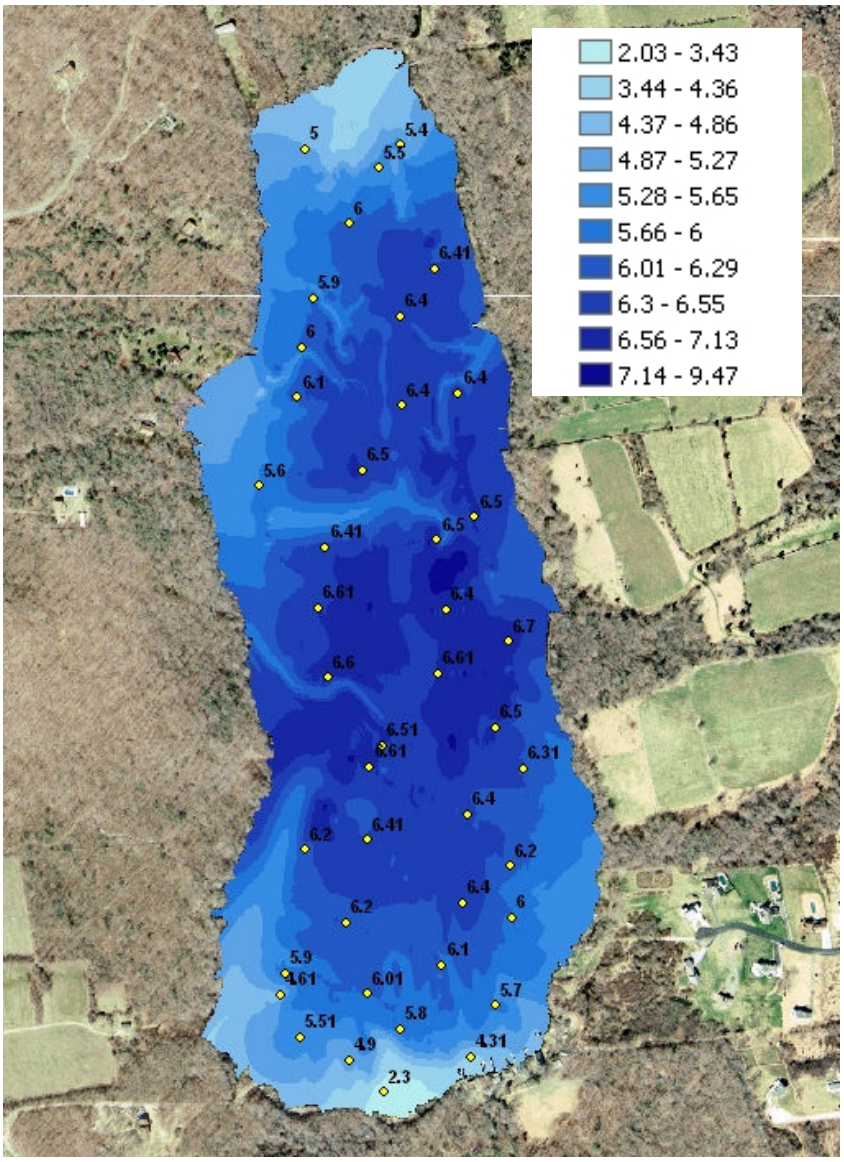
Devol Pond

Hydrographic Summary – Draft 1



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Background

Devol Pond is a small pond in Westport, MA that covers about 103 acres. Over the last ten years, residents of this pond noticed a gradual shift from clear water towards an unacceptable level of green discoloration. The pond's condition has deteriorated to the point where it is now impossible to see the bottom of the pond, even where the water is only a few inches deep. Residents concerned with this occurrence decided to form the Devol pond association with the objective of remediating this issue. To that end, the association contacted the Umass Dartmouth Advanced Technology and Manufacturing Center (ATMC) to survey the pond and provide a representation of the pond's hydrography that allows steps to be taken necessary for analysis and ultimately alleviating the pond's adverse condition.

Objective

The main objective of this effort is to analyze the pond's hydrological characteristics to potentially provide information with respect to remediation of the pond's unfavorable condition. This will be accomplished by running two surveys. The first step was to perform a bathymetric survey of the pond with the intention of determining the best spots to examine the pond's water chemistry. The subsequent step is to perform an environmental survey based on the first bathymetric survey that will analyze water samples and collect environmental data. This resulting data will then assist in determining what is causing the discoloration of the pond.

Test Equipment

An Autonomous Underwater Vehicle (AUV) is basically a robot capable of traveling underwater and recording data for post analysis with some software tool. This particular survey made use of the NanoIver AUV prototype developed by OceanServer Technology. This device is ideal for coastal and shallow water applications such as hydrographic surveys and environmental monitoring. This vehicle is single man-portable and features simple point and click mission planning. The NanoIver is fully capable of subsurface operations although all the missions for this effort were conducted on the surface.

Mission planning starts by downloading available geo-referenced charts, maps or satellite images into the NanoIver's mission planning software and then clicking position waypoints where you want the vehicle to navigate to. This simple but powerful tool allows programming the vehicle and sensor parameters for each leg, or for a complete survey. A rugged battery operated Wi-Fi box enables transfer of mission files between the user's personal computer and the vehicle via a remote desktop user interface. The time stamped, geo-referenced mission data can be downloaded into post-processing programs while the vehicle is on the surface or after the project is complete.

Test Plan

Before planning the mission, an on-site inspection was performed the day before, in order to locate any obvious marine growth or other obstructions that may cause navigational problems for the AUV. This inspection determined that there were weeds along the coast around the entire pond**.** To avoid these obstructions, the mission was cautiously planned such that the AUV would not come within 20 meters of the shoreline.

Figure 1: Original planned mission

This mission was created to maximize coverage of the pond surface, yet to minimize any boundary reed related issues. All missions were designed to execute on the surface. A possible solution to mitigate reed related issues is to execute a hydrological survey during cooler months when growth subsides.

Mission Observations

Expected Navigational Obstructions:

After running the original mission, the AUV became tangled in weeds requiring the retrieval of the vehicle and mission re-adjustment. The mission was adjusted by increasing the distance of the outermost waypoints from the boundary. This correction prevented the vehicle from coming within 40 meters of shore in order to avoid marine growth. Also, the path down the middle of the pond was deleted to save time and avoid redundancy.

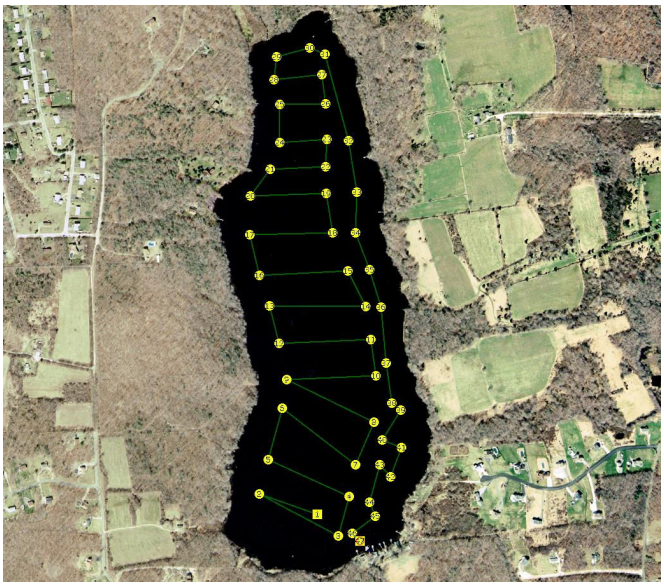


Figure 2: Revised Mission on Devol Pond

Results

Devol pond was examined on July 15, 2009 and consisted of two individual missions logging a total of 2 hours and 20 minutes and producing 6,554 data points. Using these data points, ArcGIS was able to interpolate the data to create an accurate bathymetric plot of the pond. This interpolated surface enabled us to calculate that the average depth of the pond is about 5.95 feet, and the surface area of the pond is about 104 acres.

Due to the marine growth surrounding the entire pond, all the points collected were concentrated mostly on the center of the pond. However, due to the pond's uniform

bottom, the current dataset provides a reasonable representation of the pond's hydrography.

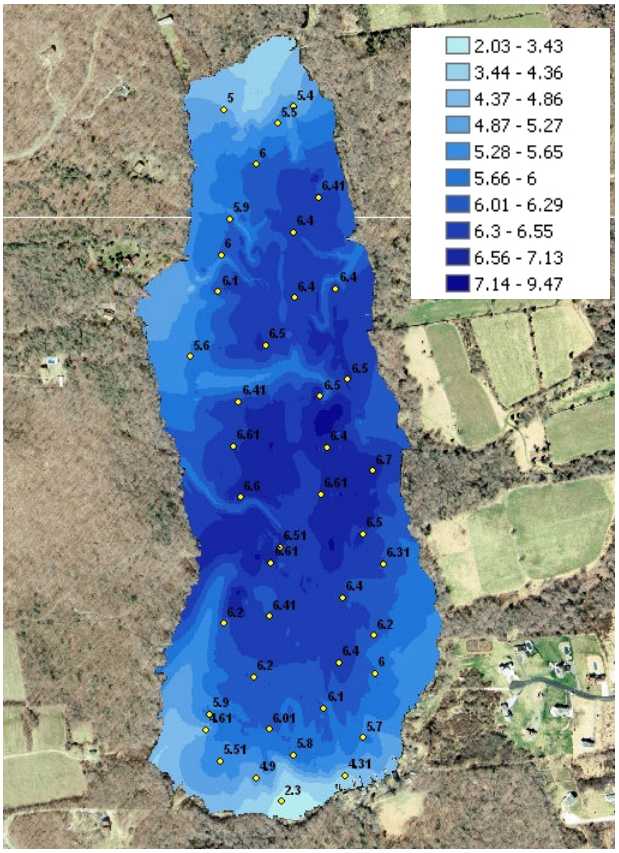
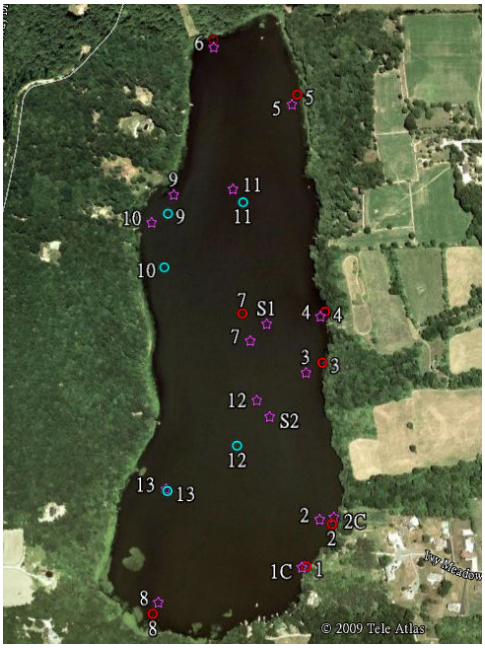
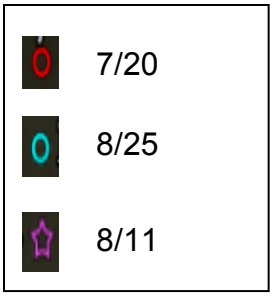


Figure 3: Devol Pond Hydrography

Appendix A – Manual Water Samples & Carlson's Trophic State Index (CTSI)



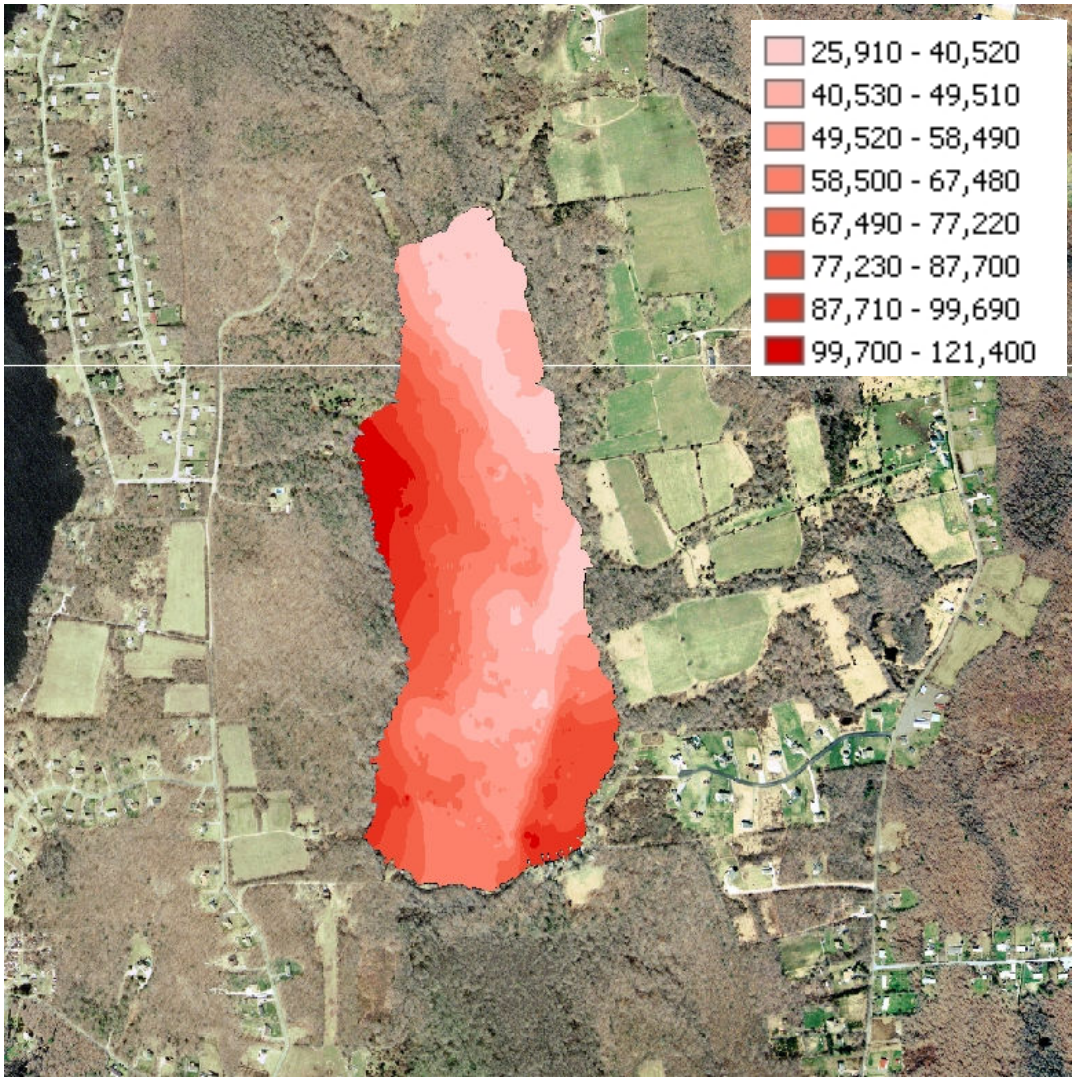


採樣點	監測 Depth (m)	採樣 Depth (m)	Chl-a (ug/L)	CTSI Chl-a	沙奇盤 (m)	CTSI SD	TP (mg/L)	CTSI TP	CTSI
1	0.3~0.5	0.50	6.50	48.96	0.83	62.69	83.33	67.93	59.86
1C	0.3~0.5	0.50	7.48	50.34	0.83	62.69	80.00	67.34	60.12
2	0.3~0.5	0.50	6.84	49.46	0.96	60.59	93.33	69.56	59.87
2C	0.3~0.5	0.50	6.54	49.02	0.90	61.52	93.33	69.56	60.03
3	0.3~0.5	0.50	7.24	50.02	1.12	58.37	66.67	64.71	57.70
4	0.3~0.5	0.50	6.90	49.54	1.37	55.46	56.67	62.37	55.79
5	0.3~0.5	0.50	7.33	50.15	1.24	56.90	53.33	61.49	56.18
6	0.3~0.5	0.50	6.49	48.95	1.37	55.46	66.67	64.71	56.37
7	0.3~0.5	0.50	7.08	49.80	1.18	57.61	63.33	63.97	57.13
8	0.5-->1	0.50	6.43	48.85	0.71	64.94	73.33	66.08	59.96
9	0.3~0.5	0.50	7.82	50.77	1.32	56.00	83.33	67.93	58.23
10	0.3~0.5		6.56	49.05	1.18	57.61			
11	0.3~0.5		6.06	48.28	1.41	55.05			
12	1		7.64	50.54	0.95	60.74			
13	1	0.50	7.35	50.17	0.89	61.68	110.00	71.93	61.26
S1	2	1.00	6.39	48.80	1.00	60.00	100.00	70.56	59.79
S2	2		5.65	47.58					

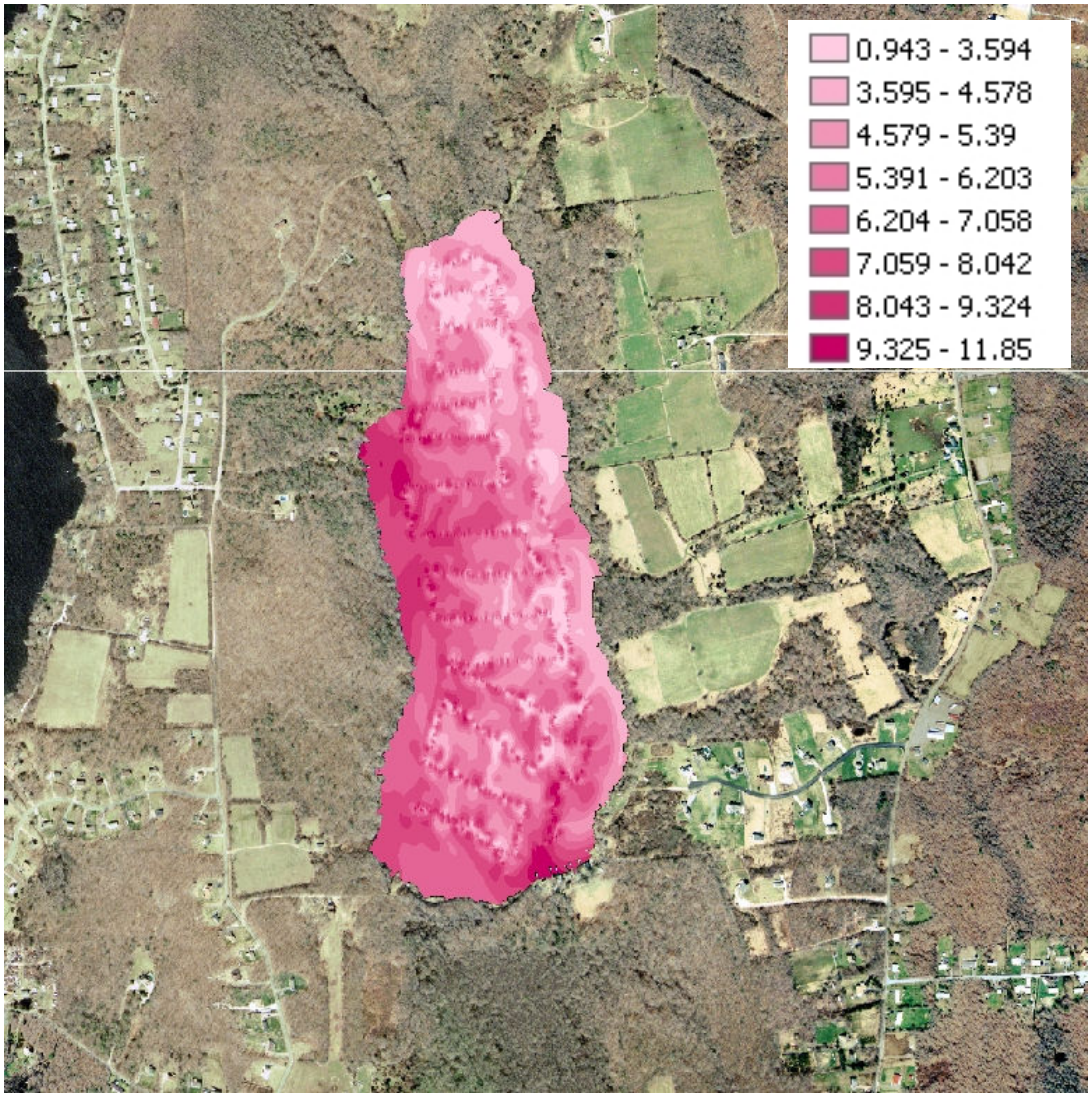
Appendix B – Environmental Data

The following is a list of environmental parameters processed during this survey. Using water quality sensors, the AUV is able to collect environmental data that are valuable in assessing the water characteristics.

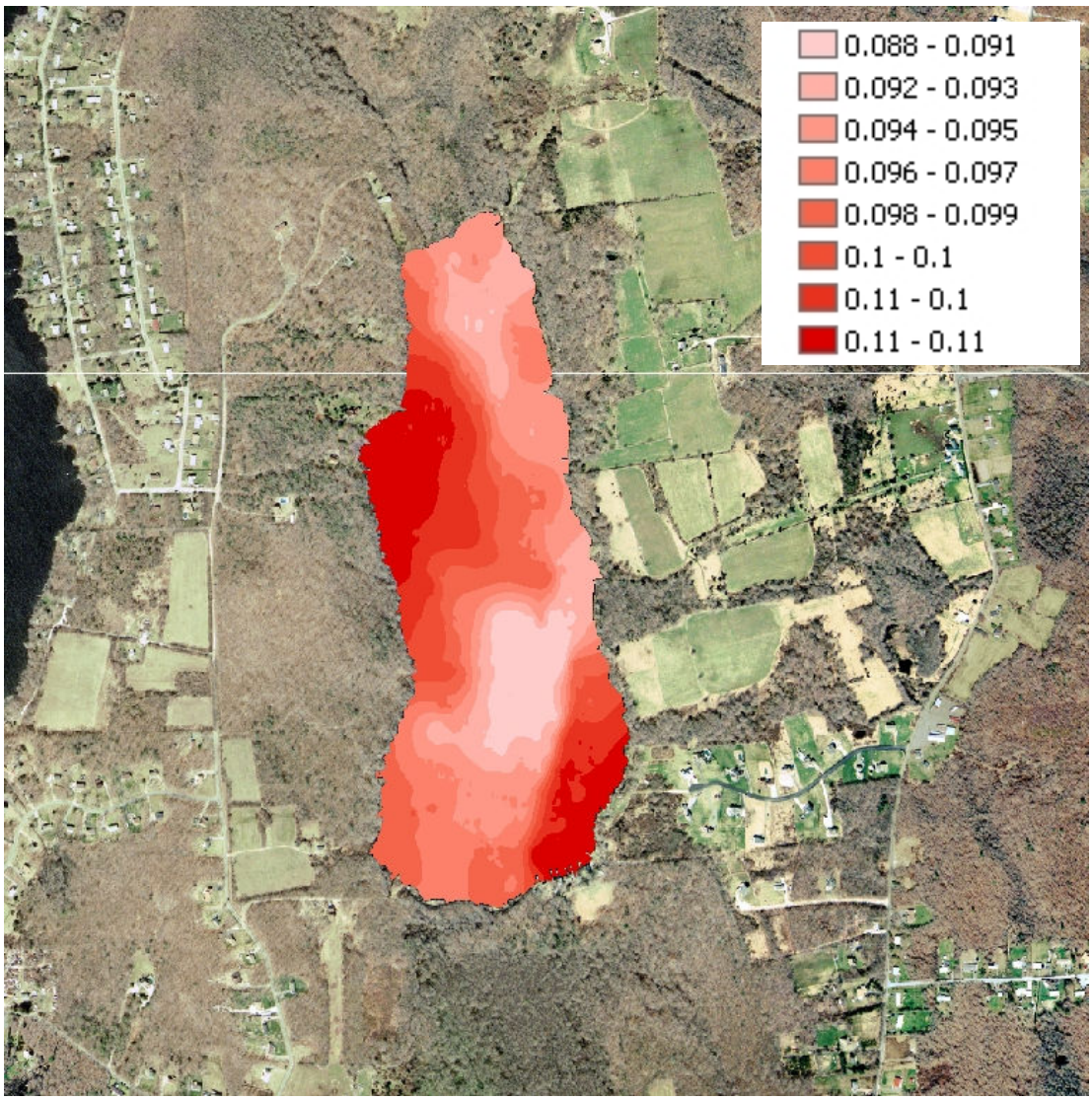
Blue Green Algae (cells/mL)



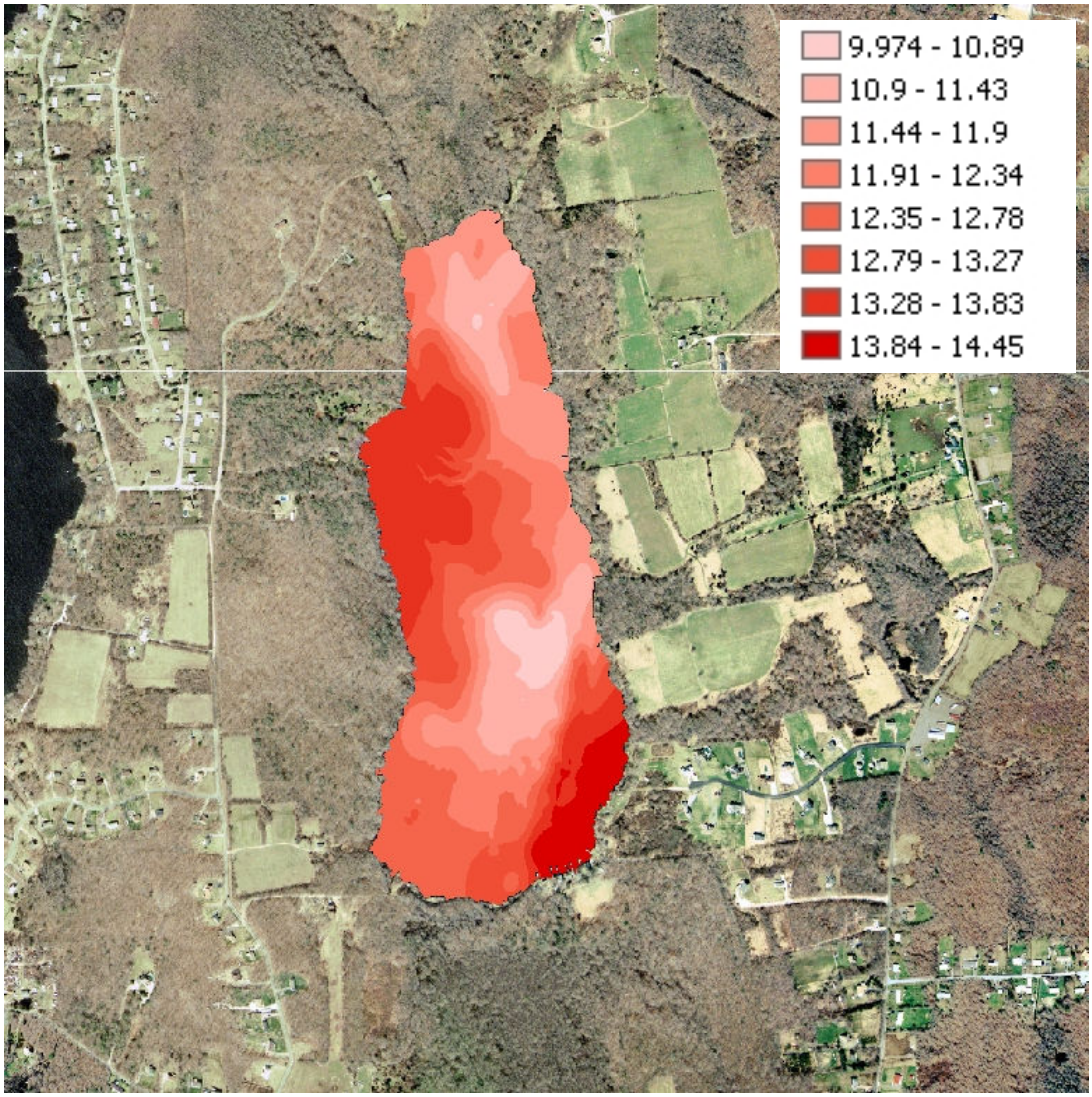
Chlorophyll (ug/L)



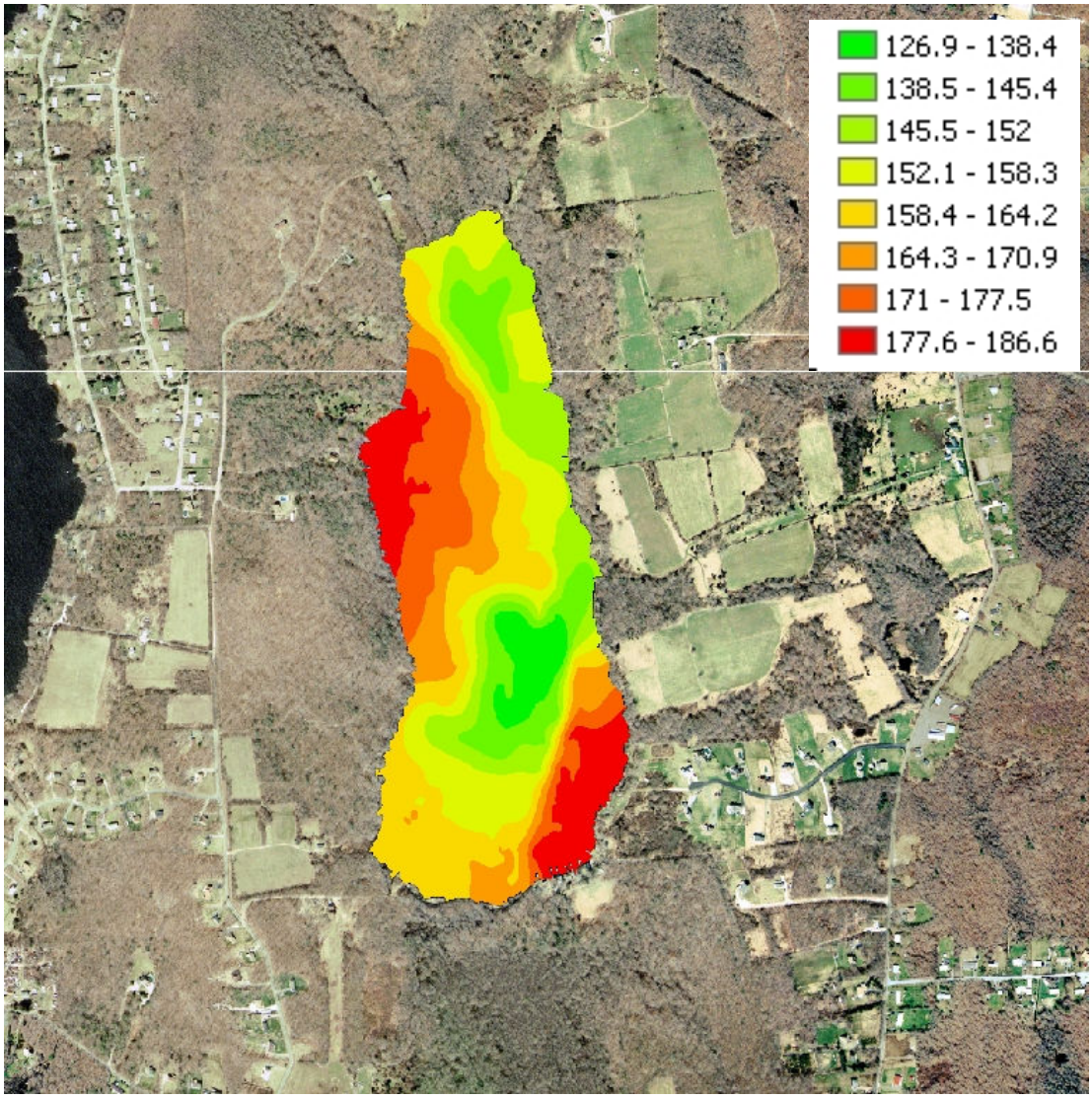
Specific Conductivity (mS/Cm)



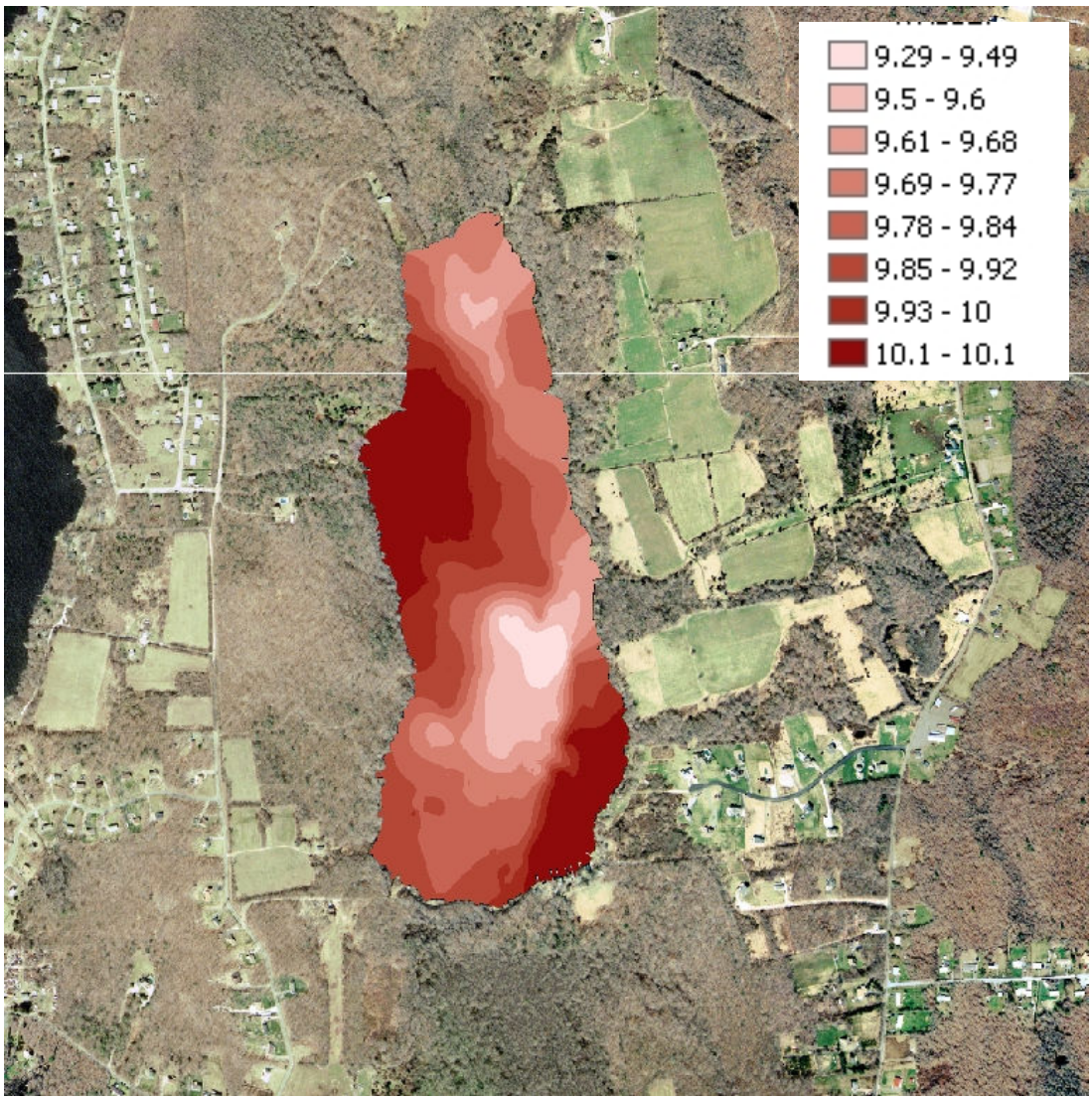
Dissolved Oxygen (mg/L)



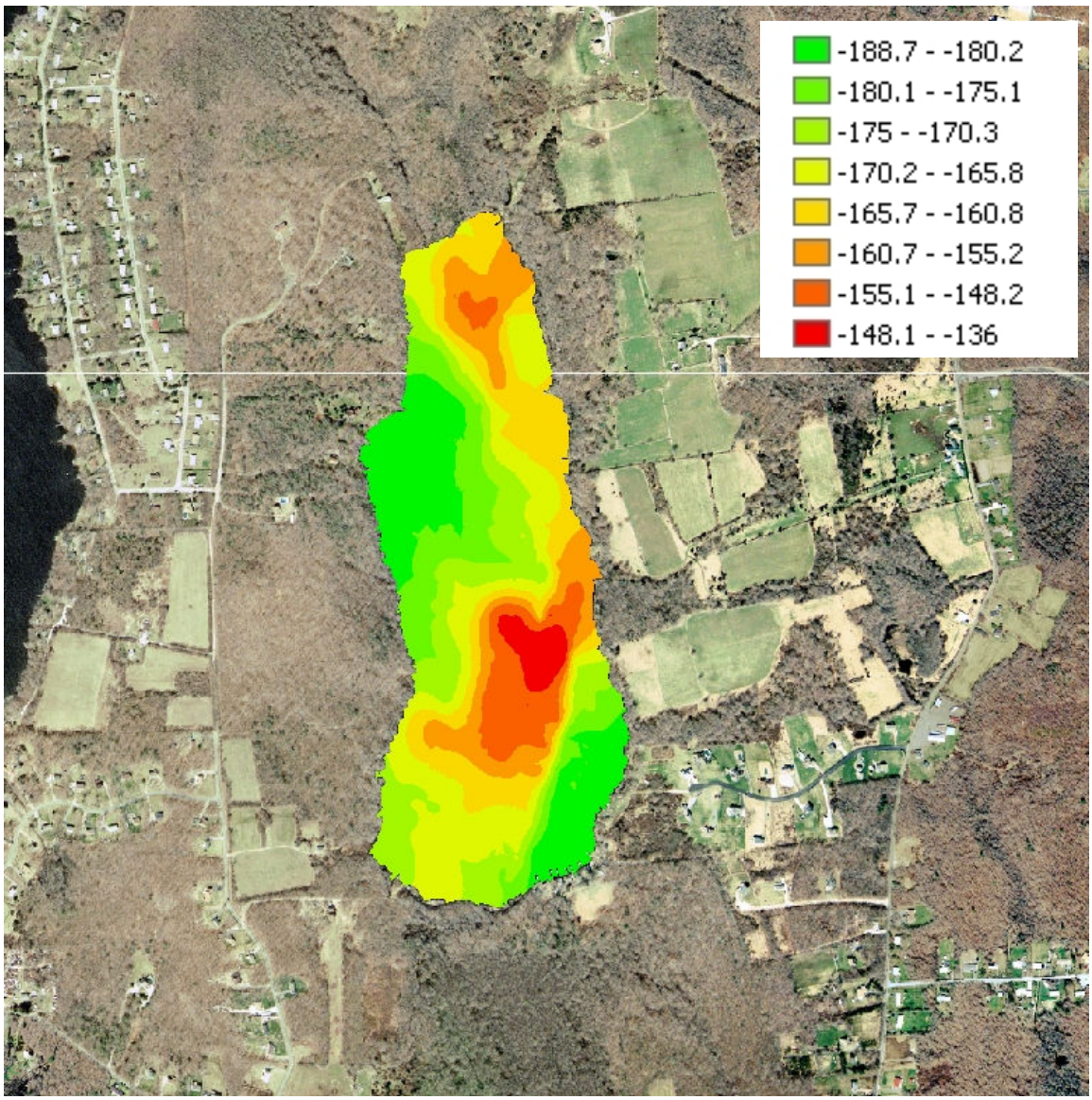
Dissolved Oxygen – Saturation (%)



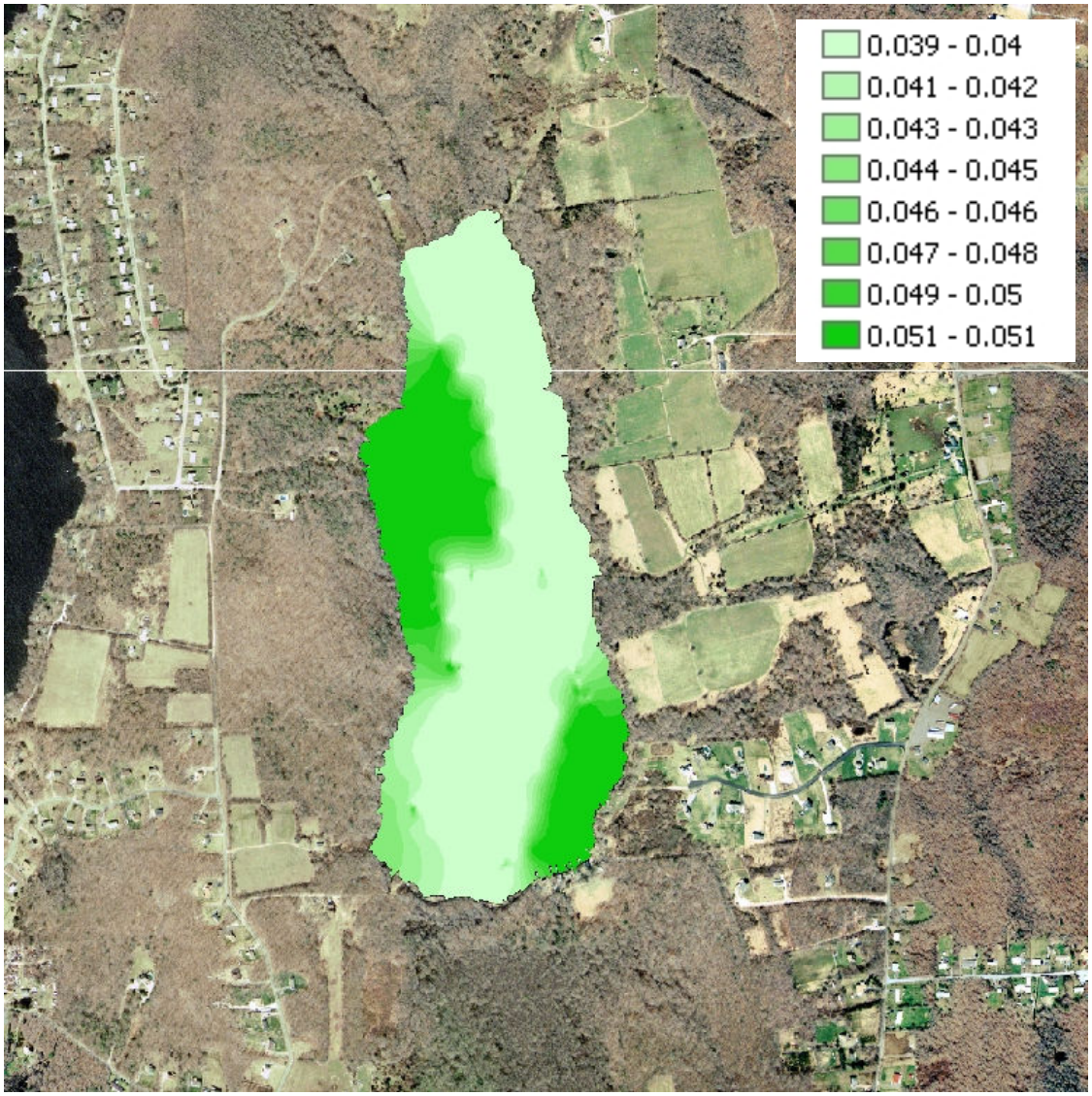
pH



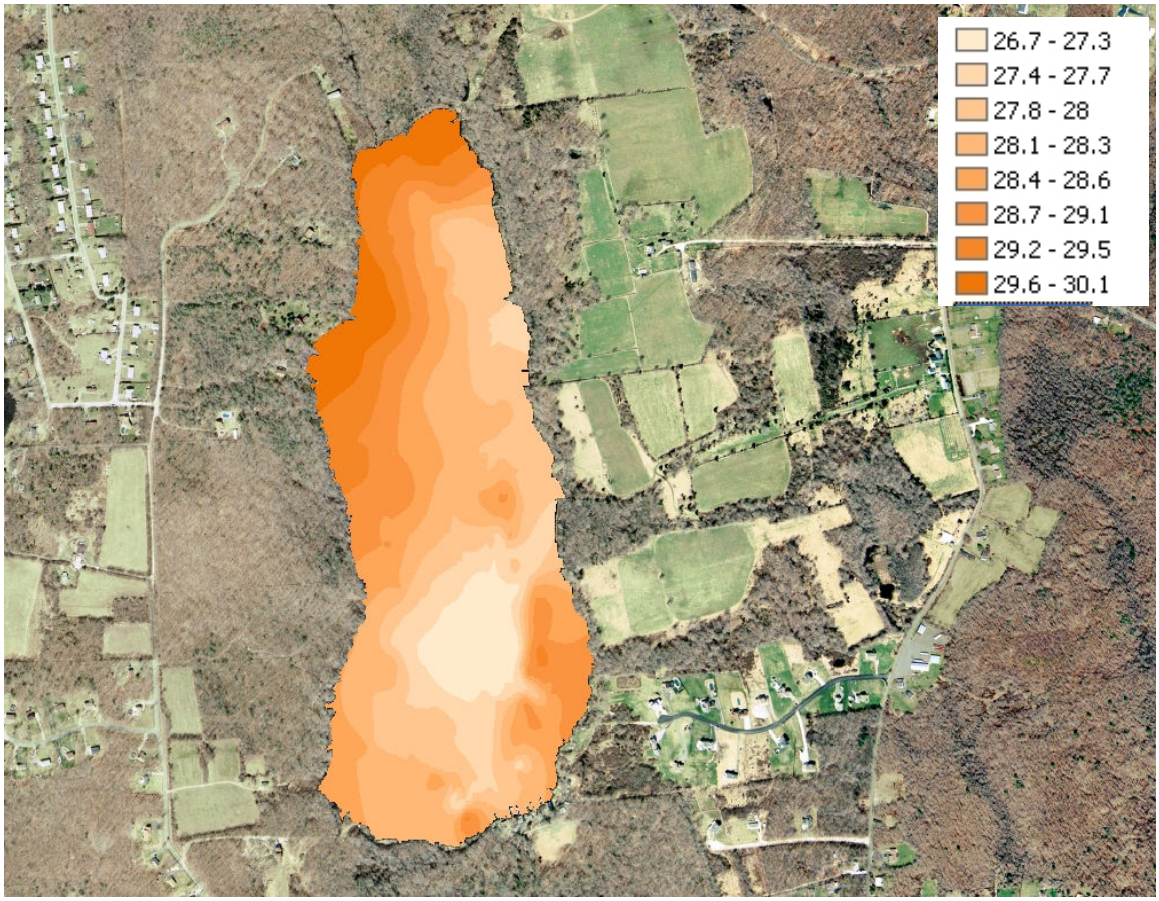
pH – mV


-188.7 - -180.2
-180.1 - -175.1
-175 - -170.3
-170.2 - -165.8
-165.7 - -160.8
-160.7 - -155.2
-155.1 - -148.2
-148.1 - -136

Salinity (ppt)



Temperature (Degrees Celsius)



Turbidity (NTU)