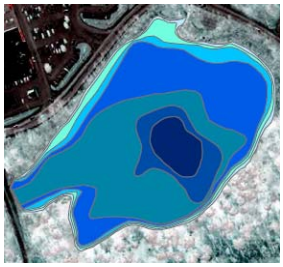
# Crystal Lake / Elginwood Pond
# Aquatic Vegetation, Bathymetric and Sediment Depth Survey

August 21, 2008



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# Crystal Lake / Elginwood Pond
# Aquatic Vegetation, Bathymetric and Sediment Depth Survey

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## EXECUTIVE SUMMARY

The City of Peabody contracted with Geosyntec Consultants in the summer of 2008 to conduct field surveys of the bathymetry, organic muck depths and aquatic plant community of Crystal Lake and Elginwood Pond. Both of these small ponds have substantial areas where dense aquatic vegetation and shallow water depths limit the potential for recreational uses such as non-motorized boating. The primary goals of this investigation were as follows:

1. Conduct mapping of the bathymetry (water depths) and muck layers of Crystal Lake and Elginwood Pond to provide baseline data for planning and determining the costs and feasibility of conducting dredging to remove accumulated sediment and restore recreational uses to the ponds.

2. Assess the Crystal Lake/Elginwood Pond aquatic plant community to provide a baseline for tracking future changes in the pond's plant abundance and species composition in response to dredging or other management techniques.

A brief summary of Geosyntec's field findings are as follows:

**Summary of Field Findings**

- **Bathymetry:** Crystal Lake is shallow throughout and slopes gradually to an area near the pond center. Crystal Lake had a maximum water depth of 4.5 feet and an average depth of 2.7 feet. The deepest part of Elginwood Pond (4.3 feet) is located near the Pond's outlet at the Cobb Avenue culvert. Overall, this pond is extremely shallow, with an average depth of only 1.1 feet. On the survey date (July 16, 2008), the entire southern half of Elginwood Pond was less than 1.5 feet deep. Overall, 75% of Elginwood Pond was between 0-2 feet deep.

- **Sediment Depths:** The average thickness of the muck layer in Crystal Lake was 2.85 feet. At a majority of the Crystal Lake sampling locations, the muck layer was underlain by peat. The average thickness of the muck layer in Elginwood Pond was 2.05 feet, with most sampling stations underlain by sand/gravel. The total in-situ volume of muck (to refusal) for the ponds is 65,118 cubic yards, with 40,276 cubic yards in Crystal Lake and 24,842 cubic yards in Elginwood Pond.

- **Aquatic Vegetation:** Plant growth in Crystal Lake ranged from sparse to very dense on the survey date, with the densest plant growth found around the pond perimeter and its northeastern quadrant. Elginwood Pond exhibited moderate to very dense plant growth, with some shallow areas nearly impassable by boat due to dense growth of water lilies. The aquatic plant community of Crystal Lake/Elginwood Pond is comprised predominantly by an assemblage of native species. Waterweed (*Elodea nuttallii*) was the most dominant submersed plant and in both ponds and Yellow Water Lily (*Nuphar variegatum*) was the dominant floating-leaved plant. Also common throughout both ponds were Lesser Duckweed (Lemna minor) and Watermeal (Wolffia sp.), tiny floating plants that can mat the water surface. Three non-native aquatic species (European Naiad, Variable Milfoil and Curly-leaf Pondweed) were found growing on the ponds in relatively small quantities. The potential spread of these species should be tracked closely in future vegetation surveys.

## SECTION 1: INTRODUCTION

Geosyntec Consultants, Inc. (Geosyntec) was contracted by the City of Peabody, MA to conduct a bathymetric survey, sediment depth survey and aquatic vegetation survey at Crystal Lake/Elginwood Pond during the summer of 2008. The primary goals of the assessment were as follows:

1. Measure the muck layer depths throughout Crystal Lake/Elginwood Pond, to provide baseline data as necessary for planning and determining the costs and feasibility of conducting dredging to remove accumulated sediment and restore recreational uses to the ponds.

2. Conduct bathymetric mapping to determine the existing pond depth contours. This information is critical when used in combination with sediment depth information to assess dredging feasibility. Bathymetric data also provides important information about current and potential littoral zone areas (areas of rooted plant growth) and is useful when assessing the feasibility of plant management alternatives such as mechanical harvesting, hydroraking and lake level drawdown.

3. Conduct an assessment and mapping of the Crystal Lake/Elginwood Pond macrophyte community. This information will provide the City with an important baseline for tracking future changes in the pond's plant abundance and species composition in response to dredging or other potential pond management techniques.

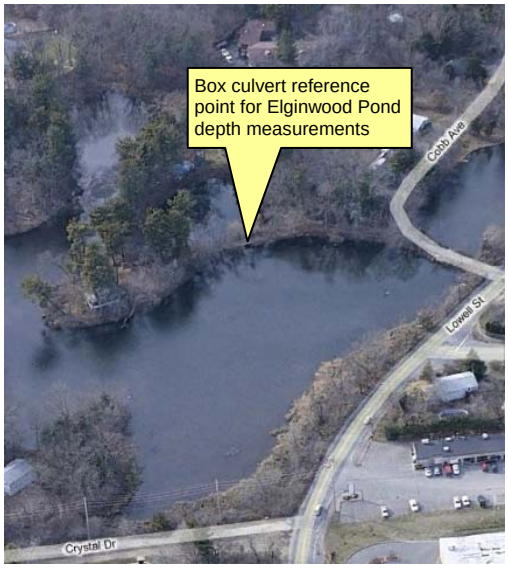
## SECTION 2: FIELD DATA RESULTS

### 2.1 BATHYMETRY AND SEDIMENT DEPTH

**Methodology**

**Bathymetry:** Geosyntec performed a detailed transect survey of Crystal Lake/Elginwood Pond based on an approximate 20-meter point intercept survey grid, which provided data at a total of 154 points located throughout the water bodies. Each survey point was mapped with a Trimble Global Positioning System (GPS) with sub-meter accuracy, as shown in Figure 1.

Geosyntec measured water depth at each of the 154 transect points by using a weighted, calibrated line. On the first day of field data collection (July 11, 2008) Geosyntec also attempted to use a Sonar depth measuring instrument. The Sonar instrument's measurements were checked for accuracy by comparison to the calibrated line. Based on this comparison, Geosyntec determined that the Sonar readings were underestimating the water depth due to the presence of submerged vegetation and flocculent sediments that were present at the sediment/water interface. As such, the calibrated line was used for all water depth measurements.




The water depth measurements for Crystal Lake were taken on July 11, 2008, when the water level was 9 inches below the concrete outlet structure (see photo). The water depth measurements for Elginwood Pond were taken on July 16, 2008, when the water level was 35.5 inches below the center of the box culvert located at a private driveway off of Cobb Avenue in the northern section of the pond (see photo) .

**Sediment Depth:** Geosyntec measured the depth of the muck layer at each of the 154 transect points described above. To measure sediment depths, Geosyntec performed manual probing with a calibrated rod to measure the depth of the muck layer to a refusal layer. Geosyntec also characterized the general substrate type of the refusal layer (e.g. peat, sand/gravel, rock) at each sediment sampling location. At minimum of one sampling point per transect, Geosyntec used a soil auger attachment on the end of the push probe to confirm the sediment type and structure at the refusal depth. Muck is defined as well decomposed accumulated organic sediment, with a low content of plant fiber relative to bulk density. Peat, which was found to underlie the muck layer in many areas of Crystal Lake/Elginwood Pond, is defined as fibric organic soil material composed primarily of plants that are only partially decomposed.

**Results**

**Bathymetry:** Figure 2 presents a bathymetric map of Crystal Lake/Elginwood Pond that Geosyntec developed using ArcMap software, based on the measurements described above. Table 1 lists the water depths measured at each sampling station.

- As shown on Figure 2, Crystal Lake is shallow throughout and slopes gradually to an area near the pond center. The maximum water depth measured in Crystal Lake was 4.5 feet and the average water depth was 2.7 feet.
- The deepest part of Elginwood Pond (4.3 feet) is located near the Pond's outlet at the Cobb Avenue culvert. Overall, this pond is extremely shallow, with an average depth of only 1.1 feet. On the survey date (July 16, 2008), the entire southern half of Elginwood Pond was less than 1.5 feet deep. Overall, 75% of Elginwood Pond was measured to be between 0-2 feet deep.

**Sediment Depth:** Figures 3 and 4 present muck layer depth maps that Geosyntec created based on the field measurements by using Mining Visualization Software (MVS) by C-Tech. Figures 5 and 6 show the depths from the water surface to the bottom of the muck layer for each pond.

- The average in-situ thickness of the muck layer in Crystal Lake was 2.85 feet. At a majority of the Crystal Lake sampling locations, the muck layer was underlain by peat. The total in-situ volume of muck to refusal in Crystal Lake is estimated at 40,276 cubic yards.
- The average in-situ thickness of the muck layer in Elginwood Pond was 2.05 feet. At a majority of the Crystal Lake sampling locations, the muck layer was underlain by sand/gravel. The total in-situ volume of muck to refusal in Elginwood Pond is estimated at 24,842 cubic yards.

*Sediment core from Crystal Lake sampling station #28, showing zone of transition from muck to peat.*

Summary statistics for the water depths and sediment depths of Crystal Lake/Elginwood Pond are listed below:

**Crystal Lake/Elginwood Pond Bathymetric and Muck Depth Statistics***

| | Crystal Lake | Elginwood Pond |
|---|---|---|
| Surface Area** | 8.9 acres | 7.7 acres |
| Average Water Depth | 2.7 feet | 1.1 feet |
| Maximum Water Depth | 4.5 feet | 4.3 feet |
| Average Muck Thickness (to refusal) | 2.85 feet | 2.05 feet |
| Total Muck Volume (to refusal) | 40,276 $yd.^3$ | 24,842 $yd.^3$ |

* Based on Geosyntec's measurements on July 11-16, 2008.

** Pond surface area based on field location of Geosyntec's GPS points and review of aerial orthophotography from MassGIS using ArcMap software. Actual surface areas may vary slightly due to fluctuations in water level, shoreline areas obscured by overhanging tree canopy, etc.

**Legend**

- GPS Locations

Notes

Image from MassGIS (2005)

**Bathymetry and Sediment Depth GPS Points**
**Crystal Lake and Elginwood Pond**
**Survey Date: July 11-16, 2008**

**Peabody, MA**

Geosyntec consultants

Acton, MA | 13-AUG-2008

FIGURE 1

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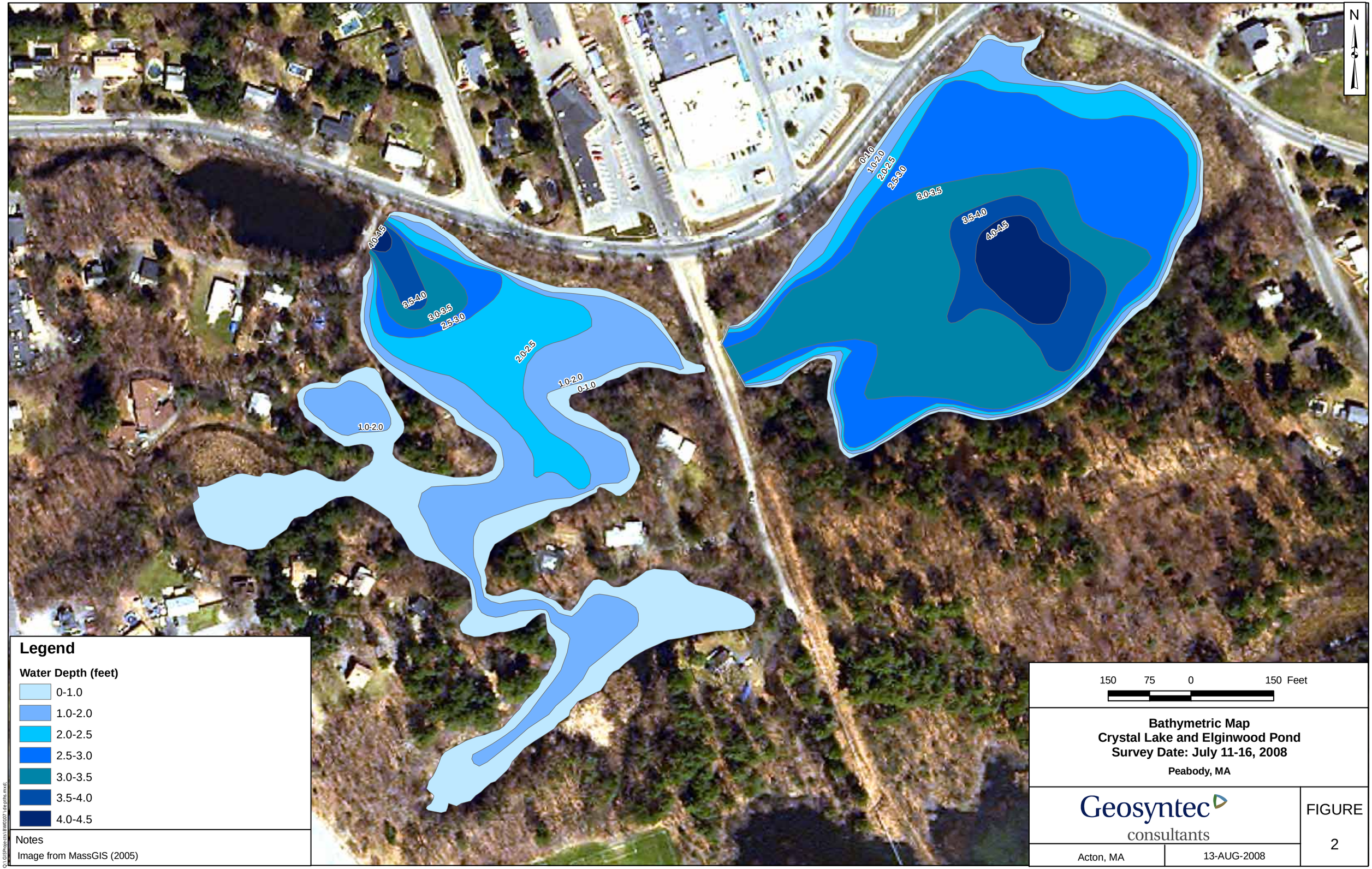



**Bathymetric Map**
**Crystal Lake and Elginwood Pond**
**Survey Date: July 11-16, 2008**

**Peabody, MA**

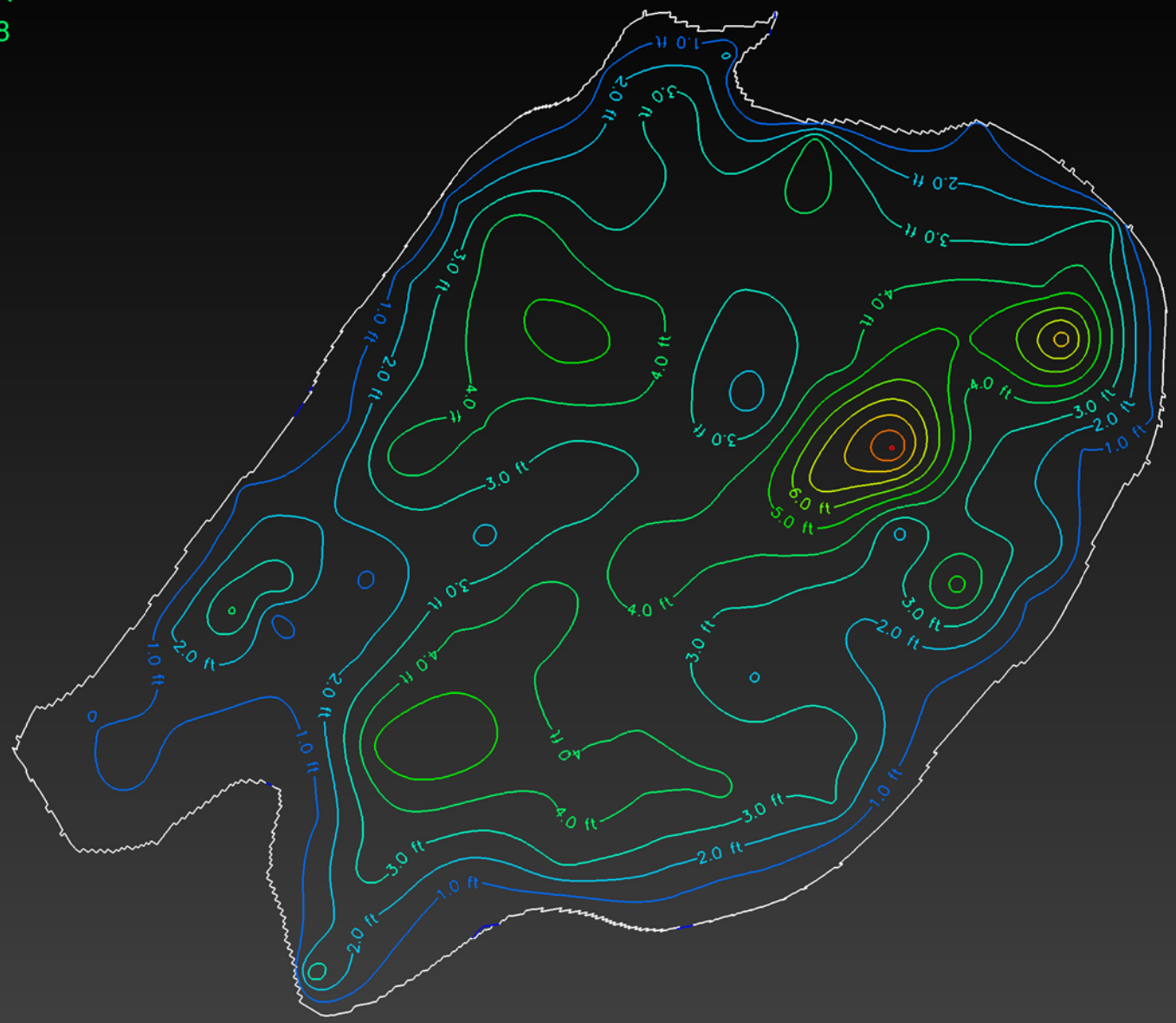
Geosyntec consultants

Acton, MA | 13-AUG-2008

FIGURE 2

Q:\GISProjects\BW0107\depths.mxd;

Figure 3. Muck Layer Thickness
Crystal Lake, Peabody, MA
Survey Date: July 11, 2008




Sediment Thickness

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Figure 4. Muck Layer Thickness
Elginwood Pond, Peabody, MA
Survey Date: July 16, 2008

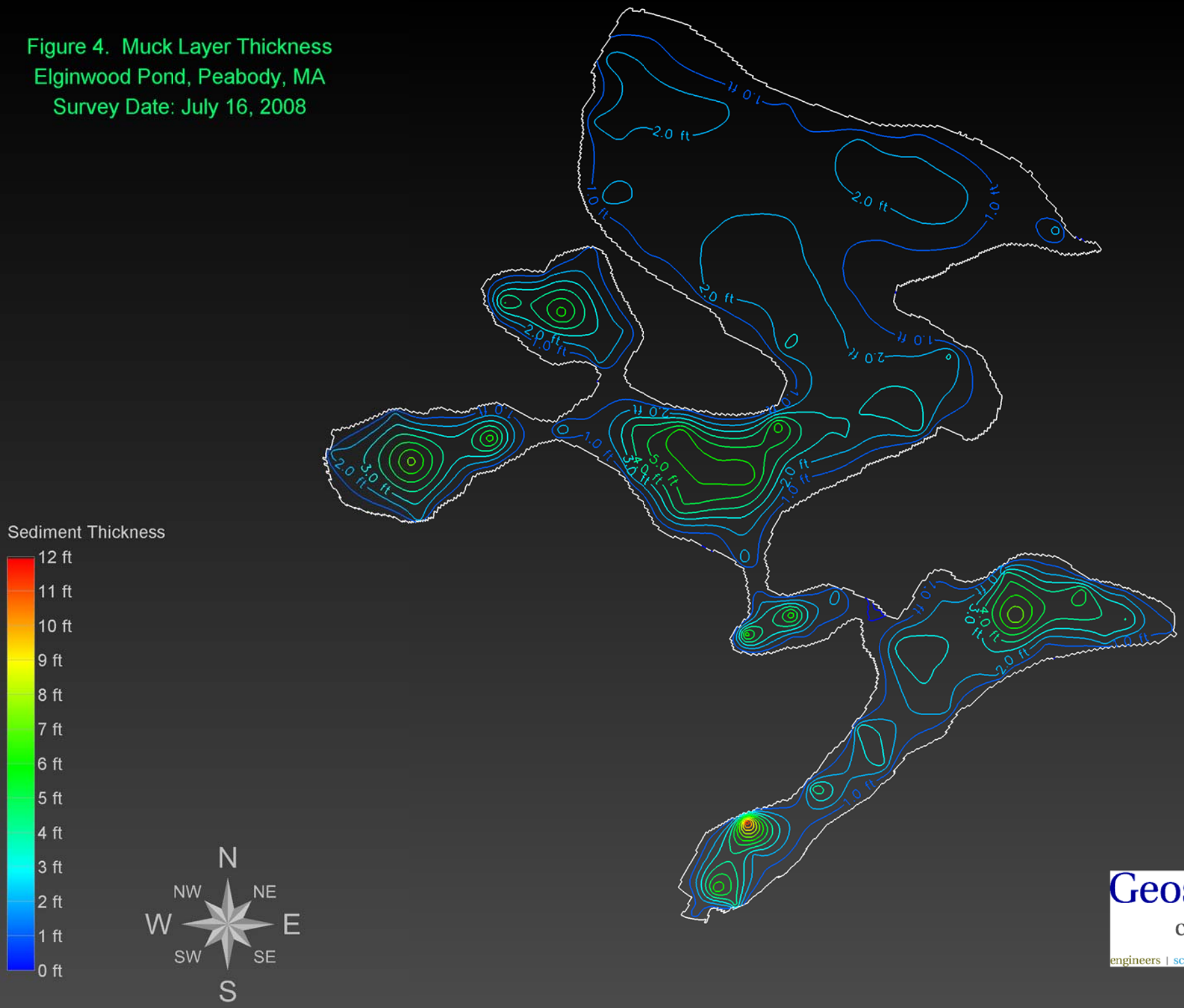


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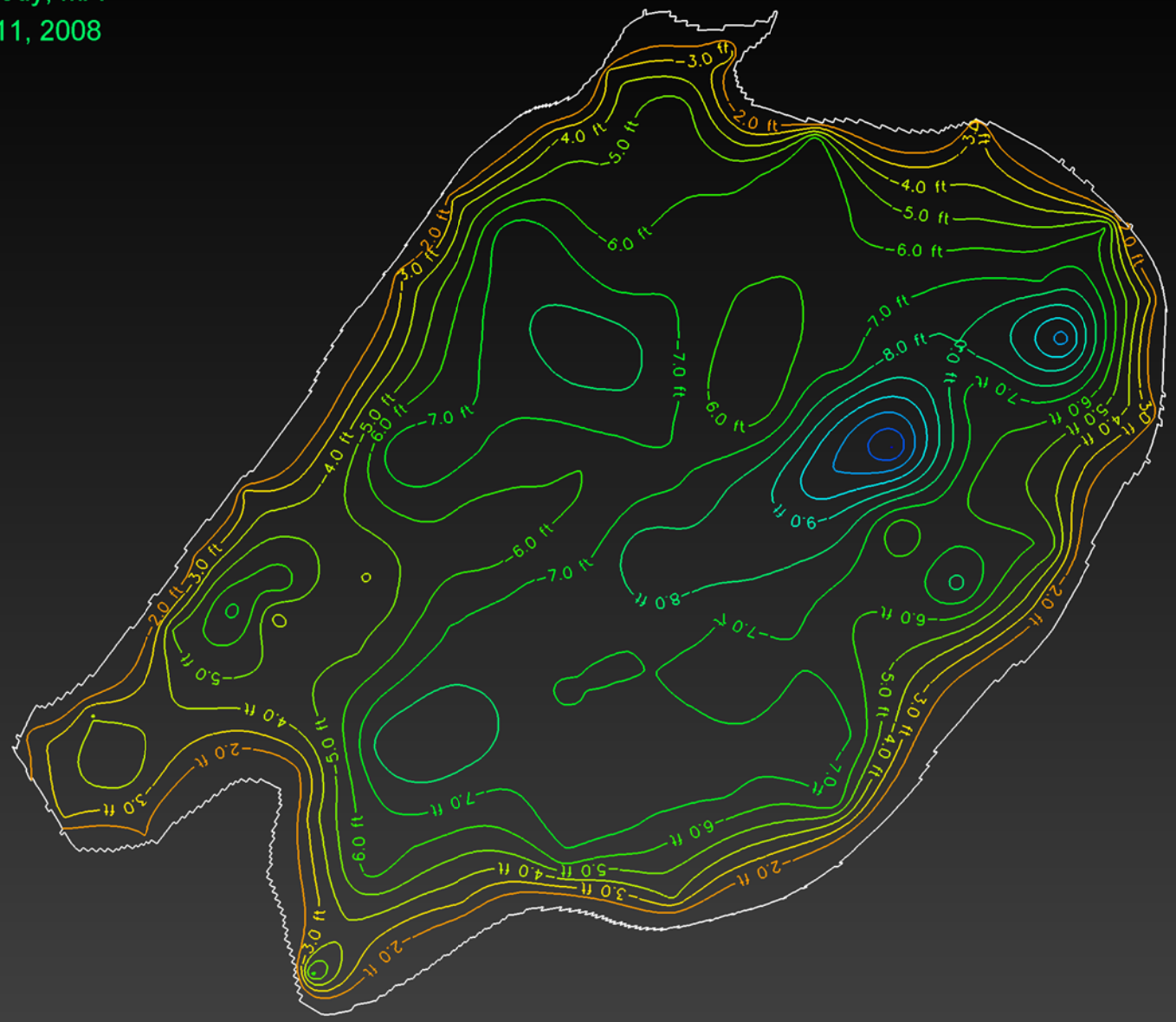
Figure 5. Combined Depth of Water and Muck Layer
Crystal Lake, Peabody, MA
Survey Date: July 11, 2008




Depth
0 ft
-1 ft
-2 ft
-3 ft
-4 ft
-5 ft
-7 ft
-8 ft
-9 ft
-10 ft
-11 ft
-12 ft
-13 ft

N
NW
NE
W
E
SW
SE
S

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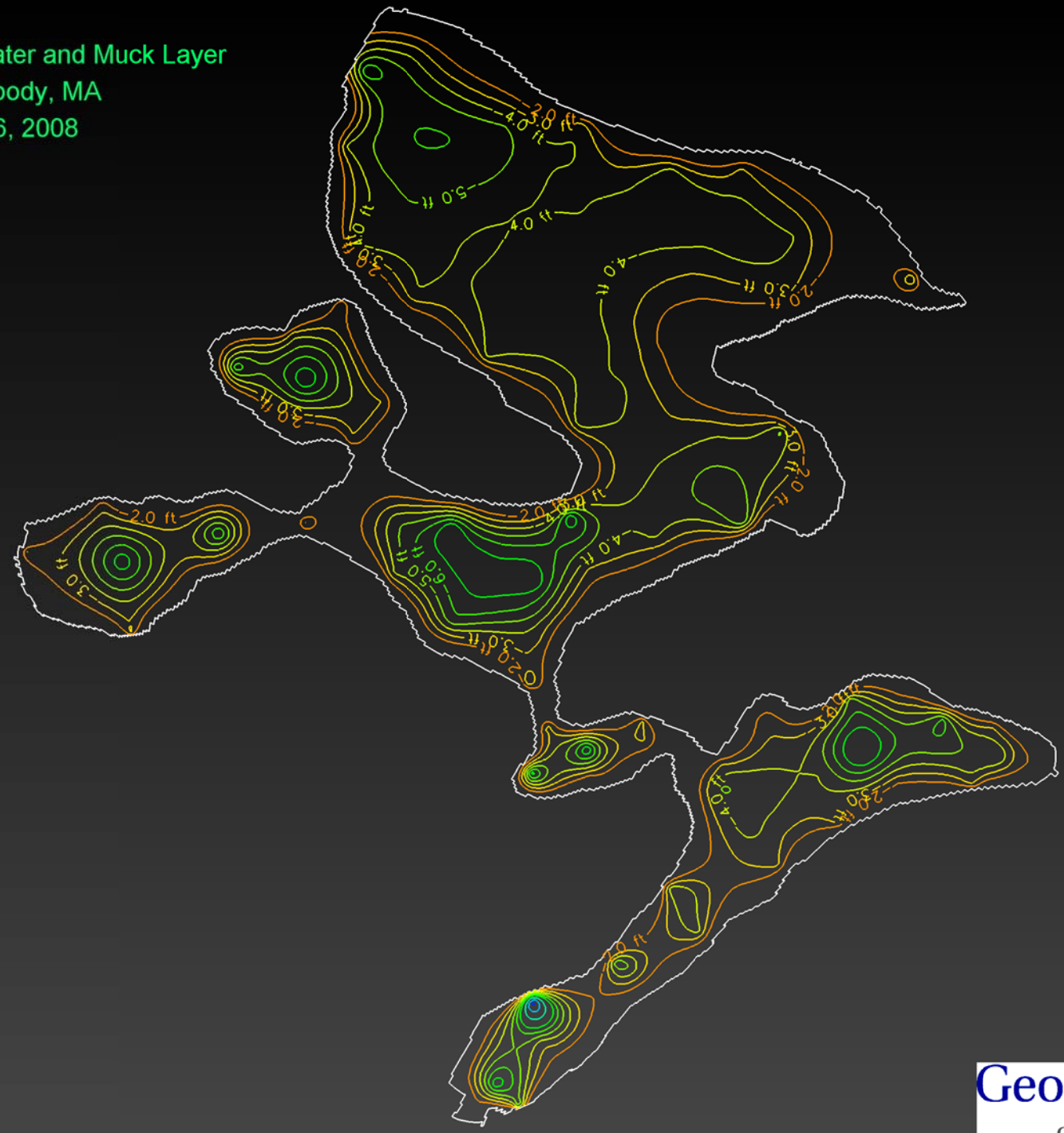
Figure 6. Combined Depth of Water and Muck Layer
Elginwood Pond, Peabody, MA
Survey Date: July 16, 2008




Depth
0 ft
-1 ft
-2 ft
-3 ft
-5 ft
-6 ft
-7 ft
-8 ft
-9 ft
-10 ft
-11 ft
-12 ft
-14 ft

N
NW
NE
W
E
SW
SE
S

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## Table 1: Crystal Lake Bathymetry and Muck Layer Depths, 07/11/08

| Site # | Water Depth* (ft) | Refusal Depth (ft) | Muck Layer (ft) | Refusal Layer Notes | Site # | Water Depth* (ft) | Refusal Depth (ft) | Muck Layer (ft) | Sediment Type/Notes |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.7 | 2.8 | 0.1 | S/G | 41 | 3.0 | 5.9 | 2.9 | Peat @ 5.9; Sand/Gravel @ 6.3 |
| 2 | 2.9 | 3.8 | 0.9 | Peat | 42 | 2.9 | 8.4 | 5.5 | Peat |
| 3 | 3.0 | 4.2 | 1.2 | Peat | 43 | 3.9 | 5.8 | 1.9 | Peat |
| 4 | 3.0 | 3.7 | 0.7 | Peat | 44 | 4.2 | 6.1 | 1.9 | Peat |
| 5 | 3.1 | 3.9 | 0.8 | Peat | 45 | 3.4 | 7.3 | 3.9 | Peat |
| 6 | 3.3 | 5.0 | 1.7 | Peat | 46 | 3.2 | 7.2 | 4.0 | Peat |
| 7 | 3.6 | 6.0 | 2.4 | Peat | 47 | 2.9 | 6.5 | 3.6 | Peat |
| 8 | 3.5 | 5.0 | 1.5 | Peat | 48 | 3.0 | 6.0 | 3.0 | Peat |
| 9 | 3.0 | 6.6 | 3.6 | Peat | 49 | 2.9 | 3.0 | 0.1 | Sand |
| 10 | 2.9 | 8.0 | 5.1 | Peat | 50 | 3.3 | 6.7 | 3.4 | Peat |
| 11 | 3.3 | 7.0 | 3.7 | Peat | 51 | 3.3 | 4.3 | 1.0 | Sand |
| 12 | 2.2 | 6.1 | 3.9 | Peat | 52 | 3.1 | 7.3 | 4.2 | Peat |
| 13 | 2.4 | 3.4 | 1.0 | Peat | 53 | 2.6 | 3.7 | 1.1 | Peat @ 3.7; Sand/Gravel @ 10.3 |
| 14 | 2.9 | 11.5 | 8.6 | Peat | 54 | 3.8 | 6.9 | 3.1 | Peat |
| 15 | 2.9 | 6.0 | 3.1 | Peat | 55 | 3.8 | 5.3 | 1.5 | Peat |
| 16 | 2.9 | 13.1 | 10.2 | Rock | 56 | 2.7 | 3.5 | 0.8 | Sand/Gravel |
| 17 | 3.3 | 11.0 | 7.7 | Peat | 57 | 2.5 | 4.9 | 2.4 | Peat |
| 18 | 4.2 | 8.8 | 4.6 | Peat | 58 | 2.0 | 4.0 | 2.0 | Peat |
| 19 | 4.2 | 9.0 | 4.8 | Peat | 59 | 2.4 | 7.0 | 4.6 | Peat |
| 20 | 3.2 | 7.7 | 4.5 | Peat | 60 | 2.6 | 5.9 | 3.3 | Peat |
| 21 | 3.1 | 7.0 | 3.9 | Peat | 61 | 1.9 | 4.2 | 2.3 | Sand/Gravel |
| 22 | 3.0 | 5.1 | 2.1 | Peat @ 5.1; Sand/Gravel @ 5.8 | 62 | 1.9 | 5.6 | 3.7 | Peat @ 5.6; Sand/Gravel @ 9.0 |
| 23 | 3.4 | 3.9 | 0.5 | Peat @ 3.9; Sand/Gravel @ 5.4 | 63 | 1.9 | 3.5 | 1.6 | Sand/Gravel |
| 24 | 3.3 | 5.1 | 1.8 | Peat @ 5.1; Sand/Gravel @ 7.2 | 64 | 2.8 | 4.2 | 1.4 | Peat @ 4.2; Sand/Gravel @ 8.8 |
| 25 | 3.2 | 4.6 | 1.4 | Peat @ 4.6; Sand/Gravel @ 10.6 | 65 | 2.6 | 5.3 | 2.7 | Peat |
| 26 | 3.0 | 3.1 | 0.1 | Sand/Gravel | 66 | 2.8 | 6.5 | 3.7 | Peat |
| 27 | 2.0 | 2.1 | 0.1 | Sand/Gravel | 67 | 2.9 | 8.5 | 5.6 | Peat |
| 28 | 1.7 | 1.8 | 0.1 | Sand/Gravel | 68 | 2.9 | 7.9 | 5.0 | Peat |
| 29 | 2.9 | 3.7 | 0.8 | Peat @ 3.7; Sand/Gravel @ 7.8 | 69 | 1.5 | 3.3 | 1.8 | Sand/Gravel |
| 30 | 3.0 | 6.5 | 3.5 | Sand/Gravel | 70 | 1.5 | 3.2 | 1.7 | Sand/Gravel |
| 31 | 2.7 | 6.5 | 3.8 | Sand/Gravel | 71 | 3.2 | 9.0 | 5.8 | Sand/Gravel |
| 32 | 3.0 | 8.6 | 5.6 | Peat | 72 | 3.1 | 7.1 | 4.0 | Sand/Gravel |
| 33 | 3.0 | 8.7 | 5.7 | Peat | 73 | 3.3 | 7.9 | 4.6 | Peat |
| 34 | 3.5 | 6.9 | 3.4 | Peat | 74 | 2.3 | 2.7 | 0.4 | Sand/Gravel |
| 35 | 4.2 | 7.0 | 2.8 | Peat | 75 | 1.6 | 3.3 | 1.7 | Sand/Gravel |
| 36 | 4.5 | 7.6 | 3.1 | Peat | 76 | 3.0 | 6.5 | 3.5 | Peat @ 6.5; Sand/Gravel @ 7.9 |
| 37 | 3.4 | 5.1 | 1.7 | Peat | 77 | 3.2 | 7.4 | 4.2 | Peat @ 7.4; Sand/Gravel @ 10.8 |
| 38 | 3.0 | 5.2 | 2.2 | Peat | 78 | 1.7 | 2.0 | 0.3 | Sand/Gravel |
| 39 | 2.8 | 3.8 | 1.0 | Peat | 79 | 3.1 | 5.3 | 2.2 | Sand/Gravel |
| 40 | 1.9 | 3.2 | 1.3 | Sand/Gravel | 80 | 2.2 | 5.3 | 3.1 | Sand/Gravel |

** Water depth measurements taken on 7/11/08, when Geosyntec measured Crystal Pond level at 9 inches below first bench of concrete outlet structure.*

## Table 2: Elginwood Pond Bathymetry and Muck Layer Depths, 07/16/08

| Station # | Water Depth * (ft) | Refusal Depth (ft) | Muck Layer (ft) | Refusal Layer Notes | Station # | Water Depth* (ft) | Refusal Depth (ft) | Muck Layer (ft) | Refusal Layer Notes |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 3.9 | 2.6 | Sand/Gravel | 38 | 1.2 | 8.0 | 6.8 | Sand/Gravel |
| 2 | 1.7 | 3.1 | 1.4 | Sand/Gravel | 39 | 0.8 | 3.2 | 2.4 | Sand/Gravel |
| 3 | 1.7 | 4.1 | 2.4 | Sand/Gravel | 40 | 1.2 | 3.0 | 1.8 | Sand/Gravel |
| 4 | 1.6 | 3.3 | 1.7 | Sand/Gravel | 41 | 1.0 | 1.1 | 0.1 | Sand/Gravel |
| 5 | 2.3 | 4.8 | 2.5 | Sand/Gravel | 42 | 1.1 | 3.3 | 2.2 | Sand/Gravel |
| 6 | 2.0 | 3.7 | 1.7 | Sand/Gravel | 43 | 1.2 | 2.8 | 1.6 | Sand/Gravel |
| 7 | 1.1 | 1.8 | 0.7 | Sand/Gravel | 44 | 0.8 | 7.8 | 7.0 | Sand/Gravel |
| 8 | 2.0 | 4.3 | 2.3 | Peat | 45 | 0.7 | 2.3 | 1.6 | Sand/Gravel |
| 9 | 2.3 | 6.1 | 3.8 | Peat | 46 | 1.2 | 5.8 | 4.6 | Sand/Gravel |
| 10 | 2.0 | 5.2 | 3.2 | Peat | 47 | 1.5 | 3.3 | 1.8 | Sand/Gravel |
| 11 | 1.3 | 4.3 | 3.0 | Sand/Gravel | 48 | 1.7 | 14.0 | 12.3 | Peat |
| 12 | 1.6 | 4.7 | 3.1 | Peat @ 4.7; Sand @ 5.0 | 49 | 0.6 | 6.2 | 5.6 | Sand/Gravel |
| 13 | 2.3 | 4.5 | 2.2 | Sand/Gravel | 50 | 1.2 | 5.0 | 3.8 | Peat @ 5.0 ; Sand @ 8.3 |
| 14 | 2.7 | 3.9 | 1.2 | Sand/Gravel | 51 | 0.5 | 2.3 | 1.8 | Sand/Gravel/Rock |
| 15 | 2.9 | 4.9 | 2.0 | Peat @ 4.9; Sand @ 5.9 | 52 | 0.5 | 4.6 | 4.1 | Sand/Gravel |
| 16 | 2.3 | 3.7 | 1.4 | Peat @ 3.7; Sand @ 6.0 | 53 | 1.2 | 4.5 | 3.3 | Sand/Gravel |
| 17 | 1.8 | 4.3 | 2.5 | Sand/Gravel | 54 | 0.9 | 4.3 | 3.4 | Sand/Gravel |
| 18 | 2.0 | 3.9 | 1.9 | Sand/Gravel | 55 | 1.2 | 4.3 | 3.1 | Sand/Gravel |
| 19 | 3.7 | 5.3 | 1.6 | Sand/Gravel | 56 | 0.8 | 3.4 | 2.6 | Sand/Gravel |
| 20 | 2.3 | 3.7 | 1.4 | Sand/Gravel | 57 | 1.3 | 5.2 | 3.9 | Sand/Gravel |
| 21 | 4.3 | 6.8 | 2.5 | Sand/Gravel | 58 | 1.0 | 3.0 | 2.0 | Peat @ 3.0 ; Sand @ 5.5 |
| 22 | 2.0 | 4.3 | 2.3 | Sand/Gravel | 59 | 1.1 | 4.0 | 2.9 | Sand/Gravel |
| 23 | 2.4 | 4.8 | 2.4 | Sand/Gravel | 60 | 0.8 | 3.3 | 2.5 | Sand/Gravel |
| 24 | 0.6 | 4.0 | 3.4 | Sand/Gravel | 61 | 0.9 | 2.0 | 1.1 | Sand/Gravel |
| 25 | 0.5 | 4.8 | 4.3 | Sand/Gravel | 62 | 0.9 | 9.0 | 8.1 | Sand/Gravel |
| 26 | 1.0 | 8.0 | 7.0 | Sand/Gravel | 63 | 0.8 | 5.5 | 4.7 | Sand/Gravel |
| 27 | 1.0 | 6.2 | 5.2 | Sand/Gravel | 64 | 0.8 | 6.3 | 5.5 | Peat |
| 28 | 0.9 | 5.7 | 4.8 | Sand/Gravel | 65 | 0.7 | 3.2 | 2.5 | Sand/Gravel |
| 29 | 1.0 | 1.3 | 0.3 | Sand/Gravel | 66 | 0.8 | 1.4 | 0.6 | Sand/Gravel |
| 30 | 1.1 | 7.8 | 6.7 | Sand/Gravel | 67 | 1.1 | 3.2 | 2.1 | Sand/Gravel |
| 31 | 1.1 | 7.8 | 6.7 | Sand/Gravel | 68 | 1.5 | 3.6 | 2.1 | Sand/Gravel/Rock |
| 32 | 1.0 | 2.8 | 1.8 | Sand/Gravel | 69 | 1.5 | 6.7 | 5.2 | Sand/Gravel |
| 33 | 1.0 | 3.2 | 2.2 | Sand/Gravel/Rock | 70 | 1.4 | 8.0 | 6.6 | Peat |
| 34 | 1.2 | 3.8 | 2.6 | Sand/Gravel/Rock | 71 | 1.2 | 2.5 | 1.3 | Sand/Gravel |
| 35 | 1.5 | 3.4 | 1.9 | Sand/Gravel/Rock | 72 | 0.6 | 3.0 | 2.4 | Sand/Gravel |
| 36 | 0.8 | 7.6 | 6.8 | Sand/Gravel | 73 | 1.0 | 3.0 | 2.0 | Sand/Gravel |
| 37 | 0.8 | 1.2 | 0.4 | Sand/Gravel | 74 | 1.3 | 3.8 | 2.5 | Sand/Gravel |

** Water depth measurements taken on 7/16/08, when Geosyntec measured Elginwood Pond level at 35.5 inches below concrete box culvert located in the northern portion of the pond (at private driveway off of Cobb Avenue).*

## 2.2 AQUATIC VEGETATION SURVEY

**Methodology**

On June 26, 2008, Geosyntec conducted a macrophyte survey of Crystal Lake/Elginwood Pond. Plant growth in Crystal Lake ranged from sparse to very dense on the survey date, with the densest plant growth found around the pond perimeter and its northeastern quadrant. Elginwood Pond exhibited moderate to very dense plant growth, with some shallow areas nearly impassable by boat due to dense growth of water lilies. Aquatic vegetation was sampled from a boat. Plant species were identified at 40 sampling locations (see Figure 7). Plants were identified by visual inspection and by using an aquatic vegetation grappling hook to sample submerged vegetation. At each station, the dominant plant(s) were recorded, as well as estimates of plant growth density and biomass. As categorized in Table 3, plant density is an estimate of the percentage of aerial coverage when looking down to the lake bottom from the water surface. Biomass estimates the amount of plant matter within the water column. For example, a sampling station with dense growth of low-growing plants may have a high density estimate but a relatively low plant biomass estimate. A station with dense growth of a long, ropey plant such as Variable milfoil, with stems reaching the water surface, would have both high plant density and high biomass estimates.

In addition to recording information from the 40 sampling stations, a running documentation of plant growth densities was estimated throughout the lakewide survey. Survey locations were mapped with a Global Positioning System (GPS). Based on the above information, Geosyntec developed an aquatic vegetation map of Crystal Lake/Elginwood Pond (Figure 7) using ESRI ArcMap GIS software.

**Results**

A listing of plant species observed at each of the forty sampling stations is provided in Table 3, including information on vegetation density, plant biomass, and dominant plants at each station. A summary of the major findings of the July 26, 2008 vegetation survey is provided below.

*Waterweed*

**Native Species:** The aquatic plant community of Crystal Lake/Elginwood Pond is comprised predominantly by an assemblage of native species, including:

- **Waterweed** (*Elodea nuttallii*) was the most dominant plant in both Crystal Lake and Elginwood Pond. This submersed aquatic plant was present at 39 out of 40 sampling stations and was a dominant plant (comprising at least 20% of the total plant growth) at 17 stations.

*Yellow Water Lily*

- The second most dominant plant in both Crystal Lake and Elginwood Pond was **Yellow Water Lily** (*Nuphar variegatum*). This is perhaps the most visually prominent plant in these ponds, due to its large floating leaves and yellow flowers. Yellow Water Lily is commonly found around the perimeter of both ponds, and can be distinguished from White Water Lily by its yellow flowers and the rounded lobes of its floating leaves. Yellow Water Lily was present at 31 out of 40 sampling stations and was a dominant plant at 14 stations.

*Lesser Duckweed*

- **Lesser Duckweed** (*Lemna minor*) was found at all 40 sampling stations, making it the most well distributed plant in Crystal Lake/Elginwood Pond.

However, this tiny floating plant was only determined to be dominant at one station in Elginwood Pond. Lesser Duckweed was typically found growing in combination with two other duckweed species, **Big Duckweed** (*Spirodela polyrhiza*) and **Star Duckweed** (*Lemna trisulca*).

*Watermeal*

- **Watermeal** (*Wolffia sp.*) was found throughout Crystal Lake/Elginwood Pond. This tiny floating plant, which is named for its granular texture, was present at 39 stations and was a dominant at 6 stations. Watermeal is typically found intermixed with the duckweed and water lily species described above.

*Thin-leaf Pondweed*

- **Thin-leaf Pondweed** (*Potamogeton pusillus*) was present at 14 stations and was dominant at 3 stations during the June 26, 2008 survey. Geosyntec noted that this plant appeared significantly more abundant in Elginwood Pond during the July 16, 2008 sediment and bathymetry survey field work.

**Non-Native Species:** Three non-native aquatic species were observed in Crystal Lake/Elginwood Pond during the vegetation survey. Although each of these species have the potential to exhibit invasive growth patterns and outcompete native species, they were observed in relatively small quantities on the 26 June 2008 survey date. The potential spread of these species should be tracked closely in future vegetation surveys. A summary of these species is as follows:

*European Naiad*

- **European Naiad** (*Najas minor*) was found at five stations in Crystal Lake and was a dominant plant at two stations. This plant was not observed at any locations within Elginwood Pond. *Najas minor* can be distinguished from other *Najas* species by its conspicuous leaf serrations.

*Curlyleaf Pondweed*

- **Curlyleaf Pondweed** *(Potamogeton crispus)* was found at a total of four stations and was dominant at the two stations where it was observed in the eastern coves of Elginwood Pond.

*Variable Milfoil*

- **Variable Milfoil** *(Myriophyllum heterophyllum)* was found in small quantities at two sampling stations in Elginwood Pond. This plant was not observed to be dominant at any locations within the ponds.

A map of the vegetation survey results and a tally sheet, documenting the plant species and dominant plants at each of the sampling stations, are provided on the following pages.

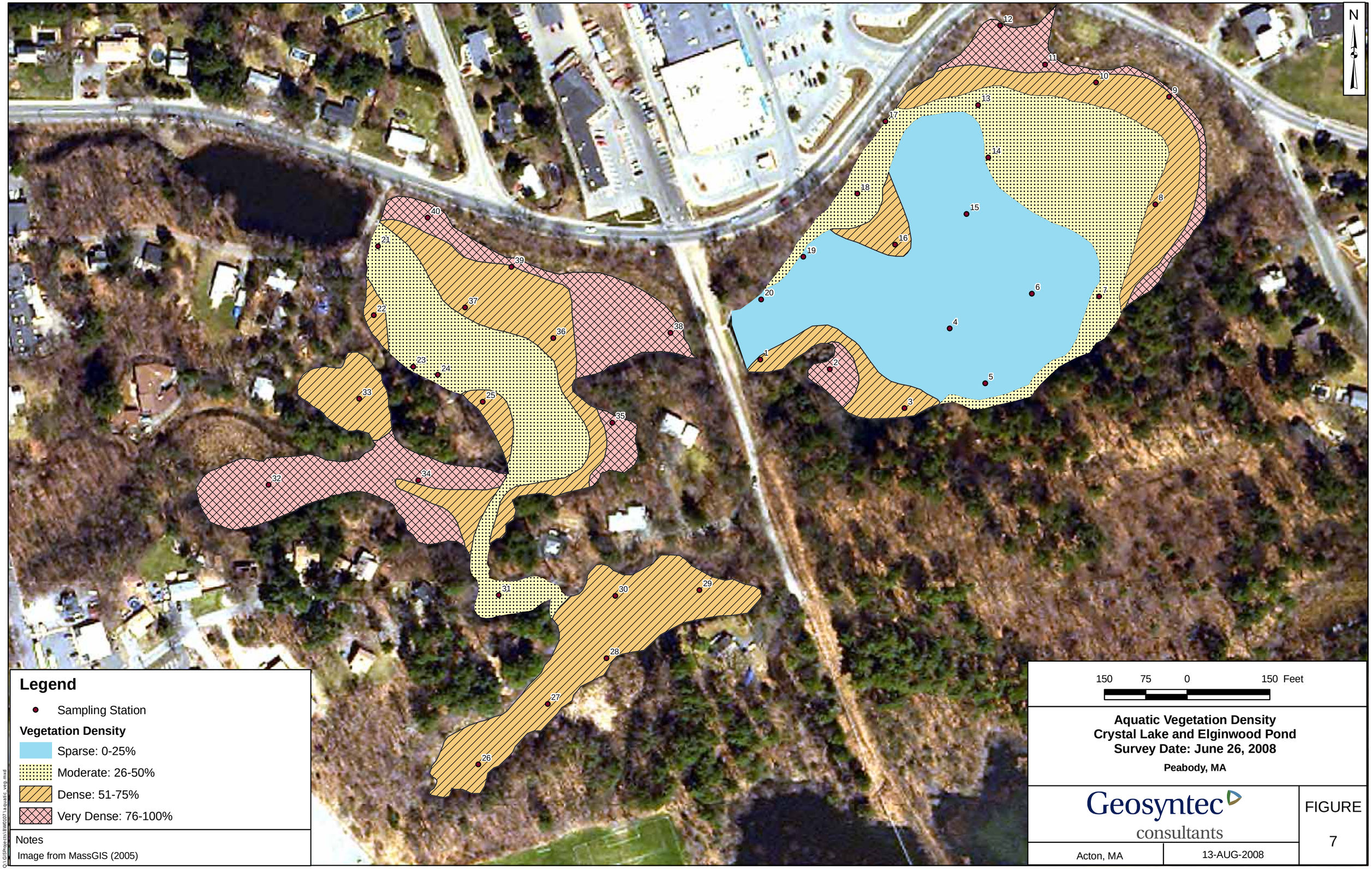
N
Legend
Sampling Station
Vegetation Density
Sparse: 0-25%
Moderate: 26-50%
Dense: 51-75%
Very Dense: 76-100%
Notes
Image from MassGIS (2005)
150 75 0 150 Feet
Aquatic Vegetation Density
Crystal Lake and Elginwood Pond
Survey Date: June 26, 2008
Peabody, MA
Geosyntec consultants
Acton, MA
13-AUG-2008
FIGURE
7
O:\GISProjects\BW0107\aquatic_veg.mxd

**Table 3: Aquatic Vegetation Survey Tally Sheet**

**Location:** Crystal Lake/ Elginwood Pond (Peabody, MA)

**Date:** 26 June 2008

**Surveyed by:** Hartzel, Rivers

● species dominant at monitoring station

● species present at monitoring station

| Plant Species | # of stations present | # of stations dominant | Monitoring Locations: Crystal Lake | | | | | | | | | | | | | | | | | | | | Monitoring Locations: Elginwood Pond | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| **Lesser Duckweed** *(Lemna minor)* | 40 | 1 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Watermeal** *(Wolffia sp.)* | 39 | 6 | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Waterweed** *(Elodea nuttallii)* | 37 | 17 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Yellow Water Lily** *(Nuphar variegatum)* | 31 | 14 | ● | ● | ● | | ● | | ● | | | ● | ● | | ● | ● | | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● |
| **Big Duckweed** *(Spirodela polyrhiza)* | 18 | 0 | | | | | | | | | | | | | | | | | | | | ● | ● | ● | ● | ● | ● | | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Filamentous Algae** | 16 | 3 | | | ● | | | ● | ● | ● | ● | ● | | | | ● | ● | | | | ● | ● | | | | ● | | ● | | | | ● | | | | | ● | ● | | ● | | |
| **Thin-leaf Pondweed** *(Potamogeton pusillis)* | 14 | 3 | | ● | | | | | | ● | | | | | | | | ● | | ● | | ● | | ● | | ● | | ● | | ● | | ● | ● | ● | ● | ● | | | | | | |
| **Cattail** *(Typha sp.)* | 14 | 1 | ● | ● | ● | | | ● | | ● | ● | ● | ● | ● | | | | | ● | | | ● | | | | | | | | | | | | | | | | | | ● | ● | ● |
| **Star Duckweed** *(Lemna trisulca)* | 12 | 1 | | | | | | | | | | | | | | | | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | | | | ● | ● | ● | | | | | | ● |
| **Coontail** *(Ceratophyllum demersum)* | 11 | 1 | ● | ● | | ● | | | | | | | | ● | | ● | | | | | | ● | | | | ● | | | | | | | | | | | ● | ● | | | ● | ● |
| **White Water Lily** *(Nymphaea odorata)* | 9 | 2 | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | ● | ● | | | | | | | ● | ● | ● | | ● | ● |
| **European Naiad** *(Najas minor)* * | 5 | 2 | | | | ● | ● | ● | | | | | | | | | | | | ● | | ● | | | | | | | | | | | | | | | | | | | | |
| **Curlyleaf Pondweed** *(Potamogeton crispus)* * | 4 | 2 | | | | | | | | | | | | | | | | | | ● | ● | | | | | | | | | | | | | ● | ● | | | | | | | |
| **Water Starwort** *(Callitriche palustris)* | 3 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | ● | | | | | |
| **Purple Loosestrife** (*Lythrum salicaria*) | 3 | 0 | | | | | | | | ● | ● | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| **Variable milfoil** *(Myriophyllum heterophyllum)* * | 2 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | ● | | | | | |
| **Common Bladderwort** *(Utricularia vulgaris)* | 2 | 0 | | | | | | | | | | | | | ● | ● | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Pickerelweed** *(Pontederia cordata)* | 2 | 0 | | ● | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | |
| **Smartweed** *(Polygonum natans)* | 2 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | ● | | | | | | | | | | | |
| **Bur-Reed** (*Sparganium sp.*) | 2 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | ● | | | | | | | | | | | |
| **Common Reed** *(Phragmites australis)* * | 1 | 0 | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| **Arrowhead** *(Sagittaria latifolia)* | 1 | 0 | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | | | | |
| **Soft-stem Bulrush** (*Scirpus validus*) | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | |
| **Plant Density Rating** | | | 3 | 4 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 4 | 4 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 4 | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 3 | 4 |
| **Plant Biomass Rating** | | | 2 | 4 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 4 | 3 | 4 |