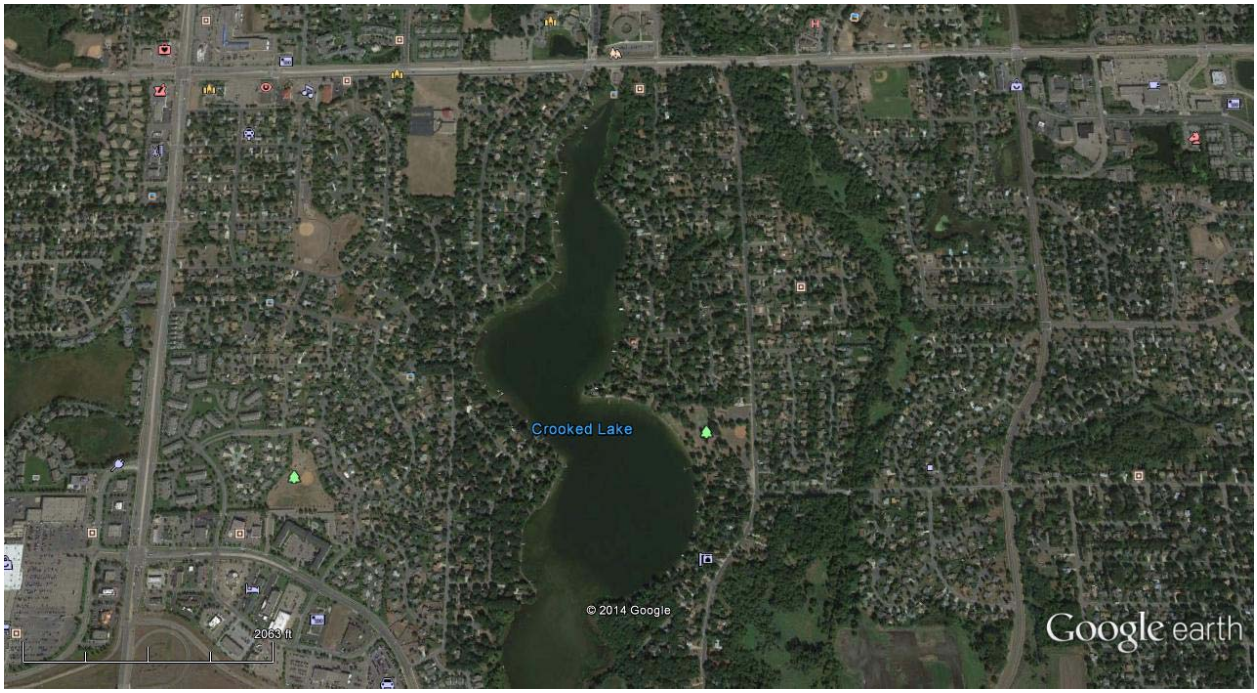
2015 Point Intercept/Contour Innovations Bio Base Survey
Crooked Lake, Anoka County, Minnesota

# Aquatic Vegetation Survey




Submitted by:

www.clarke.com

Submitted to:
Crooked Lake Area Association
(CLAA)

August 19, 2015

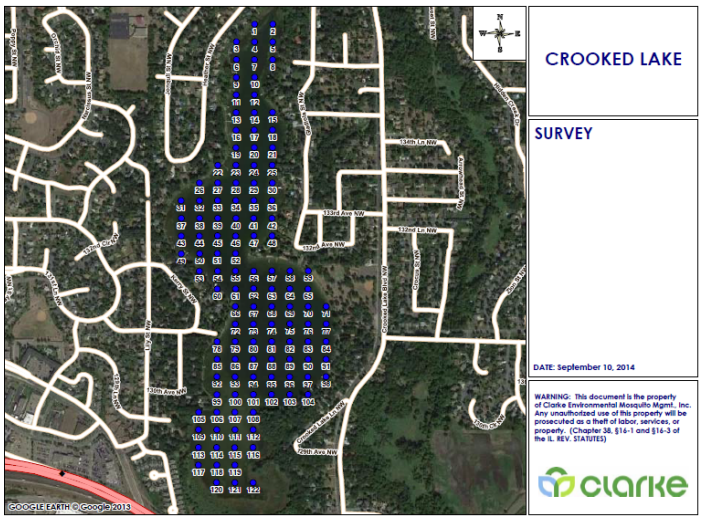
By: Rob Olson

**Summary**
An aquatic vegetation survey of Crooked Lake (DOW 02008400), located near Andover, MN in Anoka County, was conducted on August 18th. The Contour Innovations Bio Base System was used at the same time to also electronically determine vegetation densities and is available for the (CLAA) to use as a base line survey. A total of six native and one non-native plant species were identified. Plants were found to a depth of thirteen feet, but most were restricted to depths at seven feet and shallower.

Native plant species found included: Muskgrass (*Chara sp*.), Coontail (*Ceratophyllum demersum*), Large Leaf Pondweed (*Potamogeton amplifolius*), Bushy Pondweed (*Najas guadalupensis*), Water Celery (Eelgrass) (*Vallisneria americana*) and White Waterlily (*Nymphaea odorata*).

Non-native plant species found included: Eurasian Watermilfoil *(Myriophyllum spicatum*). The Eurasian Watermilfoil was found at 33 points throughout the lakes. Eurasian Watermilfoil was found at an average depth of four feet and at a max depth of eight feet, intermingled amongst native species.

**Methods:**
A Point-Intercept survey of Crooked Lake was conducted following the methods described by Madsen (1999). A Geographic Information System (GIS) was used to generate sample points across the lake surface in a 200 foot by 200 foot grid. Survey waypoints were created and downloaded into a Global Positioning System (GPS) enabled depth finder and was used to navigate the boat to each sample point.




Vegetation samples were consistently taken from the same side of the boat using a 2-sided aquatic vegetation sampling rake. The areas sampled were approximately 3 foot square in size. Depth measurements were taken at each site to determine the lake's littoral zone which was found to be at a max depth of just over 13 feet. At each site, all taxa of plants sampled was determined and recorded on a scale of 1 to 4 where 1 being the plant is present and 4 being the plant is extremely high density. At sites where the plants of concern were discovered – in this case, Eurasian Watermilfoil – we left the sampling grid and sampled vegetation by delineation. All areas were marked on the GPS unit and then loaded onto ArcMap software in order to create maps.

Clarke also utilized the Contour Innovations Bio Base mapping system which shows the bio volume and spatial distribution of vegetation. The Bio Base system allows the ability to document changes in weed densities from season to season and one year to the next (historical comparison). The Clarke supplied survey can be loaded into the MSLID's Bio Base system when they receive it and can be used as a base line.

**Vegetation results for Crooked:**
Crooked Lake was found to have seven species of aquatic plant present at the time of the survey of which six were submerged and one was a floating-leaf. The charts below illustrates the relative abundance of each species, **N** = 122 or the number of sites sampled. The number of sites a plant species was found present, divided by N equals the total percentage of sample sites a particular species was found.

**Native Submerged**

| Common Name | Scientific Name | Sites Present | % |
|---|---|---|---|
| Muskgrass | Chara sp. | 25 | 20% |
| Large Leaf Pondweed | Potamogeton amplifolius | 23 | 19% |
| Coontail | Ceratophyllum demersum | 12 | 10% |
| Bushy Pondweed | Najas guadalupensis | 3 | 2% |
| Water celery | Vallisneria americana | 1 | 1% |
| | | | |

**Floating-Leaf**

| Common Name | Scientific Name | Sites Present | % |
|---|---|---|---|
| White Waterlily | Nymphaea odorata | 8 | 7% |
| | | | |

**Non-Native Submerged**

| Common Name | Scientific Name | Sites Present | % |
|---|---|---|---|
| Eurasian watermilfoil | Myriophyllum spicatum | 33 | 27% |
| | | | |

**Native Emergent**

Cattail (*Typha spp.)* was observed around the lake, but none fell exactly in the survey point.

## *Muskgrass, Chara*

*Chara spp.*

### Description

Chara is often called muskgrass or skunkweed because of its foul, musty almost garlic-like odor. Chara is a gray-green branched multicellular algae that is often confused with submerged flowering plants. However, Chara has no flower, will not extend above the water surface, and often has a “grainy” or “crunchy” texture. Chara has cylindrical, whorled branches with 6 to 16 branches around each node.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc.). After aquatic plants die, their decomposition by bacteria and fungi provides food (called “detritus” for many aquatic invertebrates. Chara is consumed by many species of ducks.

## *Coontail*

*Ceratophyllum demersum*

### Description

Coontail, or sometimes called hornwort, is a dark olive-green, rootless submerged perennial plant that often forms dense colonies. Leaves are relatively stiff, whorled with many forks and small teeth along one edge. The tips of branches are crowded with leaves giving it a “coontail” resemblance. Coontail reproduces by seeds and fragmentation.

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# Southern Naiad, Bushy Pondweed

*Najas guadalupensis*

## Description

Southern naiad is an annual plant that branches profusely and forms very dense stands of rooted submerged vegetation. Leaves are dark green to greenish-purple, ribbon-like, opposite or in a whorl of three, mostly less than 1/2 inch long and 1/8 inch wide. Single seeds are found encased in the leaf sheath. Southern naiad reproduces by seeds and fragmentation. Flowers are at the base of the leaves but so small that they can only be observed with magnification. Bushy pondweed is often confused with sago pondweed and widgeon grass.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc.). After aquatic plants die, their decomposition by bacteria and fungi provides food (called “detritus”) for many aquatic invertebrates. Southern naiad vegetation and seeds are consumed by many species of ducks and is considered a primary food source.

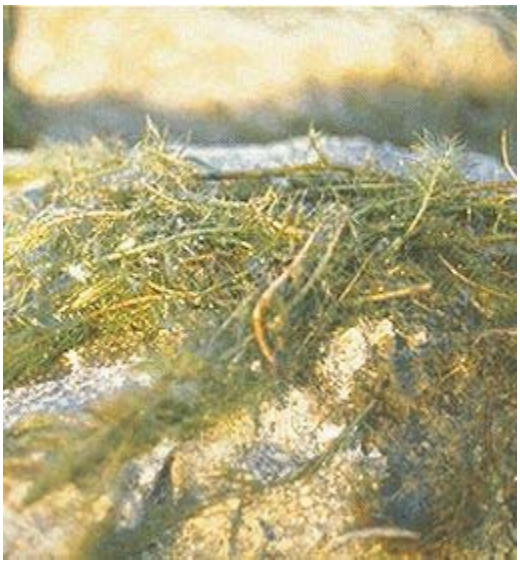
## *White Water Lily, Fragrant Water Lily*

*Nymphaea odorata*

### Description

The white water lily is a perennial plant that often forms dense colonies. The leaves arise on flexible stalks from large thick rhizomes. The leaves are more round than heart-shaped, bright green, 6 to 12 inches in diameter with the slit about 1/3 the length of the leaf. Leaves usually float on the water's surface. Flowers arise on separate stalks, have brilliant white petals (25 or more per flower) with yellow centers. The flowers may float or stick above the water and each opens in the morning and closes in the afternoon. The flowers are very fragrant. White water lily can spread from seeds or the rhizomes.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc). After aquatic plants die, their decomposition by bacteria and fungi provides food (called "detritus") for many aquatic invertebrates. Deer, beaver, muskrat, nutria and other rodents will consume the leaves and rhizomes of white water lily, while the seeds are eaten by ducks.



## *Eurasian Watermilfoil*

*Myriophyllum spicatum*

### Description

**Non-Native**

Eurasian watermilfoil is a perennial plant native to Europe, Asia, and Africa and was probably brought to the U.S. as an aquarium plant. Today it is considered one of the most aggressive and problematic plants in the U.S. because of the dense colonies which it forms. The stems are multi-branched, somewhat reddish in color, with gray-greenish feather-like leaves. The leaves are in whorls of 3 to 5 around the stem with each leaf divided into 12 or more pairs of thin thread-like leaflets. Reddish flowers are borne on leafless spikes that rise above the surface a few inches. Eurasian watermilfoil can spread from seeds or by fragmentation.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc.). After aquatic plants die, their decomposition by bacteria and fungi provides food (called “detritus”) for many aquatic invertebrates. Eurasian watermilfoil seeds are consumed by ducks, while muskrats and nutria will consume the stems. Eurasian watermilfoil is a non-native and should not be spread.

## *Eelgrass*

*Vallisneria americana*

### Description

Eelgrass, tapegrass, or wild celery are all common names for Vallisneria. Eelgrass is a rooted submerged plant often found in flowing water. It has long, thin, ribbon-like leaves (1/2 – 3/4 inches wide) that are commonly 3 to 4 feet long. The vein pattern in the leaves of eelgrass is very distinctive and resembles celery. Eelgrass has a vast rhizome system that allows it to form dense colonies and usually excludes other submerged plants.


Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc.). After aquatic plants die, their decomposition by bacteria and fungi provides food (called “detritus”) for many aquatic invertebrates. Eelgrass seeds, roots and leaves are consumed by ducks and other waterfowl, while its dense underwater structures provides an excellent habitat for invertebrates and fish.

## *Large Leaf Pondweed*

*Potamogeton amplifolius*

### Description

Large Leaf pondweed is a perennial plant that has mostly submerged leaves, sometimes with a few floating leaves in an alternate pattern. The submerged leaves are alternate, sickle-shaped (recurved) leaves that are 4-7 cm wide and 8-20 cm long. The floating leaves are 2-22 cm long, with a petiole longer than the leaf blade, supporting a large spike inflorescence that is held above the water. Stipules are large and whit, up to 12cm long, with 2 ridges on the top.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc.). After aquatic plants die, their decomposition by bacteria and fungi provides food (called “detritus”)) for many aquatic invertebrates. Large Leaf pondweed is utilized as food by ducks and some other types of wildlife.

## *Cattail*

*Typha spp.*

### Description

Cattails have flat to slightly rounded leaves that twist slightly over their length and can grow to 5 or 10 feet in height. Flowers form a dense dark brown, cigar-shape at the end of spikes (called the catkin). Cattails can be partially submerged or in boggy areas with no permanently standing water. Cattails spread rapidly because their seeds blow in the wind and float on the water's surface and vegetatively they spread from underground rhizomes.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. ducks). After aquatic plants die, their decomposition by bacteria and fungi provides food (called "detritus") for many aquatic invertebrates. The rhizomes and lower leaf portions of cattails are consumed by nutria, muskrats, and geese.

### References

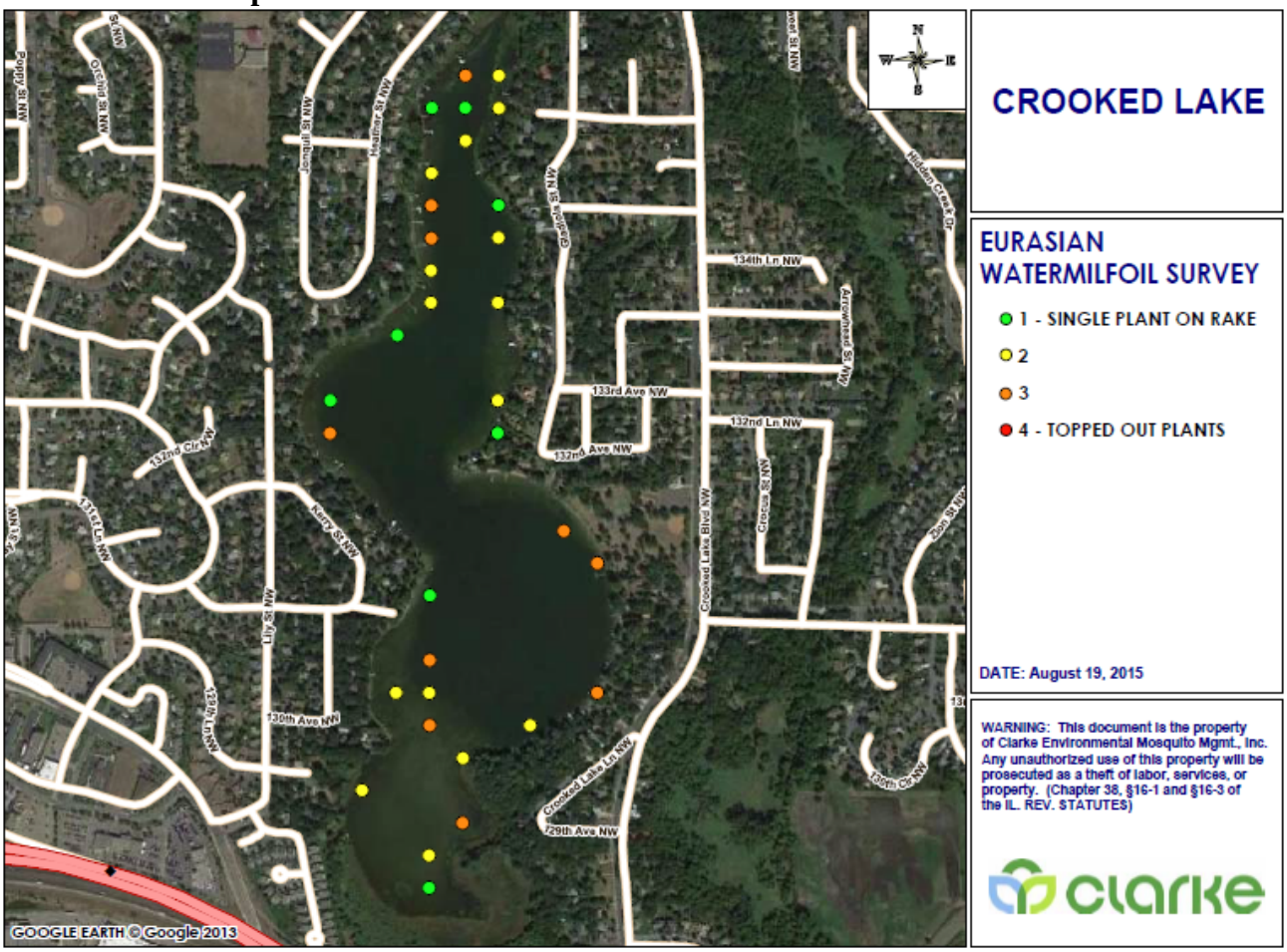
Skawinski, P. 2011. *Aquatic Plants of the Upper Midwest*. Wausau, Wisconsin

Fink, D.F. 2000. *A guide to Aquatic Plants*. Ecological Services Center of the Minnesota Department of Natural Resources

Causey, L. 2013. Published on the internet http://aquaplant.tamu.edu/plant-identification. Department of Wildlife & Fisheries Sciences, Texas A & M AgriLife Extension Service

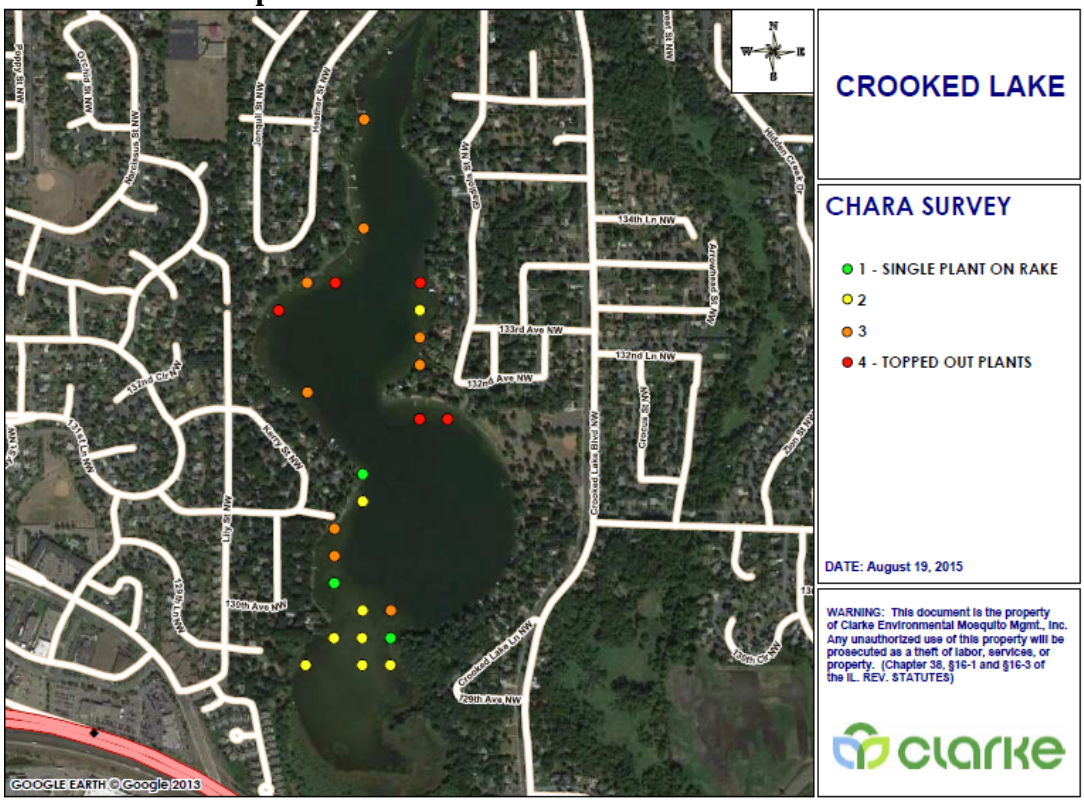
# Invasive Species Maps

## Crooked Lake Map with Eurasian Watermilfoil Locations and Densities

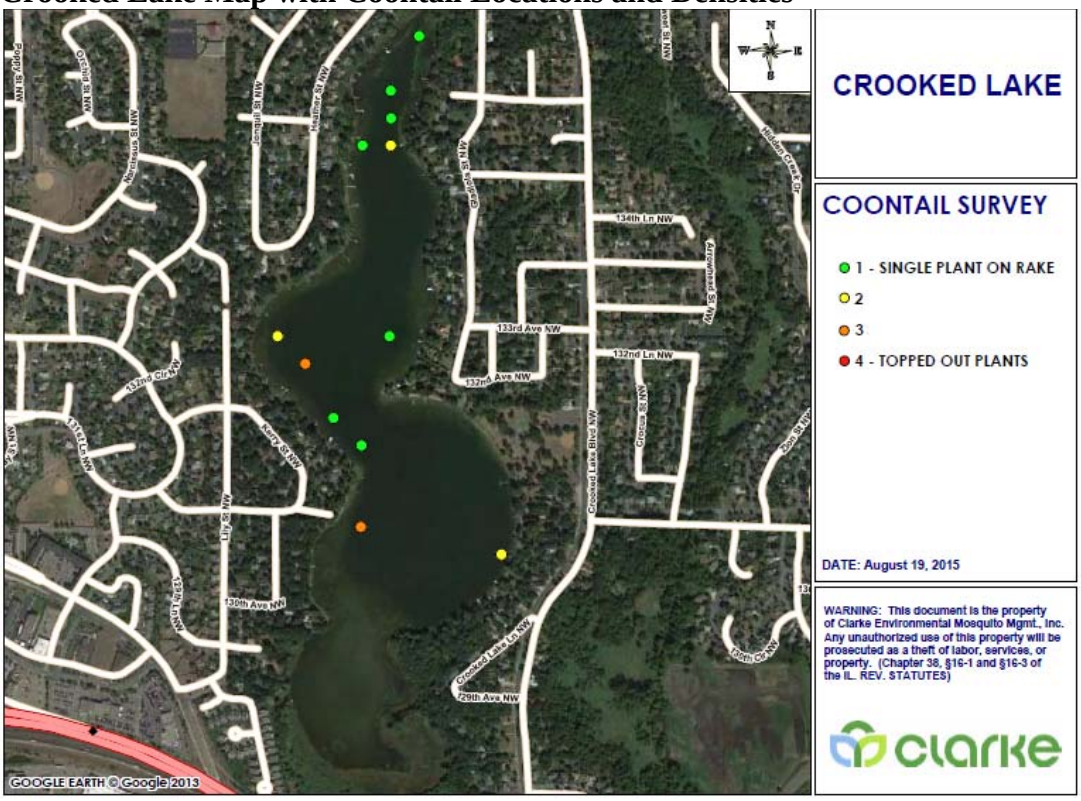


# Native Species Maps

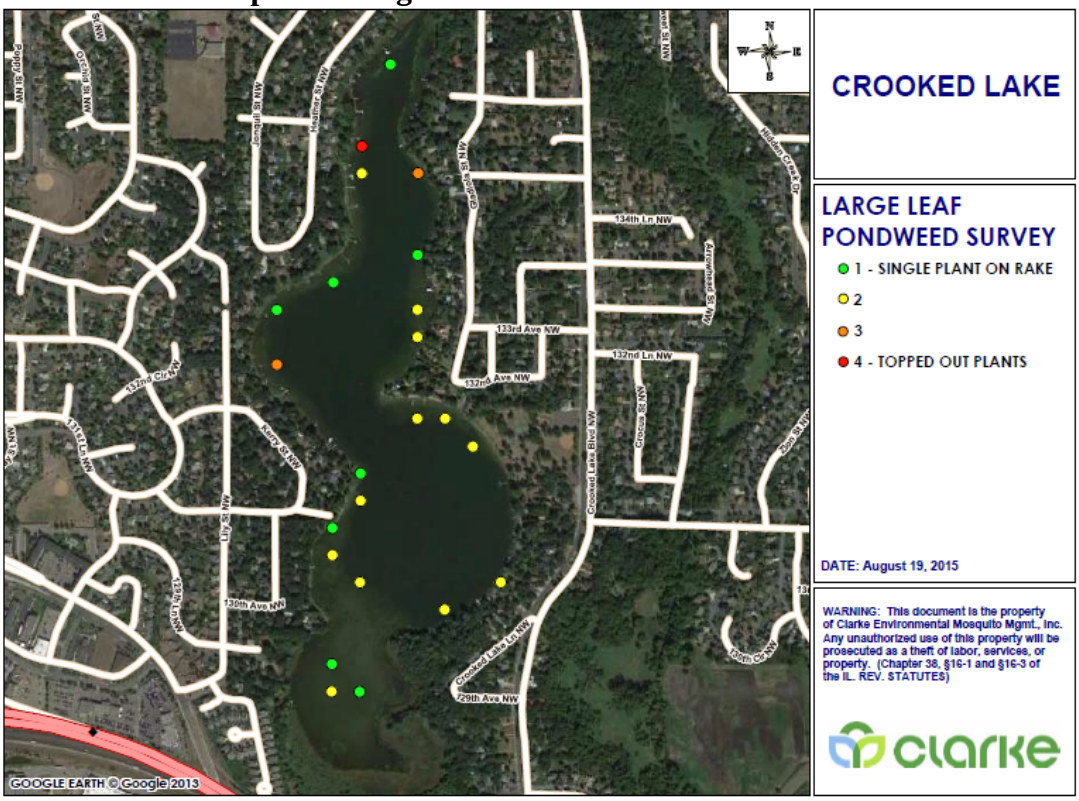
## Crooked Lake Map with Chara Locations and Densities



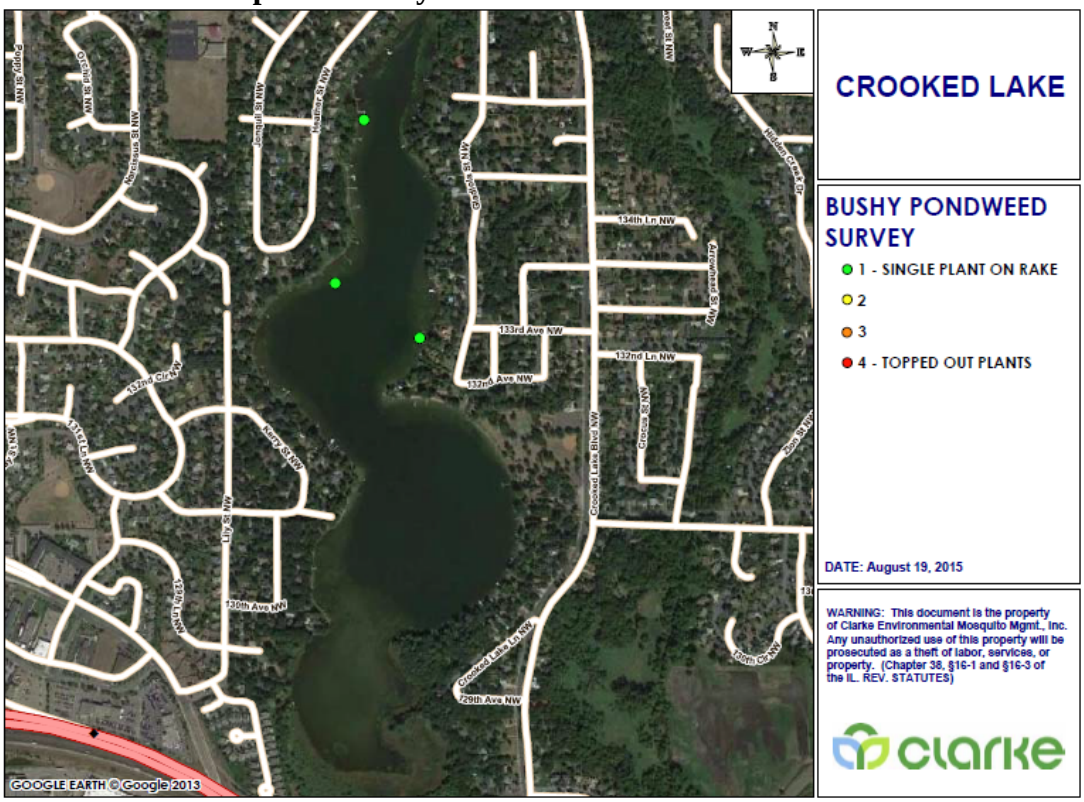

## Crooked Lake Map with Coontail Locations and Densities



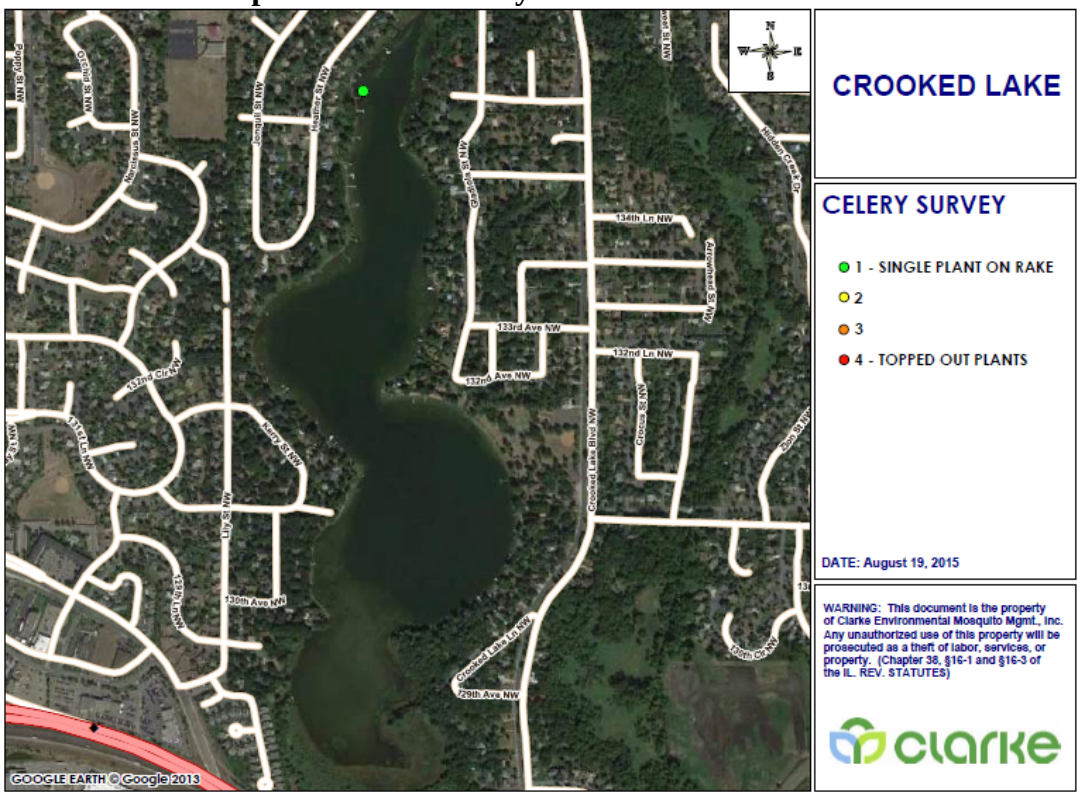
## Crooked Lake Map with Large Leaf Locations and Densities



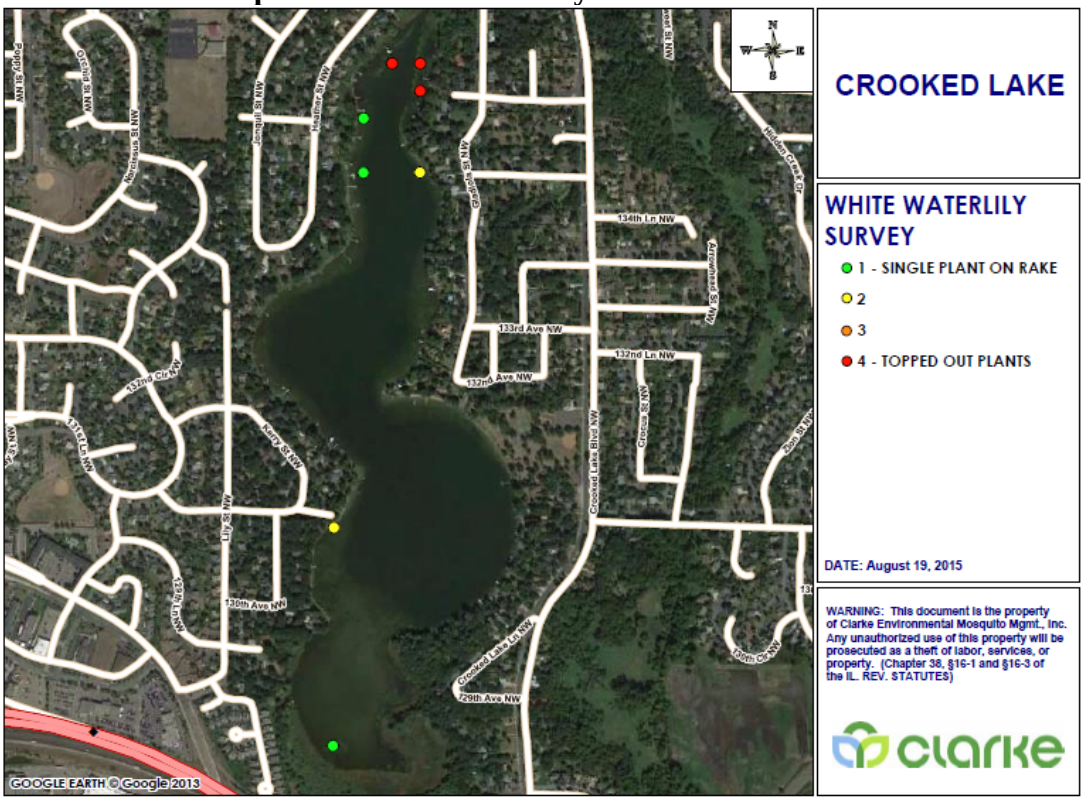

## Crooked Lake Map with Bushy Pondweed Locations and Densities



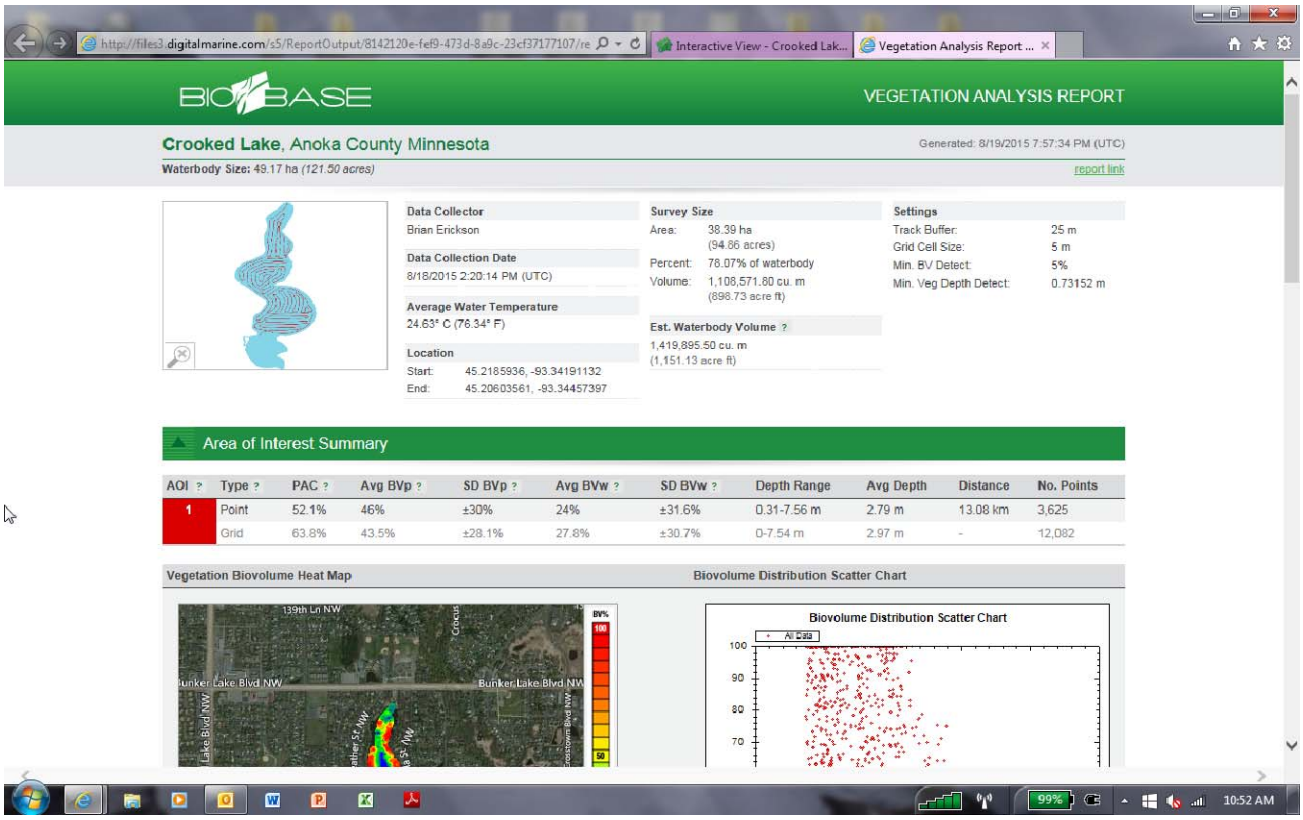
## Crooked Lake Map with Water Celery Locations and Densities

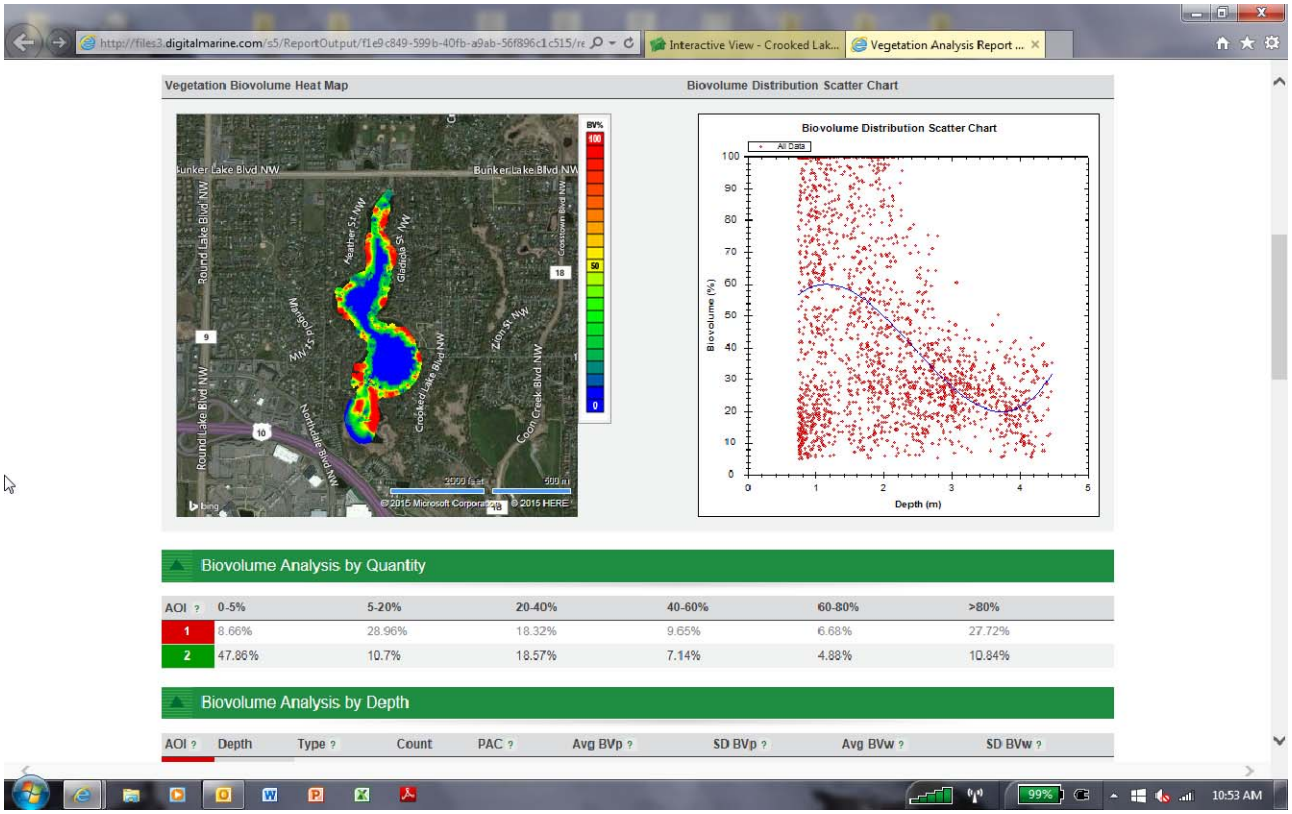


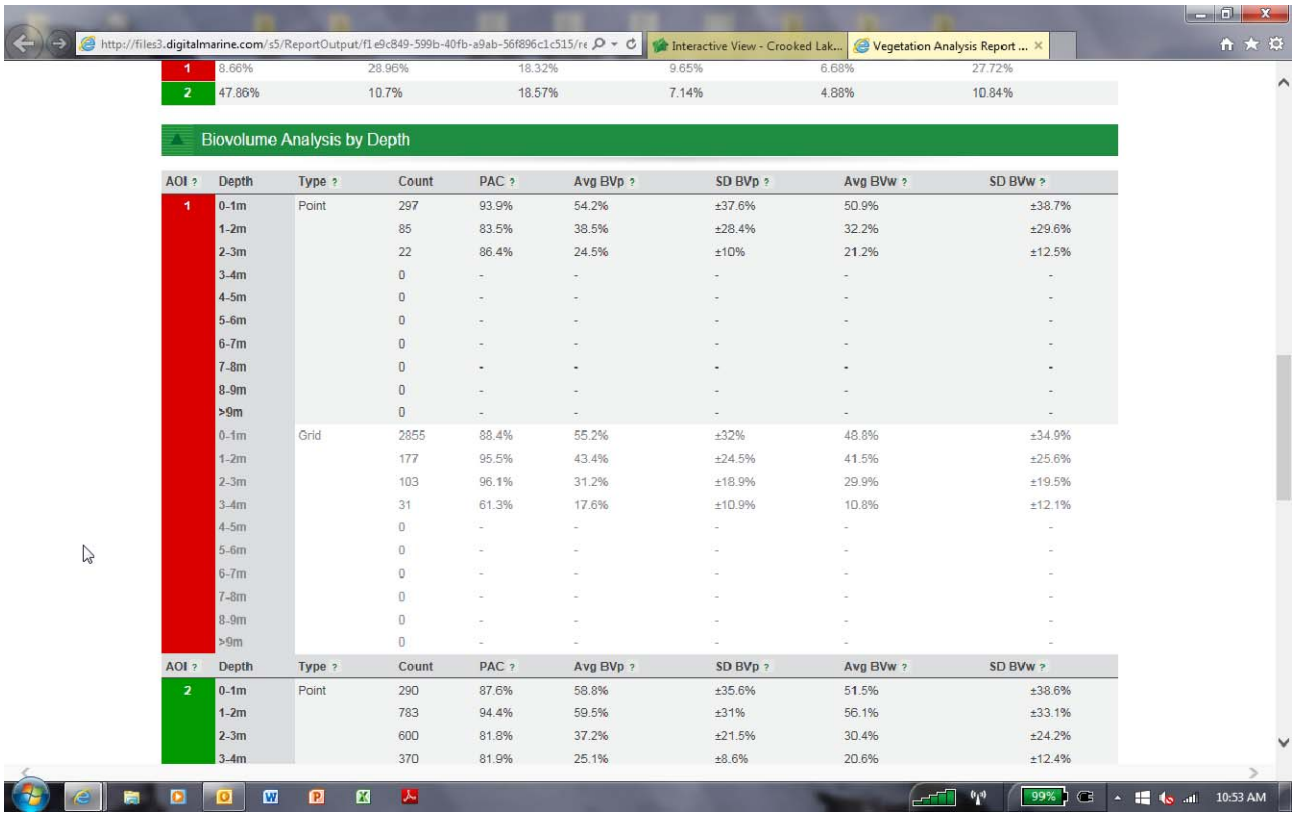

## Crooked Lake Map with White Water Lily Locations and Densities



# Contour Innovations Biobase Vegetation Analysis Report – Crooked Lake



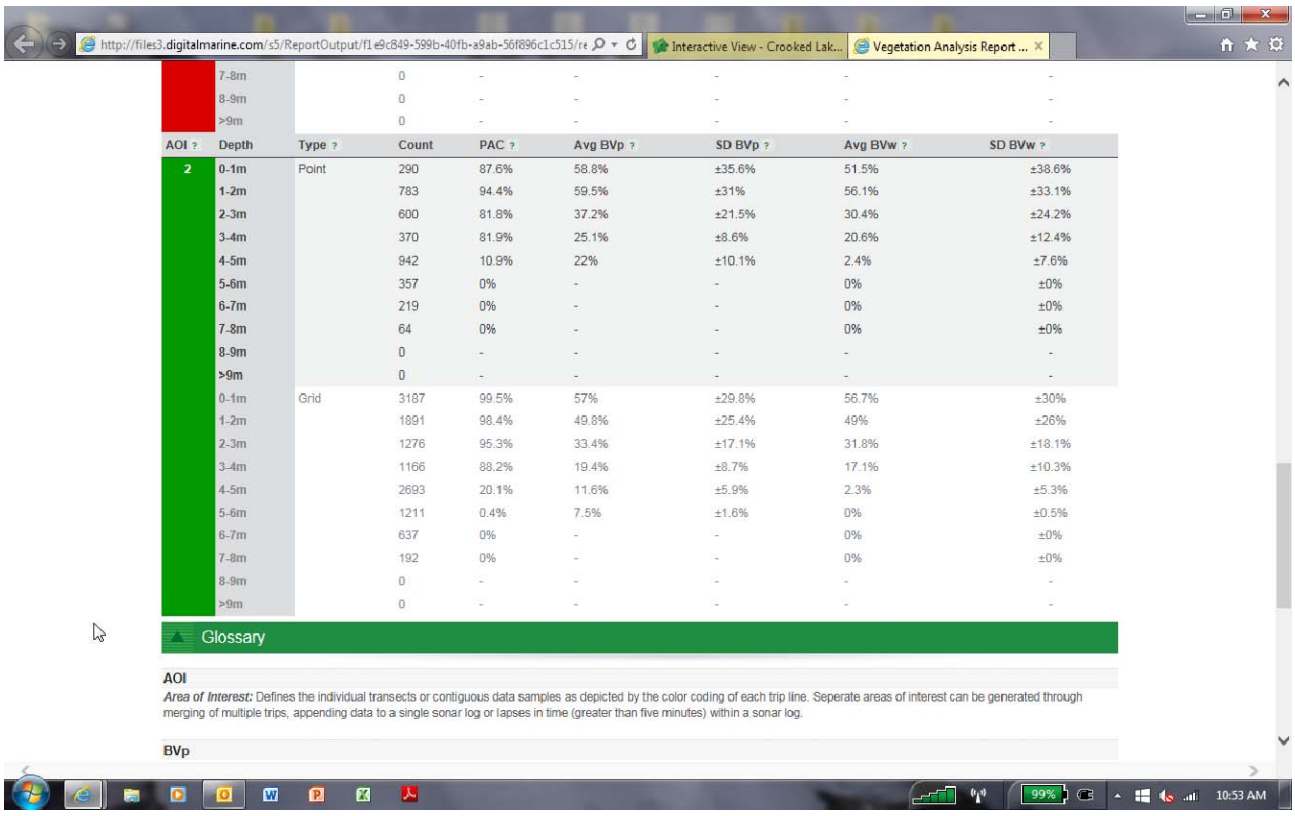






| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 8.66% | 28.96% | 18.32% | 9.65% | 6.68% | 27.72% |
| 2 | 47.86% | 10.7% | 18.57% | 7.14% | 4.88% | 10.84% |

## Biovolume Analysis by Depth

| AOI | Depth | Type | Count | PAC | Avg BVp | SD BVp | Avg BVw | SD BVw |
|---|---|---|---|---|---|---|---|---|
| 1 | 0-1m | Point | 297 | 93.9% | 54.2% | ±37.6% | 50.9% | ±38.7% |
| | 1-2m | | 85 | 83.5% | 38.5% | ±28.4% | 32.2% | ±29.6% |
| | 2-3m | | 22 | 86.4% | 24.5% | ±10% | 21.2% | ±12.5% |
| | 3-4m | | 0 | - | - | - | - | - |
| | 4-5m | | 0 | - | - | - | - | - |
| | 5-6m | | 0 | - | - | - | - | - |
| | 6-7m | | 0 | - | - | - | - | - |
| | 7-8m | | 0 | - | - | - | - | - |
| | 8-9m | | 0 | - | - | - | - | - |
| | >9m | | 0 | - | - | - | - | - |
| | 0-1m | Grid | 2855 | 88.4% | 55.2% | ±32% | 48.8% | ±34.9% |
| | 1-2m | | 177 | 95.5% | 43.4% | ±24.5% | 41.5% | ±25.6% |
| | 2-3m | | 103 | 96.1% | 31.2% | ±18.9% | 29.9% | ±19.5% |
| | 3-4m | | 31 | 61.3% | 17.6% | ±10.9% | 10.8% | ±12.1% |
| | 4-5m | | 0 | - | - | - | - | - |
| | 5-6m | | 0 | - | - | - | - | - |
| | 6-7m | | 0 | - | - | - | - | - |
| | 7-8m | | 0 | - | - | - | - | - |
| | 8-9m | | 0 | - | - | - | - | - |
| | >9m | | 0 | - | - | - | - | - |
| AOI | Depth | Type | Count | PAC | Avg BVp | SD BVp | Avg BVw | SD BVw |
| 2 | 0-1m | Point | 290 | 87.6% | 58.8% | ±35.6% | 51.5% | ±38.6% |
| | 1-2m | | 783 | 94.4% | 59.5% | ±31% | 56.1% | ±33.1% |
| | 2-3m | | 600 | 81.8% | 37.2% | ±21.5% | 30.4% | ±24.2% |
| | 3-4m | | 370 | 81.9% | 25.1% | ±8.6% | 20.6% | ±12.4% |




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7-8m | | 0 | - | - | - | - | - |
| | 8-9m | | 0 | - | - | - | - | - |
| | >9m | | 0 | - | - | - | - | - |
| AOI | Depth | Type | Count | PAC | Avg BVp | SD BVp | Avg BVw | SD BVw |
| 2 | 0-1m | Point | 290 | 87.6% | 58.8% | ±35.6% | 51.5% | ±38.6% |
| | 1-2m | | 783 | 94.4% | 59.5% | ±31% | 56.1% | ±33.1% |
| | 2-3m | | 600 | 81.8% | 37.2% | ±21.5% | 30.4% | ±24.2% |
| | 3-4m | | 370 | 81.9% | 25.1% | ±8.6% | 20.6% | ±12.4% |
| | 4-5m | | 942 | 10.9% | 22% | ±10.1% | 2.4% | ±7.6% |
| | 5-6m | | 357 | 0% | - | - | 0% | ±0% |
| | 6-7m | | 219 | 0% | - | - | 0% | ±0% |
| | 7-8m | | 64 | 0% | - | - | 0% | ±0% |
| | 8-9m | | 0 | - | - | - | - | - |
| | >9m | | 0 | - | - | - | - | - |
| | 0-1m | Grid | 3187 | 99.5% | 57% | ±29.8% | 56.7% | ±30% |
| | 1-2m | | 1891 | 98.4% | 49.8% | ±25.4% | 49% | ±26% |
| | 2-3m | | 1276 | 95.3% | 33.4% | ±17.1% | 31.8% | ±18.1% |
| | 3-4m | | 1166 | 88.2% | 19.4% | ±8.7% | 17.1% | ±10.3% |
| | 4-5m | | 2693 | 20.1% | 11.6% | ±5.9% | 2.3% | ±5.3% |
| | 5-6m | | 1211 | 0.4% | 7.5% | ±1.6% | 0% | ±0.5% |
| | 6-7m | | 637 | 0% | - | - | 0% | ±0% |
| | 7-8m | | 192 | 0% | - | - | 0% | ±0% |
| | 8-9m | | 0 | - | - | - | - | - |
| | >9m | | 0 | - | - | - | - | - |

## Glossary

**AOI**

***Area of Interest:*** Defines the individual transects or contiguous data samples as depicted by the color coding of each trip line. Seperate areas of interest can be generated through merging of multiple trips, appending data to a single sonar log or lapses in time (greater than five minutes) within a sonar log.

**BVp**