll500 Water Level Recorder mounted on a mushroom anchor directly below a benchmark on a stone and concrete seawall at the water's edge (Plate 1), and set to record water depth every 6 minutes. The vertical control benchmark was surveyed by Bolduc Land Consultants, LLC and the elevation was 5.45 ft (NAVD 88).

Bathymetric data were processed using the HYPACK Single Beam Processor Module. Individual transect data were visually inspected in profile format, and components of processing included removal of outlying soundings associated with water column interference (e.g., fish, vegetation, or mid-water column debris), adjustments of soundings for variations in sound velocity, the elevation of the aforementioned benchmark was used to convert the raw soundings into pond bottom elevations.

After performing data adjustments, the processed bathymetric data for the pond were combined into a comma-delimited ASCII text files including fields for Northing, Easting, and elevation. Figures 1 and 2 are bathymetric contour maps of the entire pond at a 0.5 foot contour interval and the Noroton River inlet to Holly Pond at a 0.25 ft contour interval, respectively.

Holly Pond elevations ranged from about elevation 2 to -14 NAVD88. The deepest portion of Holly Pond is at its southern end in the vicinity of the dam, and the shallowest at the northern extent in the Noroton inlet to Holly Pond. Photographic Plates 1 and 2 show areas of northern Holly Pond during an extreme high tide and an extreme low tide, respectively.

2.4 Sediment Thickness Mapping and Processing

On November 13, 2008, CR personnel conducted sediment probing to estimate sediment thickness in the Noroton River inlet of Holly Pond. Thirty-two sediment probes were conducted by driving a steel probe into the sediment until refusal. The DGPS position, water depth and total penetration were recorded digitally using HYPACK at each location (Table 1). Data were contoured to produce a map of estimated sediment thickness in the Noroton inlet of Holly Pond (Figure 3). Sediment thickness increased southward ranging from 0.2 ft near the Route 1 Bridge to 7.8 ft at the mouth of the Noroton inlet to Holly Pond.

3.0 TASK 3 - VIBRACORE AND GRAB SAMPLING

On December 2, 2008, CR personnel traveled to Stamford, CT and prepared for the sediment sampling operation in the Noroton inlet to Holly Pond. CR's coring raft was launched from the shore of Holly Pond, and grab samples were taken under the supervision of CH2M Hill's field representative. Only two stations could be sampled before low water forced the crew to abandon the raft and wait for higher water. On the morning of December 3, 2008, the crew arrived at Holly Pond to find that the tide was extremely low. The remaining sampling stations were exposed and safely accessible via wading or walking across the mud flats. Therefore, the DGPS system was interfaced with a Juniper Systems Allegro handheld field PC running StarPal GPS navigation software, the nine remaining stations were marked with stakes, and the sediment samples collected with either a push/piston core or as a grab sample. One station was located in a rocky shoal. To collect this sediment sample, a shallow pit was dug using a clean stainless steel shovel, and sediment was collected from the walls of the pit. CH2MHill's on-site representative supervised the sediment

sampling effort, processed, and prepared the sediment for shipment to the laboratory. The coordinates for the sediment sampling stations are provided in Table 2 and are plotted on Figure 4.

4.0 TASK 4 - STREAM MONITORING: VELOCITY, STAGE, AND WATER QUALITY

During the mobilization day for the bathymetric survey and probing effort, November 11, 2008, CR personnel conducted an acoustic doppler profile across the Noroton River upstream of the I-95 bridge using a StarFlow Ultrasonic Doppler Instrument (UDI) (Plate 3). Water velocity, temperature, and depth measurements were taken with the UDI approximately every 5 ft along the river transect. The transect location was marked with spray paint on a tree on the southwest side of the river and a concrete abutment of the I-95 bridge on the northeast side of the river. The UDI was then moored to the river bottom (see Plate 4), and left to collect measurements until it was removed on December 4, 2008, during the sediment sampling effort (Task 3 Section 3.0). To provide velocity data during a period of higher water levels an additional set of UDI measurements were made across the river transect on December 20, 2008 (Figures 6 and 7).

Water samples for total suspended solids (TSS) and nutrients were taken from mid-water column several feet from the bank of the Noroton River upstream of the I-95 bridge on December 3, 2008, and delivered to the CH2MHill field representative for delivery to Phoenix Laboratories for analysis. Additional sets of water samples were collected on December 20, 2008 for TSS and nutrients, and on February 9 for TSS only and sent to Phoenix Laboratories for analysis.

Following the bathymetric survey on November 13, 2008, the InSitu, Inc. LevelTroll500 water level recorder was transferred to a stilling well and suspended from the I-95 Bridge support over the Noroton River (see Plate 5). This instrument measures the river stage every 10 minutes and will be in operation for a minimum of 4 months. The data from the LevelTroll500 was downloaded on December 4, 2008 when the Starflow system was retrieved, January 12, and February 9, 2009. River velocity, temperature and stage data have been tabulated and sent to CH2MHill personnel electronically.

5.0 TASK 5-PRELIMINARY BENTHIC COMMUNITY ASSESSMENT

After the sediment probing effort, on November 13, 2008, CR personnel conducted a preliminary benthic community assessment of Holly Pond that included the collection of benthic grab samples and underwater video footage at 13 stations throughout the pond (Figure 5). The benthic samples were collected using a .025 m^2 Wildco stainless steel petite ponar grab sampler, sieved with a 2 mm mesh 12-inch diameter sieve, and stored in one liter wide mouth jars preserved in 90% alcohol.

Field observations on macroinvertebrates and macroalalgae were recorded. Benthic samples were sorted at the office quantified and identified.

Underwater video data were also collected at each station with a SeaViewer Model 950 Drop Camera interfaced to a SeaViewer SeaDVR digital video recorder. The camera was dropped over the side of the survey vessel and one minute video clips of the pond bottom were recorded, as the vessel drifted.

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Table 3 lists the station number, time of collection, X-Y position, number of individuals and identifications of organisms from the benthic sampling and video survey. A full benthic grab sample was obtained at all stations with the exception of station 10, where gravel, cobble bottom was encountered. Underwater video screen captures from the station surveys are provided in Plates 6 and 7.

The bottom substrate at the majority of sampling stations in Holly Pond was soft muddy silt. The exceptions included: HBP-1 at the northern end of the Noroton inlet to Holly Pond which had a firmer sand gravel bottom; HPB-8 and -9 at the southwestern corner of the pond which had sand, gravel bottom; and HPB-10 north of the dam which had cobble, gravel bottom.

Benthic biota were generally observed to be sparse in Holly Pond. The dominant organisms observed were mud snails (*Nassarius obsoletus*) with patches of a branching red algae (possibly *Gracilaria* sp.) and sea lettuce (*Ulva lactuca*). Other organisms observed in lesser number included two unidentified bivalve species, American oysters (*Crassostrea virginica*), crabs, shrimp, amphipods, a juvenile horseshoe crab (*Limulus polyphemus*) and trumpet worms (*Pectinaria* sp.). A few oyster beds were observed on the southeastern shore of Holly Pond on sand bottom in the vicinity of HPB-8.

The biological assessment also included staking the upper and lower boundary of marsh plants in the vicinity of the Noroton inlet of Holly Pond for survey by others to provide information for potential salt marsh restoration efforts. This task was accomplished on November 12th after completion of the bathymetric survey during a low tide period. Plate 8 images are aerial photographs showing the upper and lower limits of Common Reed (*Phragmites australis*) at stake P1 and stake P2, south of the Giovanni's parking lot; and the lower limit of *Spartina alterniflora* low salt marsh at stake S-1 and the upper limit of high salt marsh at the extent of Marsh Elder (*Iva frutescens*), south of the boat access point. The location of the vertical control point used to reference the bathymetric data is also shown in the aerial photos. In Plates 9 and 10, the stakes at the lower and upper limits of the *Phragmites* and *S. alterniflora* are pictured, respectively. One salinity reading taken at the southern end of Holly Pond on November 12, 2008 was 20 parts per thousand (ppt).

Sincerely,
CR Environmental, Inc.

John H. Ryther, Jr.
Oceanographic Operations Manager

Charlotte M. Cogswell.
Senior Ecologist/President

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ATTACHMENT 1

GEOPHYSICAL AND HYDROGRAPHIC SURVEY UNCERTAINTIES AND LIMITATIONS

1. Acoustic methods of remote sensing in aquatic environments are influenced by the chemical and physical characteristics of the waterbody and underlying sediment. Water column characteristics which introduce uncertainty include: biological interference (e.g. fish or debris in mid-water column); salinity and temperature as they affect sound velocity; and weather and other surface conditions as they effect navigation. Sediment and bottom characteristics which introduce uncertainty include supersaturated flocculent sediments; sediments which contain entrained natural gases (e.g., sulfides, methane) which limit sonar penetration; steep slopes which may limit sonar bottom penetration due to increased angle of incidence or scattering; and rooted vegetation. CR Environmental, Inc. (CR) has made all technically feasible attempts to minimize the above uncertainties as described in the report.

2. The observations described in this report were made under the conditions stated therein. The conclusions presented in the report were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of services or the time and budgetary constraints imposed by the Client.

3. The conclusions and recommendations contained in this report are based in part upon the data obtained using acoustic remote sensing observations obtained along survey transects spaced approximately 10 to 25 feet apart. Information presented in this report between the survey transects (i.e., depth contours) is based on mathematical interpolation. Not suitable for navigation.

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TABLES

TABLE 1

HOLLY POND SEDIMENT PROBE DATA
Stamford, Connecticut
(Coordinates are in CT State Plan, NAD83, USFoot)

Probe ID	Water Depth (ft)	Refusal Depth (ft)	Sediment Thickness (ft)	Time	X Northing	Y Easting
p1	3.8	11	7.2	09:27:26AM	791861.713	582512.917
p2	4	11.3	7.3	09:30:11AM	791911.696	582543.688
p3	4.2	12	7.8	09:34:18AM	791958.22	582593.646
p4	4.3	10.5	6.2	09:36:36AM	791983.175	582659.396
p5	4.6	6.8	2.2	09:39:44AM	792044.368	582734.733
p6	4.9	10.5	5.6	09:42:50AM	791846.589	582876.781
p7	4.2	10.5	6.3	09:45:50AM	791799.655	582832.725
p8	4.1	11	6.9	09:48:33AM	791746.23	582789.123
p9	3.9	10.8	6.9	09:50:47AM	791680.49	582737.394
p10	4.6	10.5	5.9	09:53:23AM	791605.488	582697.57
p11	5.4	8	2.6	09:56:35AM	791444.339	582892.865
p12	4.1	7.8	3.7	09:58:57AM	791495.171	582935.827
p13	4	9	5	10:01:03AM	791553.573	582979.706
p14	4.7	8.5	3.8	10:03:20AM	791625.288	583044.442
p15	5.2	8	2.8	10:05:03AM	791658.113	583089.086
p16	4.4	5	0.6	10:12:54AM	791413.933	583230.808
p17	4.8	8.8	4	10:16:00AM	791372.558	583194.515
p18	4.3	8.2	3.9	10:18:07AM	791336.032	583131.674
p19	4.4	7.5	3.1	10:20:18AM	791273.58	583085.516
p20	4.6	4.8	0.2	10:22:22AM	791251.886	583028.127
p21	3.6	7.7	4.1	10:26:02AM	791106.829	583299.871
p22	3.8	7.8	4	10:43:31AM	791145.04	583317.101
p23	5.1	7.3	2.2	10:45:43AM	791197.556	583308.025
p24	4.9	8.1	3.2	10:48:21AM	791241.523	583325.124
p25	4	7.6	3.6	10:50:46AM	791294.643	583341.678
p26	4.2	6	1.8	10:53:44AM	791213.501	583526.33
p27	5.6	8	2.4	10:57:10AM	791188.517	583456.324
p28	3.8	7.5	3.7	10:59:48AM	791125.173	583430.095
p29	3.6	8	4.4	11:04:01AM	791101.123	583414.711
p30	2.9	3.7	0.8	11:08:02AM	791117.44	583634.55
p31	4.3	4.8	0.5	11:12:36AM	791170.664	583631.081
p32	4.4	6.5	2.1	11:14:49AM	791200.252	583632.944

TABLE 2

SEDIMENT SAMPLING LOCATIONS
HOLLY POND, STAMFORD, CT
December 1 and 2, 2008

Sample ID	WGS84_Longitude	WGS84_Latitude	Conneticut State Plane NAD 1983 Feet x	y
SD01 Grab/Core[1]	-73.5074236	41.0603010	791115.47400	583613.20400
SD02 Grab	-73.5073928	41.0601698	791123.54900	583565.32700
SD03 Grab	-73.5074580	41.0599854	791104.97900	583498.30000
SD04 Grab	-73.5074916	41.0596828	791094.74700	583388.13000
SD05 Grab/Core	-73.5073692	41.0594166	791127.65200	583290.84500
SD06 Grab/Core	-73.5067900	41.0590446	791286.19600	583153.90900
SD07 Grab/Core	-73.5061556	41.0587118	791460.09100	583031.12400
SD08 Grab	-73.5055008	41.0586182	791640.37500	582995.44100
SD09 Grab/Core	-73.5055894	41.0584210	791615.31300	582923.80600
SD10 Grab	-73.5051259	41.0581982	791742.42900	582841.51200
SD11 Grab	-73.5054722	41.0581282	791646.70200	582816.84300

[1] Due to gravelly/rocky deposit substrate conditions a push core could not be completed, therefore, the sediment sample was collected by excavating a pit to a depth of 22 inches, and collecting the finer sediment.

TABLE 3

HOLLY POND RECONNAISSANCE BENTHIC SAMPLING AND VIDEO OBSERVATIONS - Stamford, Connecticut

		Northing	Easting	Mollusca			Annellidae	Crustacea				TOTAL No.	TOTAL No.	Algae		TOTAL No.
Station ID	TIME	X	Y	Mud Snail	Bivalves*	American Oyster	Trumpet Worm	Horseshoe Crab	Crab	Shrimp	Amphipod	Invertebrate Spp.	Individuals	Sea Lettuce	Red Alga	Algal Spp.
HPB-1	01:27:54PM	791120.5099	583275.6689	0	0	0	0	0	0	0	0	0	0	present	-	1
HPB-2	01:36:20PM	791437.1023	582916.0214	0	0	0	0	0	0	0	0	0	0	-	present	1
HPB-3	01:44:08PM	791563.1905	582934.2431	0	0	0	0	1	0	0	0	1	1	-	present	1
HPB-4	01:53:36PM	791579.8222	582759.0837	2	0	0	0	0	0	0	0	1	2	-	-	0
HPB-5	02:01:26PM	792015.3227	582501.2444	7	0	0	1	0	0	1	0	3	9	present	present	2
HPB-6	02:10:32PM	792571.8596	582416.8149	6	7	0	0	0	0	0	0	2	13	-	present	1
HPB-7	02:25:44PM	793881.3321	582075.6176	6	2	0	0	0	0	1	1	4	10	present	present	2
HPB-8	02:40:49PM	794887.8761	581094.4816	0	0	1	0	0	0	0	0	1	1	-	-	0
HPB-9	02:50:51PM	793740.0174	579852.6357	11	0	0	0	0	0	0	0	1	11	-	-	0
HPB-10	02:56:47PM	793278.981	579729.8725	NC	NC	NC	NC	NC	NC	NC	NC	NA	NA	NC	NC	NA
HPB-11	03:01:02PM	792948.5188	580554.5845	0	1	0	0	0	0	0	0	1	1	-	-	0
HPB-12	03:10:03PM	792647.3291	581312.8191	1	2	0	0	0	1	0	0	4	4	-	-	0
HPB-13	03:17:31PM	792197.1554	581688.641	2	1	0	1	0	0	0	0	3	5	-	-	0
TOTAL NUMBER				**35**	**13**	**1**	**2**	**1**	**1**	**2**	**1**	**9**	**51**			**2**
PERCENT FREQUENCY				**58%**	**42%**	**8%**	**17%**	**8%**	**8%**	**17%**	**8%**			**25%**	**42%**	

Notes: NC - not collected due to hard substrate NA - not applicable

* category includes 2 unidentified bivalve species

Number of individuals within a petite ponar grab sample that were retained on a 2 mm mesh sieve

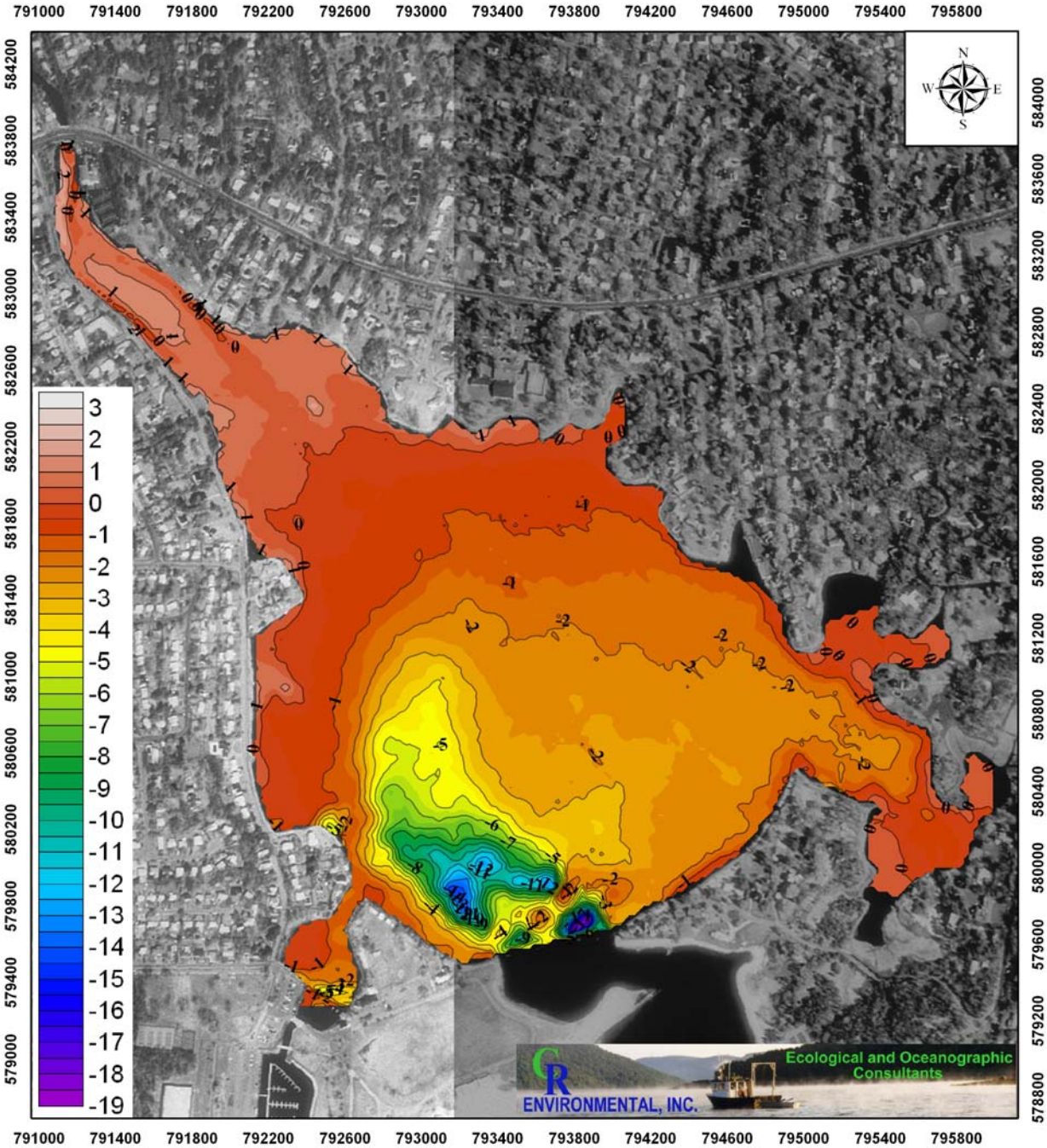
Coordinates are in CT State Plane, NAD83, US Foot

Station ID	Substrate Notes
HPB-1	sand, pebbles and gravel; and few mud snail shells
HPB-2	sand, pebbles and gravel; and few mud snail shells
HPB-3	brown, fine sand; leaf and small woody debris
HPB-4	fine sand, small pebbles; leaf and small woody debris; and few snail shells
HPB-5	brown silt; leaf and small woody debris; mussel shell with barnacles
HPB-6	brown silt; leaf and small woody debris; few mud snail shells
HPB-7	dark brown silt; some leaf and small woody debris; few snail shells
HPB-8	silty sand, small pebbles, small stones, few mud snail shells
HPB-9	fine sand, small pebbles, some leaf matter, few mud snail shells
HPB-10	gravel and rock substrate; video crashed (no grab sample collected)
HPB-11	fine, silty sand; few gem clam and mud snail shells
HPB-12	brown, fine silty sand; some leaf and eel grass debris, few mud snail shellls
HPB-13	brown silt; leaf and small woody debris; few mud snail shells

FIGURES

FIGURE 1

HOLLY POND BATHYMETRY
0.5 FOOT CONTOUR INTERVAL (NAVD88 ELEVATIONS)
Stamford and Darien, Connecticut



Notes:

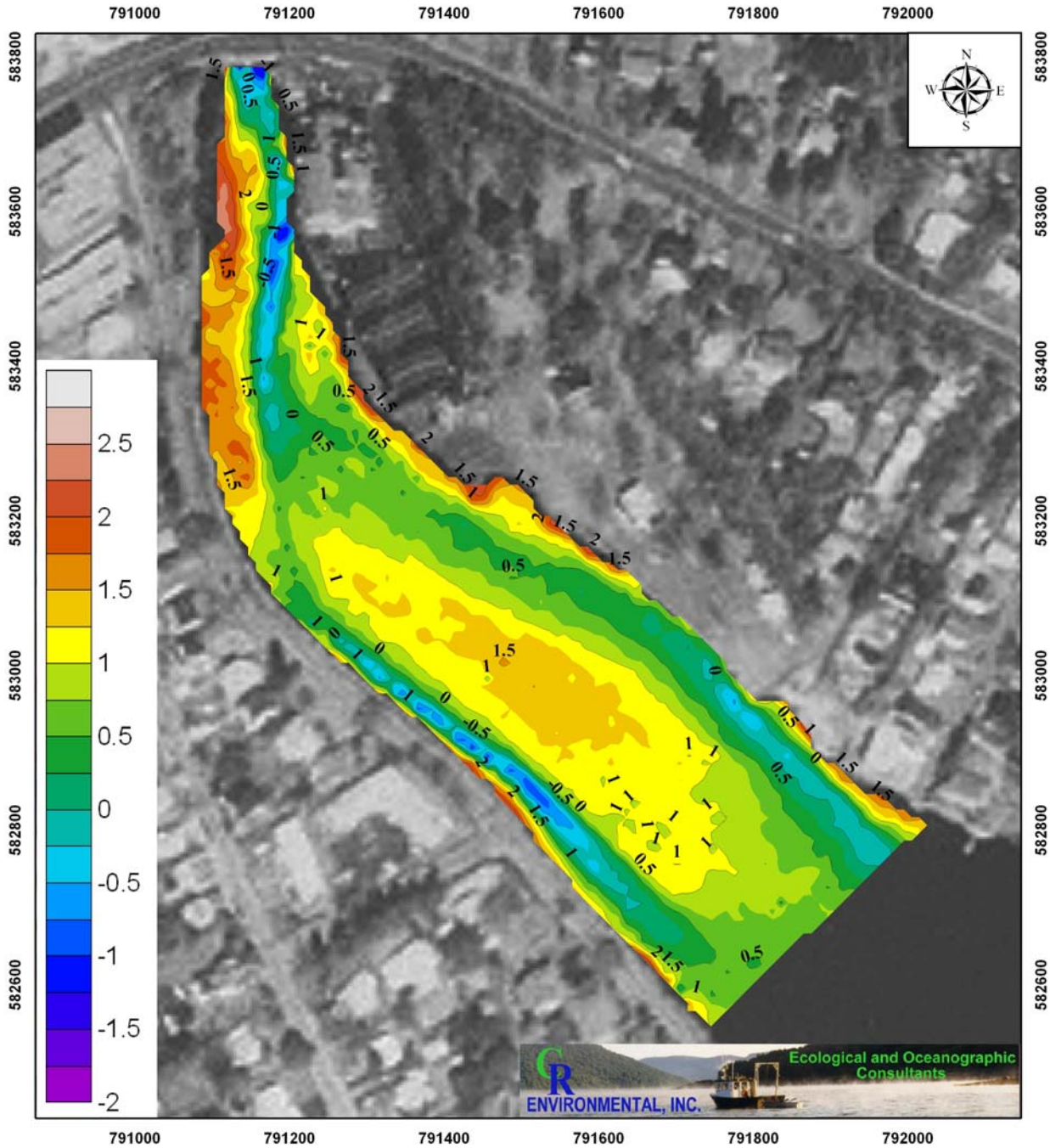
1. Survey conducted November 12, 2008.
2. Grid: CT State Plane, NAD83, US Foot.
3. NAVD88 Elevations. Lines use 1.0 foot contour interval. Spectrum map uses 0.5-foot Contour Interval.
4. Not for Navigation.

0 255 510 1,020 1,530 2,040 Feet

1:8,500

FIGURE 2

BATHYMETRY AT THE NOROTON INLET TO HOLLY POND
0.25 FOOT CONTOUR INTERVAL (NAVD88 ELEVATIONS)
Stamford and Darien, Connecticut



Notes:

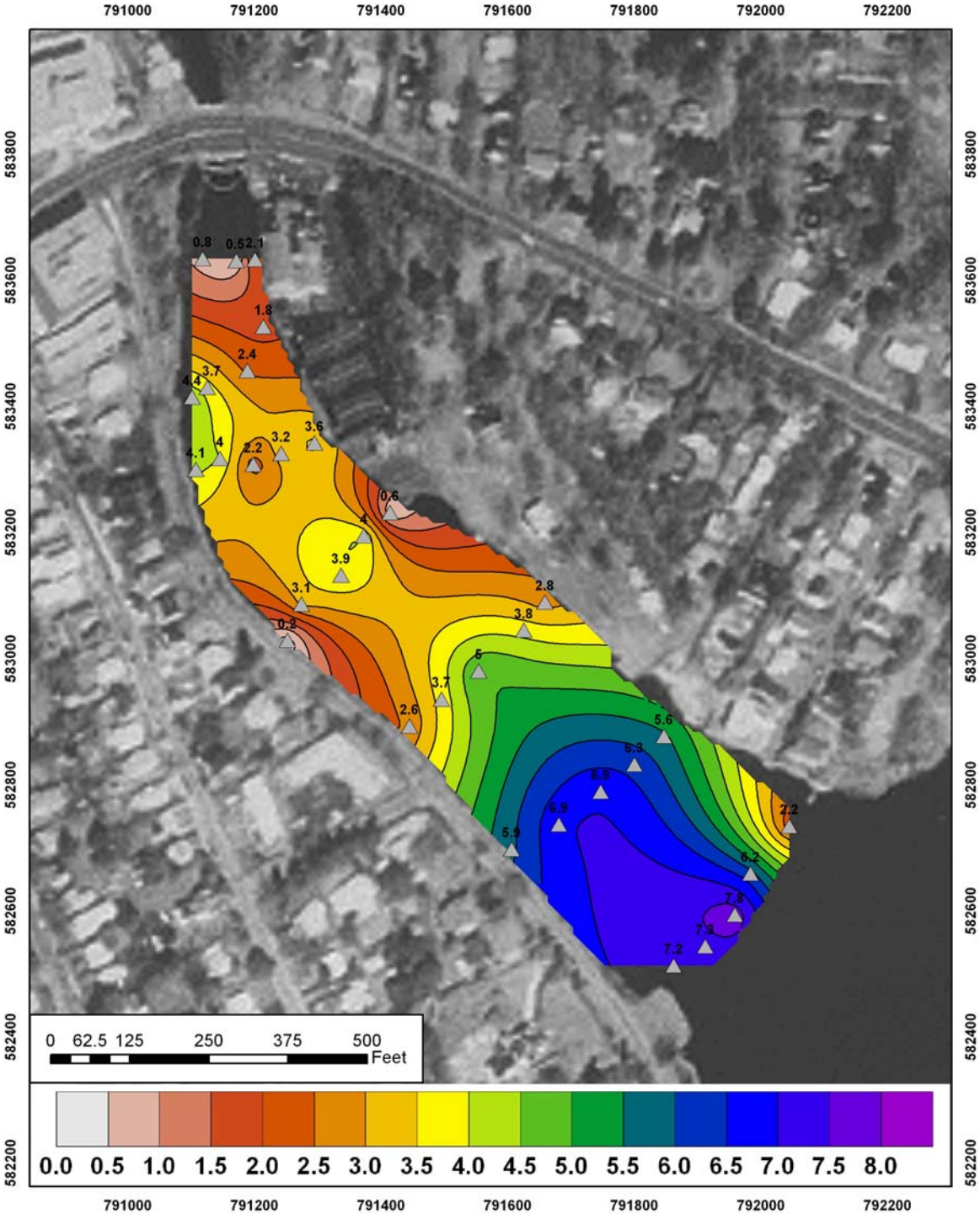
1. Survey conducted November 12, 2008.
2. Grid: CT State Plane, NAD83, US Foot.
3. NAVD88 Elevations. Lines use 0.5 foot contour interval. Spectrum map uses 0.25-foot Contour Interval.
4. Not for Navigation.

0 62.5 125 250 375 500 Feet

1:2,100

FIGURE 3

CONTOUR MAP OF SEDIMENT THICKNESS WITH PROBE LOCATIONS AT NOROTON INLET TO HOLLY POND
Stamford and Darien, Connecticut



Notes:

1. Sediment probing conducted November 13, 2008.
2. Grid: CT State Plane, NAD83, US Foot.

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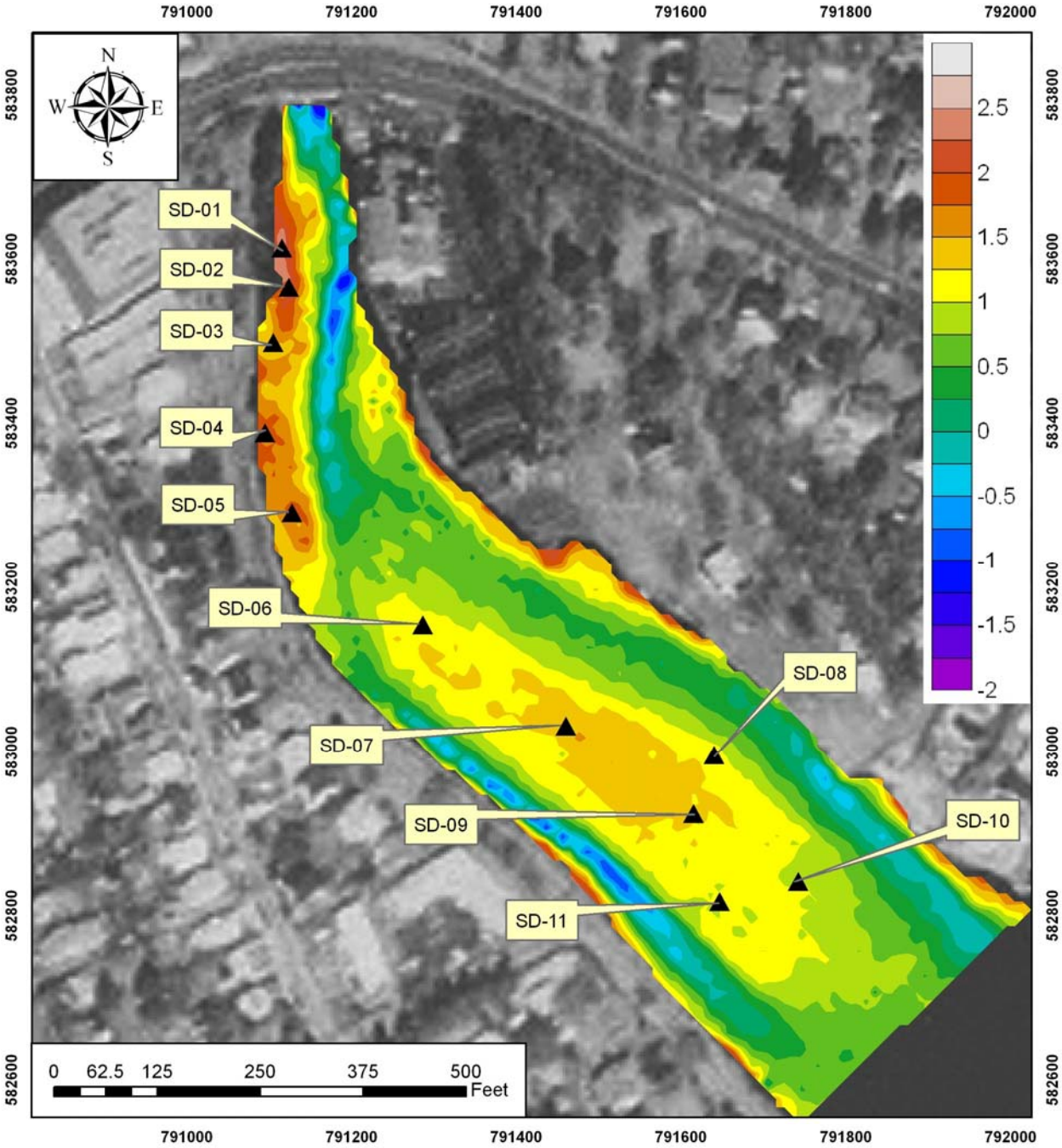
FIGURE 4

SEDIMENT SAMPLING LOCATIONS FOR CHEMICAL ANALYSES AT THE NOROTON INLET TO HOLLY POND
Stamford and Darien, Connecticut



Notes:

1. Sampling conducted November 13, 2008.
2. Grid: CT State Plane, NAD83, US Foot.
3. NAVD88 Elevations. Contour interval = 0.25-foot.

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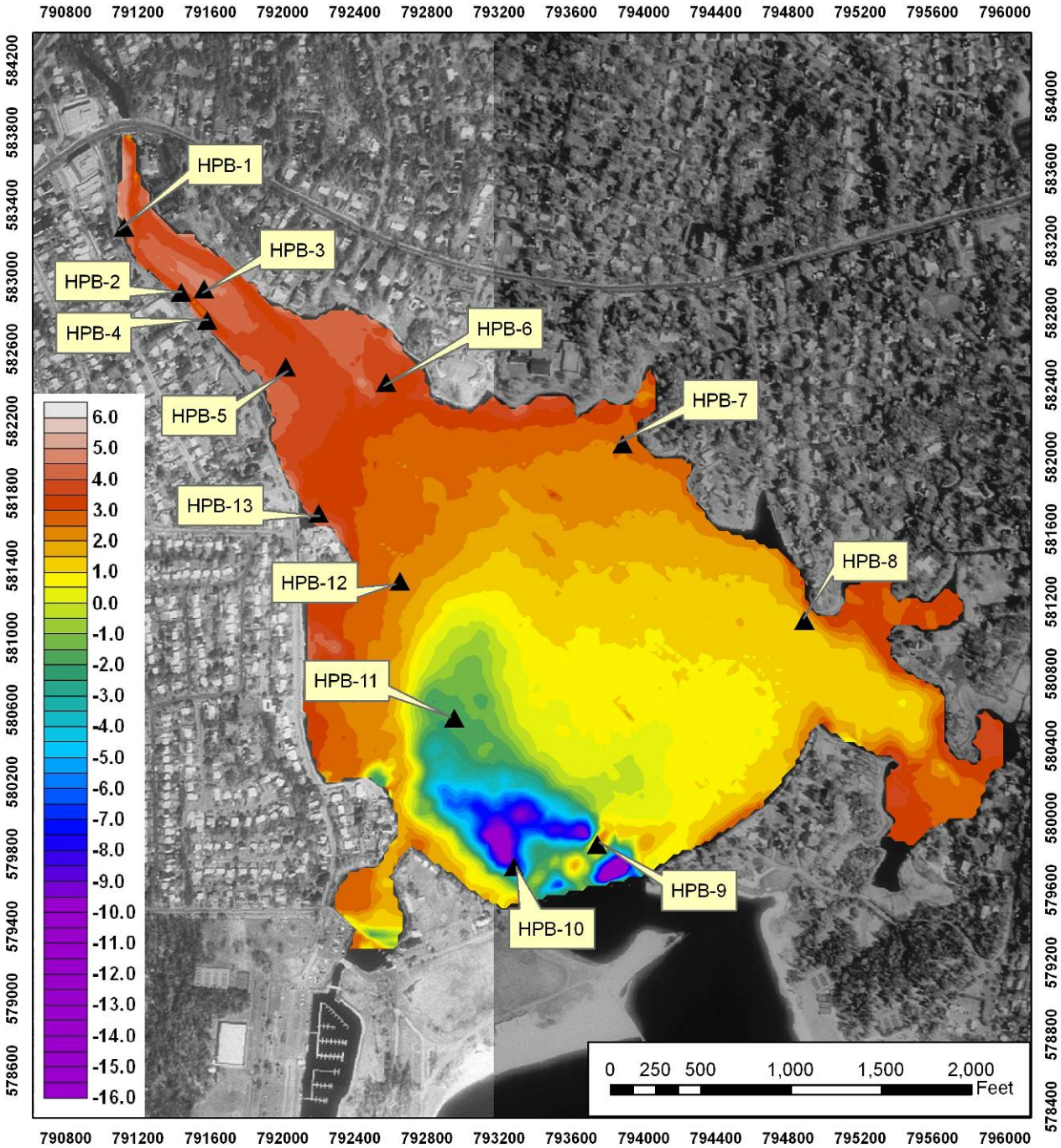
FIGURE 5

HOLLY POND
LOCATIONS OF BENTHIC SAMPLES AND VIDEO OBSERVATIONS
Stamford and Darien, Connecticut



Notes:

1. Sampling conducted November 13, 2008.
2. Grid: CT State Plane, NAD83, US Foot.
3. Estimated MLW elevations based on adjustment of site-specific tide data to NOAA Bridgeport data.

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FIGURE 6

NOROTON RIVER CROSS-SECTION
APPROXIMATELY 40 FEET UPSTREAM OF ROUTE 95 CULVERTS
November 11, 2008

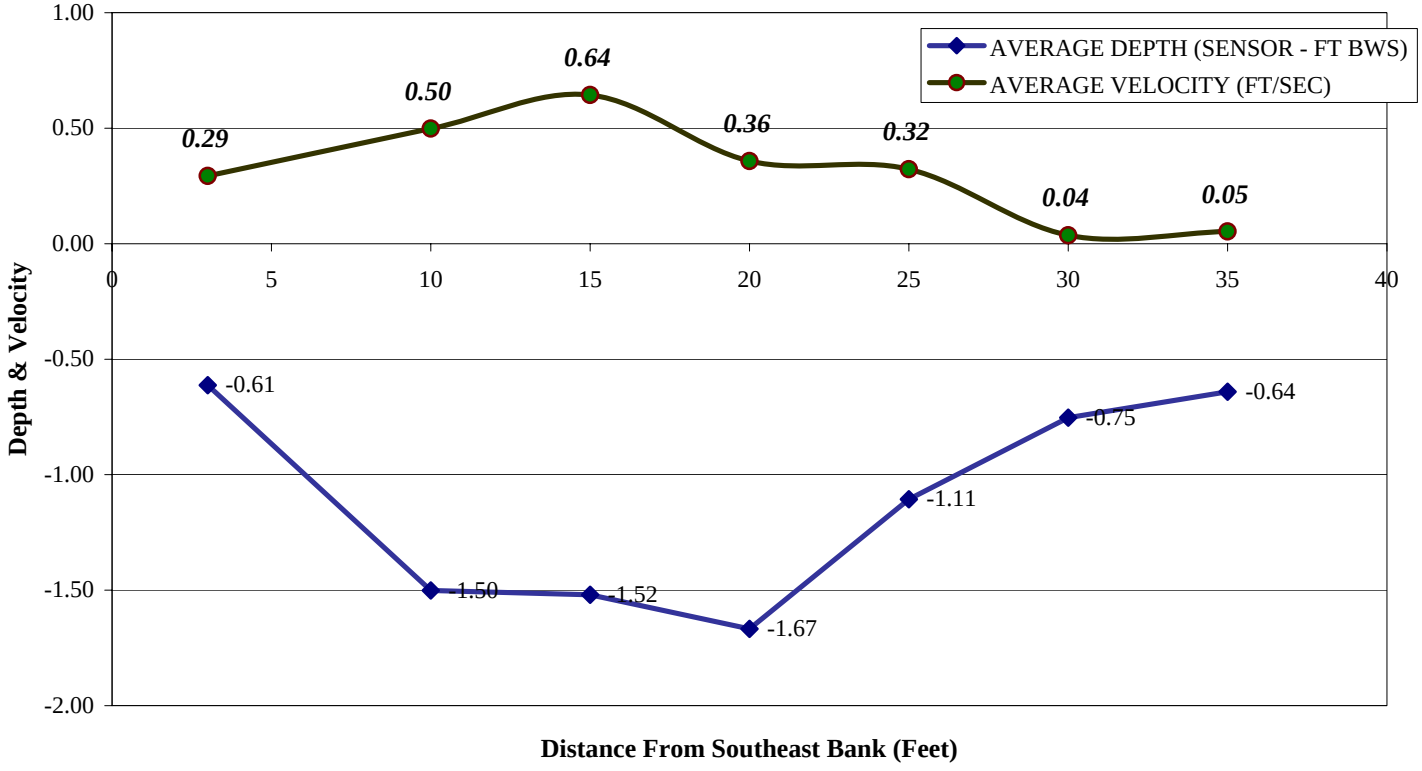
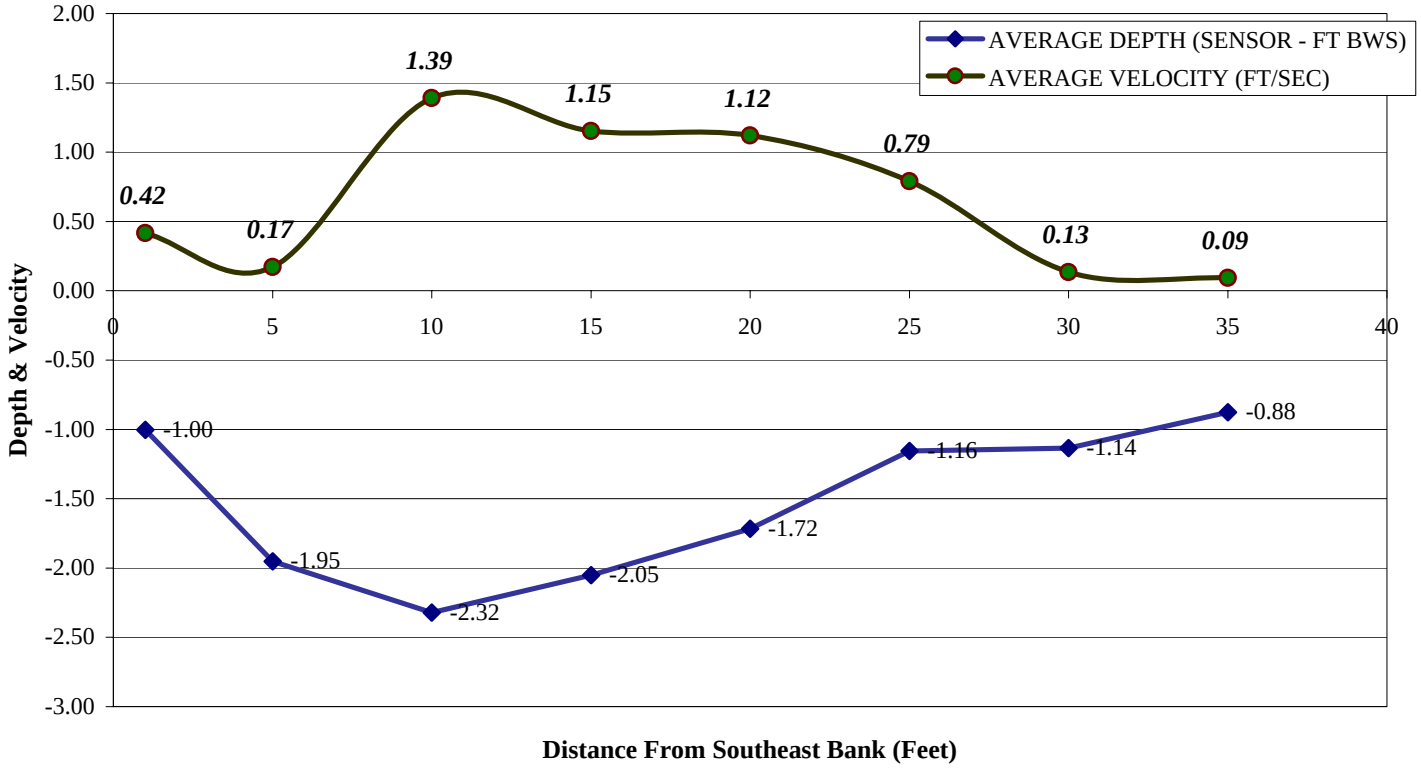


FIGURE 7

NOROTON RIVER CROSS-SECTION
APPROXIMATELY 40 FEET UPSTREAM OF ROUTE 95 CULVERTS
December 20, 2008



PLATES

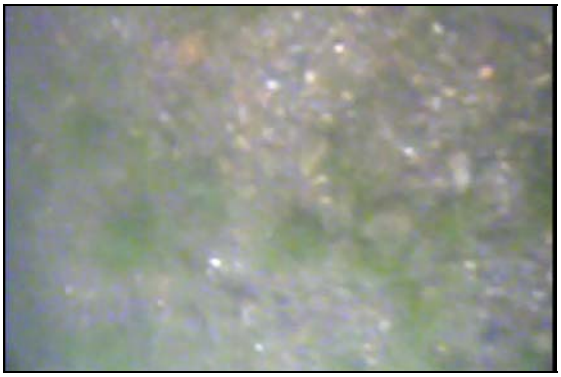
Plate 1 Top image is view of Holly Pond to the south from near the boat launch. Mowed salt marsh vegetation was present (*Atriplex arenaria*) where flooding occurs above the seawall. Bottom image is a view looking north towards the Noroton River inlet to Holly Pond at the shallow draft survey boat on an extreme high tide in Holly Pond. (November 12, 2008)

Plate 2 Extreme low tide looking north at the Noroton Inlet to Holly Pond, and the Route 1 bridge in the background (top). Boat access at Holly Pond to the south at low tide. Green algae along the shoreline and Marsh Elder (*Iva frutescens*) at the limit of tidal inundation (bottom).

Plate 3 Reach of the Noroton River where Acoustic Doppler Profile measurements were taken along a x-sectional transect upstream of the I-95 Bridge.

Plate 4 Location of the moored Starflow Ultrasonic Doppler Instrument (UDI) in front, north of the I-95 Bridge.

Plate 5 Location of the Stilling Well and InSitu Water Level Recorder at the right side of the I-95 Bridge.



HBP-1 Gravel, sand, sea lettuce

HPB-2 Mud, leaf litter, branching red algae

HPB-3 Mud, Bacterial floc

HPB-4 Mud, tree limb, mud snails

HBP-5 Branching red algae, mud snails

HPB-6 Mud bottom, mud snails

HPB-7 Branching red algae, mud snails

HPB-8 Sand, gravel, cobble, shell

Plate 6 Underwater Video Screen Captures Benthic Sampling Stations HPB-1 through -8

HPB-9 Sea lettuce, mud snails

HPB-10 Gravel, Cobble

HPB-11 Sandy silt, mud snails

HPB-12 Mud, leaf litter, crab claw

HPB-13 Mud, leaf litter, mud snails

Plate 7 Underwater Video Screen Captures Benthic Sampling Stations HPB-9 through-13

Upper and Lower Limit of *Phragmites australis* south of Giovanni's Parking Lot

Lower limit of *Spartina alterniflora* and upper limit of Marsh Elder (*Iva frutescens*) near the boat access site.

Plate 8

Plate 9 Staking the lower limit of *Phagmites australis* and *Spartina alterniflora* at Holly Pond

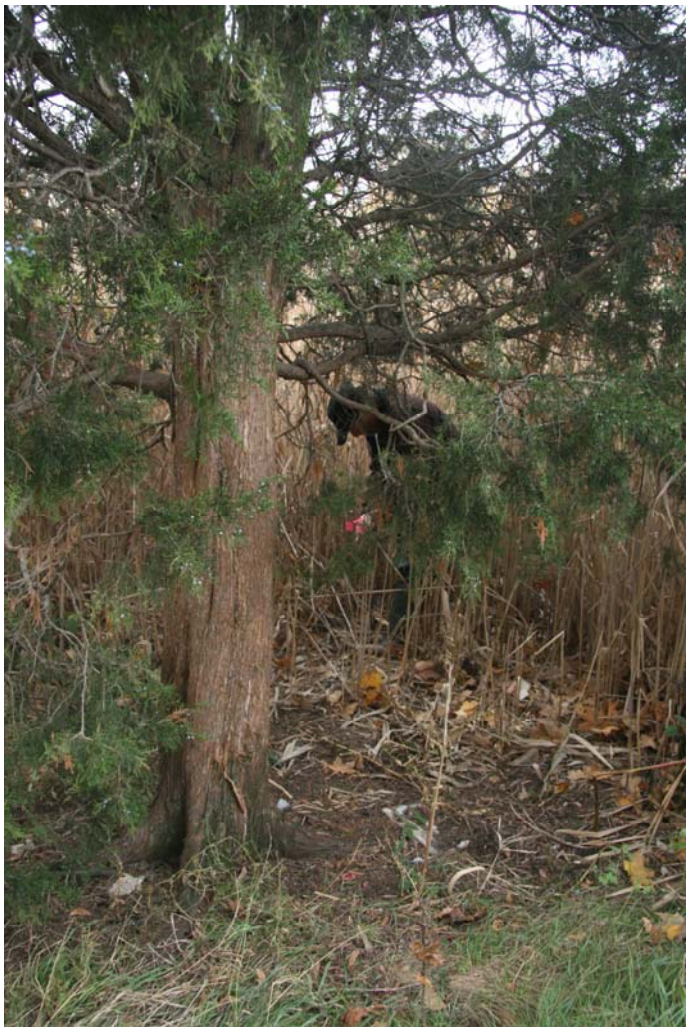


Plate 10 Upper limit of salt marsh at fence lined by Marsh Elder (*Iva frutescens*) (top) and upper limit of Common Reed at P-2 (*Phragmites australis*) near a Cedar tree (bottom)

DATE: June 4, 2009

TO: Erin Mosley, CH2M Hill – Boston

FROM: Charlotte Cogswell, CR Environmental, Inc.

RE: **Response to Comments in email dated 6/2/09**

The document indicates (second paragraph, page 4) that "Benthic samples were sorted at the office quantified and identified". It also states that the samples were sieved at 2mm. The results are presented in Table 3. I have the following comments and thoughts:

- Given the sampling and processing methods used, I was very surprised not to see any polychaetes in the samples. These organisms typically dominate estuarine muds and to see none at all is unusual to say the least. Did their sampling method preclude collecting polychaetes? If they have another explanation for not finding any, even if it is speculation, they should comment.

Response: *Scope was to identify to order. Samples were sorted by eye not under the microscope -so macroinvertebrates.*

As listed on Table 3, the polychaete Pectinaria sp. (trumpet worm) was found in two of the 12 samples. If other macroinvertebrate worms were present in the petite ponar grabs we would have seen them.

The organisms except for mud snails (Nasarrius obsoletus) were in low in numbers, and diversity was low possibly due to poor water quality, shallow water depths (can result in wide temperature fluctuations), and abundant algae particularly sea lettuce which can cause low DO in the bottom water during the night when the algae is respiring. Water column salinity information over various tidal cycles is lacking but some measurements were taken during the bathymetric survey for sound velocity checks. Salinity measurements in Holly Pond Cove on 11/13/08 were: Salinity mid-water (~3'depth) 25.5 PSU; about 1 hour into the ebb, Salinity was 24.5 PSU mid-water (~3' depth) and about 5-7 PSU from 0 – 3 inches below the water surface (freshwater input riding on the surface).

Note PSU = practical salinity units~ equivalent to parts per thousand. For reference seawater is 35 PSU.

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- Table 3 and the text list: bivalves, crabs, and shrimp but provides no identification. These should be identified at least to the generic level. These identifications would help us better understand and evaluate habitat restoration options.

Response: *Again scope said identify macroinvertebrates to order. The crab was observed in video footage (see claw in video clip sent with report), and could not be accurately identified. It was likely one of the swimming crabs (Portunidae family). The horseshoe crab is Limulus polyphemus.*

The bivalves are Eastern oysters (Crassostrea virginica), the small 'unidentified' bivalves ~ ¼ inch long include juvenile soft shell clams (Mya arenaria) and juvenile hardshell clams (Mercenaria mercenaria). Some empty shells were tentatively id'ed as gem clams (Gemma gemma).

Shrimp species was a Palaemonetes spp. Grass Shrimp.

The results of the marsh vegetation are presented as Plates 8, 9, and 10. I have the following comments:

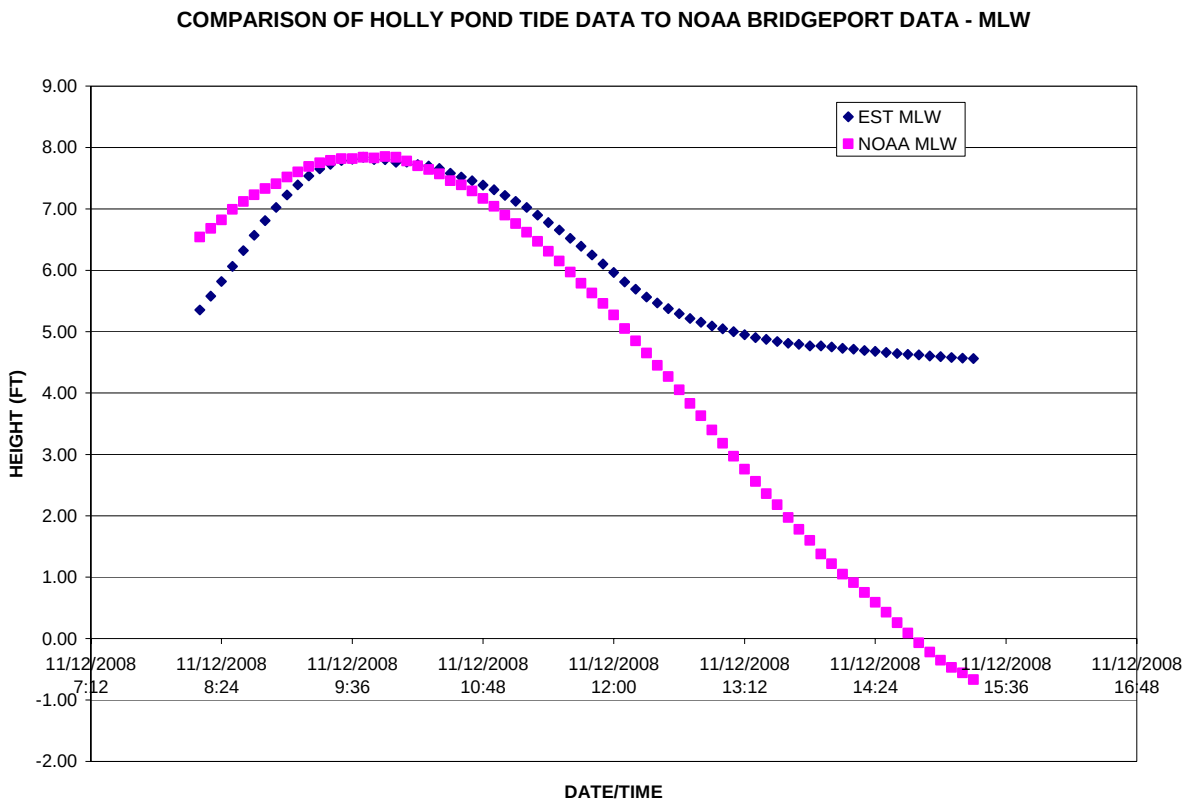
- A simple, schematic cross section of the wetlands would be very helpful. It would show the distances (i.e. width) of grasses and if possible the ground surface elevation. This would be very helpful as we evaluate habitat restoration options.
- Any comments, no matter how qualitative, on the condition of the marsh grasses would be helpful

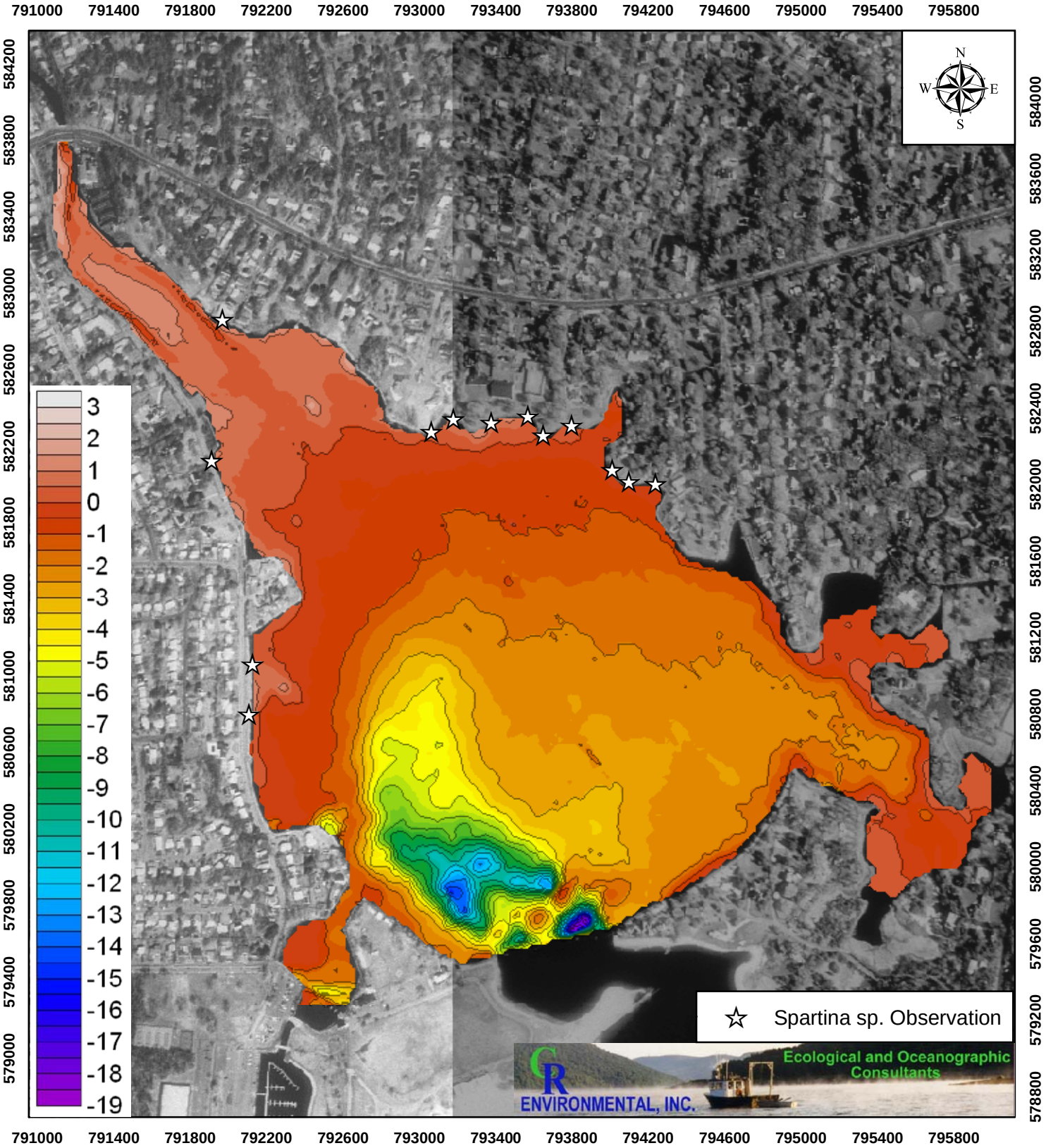
Response: *Seawalls/hard structures and landscaped homes surround the majority of the pond's shoreline. The northern portion of Holly Pond (the inlet area) closest to the Noroton River has common reed (Phragmites australis) along the shoreline. Holly Pond proper has some small isolated narrow bands of low marsh grass, Spartina alterniflora and then primarily marsh elder, Iva frutescens in the high marsh. At best these are areas about 15 ft wide and 5 to 15 ft deep. The band of Spartina is often narrow (i.e. ~ 4 ft). The salt marsh cordgrass where it was present appeared healthy and flowering, however, we were viewing it in November. As requested by CH2MHill stakes were placed in a couple of spots at the lower and upper limit of salt marsh and upper limit of common reed for CH2MHill to have surveyed for elevation (these images were emailed to the CH2MHill team). A figure is attached showing where patches of salt marsh were observed during the bathy work (not exhaustive). The southeastern cove area was not accessed and some salt marsh may be present. We suggest it would be advantageous to deploy a CTD for a number of months (minimum of one, two better) in the Holly Pond basin to measure DO, salinity, temperature, and water level prior to any restoration efforts.*

In addition to the biological related topics I had the following comment:

- Figure 1- the tide stage (high, low or somewhere in between) represented by the map is important. Ideally there would be one map for low tide, sowing exposed flats and another at high which would show the depth of water over the flats. If they monitored the tides, they should be able to do this. (Same comment applies to Figure 2).

Response: *The vertical control point provided by CH2M Hill surveyors was relative to NAVD88. CR recorded tides for approximately 8-hours during the survey, and while we managed to record a single series of high/low water heights, this record is insufficient for production of a defensible map depicting actual MLW or MLLW elevations. As shown on the image below, the remnants of the Holly Pond dam have a profound influence on low water elevations (>4 foot on the date of the survey) and on the flood/ebb rates of change. Nonetheless, because the tidal benchmark on Holly Pond had not yet been surveyed following the field effort, CR produced and delivered to CH2M Hill draft maps depicting estimated MLW elevations to help selection of sediment sampling stations. If maps depicting actual MLW or MLLW elevations are desired, CR suggests that deployment of a single recording tide gage for a minimum of 30-days would allow an assessment of tidal datum offsets at the site for non-navigational purposes.*





Notes:

1. Survey conducted November 12-13, 2008.
2. Grid: CT State Plane, NAD83, US Foot.
3. NAVD88 Elevations. Lines use 1.0 foot contour interval.
   Spectrum map uses 0.5-foot Contour Interval.
4. Not for Navigation.

0 250 500 1,000 1,500 2,000 Feet

1:8,500