Lake Erie and Campbell
2004 Aquatic Plant Survey

Fall 2004

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Introduction and Project Overview

Erie and Campbell Lakes are located in Washington State in western Skagit County. Lake Erie is a 110 acre water body with a mean depth of 6 feet and maximum depth of 14 feet. The lake has a relatively small drainage area with a watershed of 1.62 square miles. The shoreline is a mix of residential and commercial development with large areas remaining in a natural state. Lake Erie drains to Lake Campbell located approximately one mile to the south. Lake Campbell is a 370 acre water body with a mean depth of 8 feet and a maximum depth of 16 feet. The watershed draining into Campbell is 5.68 square miles in size.

These lakes have been negatively impacted by aquatic plants and algae for a number of years. This is primarily due to their shallow nature and nutrient loading from the watershed. In the early 1980's a Phase One Lake Restoration Study was performed on these lakes using grant funds from the Department of Ecology (DOE). This study resulted in additional grant funding to implement the Phase Two Lake Restoration Efforts. An Alum treatment was performed on these lakes and the County purchased an aquatic weed harvester that was used to help manage those problems. Over time, the harvester work was abandon due to the high costs of operation and the limited production capabilities of the system. By the early 2000's weed and algae growth were again posing a major problem to the residents of these lakes and the public access users. Eurasian Milfoil was discovered in these lakes in this time frame as well.

The citizens living around the lake began to work with the Skagit County Public Works Department to mitigate the impact of these weeds on their use and enjoyment of the lakes. They formed a working group and began to educate themselves on the problems and options for management. A number of public meetings were held to discuss this issue and get consensus from the community on management options.

The County Lakes staff assisted the community by developing an Integrated Aquatic Vegetation Management Plan (IAVMP). This process focused the community on developing workable solutions for the problems they face. Once adopted, the plan can also be used to request funding from the DOE for implementation.

In this time frame the citizens also formed a Lake Management District (LMD) to fund the implementation of the plan. This type of special local district is set up after landowners who benefit from the improvements to the lake vote to create the district. The LMD has been active for approximately 3 years. Through the County, the LMD has contracted with Aquatechnex, LLC to provide aquatic plant management services since 2002 (prior year end reports provide additional information on specific tasks and accomplishments for previous years, these are on file with the County)

In early 2003, these lakes were stocked with Triploid Grass Carp. This fish is a native of the Amur River in northern China/Siberia. Grass carp are biological control agents for many species of submerged aquatic weeds. They consume plant material thereby suppressing the abundance of the problem growth.

There are regulatory hurtles to clear prior to stocking this fish. Outlets to the lakes need to be screened to insure the fish do not escape to downstream waters. This work requires a HPA permit from the Department of Fish and Wildlife (DFW). This permit was secured by Aquatechnex and the screens were designed and installed in the fall of 2002. The next step is to secure a stocking permit from the same department to allow the introduction of this biological control agent. The DFW has to balance the desire for weed control with the potential impact this biological control agent will have on the ecosystem in the lakes under consideration. If too many grass carp are placed in a lake, they will eventually consume all aquatic vegetation, often to the detriment of other species. Aquatic plants are a key component in an aquatic ecosystem; they provide structure and cover for fish and invertebrates. If all plant life is removed, it impacts the populations of these other species.

The permit issued for this lake system allowed approximately 700 fish for Lake Erie and 2,200 fish for Lake Campbell. Generally, the department allows up to 10 fish per vegetated acre but in recent years the trends have become lower. The permit is good for one year after the date of issue. The Department indicated that future stocking of this biological tool would be dependent on a monitoring program that documented the need for additional fish.

Approximately 100 fish were stocked in Lake Erie and 600 fish were added to Campbell Lake. This stocking rate is lower than that allowed by the DFW. The permit allowed stocking of up to 6 fish per surface acre of each lake. Aquatic vegetation does not impact this number of acres in reality however. Lake Erie was treated in 2002 for the rapidly expanding Eurasian Milfoil problem with Sonar aquatic herbicide. This reduced the volume of aquatic plant life present because the milfoil removed made up much of the infested volume of the lake. Lake Campbell has historically had an algae bloom limiting aquatic plant growth to the shallow margins of the lake. The actual acres that support aquatic plants are much lower than the 370 surface acres of the lake.

The LMD hired Aquatechnex to implement a monitoring program on these lakes to characterize the aquatic plant communities and help determine the need for additional aquatic plant management activities over the life of the LMD.

This report summarizes the monitoring performed during the summer of 2004 of the impact of the grass carp on the aquatic plant communities. It also presents protocols for ongoing monitoring and suggests aquatic plant management objectives for 2005.

Methods

The objectives of the field aquatic plant survey efforts for 2004 were as follows:

- To monitor the changes in the aquatic plant communities over time.

- Insure that the maps and data contain the information necessary to support aquatic plant management permit applications in future years.

- To characterize the conditions present in the lakes during the summer of 2004 and make recommendations to the community regarding additional control efforts.

Our first step was to review the previous aquatic plant mapping efforts performed on the lake. There have been a number of surveys performed on these lakes in the past few years by the County and the Lake Management District. Planning and assembly of equipment was the next step undertaken in this effort. Boats, sampling equipment and data collection equipment were mobilized to the lake for the 2004 summer survey.

The survey team used a Trimble GeoXT Differential Global Positioning System (DGPS) receiver and data logger to support the data collection mission. Prior to going to the field a data dictionary was developed for the project. Using Trimble Pathfinder software, the Data Dictionary Editor function was used to build the Erie/Campbell Data Dictionary. Three Features were entered into this system and they were:

Eurasian Milfoil, Point
Eurasian Milfoil, Area
Native Plant, Point

Default feature settings were established for each feature on the Trimble GeoXT. The logging interval was set for one second. This function directs the receiver to collect a GPS signal at one-second intervals. The accuracy default was set for “code”. The default minimum number of positions collected for each feature was set for 10. Display symbols and colors for the symbols were also selected and set.

A number of attribute menus were established for the Native Plant, Point feature. These menus were set based on the types of plants that were expected in the survey area. They were:

Elodea	Coontail	Pot 1	Pot 2	Pot 3
Pot 4	Pot 5	Pot 6	Macro Algae	No Plants

Five pull down menus for native plant attributes were created for this feature, each having the species listed above. The Pot 1-6 attributes were established because a number of Potamogeton species were expected to be encountered during the survey. As these species were not known prior to the survey, each label would be assigned in the field to a particular species as the team moved around the lake.

The data dictionary (file name Erie/Campbell.ddf) was then transferred to the Trimble GeoXT using the docking station and Pathfinder Data Transfer Utility. Images of the lakes were also transferred using this utility to provide a visual reference of the survey team's location on the lakes. The Coordinate System used was UTM, zone 10 North and datum NAD 1983 (Conus).

The survey team also assembled the other necessary equipment to conduct the survey. This included SCUBA dive equipment, sleds to tow divers, a polychain with one foot increments to be used to establish transects for the divers, aquatic plant sample collection equipment, aquatic plant identification keys, underwater writing equipment and a data log book. The team was then ready to move into the field.

The data collection was performed over a number of days in July and early August. The Trimble GeoXT was initialized and the Terrasync software used for data collection was opened. A rover file was created for this project and the data dictionary and background image were opened and made ready for use.

Four methods were used to map the aquatic plants present in each lake. The first method was to establish a number of data collection points throughout the littoral area of the lake and use a rake sampler to collect and identify the species of plants present at each point. The second method was to establish a number of transect lines in the lake. These lines were then surveyed by divers who recorded the species present and percent bottom cover at regular intervals. The third method was to perform visual observations between transects and points, and note conditions present. The fourth method was to collect biomass samples at random points along two transect lines.

The point sampling was performed first. The boat crew established a grid across the littoral area of the lake using the GeoXT. At each survey point, the crew used a sampling rake and methodology developed by the Washington Department of Ecology to collect plant samples (Parsons, 2001). The GeoXT GPS unit has a Windows CE computer built into the system. Terrasync software allows for the display of a background aerial image of the lake, the location of the unit geographically referenced to the image and any data features collected. The boat operator used this view to navigate to the collection point. At the collection point, a sampling rake was thrown and retrieved. A double sided rake was used with a 50 foot rope. When the rake was retrieved, the species present were noted. Using the GeoXT and Terrasync software, a native plant feature was stored at the sampling location. Species attributes were then recorded for that point. The data logging system was set up to have five pull down menus with the species selection so that five species attributes could be established for each sampling point. The survey team recorded a species attribute for each species found at that point with the stylus from this menu selection. They also recorded a plant abundance rating of sparse, moderate or dense based on the amount of plant material collected on the rake.

The next task was to collect the transect data. Aquatechnex divers established each transect line by deploying a calibrated polychain. The polychain was 300 feet in length with distances displayed in feet on the chain. A weight was attached to the deep water end of the chain. At each transect location, one diver held the chain in place as the other diver swam the chain out across the littoral area. The support crew in the boat then used the Trimble GeoXT to record the exact location of the transect by collecting a generic line feature over the length of the chain. One diver then swam the length of the transect and recorded the species present and percent bottom coverage at each twenty foot interval on an underwater tablet. When the diver arrived at the next interval on the polychain, he reviewed a one square meter area centered on the interval marker and recorded his observations. At the conclusion of each transect, the diver gave the underwater tablet to the boat support crew where the information was transferred into a “Write in the Rain” field notebook while the divers recovered the polychain. They then moved to the next transect location and repeated this process until all ten transects were completed.

Aquatic plant biomass samples were then collected by the divers at two points along two transects. Divers placed a sampling grid on the lake bottom. They then collected and bagged the aquatic vegetation present in each site. The plants were taken back to the lab, dried and weighed for inclusion in this report.

The last step was to perform a complete visual inspection of the areas in the lake between each transect. This qualitative assessment was designed to give the survey team a better overall view of the conditions present. A number of additional GPS points were collected to establish the outside edge of the plant communities between transects to see if there was variation. The make up of the plant community was noted in greater detail. The team looked for other plant species that were not present on the transects or in the data collection as well.

On completion of the field efforts, the Trimble GeoXT was placed in the docking station and the Trimble Pathfinder software’s data transfer utility was used to collect the rover file from the GPS receiver. Using the differential collection utility in Pathfinder, the data was converted to ESRI shape files and moved to Arc View GIS software for analysis.

Maps were created that document the location of the sampling sites and represent the aquatic plant communities present at the time of each survey.

Results

Erie and Campbell Lakes have different characteristics and history of aquatic weed issues. They will be discussed separately.

Lake Erie

There was no Eurasian Milfoil detected in Lake Erie. This lake was heavily impacted by this weed in 2002 and treated with Sonar aquatic herbicide prior to grass carp stocking. No milfoil was observed the first year post treatment. The point survey, diver observation and boat visual observation took a very close look at the lake for this noxious weed and it is absent. Continued vigilance is required to prevent this plant from re-establishing in the lake.

There was some concern expressed about potential herbicide impacts to the native water lilies present along the south shoreline of the lake. Our team did observe these plants and concluded that they were being impacted by insect feeding. This is fairly common in Washington State. There was no evidence of herbicide injury in these areas.

One of the unique things about Lake Erie is that the majority of the surface area of the lake is considered the littoral zone. The littoral zone of a lake is the area that supports aquatic plant growth. It is normally determined by the depth to which light penetrates the water column with sufficient intensity for aquatic plants to survive. The littoral area of a lake is generally the shallows areas along the shorelines and out to a depth contour where light levels are so low that plant life can not survive. As Lake Erie is shallow throughout, light reaches the lake bottom throughout and aquatic plant life can thrive anywhere in the system. As that is the case, the sampling protocols were established to survey the entire lake.

The point survey collected an increased number of aquatic plant species when compared to the 2003 survey data. Table 1 presents the common and scientific names for each of the species present in each year.

Table One, Aquatic Plant Species Detected during the 2003 and 2004 Aquatic Plant Surveys for Lake Erie

2003-2004 PLANT SPECIES	2003 ABUNDANCE	2004 ABUNDANCE
Ceratophyllum demersum (Coontail)	83 of 127 survey points	0 of 127 survey points
Potamogeton pusillus (Small Pondweed)	46 of 127 survey points	2 of 127 survey points
Potamogeton amplifolius (Big Leaf Pondweed)	4 of 127 survey points	0 of 127 survey points
Potamogeton foliosus (Leafy Pondweed)	0 of 127 survey points	113 of 127 survey points
*Stuckenia pectinatus (*Sago	0 of 127 survey points	1 of 127 survey points

Pondweed)		
Ranunculus sp. (Water Buttercup)	0 of 127 survey points	2 of 127 survey points
Utricularia sp. (Common Bladderwart)	0 of 127 survey points	1 of 127 survey points
Chara/Nitella	0 of 127 survey points	93 of 127 survey points
Filamentous Algae	Data not collected for this species, very scattered distribution	51 of 127 survey points

As Table One shows, there has been a considerable change in the aquatic plant community in Lake Erie between the 2003 and 2004 surveys. There were three species of submerged aquatic plants sampled in the lake during 2003 and five species sampled in 2004. Big Leaf Pondweed was not found during the 2004 point survey while a few points yielded new species such as Bladderwart, Sago Pondweed and Water Buttercup. It should be noted that this survey collected plants at survey points in the lake. It is possible that all of these species are present elsewhere in the lake at very low densities.

In 2003 the dominant weed species was Coontail. During the 2004 survey, this plant was not found. Small Pondweed numbers also decreased while Leafy Pondweed numbers increased dramatically. It should be noted that these two Potamogeton species are very similar and during the 2003 survey the plants in these two families were very young small plants. It is hard to tell them apart at that stage (See Ecology's online site at http://www.ecy.wa.gov/programs/wq/plants/plantid2/descriptions/potpus.html). During the 2004 survey, these plants were much more mature. It is possible that some of the 2003 finds were in fact Leafy Pondweed. Chara/Nitella expanded dramatically since 2003 and filamentous algae was noted at a number of sampling sites in the northern portion of the lake. Macro algae species such as Chara and Nitella are normally considered beneficial species. They take up space on the lake bottom that might otherwise be colonized by more aggressive aquatic plants. They are low growing and will not interfere with most beneficial uses of a lake except near docks in shallow waters. Triploid grass carp will generally not feed on these algae species.

The most notable difference between the 2003 and 2004 survey was the density of the aquatic plant growth in the lake. When the rake samples were collected, the biologists used a rating system to record the amount of vegetation retrieved from each site. A "sparse" rating indicated that plants were collected and 0 to 30 percent of the rake was covered with plant material. A "moderate" rating indicated that the plants collected covered from 30 to 60 percent of the rake. A "dense" rating indicated that plants collected covered from 60 to 100 percent of the rake.

During the 2003 survey, the ratings for all sites were sparse to moderate. During the 2004 survey, the majority of the sites had a dense rating. This data was supported by the visual boat observation survey as well. During 2003, no aquatic plants approached the surface of the lake and would be been considered a problem. During the 2004 survey, aquatic plant growth dominated by Leafy Pondweed approached the surface or formed mats on the surface. Many of the lake residents indicated at the fall public meeting that they considered the levels present in the lake problematic and noted an impact on beneficial uses including swimming, boating and fishing. Many complained of fishing lines becoming tangled in the plant growth.

Aquatic plant Biomass data again reflected this trend. Four sites were surveyed. The results for these are as follows:

Table Two, Aquatic Plant Biomass from 2003 and 2004 Aquatic Plant Survey, Weight in Grams per square meter

SITE	JULY, 2003	SEPTEMBER, 2003	AUGUST, 2004
Transect 2, Station One	12.04 g/sq m	15.15 g/sq m	43.12 g/sq m
Transect 2, Station Two	10.85 g/sq m	13.75 g/sq m	43.76 g/sq m
Transect 6, Station One	No Plants	7.25 g/sq m	120.2 g/sq m
Transect 6, Station Two	7.45 g/sq m	9.94 g/sq m	152.28 g/sq m

Aquatic plant biomass increased dramatically in these samples. This supported the other data and the observations of the survey team on the lake.

A number of maps were produced for Lake Erie. An overview map that shows the plant communities is presented here and the reaming maps of individual species locations are found in the appendix. As the overview map shows, the plant coverage on the lake has expanded dramatically from 2003. Two polygons are presented on this map. Conditions within each were fairly uniform. The dominate species was Leafy Pondweed, with an under-story of Chara/Nitella. In the northern portion of the lake, the plant polygon shows an additional trend where filamentous algae was present in the majority of the points sampled as well as on the plants observed. This was not as prevalent in the southern portion of the lake. The maps in the appendix show the survey points and transect locations. There is also an individual map presented for each of the species found with their location.

Discussion

Our biologists have been working on this lake for a number of years including a couple prior to the formation of the LMD. This lake has exhibited shifts in the makeup of the plant community a number of times prior to and after institution of control measures. During the past three years we have been monitoring the effects of various treatment strategies on these plant communities with the objective of protecting beneficial uses. The Eurasian Milfoil that was taking over the lake was removed using a herbicide treatment program in 2002 and has not re-appeared. The lake has been stocked with 100 triploid grass carp at a rate of about 1 fish per vegetated acre in 2003. The current conditions are that aquatic plant growth is still having a noticeable effect on the beneficial uses on the lake such as recreation, swimming and fishing.

The stocking rate for the grass carp in 2003 was based on the fact that weed populations in the lake were low as a result of the treatment targeting the Eurasian milfoil the previous year. As the data shows, the aquatic plant densities have increased and the grass carp remaining in the system are not having a significant impact on densities.

The use of a biological control agent such as grass carp is an ongoing process. Stocking the fish at high rates often will result on the complete removal of aquatic vegetation from the system. This is not a desired outcome. Some aquatic plant life is necessary to support a healthy aquatic ecosystem. Fish and other organism rely on aquatic plant life for food, shelter and protection from predators. An overly aggressive stocking program results in the biological control agent consuming the vegetation present and then searching for any new plant growth emerging from the lake sediments. It is important to start at the low end of the stocking range and add fish gradually after evaluating the need.

It is our conclusion that Lake Erie can support additional grass carp. The permitting process in Washington State is managed by the Department of Fish and Wildlife. When stocking permits are issues, as was the case for the initial stocking of the lake, they are good for one year. We had permission to place 700 fish in the lake on the first stocking permit but chose to introduce 100 of those because of the low plant population. The plant community has changed and it is recommended that a second permit be obtained and additional fish stocked during the 2005 season.

At this point, other control options are not recommended for Lake Erie. The plant growth is wide spread and uniform throughout the lake. Herbicide treatments would be cost prohibitive when compared to additional grass carp stocking. Non-chemical treatment options such as mechanical or use of bottom barriers would also be cost prohibitive.

Lake Campbell

There was no Eurasian Milfoil detected in Lake Campbell. This lake was infested in limited areas by this weed and treated with 2,4-D aquatic herbicide prior to grass carp stocking. No milfoil was observed the first year post treatment. The point survey, diver observation and boat visual observation took a very close look at the lake for this noxious weed and it is absent. Continued vigilance is required to prevent this plant from re-establishing in the lake. It should be noted that there is an expanding population of native milfoil along the south shoreline. Care should be taken to distinguish between these species during future survey work.

Over the years we have been involved with or have observed Lakes Erie and Campbell the major difference between the two is water clarity. Lake Campbell has historically had a significant algae bloom each summer. Excessive amounts of algae cells in the water column will significantly reduce the light available to support aquatic plant life. While the lake is shallow, light penetration has limited plant growth to the shallow margins of the lake historically. This trend continued into 2004.

The point survey collected an increased number of aquatic plant species when compared to the 2003 survey data. Table 1 presents the common and scientific names for each of the species present in each year.

Table 3, Aquatic Plant Species Detected during the 2003 and 2004 Aquatic Plant Surveys for Lake Campbell

2003-2004 PLANT SPECIES	2003 ABUNDANCE	2004 ABUNDANCE
Ceratophyllum demersum (Coontail)	15 of 88 survey points	33 of 100 survey points
Potamogeton amplifolius (Big Leaf Pondweed)	4 of 88 survey points	0 of 100 survey points
Potamogeton illinoensis (Illinois Pondweed)	0 of 88 survey points	12 of 100 survey points
Potamogeton richardsonii (Richardson's Pondweed)	14 of 88 survey points	0 of 100 survey points
Potamogeton filiformis (Slender-leaved Pondweed)	1 of 88 survey points	0 of 100 survey points
Potamogeton foliosus (Leafy Pondweed)	0 of 88 survey points	10 of 100 survey points
*Elodea canadensis (*common waterweed)	6 of 88 survey points	6 of 100 survey points

Myriophyllum sp. (native milfoil)	23 of 88 survey points	6 of 100 survey points
*Najas sp. (*Slender water nymph or Naiad)	0 of 100 survey points	12 or 100 survey points
Potamogeton cripus (Curly Leaf Pondweed)	0 or 100 survey points	1 of 100 survey points
Vallisneria americana (Tapegrass)	0 of 88 survey points	5 of 100 survey points
Chara/Nitella	56 of 88 survey points	23 of 100 survey points
No Plants Present	n/a	29 of 100 survey points

As Table Three shows there has been some change in the makeup of the aquatic plant community in terms of species present from 2003 to 2004. There were seven submersed aquatic plant species present in 2003 and nine species of aquatic plants sampled in 2004 for an increase of two species present. New species found in the lake include Tapegrass, Illinois Pondweed, Curly Leaf Pondweed, Naiad and Leafy Pondweed. The point sampling did not locate Big Leaf Pondweed, Slender-leaf Pondweed and Richarson's Pondweed, species that were found in 2003. As this is a point sampling method, it is possible that these species are still present in the lake but were not present at the sampling stations. Coontail remains the dominant species present in the lake and we noted a slight increase in abundance of this plant. The macro algae Chara was the second most abundant and we noted a decline of this species present at sampling points. The milfoil populations declined as well at sampling points.

It should be noted that Curly Leaf Pondweed was added to the Washington State Noxious Weed list in the fall of 2004. One sampling site contained this species. While this plant should be a preferred species for grass carp, the populations of this weed should be monitored in the future. Curly Leaf Pondweed does well in low light conditions and can expand rapidly without management. The grass carp in the system will provide control of this plant when encountered.

The biomass data for the project is presented below.

Table Four, Aquatic Plant Biomass from 2003 and 2004 Aquatic Plant Survey, Weight in Grams per square meter

SITE	JULY, 2003	SEPTEMBER, 2003	AUGUST, 2004
Transect 1, Station One	88.25 g/sq m	93.35 g/sq m	15.60 g/sq m
Transect 1, Station Two	76.54 g/sq m	83.54 g/sq m	13.6 g/sq m
Transect 3, Station One	112.54 g/sq m	139.25 g/sq m	83.40 g/sq m
Transect 3, Station Two	83.35 g/sq m	94.65 g/sq m	60.80 g/sq m

There was a general decline in the plant biomass data for this lake. This was backed up by visual observations around the lake shoreline. The aquatic plant map for Lake Campbell is presented here. This map documents the location of aquatic plant beds in the lake and the dominant species. The appendix contains maps of the individual species locations and other information.

Discussion

The overall conditions in Lake Campbell have not changed much since the 2003 survey. The aquatic plant communities continue to be limited to the shallow waters by the lack of light in deeper water due to extensive algae blooms. While the plant biomass data shows a slight decline from 2003 levels, there are healthy aquatic plant communities along the littoral edges of the lake, most notably along the north and south shorelines. There was a slight increase in species abundance noted between 2003 and 2004. Overall, the aquatic plant growth present in the lake is not impacting beneficial uses such as recreation, swimming or fishing. This can be attributed to management of the vegetation using triploid grass carp.

The majority of the lake shoreline is undeveloped and healthy aquatic plant beds along the undeveloped shorelines provide good habitat for fish and wildlife. There are however areas where this submerged aquatic plant growth is having an impact on individual property owner's access to the lake. Thick weed growth adjacent to their docks and beaches has caused problems such as plants becoming entangled in outboard motors and not being able to use areas for swimming and fishing. As there is an impact on these beneficial uses locally, control measures should be considered in these areas.

The Integrated Aquatic Vegetation Management Plan (IAVMP) developed by the County for these two lakes focuses on triploid grass carp as a primary control method supplemented by herbicide treatments or other non-chemical control strategies as necessary.

It is recommended that a grass carp stocking permit application be filed for Lake Campbell at the same time as the Lake Erie application is submitted. This will allow for the use of this tool if the LMD determines more fish should be introduced.

One consideration the County and the LMD should take into account is that fish have to be stocked at a rate that will significantly suppress aquatic vegetation lake-wide in order to provide relief to the areas around the docks and beaches. Grass carp cannot provide focused control at one locale within a lake, such as an individual dock or beach, without being stocked at a rate that will provide that same level of control lake-wide. Other aquatic plant management options can provide focused control.

The County and LMD should consider other control strategies for these areas as well and weight the impacts vs. costs for each. Aquatic herbicides could be used to suppress this growth as necessary in the exact areas where they are problematic while not impacting the remaining aquatic vegetation in areas where it is not impacting beneficial uses. Bottom barriers could also be considered.

When making this decision, the County and the LMD should focus on the objective of the treatment and the impacts. Input from the LMD and community should be considered as well. At this point, it appears that small areas adjacent to some properties could use additional weed control, while aquatic plant communities in the remainder of the lake are not causing major problems. Control options for 2005 should meet the needs of the community in this regard.

If aquatic herbicides are selected to provide more localized control the following costs and tasks would have to be considered. A NPDES permit is required to apply aquatic herbicides to within Washington State. That permit can be obtained by applying to the Washington Department of Ecology. This application would have to move forward in the early winter in order to be processed and available for use this summer. There are permit costs (to Ecology) of approximately $350.00. There are costs associated with filing two newspaper legal notices as required by Ecology prior to issuing the permit. Costs for herbicide treatment average $575.00 per treated acre for Aquathol Super K granular, an effective broad spectrum herbicide. Treatments as small as ½ acre in front of impacted properties would provide season long relief. This decision should be made by the end of February to insure permits can be filed and received in time to perform this work.

Bottom barriers could also be considered. These are a more long term solution to this problem.

There is an invasive water lily species present in Lake Campbell and they have expanded somewhat from 2003 to 2004. These species are on the state noxious weed list as they degrade water quality and habitat in infested lakes. They are also a threat to swimmers. Grass carp will not feed on this plant species and other methods of control are necessary.

The most effective treatment would be to apply glyphosate herbicide during the summer of 2005. The NPDES permit for noxious aquatic weed control does not have fees or require newspaper public notices. The estimated cost for lily control for 2005 would be $1,750.00 and $350.00 for deliver of the required 10 day prior notification to all dwellings on the lake.

We would like to meet with the LMD committee in January or early February of 2005 to discuss this report and it's recommendations for 2005. Please contact Terry McNabb at terry@aquatechnex.com to schedule that meeting.

Thank you for your consideration.

References

Fasset, Wayne, 1969. A Manual of Aquatic Plants. University of Wisconsin Press. Madison, WI.

Parsons, Jennifer 2001. Aquatic Plant Sampling Protocols, Washington Department of Ecology Publication No. 01-03-017.

Washington Department of Ecology, 2001. An Aquatic Plant Identification Manual for Washington's Freshwater Plants, Washington Department of Ecology Publication No. 01-10-032.

Transect Data

Key Aquatic Plants

	Potamogeton pusillus	*Pp*
	Potamogeton foliosus	*Pf*
	Stuckenia pectinatus	*Sp*
	Potamogeton illinoensis	*Pl*
	Potamogeton crispus	*Pc*
	Elodea canadensis	*E*
	Myriophyllum sp.	*M*
	Najas sp.	*N*
	Vallisneria americana	*V*
	Ceratophyllum demersum	*C*
	Utricularia vulgaris	*U*
	Ranunculus aquatilis	*R*
	Chara/Nitella	*Ch*
	Filamentous algae	*F*
	Ruppia maritime	*R*
	No Plants Present	*X*

Lake Erie Transect Data

Transect One

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	PF,F,Ch,R	90	40	Pf,F,Ch	95
60	Pf,F,Ch	95	80	Pf,F,Ch	100
100	Pf,F,Ch	100	120	Pf,F,Ch	100
140	Pf,F,Ch	100	160	Pf,F,Ch	100
180	Pf,F,Ch	100	200	Pf,F,Ch	100
220	Pf,F,Ch	100	240	Pf,F,Ch	100
260	Pf,F,Ch	100	280	Pf,F,Ch	100
300	Pf,F,Ch	100			

Transect Two

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf,F	85	40	Pf,F	85
60	Pf,F	90	80	Pf,F	70
100	Pf,F	100	120	Pf,F	100
140	Pf,F	100	160	Pf,F	100
180	Pf,F	100	200	Pf,Ch, F	100
220	Pf,Ch, F	100	240	Pf,Ch, F	100
260	Pf,Ch, F	100	280	Pf,Ch, F	100
300	Pf,Ch, F	100			

Transect Three

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf,F	100	40	Pf,F	100
60	Pf,F	100	80	Pf,F	100
100	Pf,F	100	120	Pf,F	100
140	Pf,F	100	160	Pf,F	100
180	Pf,F	100	200	Pf,F	Pf,F
220	Pf,F	100	240	Pf,F	100
260	Pf,F	100	280	Pf,F	100
300	Pf,F	100			

Transect Four

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf,F	85	40	Pf,F	80
60	Pf,F	90	80	Pf,F	90
100	Pf,F	100	120	Pf,F	100
140	Pf,F	100	160	Pf,F	100
180	Pf,F	100	200	Pf,F	100
220	Pf,F	100	240	Pf,F	100
260	Pf,F	100	280	Pf,F	100
300	Pf,F	100			

Transect Five

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf	75	40	Pf	80
60	Pf	80	80	Pf	85
100	Pf	90	120	Pf,F,Ch	100
140	Pf,F,Ch	100	160	Pf,F,Ch	100
180	Pf,F,Ch	100	200	Pf,F,Ch	100
220	Pf,F,Ch	100	240	Pf,F,Ch	100
260	Pf,F,Ch	100	280	Pf,F,Ch	100
300	Pf,F,Ch	100			

Transect Six

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf,Ch,F	75	40	Pf,Ch,F	75
60	Pf,Ch,F	80	80	Pf,Ch,F	80
100	Pf,Ch,F	75	120	Pf,Ch,F	80
140	Pf,Ch,F	85	160	Pf,Ch,F	85
180	Pf,Ch,F	85	200	Pf,Ch,F	85
220	Pf,Ch,F	85	240	Pf,Ch,F	85
260	Pf,Ch,F	85	280	Pf,Ch,F	80
300	Pf,Ch,F	80			

Transect Seven

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf,Ch,F	75	40	Pf,Ch,F	75
60	Pf,Ch,F	75	80	Pf,Ch,F	75
100	Pf,Ch,F	65	120	Pf	70
140	Pf	70	160	Pf	70
180	Pf	75	200	Pf	75
220	Pf	75	240	Pf	75
260	Pf	75	280	Pf	75
300	Pf	75			

Transect Eight

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf,F,Ch	85	40	Pf,F,Ch	85
60	Pf,F,Ch	85	80	Pf,F,Ch	95
100	Pf,F,Ch	95	120	Pf,F,Ch	95
140	Pf,F,Ch	95	160	Pf,F,Ch	95
180	Pf,F,Ch	100	200	Pf,F,Ch	100
220	Pf,F,Ch	85	240	F	75
260	Pf,F,Ch	85	280	Pf,F,Ch	85
300	Pf,F,Ch	85			

Lake Campbell Transect Data

Transect One

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	X	0	40	X	0
60	F	40	80	Ch	35
100	X	0	120	C	45
140	X	0	160	X	0
180	X	0	200	X	0
220	X	0	240	C	25
260	X	0	280	X	0
300	X	0			

Transect Two

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	X	0	40	X	0
60	X	0	80	X	0
100	X	0	120	X	0
140	X	0	160	C	35
180	C	35	200	C	35
220	C	40	240	C,E	55
260	E	35	280	C	25
300	X	0			

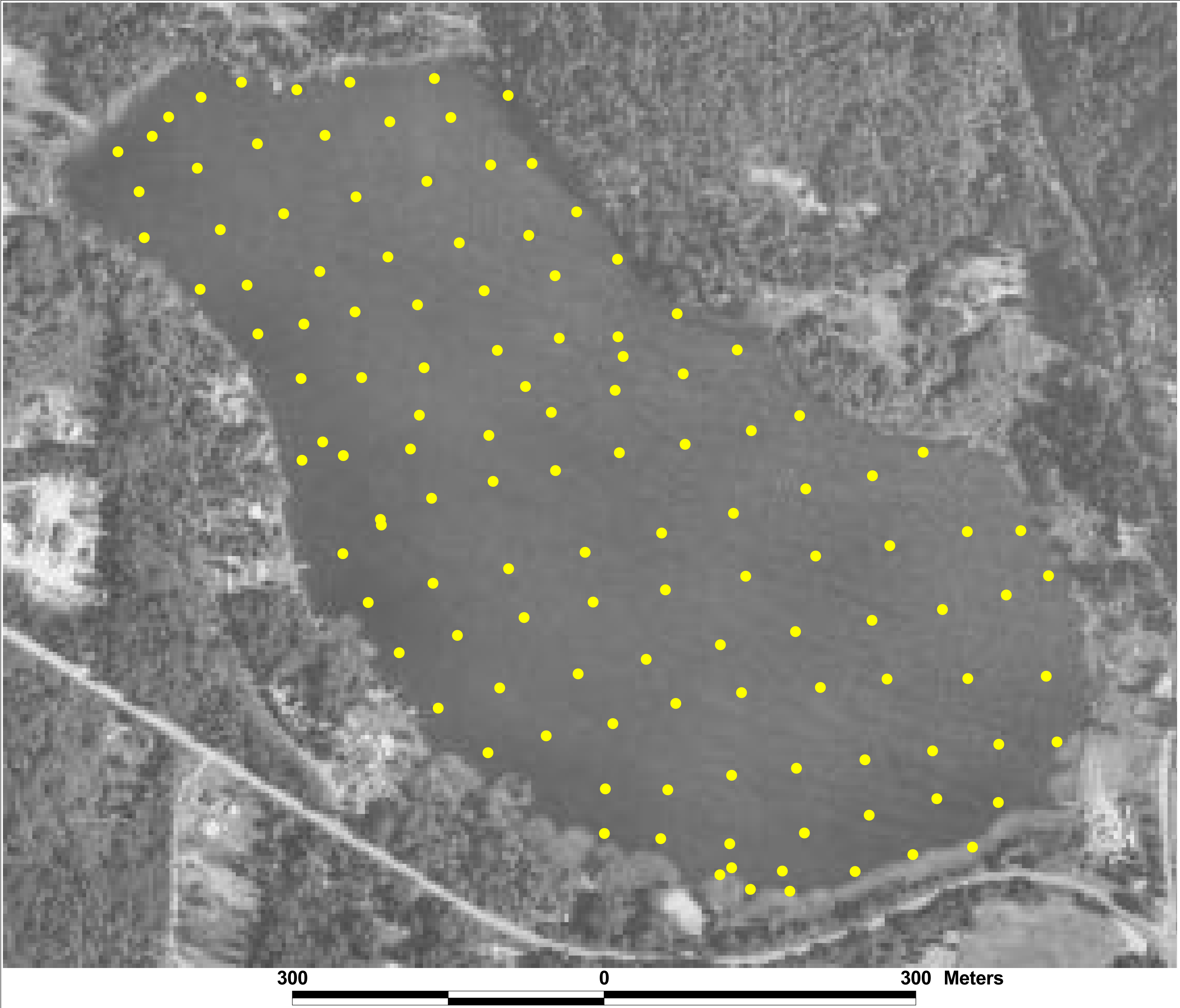
Transect Three

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	Pf	65	40	Pf	65
60	X	0	80	C	25
100	X	0	120	Ch,F	65
140	C,F,Pf,Ch	45	160	C,F,Pf,Ch	40
180	C,F,Pf,Ch	40	200	C,F,Pf,Ch	40
220	C,F,Pf,Ch	35	240	C,F,Pf,Ch	25
260	C,F,Pf,Ch	25	280	X	0
300	X	0			

Transect Four

DISTANCE	PLANTS	BOTTOM COVERAGE	DISTANCE	PLANTS	BOTTOM COVERAGE
20	C,Pf	35	40	C,PF	40
60	X	0	80	X	0
100	X	0	120	X	0
140	Pf	35	160	C,Pf	35
180	Pf	40	200	Pf	35
220	Pf	35	240	C,Pf	35
260	Pf	35	280	Pf	25
300	Pf	25			

Lake Erie 2004 Plant Survey



● Surveyed Points

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N
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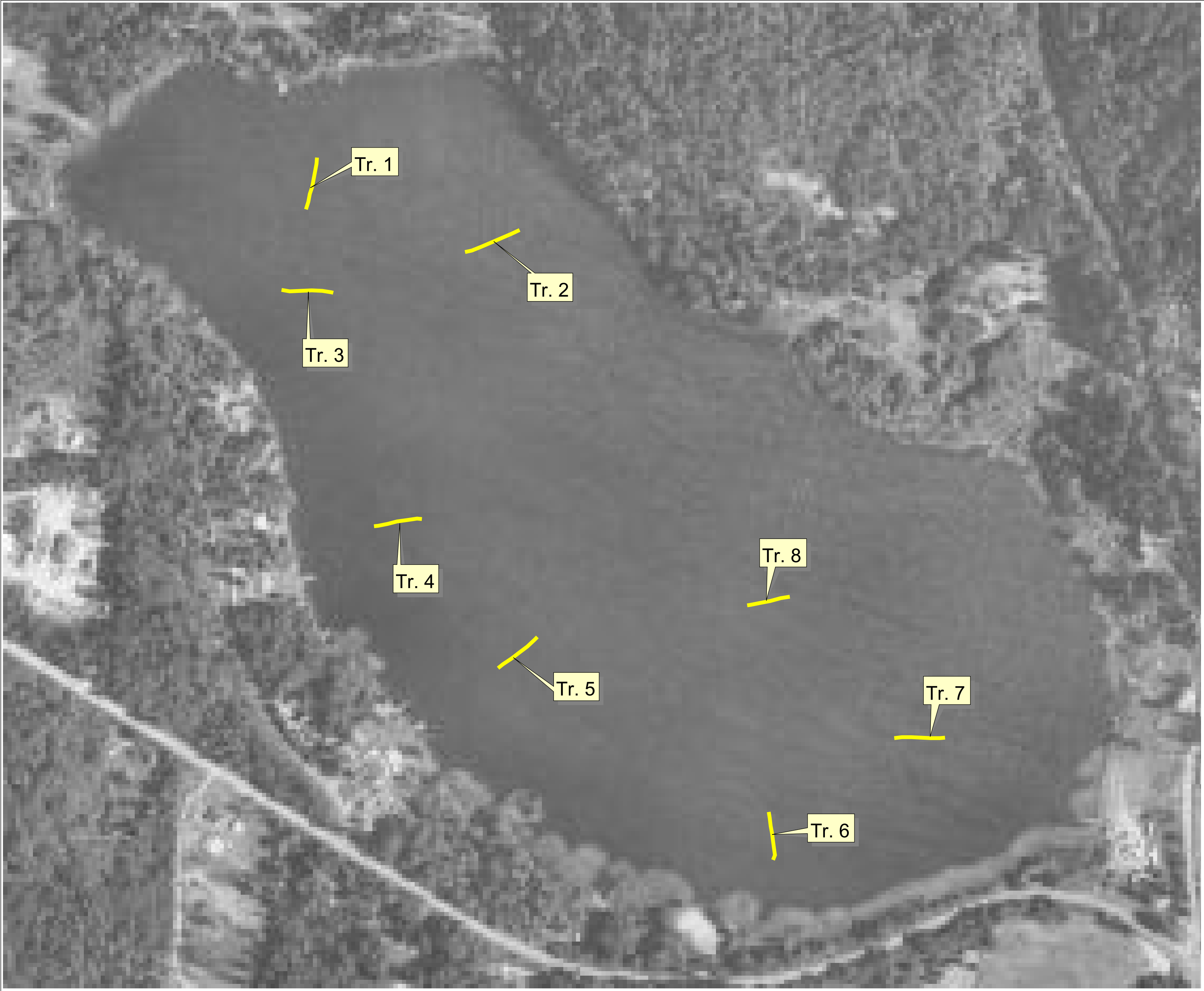
Lake Erie 2004 Plant Survey

Transect Lines



300 0 300 Meters

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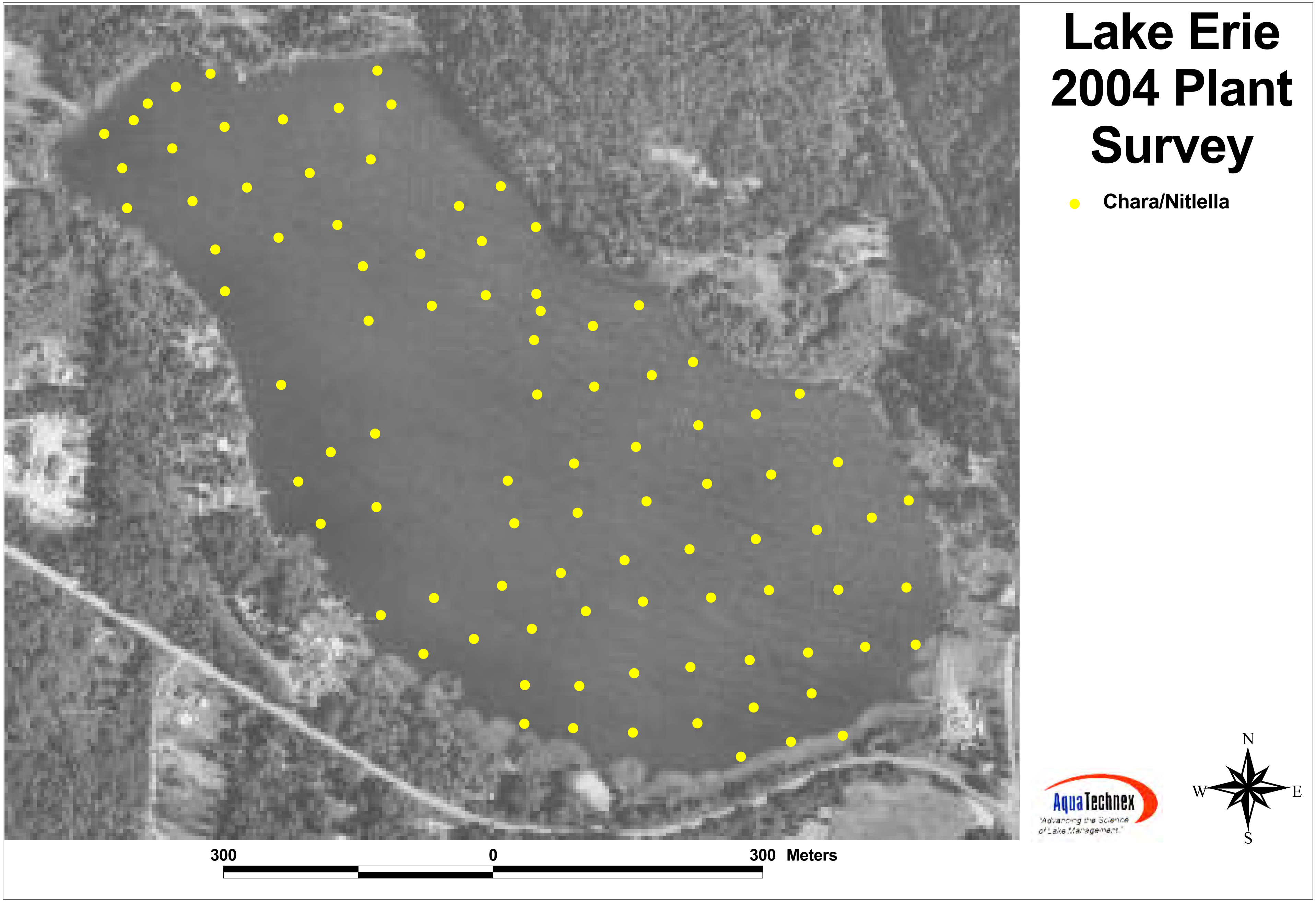
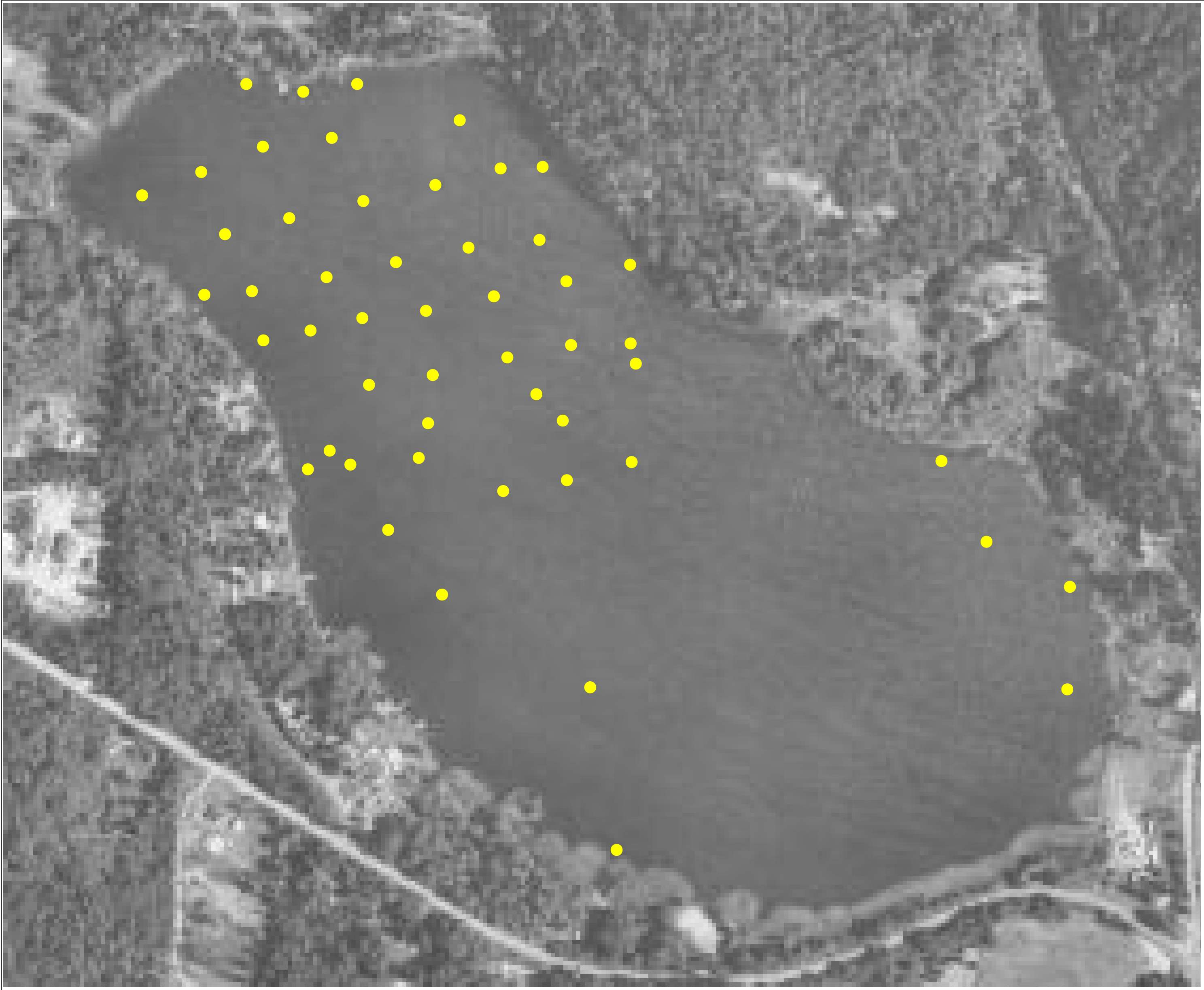
Lake Erie 2004 Plant Survey



Lake Erie 2004 Plant Survey



Filamentous algae

300 0 300 Meters

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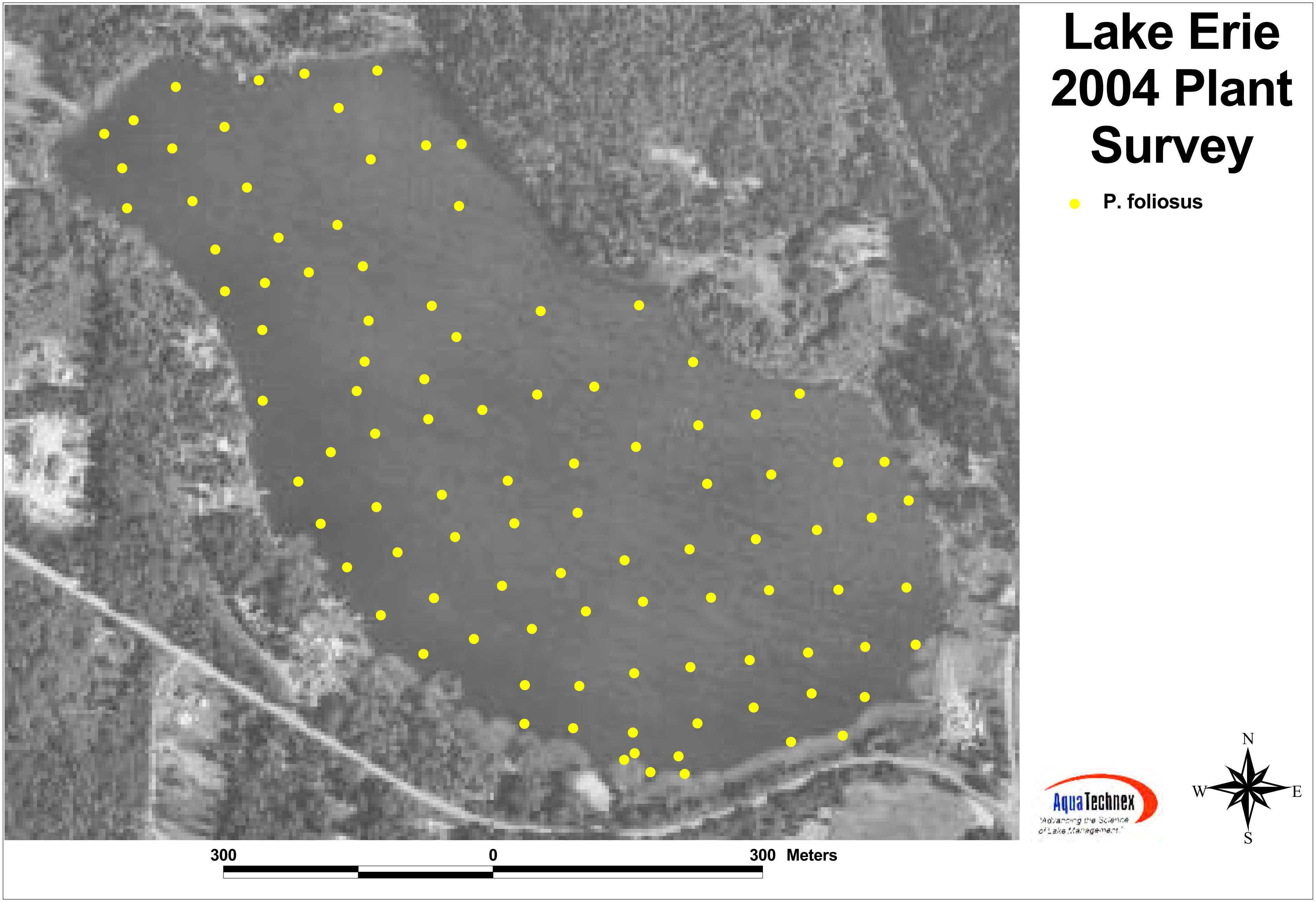
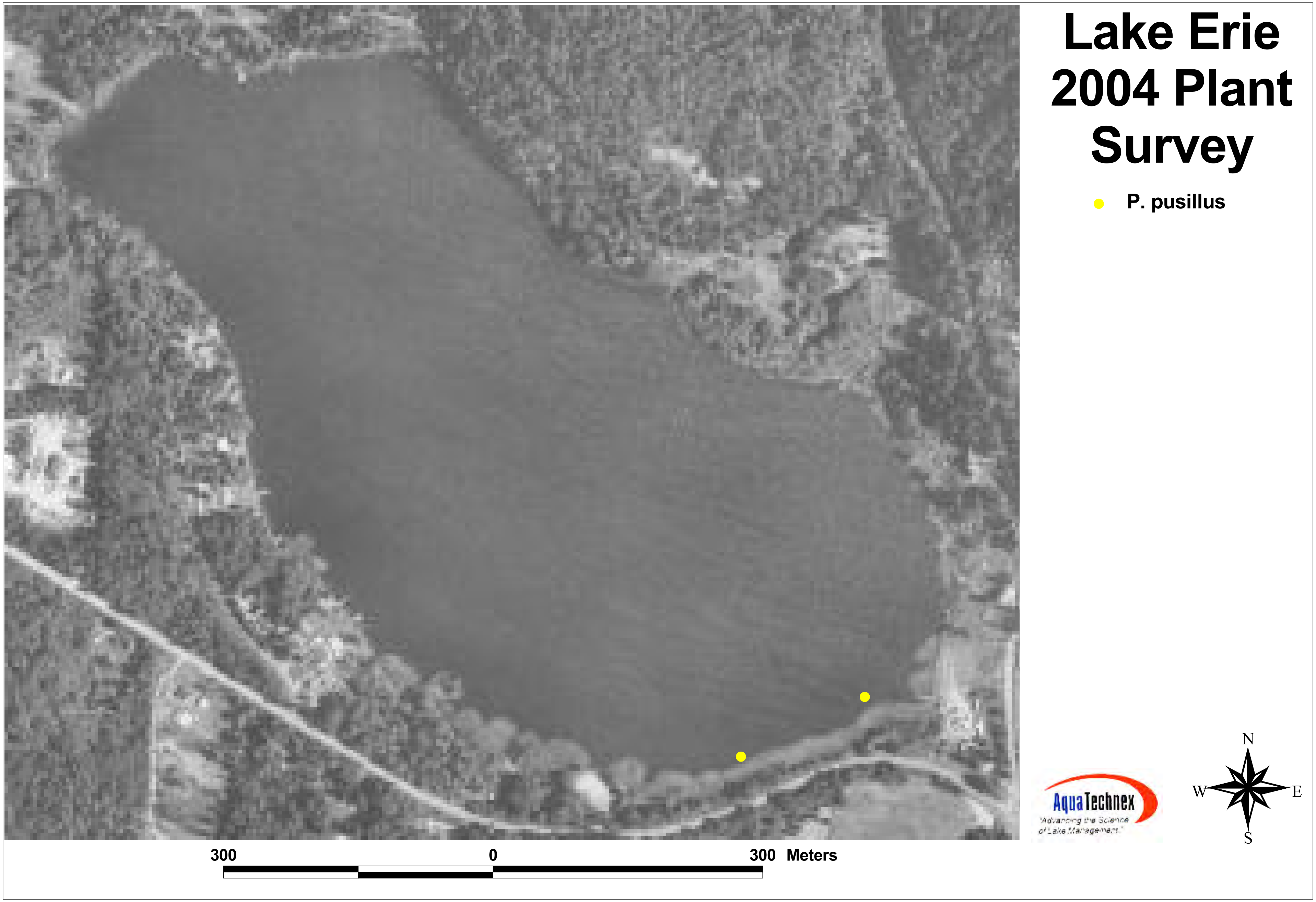
Lake Erie 2004 Plant Survey

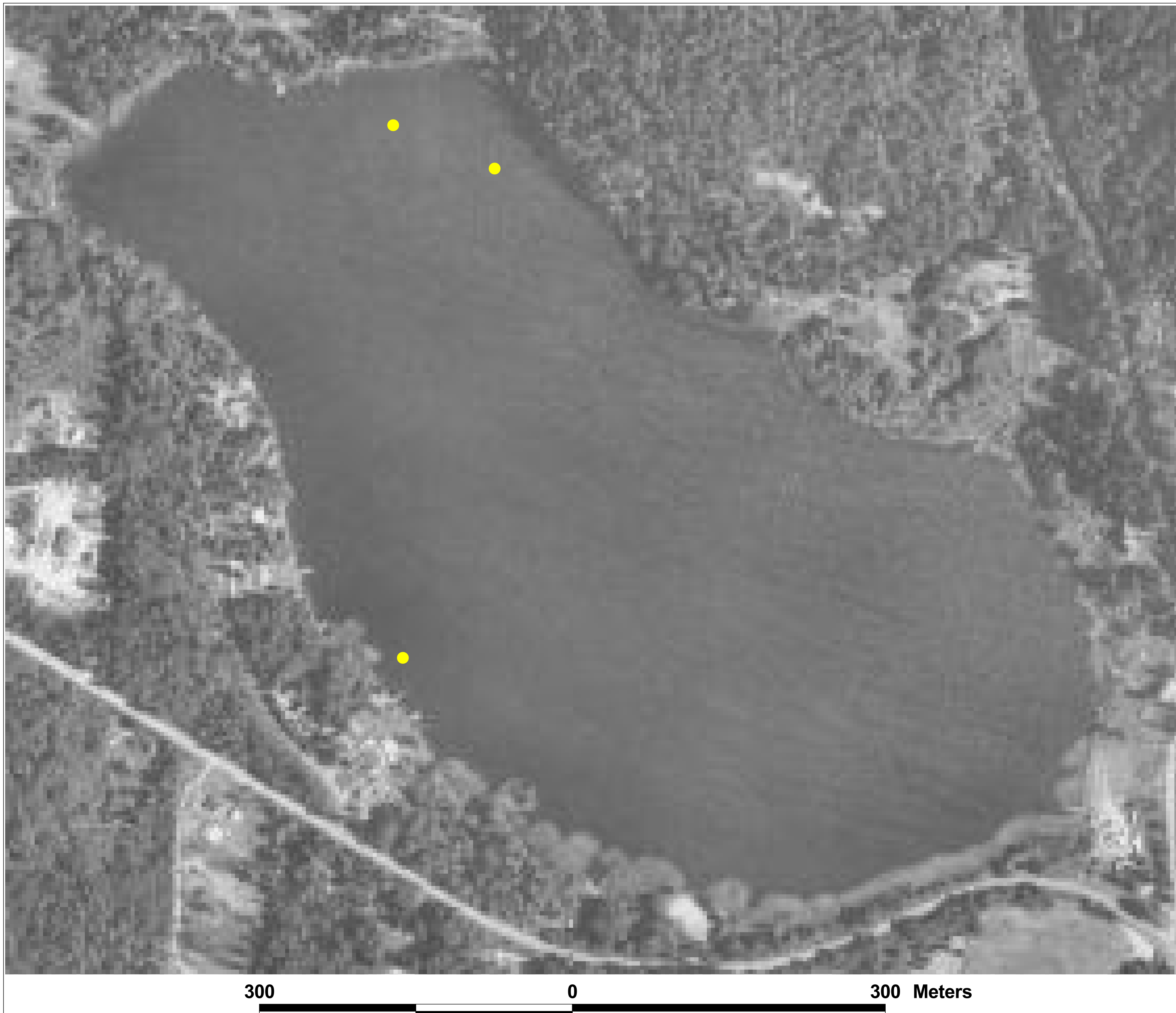


Lake Erie 2004 Plant Survey



Lake Erie 2004 Plant Survey

● **Ranunculus aquatilis**



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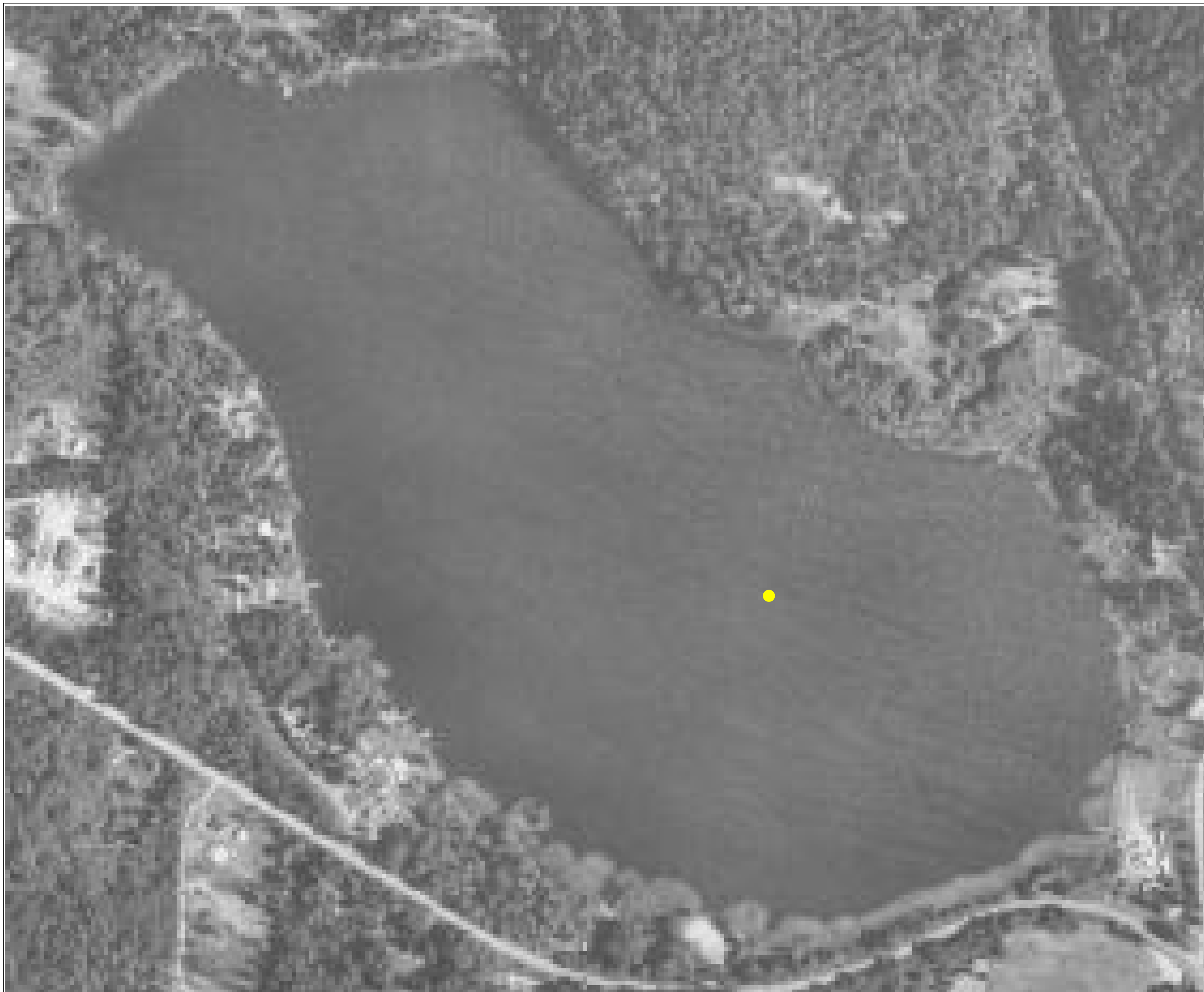
Lake Erie 2004 Plant Survey

Stuckenia pectinatus



300 0 300 Meters

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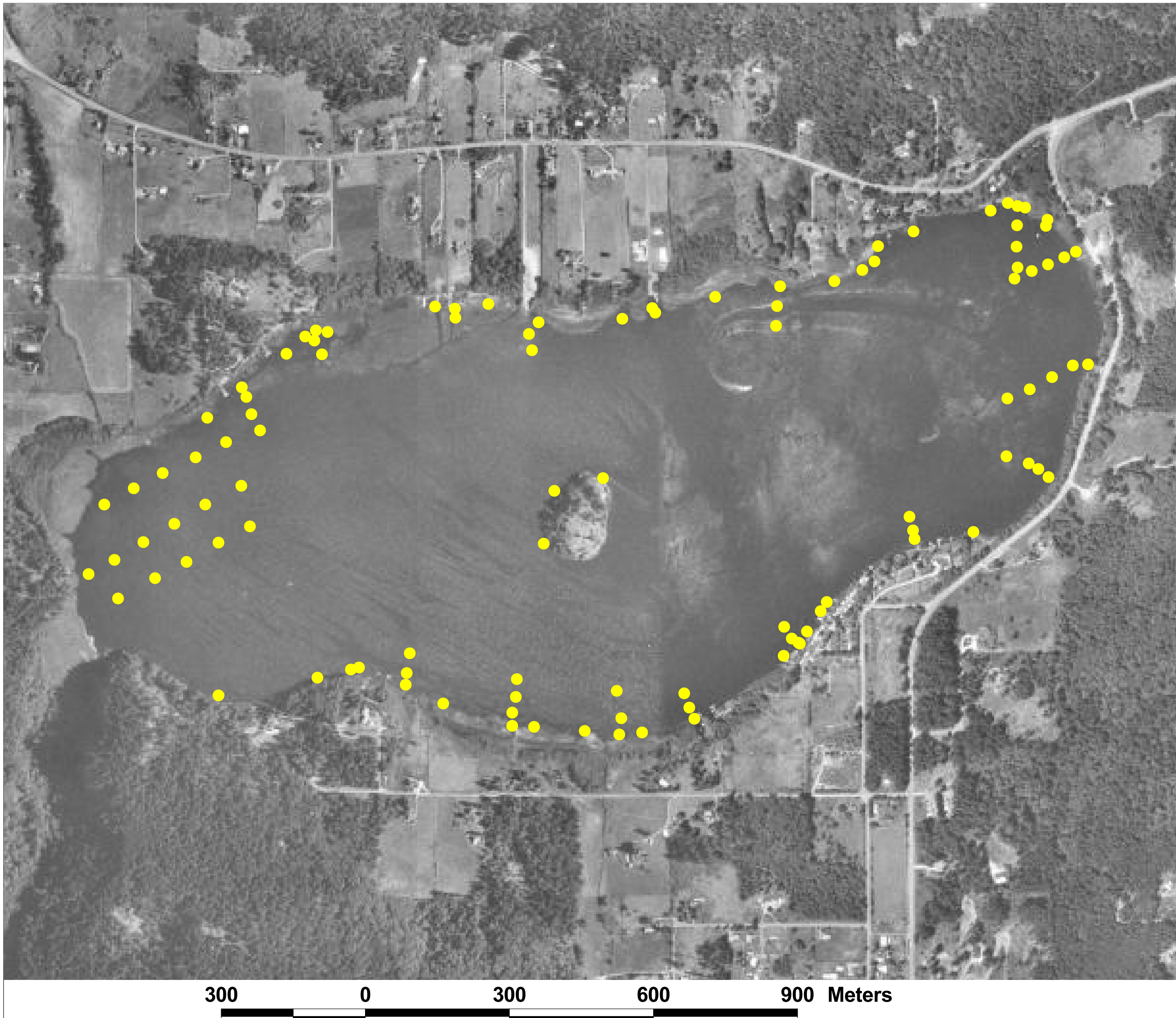
Lake Erie 2004 Plant Survey

Utricularia spp.

Lake Campbell 2004 Plant Survey

Surveyed Points



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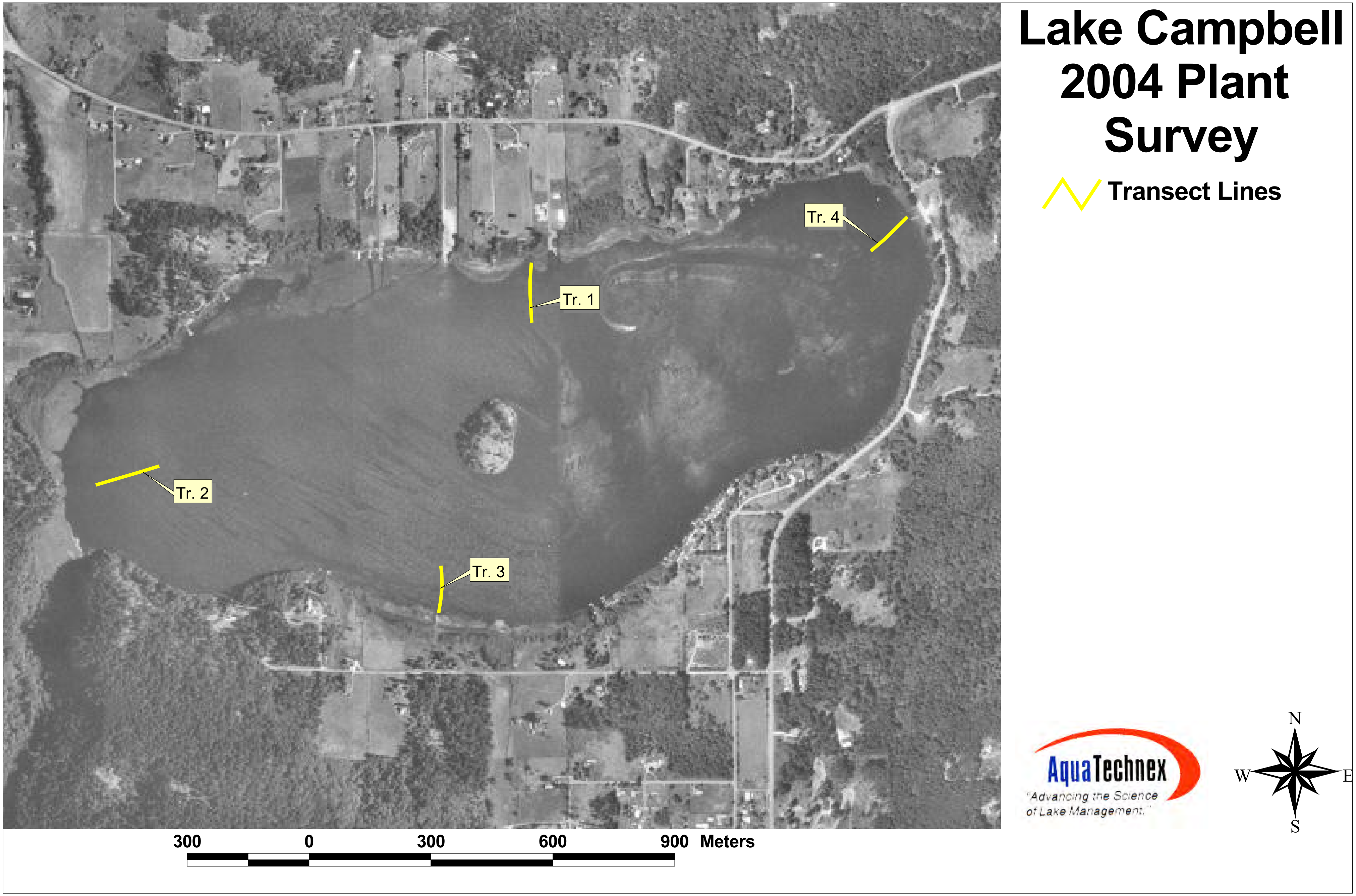

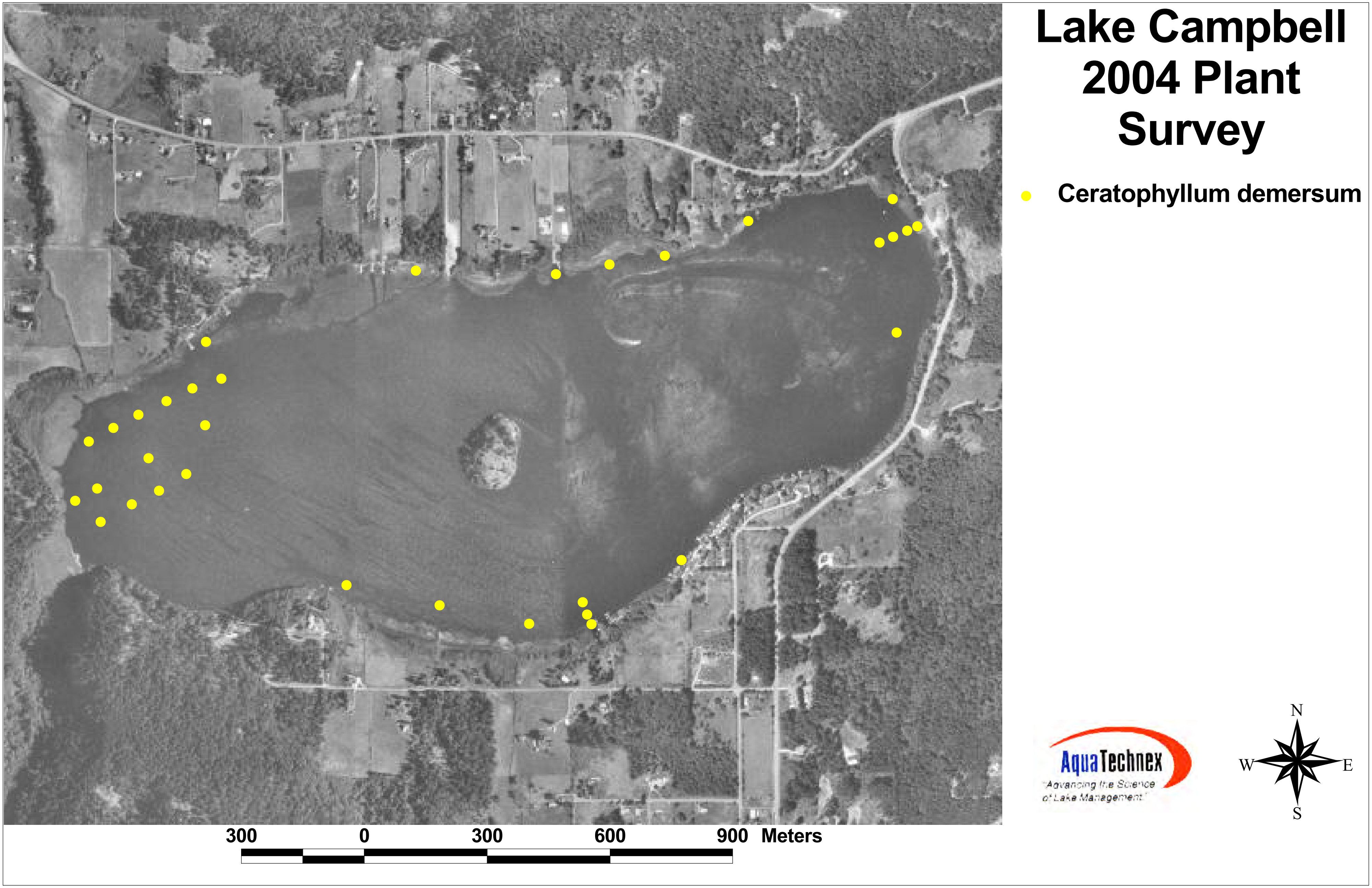

Lake Campbell
2004 Plant
Survey
Ceratophyllum demersum
300 0 300 600 900 Meters
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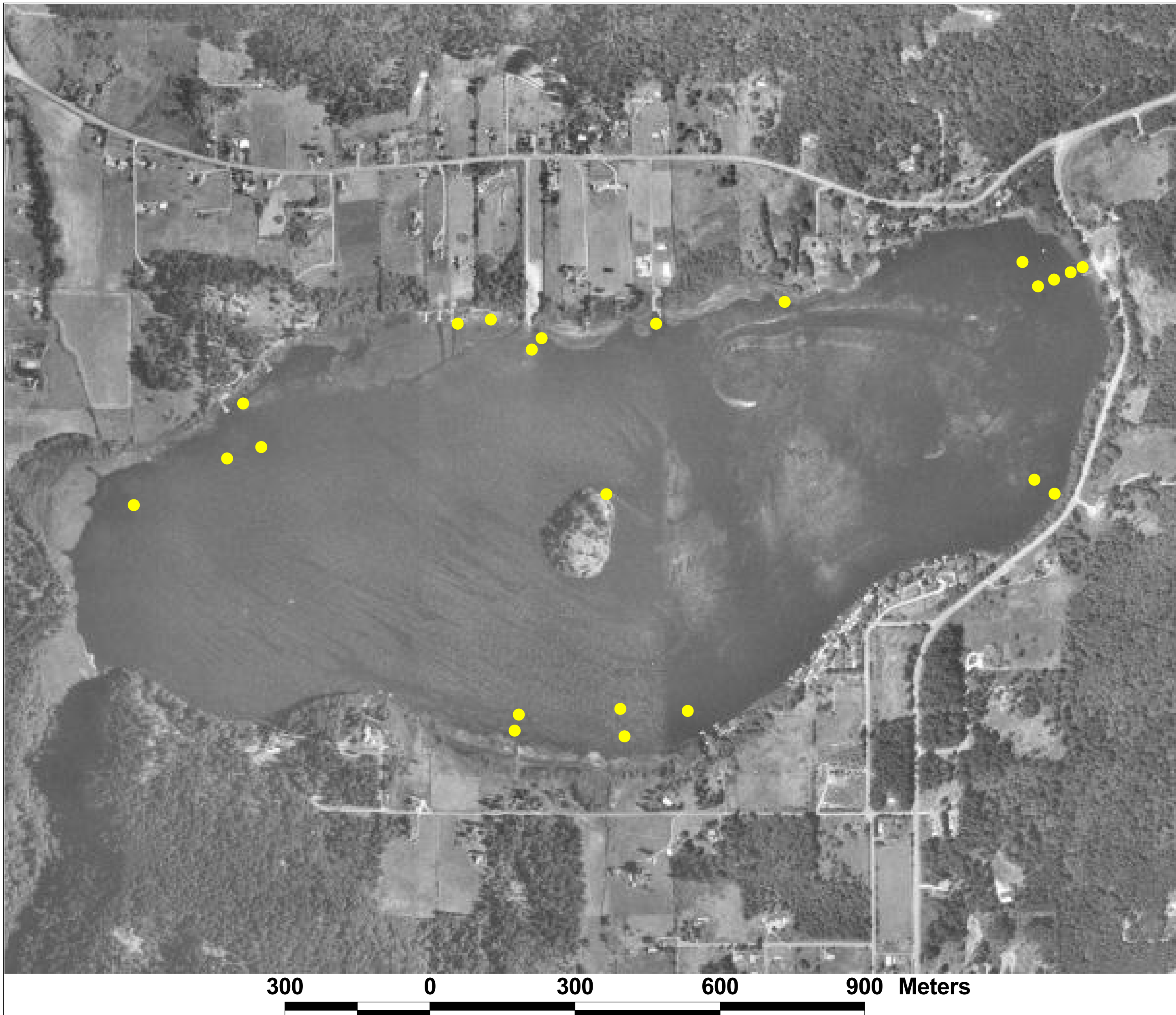
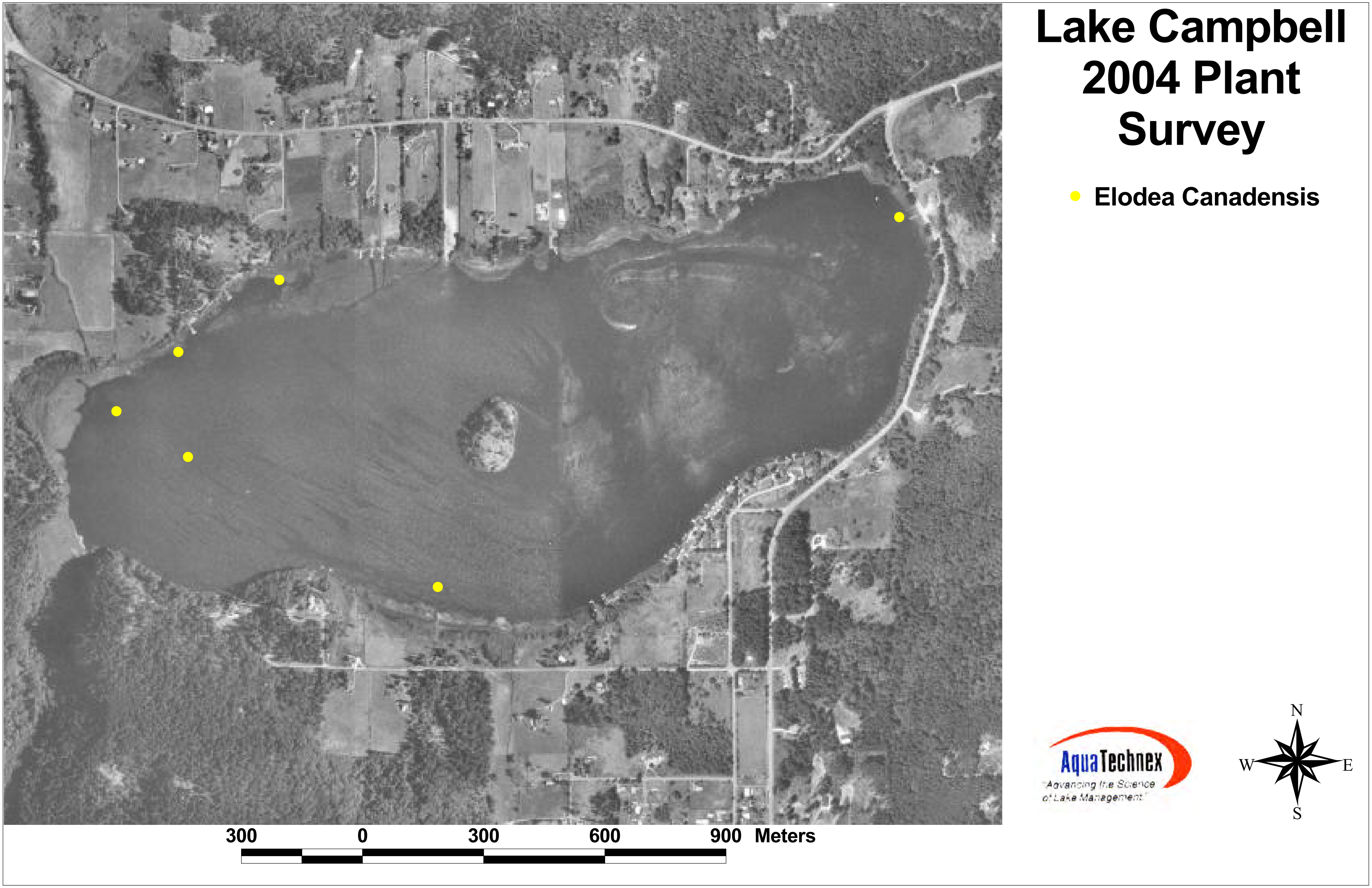
Lake Campbell 2004 Plant Survey

Chara/Nitella

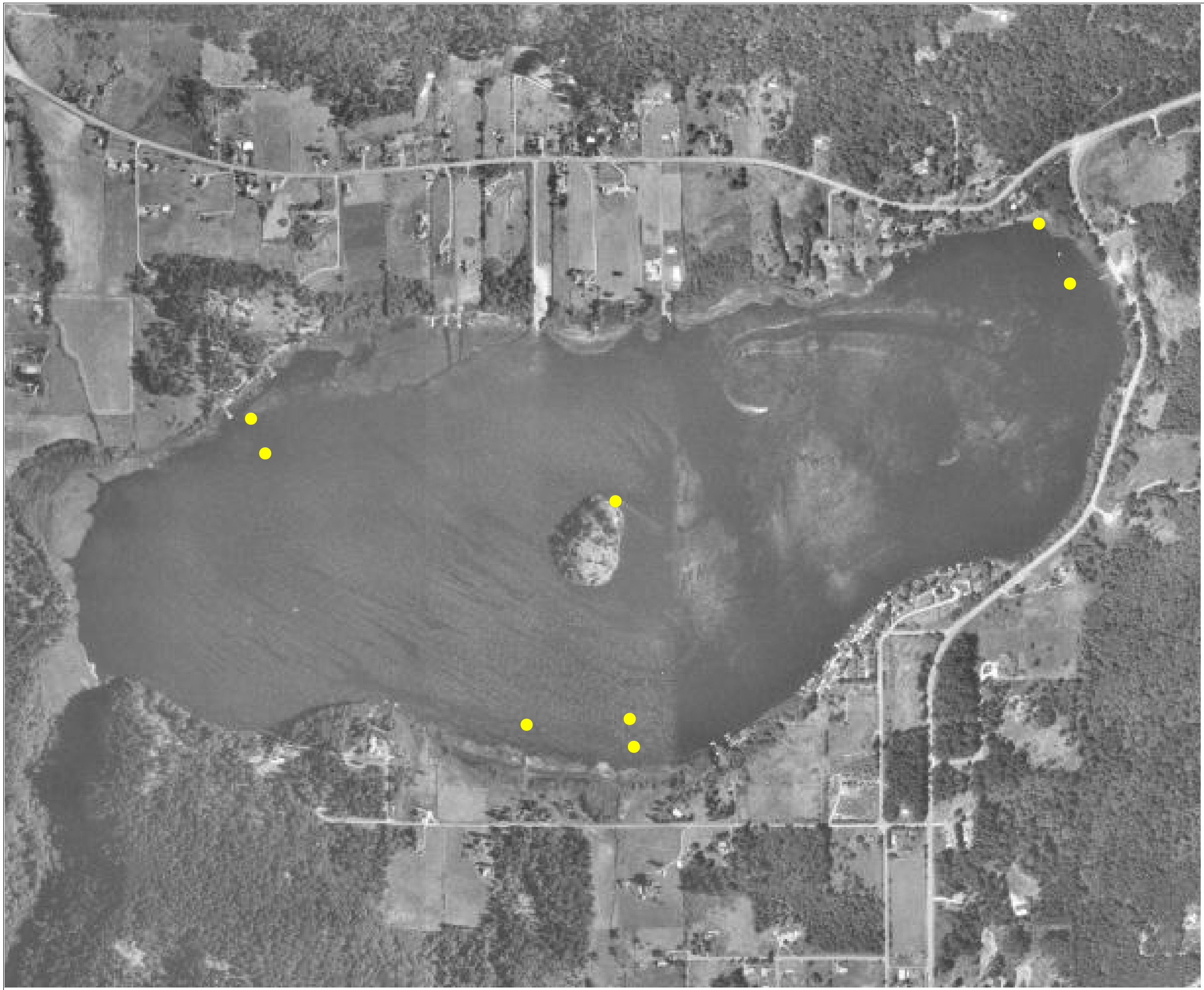


Lake Campbell 2004 Plant Survey



Lake Campbell 2004 Plant Survey

● Filamentous algae



300 0 300 600 900 Meters

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N
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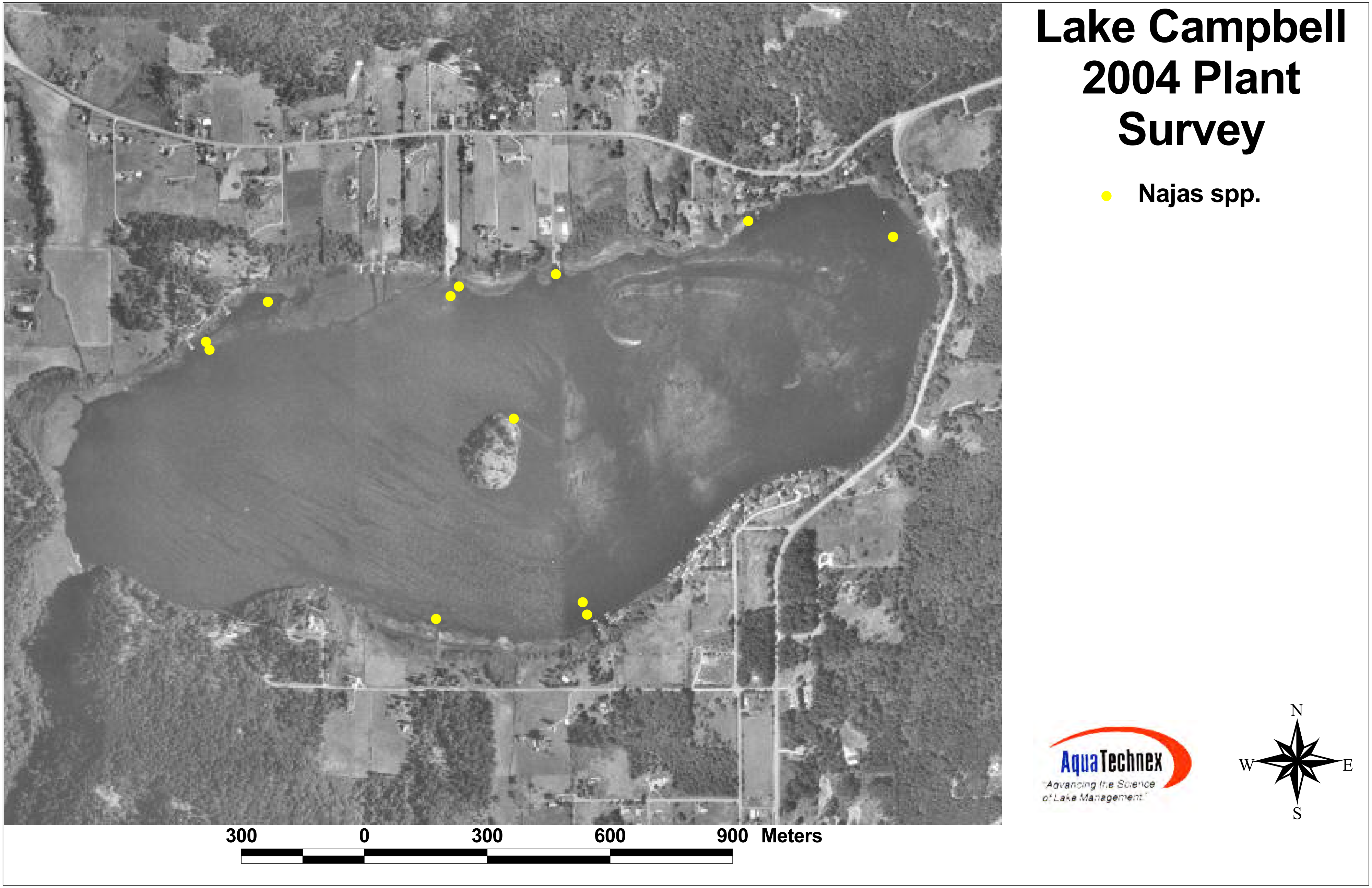
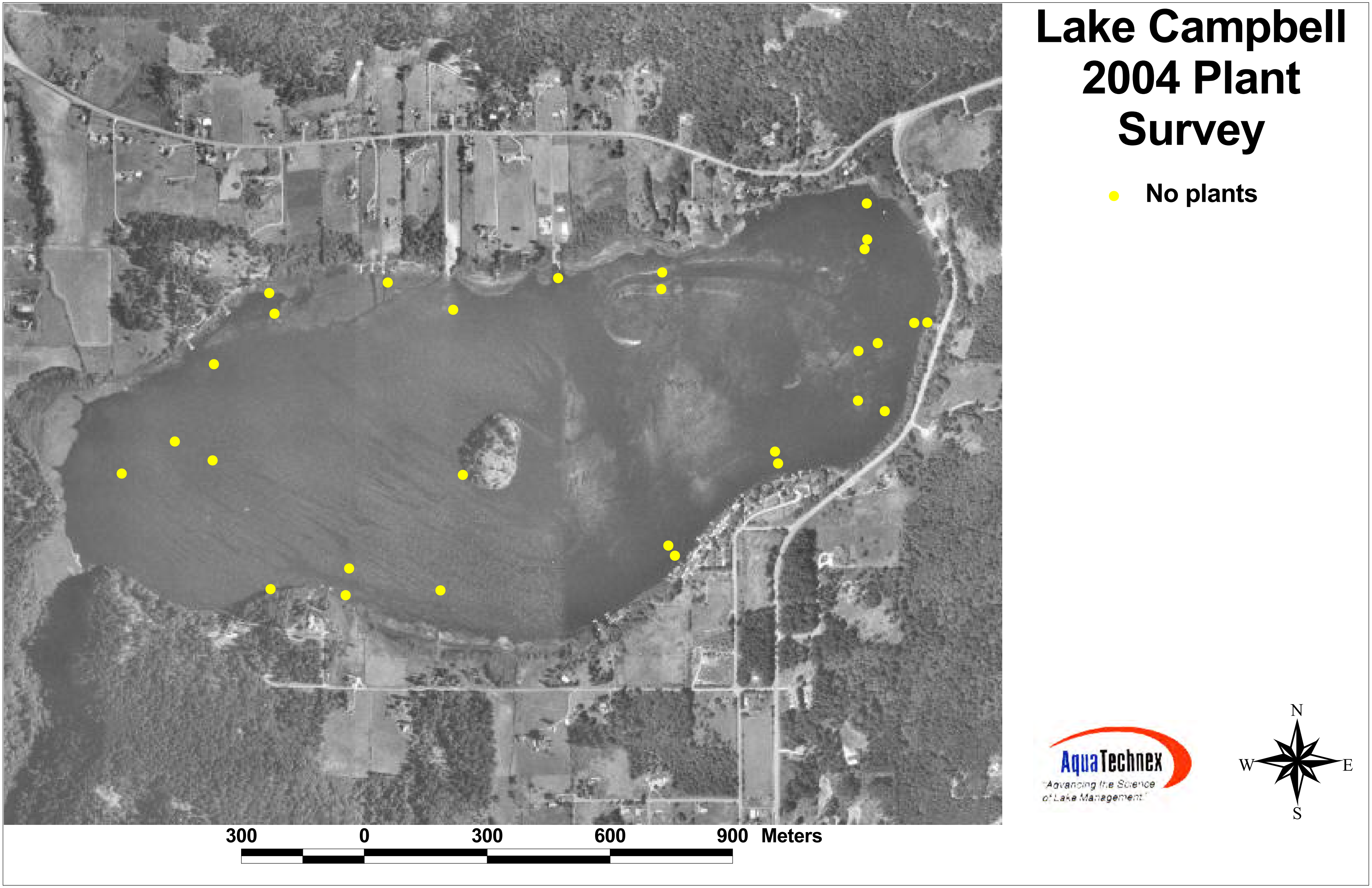

Lake Campbell
2004 Plant
Survey
Najas spp.
300 0 300 600 900 Meters
AquaTechnex
"Advancing the Science
of Lake Management"
N
W
E
S


Lake Campbell
2004 Plant
Survey
No plants
300
0
300
600
900
Meters
N
W
E
S

Lake Campbell 2004 Plant Survey

● P. crispus

300 0 300 600 900 Meters

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N
W E
S

Lake Campbell 2004 Plant Survey

● P. foliosus

300 0 300 600 900 Meters

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N
W E
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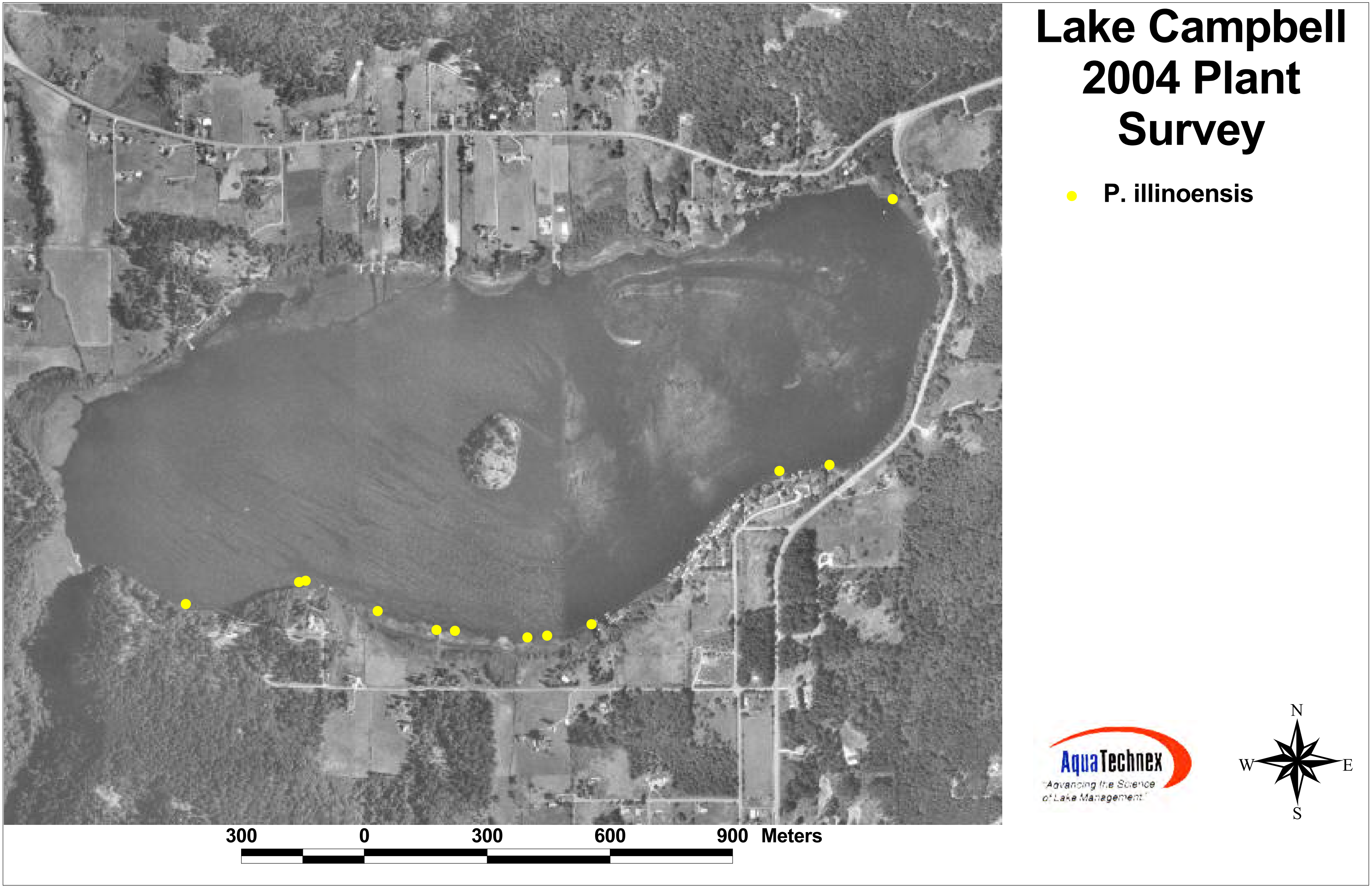
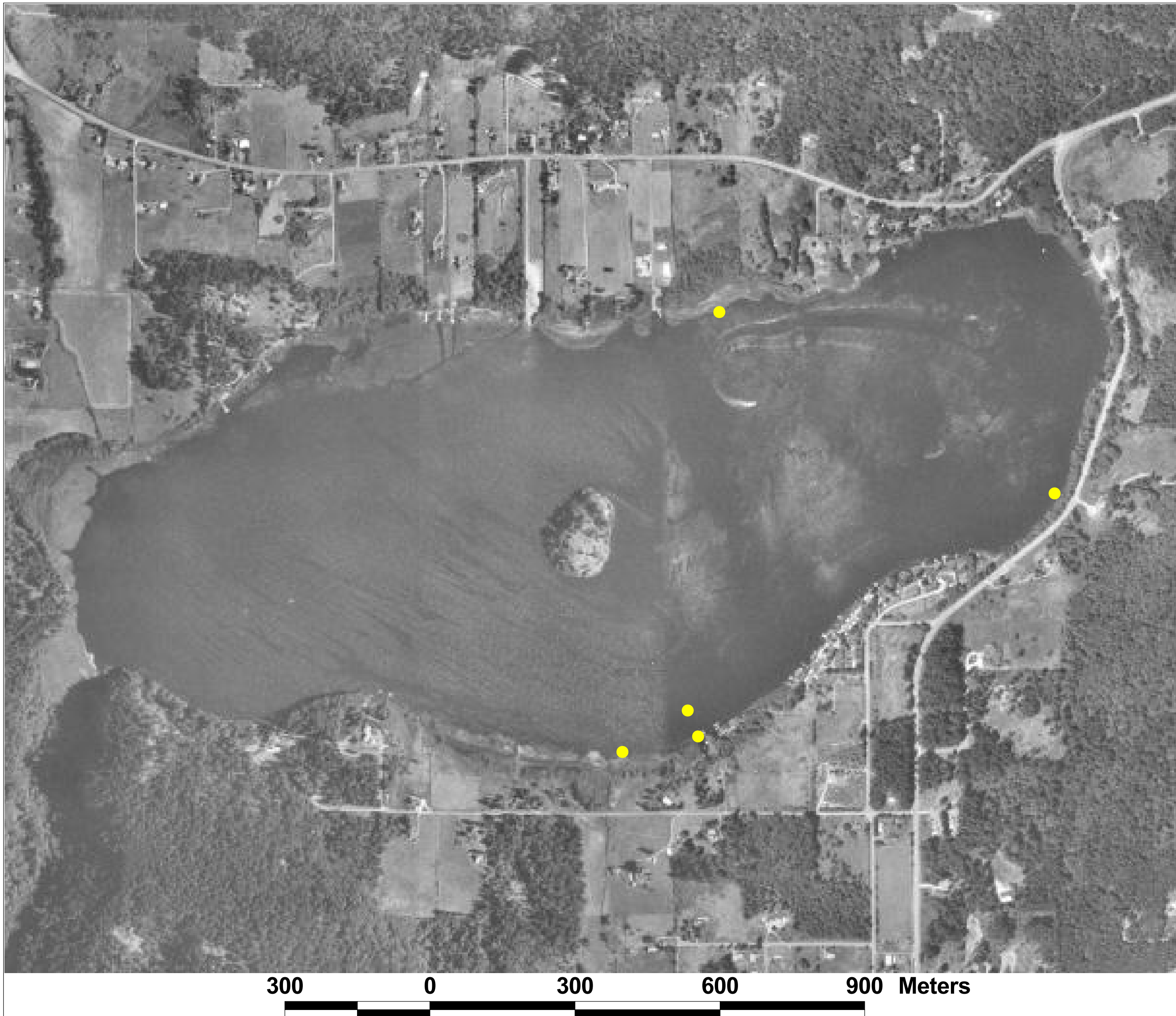
Lake Campbell 2004 Plant Survey



Lake Campbell 2004 Plant Survey

● Vallisneria americana



Lake Campbell 2004 Plant Survey