Cayuga Inlet Hydrilla Management Plan

Background

The highly invasive aquatic plant, *Hydrilla verticillata*, known commonly as 'hydrilla' or 'water thyme' was first detected in August 2011 in the Cayuga Inlet by staff from the Floating Classroom. A follow-up survey located several areas of the Inlet with extensive populations of hydrilla. The plant identification was verified by Racine-Johnson, the NYSDEC, and researchers from the University of Florida and the US Army Corps of Engineers. To date, hydrilla appears to be localized to the Cayuga Inlet, with no evidence that it has yet rooted in Cayuga Lake.

This was the first detection of hydrilla in upstate New York's waters, and the risk of it spreading to Cayuga Lake and other regional waterbodies is substantial. Hydrilla was confirmed in the Erie Canal in North Tonawanda, Niagara County, by a US Fish and Wildlife Service aquatic biologist in September, 2012. Fragments of the plant, which are easily caught and transported by boats and boat trailers, can sprout roots and establish new populations. Fragments also float and are capable of dispersing via wind and water currents. Hydrilla grows aggressively, up to a foot a day. Early in the season, it grows mostly horizontally along the bottom of the waterbody. Side shoots and new tubers can develop at the nodes as the plant grows. As the water temperature increases, the stems elongate, sending the shoot tips, which can themselves grow an inch a day, toward the water surface.

The plant creates a thick mat of vegetation when it reaches the water's surface. It quickly shades out other aquatic plants, displacing native species like pondweeds and wild celery.
Hydrilla has long slender stems that can grow underwater to lengths of up to 25 feet. Hydrilla can set seed, but primarily reproduces vegetatively via floating pieces that set roots, buds produced along the stems (called turions), or overwintering tubers.

Problem Statement

The overall goal of the project is to eradicate hydrilla from the Cayuga Inlet and its connecting tributaries and prevent its spread to Cayuga Lake, the other Finger Lakes, and the Great Lakes. Eradication of hydrilla will allow native species to return to the Inlet and will help prevent native species decline and habitat loss from hydrilla in other areas. The objectives of the 2012-2013 component of the project are to:

- reduce the biomass by 95% and prevent tuber production in 166 acres of the Inlet,
- contain and prevent any movement of the plant out of the Inlet, and
- monitor for growth, re-growth, treatment efficacy, and spread.

Funding from New York State and the federal government aimed at these objectives will facilitate the goal of eradication within 8-10 years

Cayuga Inlet Plant Growth

Infestation Zone

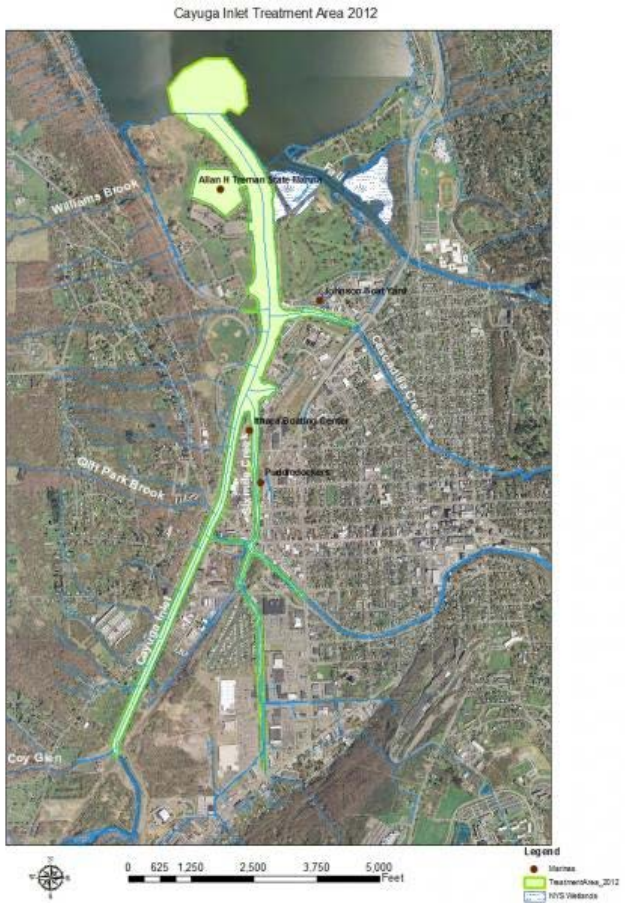

Figure 1: Hydrilla Treatment Map 2012. Cayuga Inlet and Surrounding Waterways

Figure 1 shows the known infestation area within Cayuga Inlet and the surrounding waterways. Extensive survey work was conducted in the fall of 2011 by the Cayuga Inlet Local Task Force (including Racine Johnson Aquatic Ecologists, the City of Ithaca, Cornell University, NYSDEC, and others) and overseen by Racine-Johnson Aquatic Ecologists. These surveys included Cayuga Inlet, Cascadilla Creek, Six Mile Creek, Fall Creek, and several connected unnamed waterways within the Cayuga Inlet "system". Surveying also included many locations within Cayuga Lake, including more than 400 sites on the south shelf and boat launch sites along the eastern shore of the lake.

The results of the survey showed hydrilla infestations ranging from trace (single stem) populations to dense beds within Cayuga Inlet, Cascadilla Creek, and connected waterways. Rooted hydrilla was not found in Fall Creek, Six Mile Creek or Cayuga Lake. The infestation zone was considered to comprise an area of about 75 acres in 2011, based on initial monitoring data at the time of the aquatic herbicide permit application in mid September of 2011, and was expanded in 2012 to comprise an area of about 166 acres, based on additional monitoring conducted between the fall of 2011 and early summer of 2012. However, it is likely that the actual infestation zone was similar in both years.

Identification of Aquatic Plants

Figure 2 shows the known locations of hydrilla within the infestation zone, as displayed in the iMap invasives mapping program. The cited location numbers correspond to the documented occurrences at that location at the scale displayed on the map. The specific hydrilla locations within the infestation zone have not been completely documented, but

Figure 2 demonstrates that this invasive plant is found extensively throughout the infestation zone.

History of Invasive Weed Growth-

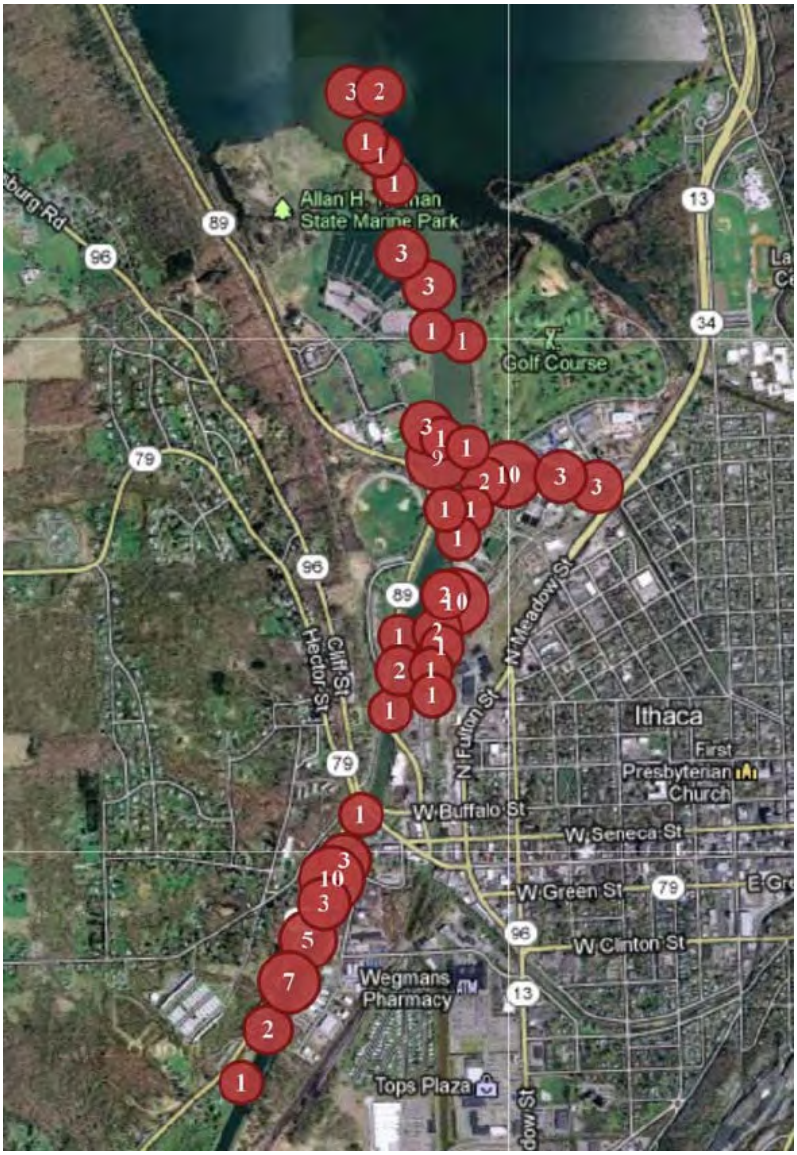

Figure 2- Documented Hydrilla Sites Within Infestation Zone

Aquatic plant communities in Cayuga Inlet were not well documented prior to the hydrilla discovery in 2011. Due to high flow and turbidity within the Inlet, aquatic plant growth has historically been sparse, with both native and exotic plants found within the aquatic plant community. The following exotic plants have been found in Cayuga Inlet and surrounding waterways:

Eurasian watermilfoil (*Myriophyllum spicatum*)- Cayuga Inlet, Fall Creek

Curly-leafed pondweed (*Potamogeton crispus*)- Cayuga Inlet, Fall Creek

Brittle naiad (*Najas minor*)- Fall Creek

European four leaf clover (*Marsilea quadrifolia*)- Fall Creek

Prior to the introduction and spread of hydrilla, none of these exotic plants were reported to be growing invasively in the Inlet, and there were also no reports of nuisance plant growth in association with any of the native plant species found within Cayuga Inlet, Fall Creek, or any of the connected inlet waterways.

There is a long history of aquatic plant survey work in Cayuga Lake, starting with surveys conducted by W.R. Dudley (1886), Weigand and Eames (1925), and the seminal work by W. C. Muenscher in 1927. Eurasian watermilfoil was first documented in Cayuga Lake in the 1960s and has grown invasively in the lake for many years, although the invasive growth has been substantially reduced by aquatic moth herbivory, which was first documented in the north end of the lake in the 1990s. The most recent extensive survey work was conducted by Cornell University from 1987 to 2000, and documented the Eurasian watermilfoil herbivory at the Southern end of the lake. The sites sampled in this survey work are shown in Figure 3; these data were collected too long ago to be considered a viable estimate of "pre" conditions in the south end of the lake. Habitat assessment, including a listing of prominent aquatic plant species, was conducted in 2008 by Ecologic, LLC in preparation for future dredging of the Inlet,

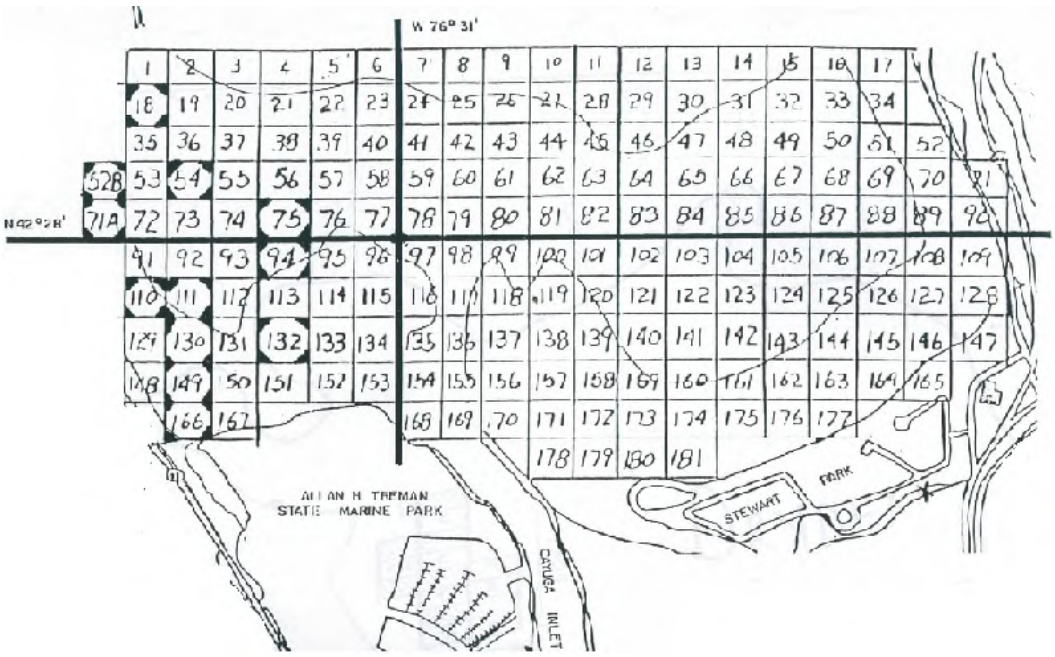

Figure 3- 1998 South Lake Plant Sampling Sites

(http://www.ecologicllc.com/pdf/DEIS/AppendixK.pdf).

Curly leafed pondweed (*Potamogeton crispus*) has been in Cayuga Lake since at least 1978, and variable leaf watermilfoil (*Myriophyllum heterophyllum*) was reported in the lake in 1928 by Muenscher, although the Dudley study of the lake in 1886 also references variable leaf watermilfoil at Union Springs and *Potamogeton crispus* growing "abundant in the deeper water of inlet and lake…fertile in shallower channels and ditches", also noting that it is rarely fertile by early summer. The same publication also cites *Myriophyllum spicatum* growing throughout the Inlet, Fall Creek, and the lake proper, but there is little evidence that this plant was found in North America prior to the 1940s. It is more likely that this reference represents extensive growth of northern watermilfoil (*Myriophyllum sibericum*), which was commonly misidentified as Eurasian watermilfoil from the 1800s through at least the 1990s.

Known Occurrences of Rare/Endangered Species
The black shiner (*Notropis heterodon*) was observed in Fall Creek in 1926, but not in a 1993-1997 fish survey. It is considered an "unlisted" species. Hills pondweed (*Potamogeton hillii*) is a threatened species reported in an 1886 survey of Cayuga Lake and 1924 survey of Cayuga Inlet, but this plant was not found in a 1999 survey of the Inlet. The Natural Heritage reports in recent years have not identified any of these species or any additional protected species in Cayuga Inlet or the surrounding waterways.

Uses Impaired-

There are no use impairments in the Cayuga Inlet. It is used primarily for boating and in support of aquatic life. The waterways affect the local economy in three primary ways; through flood protection, property tax revenues and tourism spending, particularly spending associated with recreational boating and water-dependent businesses.

Recreation: Boating

Ithaca is a boating destination. Because of its connection to the Erie Canal, an avid boater could travel from Ithaca to the Atlantic Ocean via the Saint Lawrence Seaway or to the Gulf of Mexico via Lake Erie and the Mississippi River.

Property values in the waterfront are high; although nearly 97% of waterfront properties are tax exempt, annual tax revenues from the remaining 3% is over $2 million. Finally, water-dependent businesses generated over $2 million in sales (nearly $700,000 of which came from docking fees) in 2008. Revenues from facilities specializing in non-motorized boats are not included. The Inlet has four primary facilities catering to non-motorized boaters: Cornell University and Ithaca College Crew facilities, a business that rents and sells canoes and kayaks, and the Cascadilla Boat Club, which has approximately 175 members paying annual membership and training fees totaling $60,000 a year.

Land use surrounding the Cayuga Inlet includes the following:

- 347 acres (84%) of waterfront properties within the City are publicly owned parkland and open space.
- 6 restaurants and bars, a spa and health club
- Ithaca Farmer's Market, with 125 vendors and over 5,000 visitors a day - by foot, bike, car and boat access (motorized and paddle boat docks/launches are on-site)
- Cornell University and Ithaca College crew teams - during their season 30+ boats share training space daily
- Ithaca Dragonboat Club
- Large Educational and Commercial touring vessels
- Allan H. Treman Marine State Park has 370 seasonal boat slips and an 8-lane boat launch ramp
- Two other boatyards and a sailing center
- Water Music, Rhiner Festival and other local events incorporate Inlet usage

Flood Control

The current Flood Control Channel capacity is only 38% of the US Army Corps of Engineers (ACOE) design dimensions, based on 2008 bathymetric data - this estimate does not account for aquatic vegetation impeding flows. Sedimentation and a lack of maintenance in the Inlet have caused this loss of capacity. The ACOE recently failed the flood control channel as an effective structure. Hydrilla's ability to clog flood control structures and impede water flow will only exacerbate the current situation.

The value of the waterways is derived from their function as flood mitigation and their role as a navigable waterway. The economic vitality of the waterfront evolved based partially on a navigable waterway. Any impact that reduces the use, enjoyment or function of the waterway can be assumed to diminish its current and future economic value.

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Aquatic life and ecological Impacts

Hydrilla is uniquely adapted to grow under low light conditions, which allows it to colonize water that is deeper than most native submersed species can tolerate. For example, native submersed plants typically colonize the margins of shallow lakes where water depth is 6 to 8 feet. Hydrilla competes with native plants in these shallow areas, but also grows in much deeper water with no competition, which greatly extends the spread of the vegetated littoral zone outward from the shoreline. This surface canopy or mat formed in the upper 1 to 2 feet of water comprises as much as 80% of the biomass of the plant on an area basis and limits light availability to lower-growing native submersed plants, which reduces species diversity over time (Haller and Sutton, 1975). The ecological effects of this dense growth on the water surface include significant changes in water temperature, wave action, oxygen production, pH and other parameters, which reduce the suitability of infested waterways for use by aquatic fauna (Haller, 2009).

Invasive plants reduce native plant growth and impede human uses of waters by forming dense surface canopies that shade out lower growing native plants and interfere with water flow, boat traffic and fishing. Dense surface canopies also radically change the habitat quality for fish. Dense plant beds provide a place for small forage fish to hide and reduce the ability of predatory fish such as bass and northern pike to see their prey. This tends to lead to a large number of small, stunted forage fishes and poor production of game fishes (Dibble, 2009).

Invasive plants also reduce water quality. While the increased biomass and dense canopies formed by invasive species tend to increase water clarity, they also lead to increased organic sedimentation. The fate of lakes over geological time is to progress from lakes to wetlands to marshes to upland areas as lakes fill with sediments due to erosion and accumulation of organic matter. For infested streams and flowing waterways,

this accumulation can significantly alter flow and habitat. Water also becomes stagnant under dense plant canopies and suppresses or prevents oxygen recirculation. In addition, the amount of dissolved oxygen under dense plant canopies may be insufficient to support desirable fish species and may result in fish kills (Madsen, 2009a).

Many animal species are linked to specific native plant communities and the diversity of native communities provides a variety of habitats for aquatic insects and other fauna. Invasive plants reduce the diversity of native plant communities, which leads to a reduction in the diversity of both fish and aquatic insects. Therefore, invasive plants are harmful to the diversity and function of aquatic ecosystems and can have significant adverse impacts on water resources. (Madsen, 2009a)

Cayuga Lake

One of the primary objectives of the hydrilla eradication project is to avoid an impairment of uses in both the Cayuga Inlet and surrounding waterways, including Cayuga Lake. In addition to non-contact recreation and aquatic life support, Cayuga Lake supports potable water use, and contact recreation (swimming and immersion recreation). However, hydrilla has not been found in Cayuga Lake, and thus none of these uses have been impaired in the lake. If hydrilla is found in the lake, this portion of the management plan will be revised.

Management History

Does Overall Cayuga Inlet Management Plan Exist?

An overall management plan does not exist for Cayuga Inlet, and a specific aquatic plant management plan for Cayuga Lake has not been developed. A management plan does exist for the Cayuga Lake watershed, the Cayuga Lake Watershed Restoration and Protection Plan (RPP), which includes the Inlet. The RPP does not include a detailed plan for aquatic plant management. Funds were secured in 2009 to update the RPP; however, that effort has stalled due to a lack of staff. Other management actions, including dredging of the Inlet and possible total maximum daily load (TMDL) development for the south end of the lake, the latter in support of federal requirements, may eventually be combined into the update of the RPP. In lieu of a plan that targets invasive species in the Inlet, a separate Management structure has developed.

Management Team-

The management of the hydrilla infestation in Cayuga Inlet is being undertaken by the Hydrilla Task Force of the Cayuga Lake Watershed. The Task Force is comprised of four groups who work together in a coordinated fashion to learn the science, seek out possible management options, understand the regulatory options and constraints, share information and implement the management measures most likely to result in eradication of hydrilla in Cayuga Inlet. These groups include:

Statewide Task Force:

This overarching coordination group is led by the NYSDEC Office of Invasive Species Coordination (OISC; now the Invasive Species Coordination Unit in the NYSDEC Division of Lands and Forests). This group provides updates from DEC OISC, particularly with regards to funding or State level efforts, and provides minutes on general progress. Statewide conference calls, initiated by OISC on a biweekly to monthly basis, provide opportunities for all stakeholders to get updates. The statewide Task Force also coordinates updates from the other associated groups.

Management:
Led by the NYSDEC, the management subgroup includes representatives from the City of Ithaca, Tompkins County SWCD and Department of Health, State Parks, the Education and Outreach subgroup, and consulting scientists. The management subgroup determines the necessary steps to formulate management plans, contacts and consults with scientists (including an external peer review group) for input on chemicals, alternative methods, monitoring and plant growth specifics. This group also works closely with contractors who treat invasive aquatic plants to develop treatment proposals and budgets, oversee survey and monitoring work, and prepare base information for technical papers and outreach materials.

Outreach and Education:
Led by the Tompkins County Cornell Cooperative Extension (CCE-Tompkins), this subgroup includes representatives from the City of Ithaca, Tompkins County SWCD, the Water Resources Council, State Parks, Cornell University, and other community stakeholders. The outreach and education subgroup receives and sends out updates from the other subgroups, develops and distributes outreach materials, including brochures, handouts, presentations and press releases to the public; maintains the hydrilla website (hosted by CCE-Tompkins), organizes hydrilla ID training workshops and public meetings, and provides speakers for community groups wanting updates on management plans.

Local Task Force:
Led by the City of Ithaca, the Local Task Force also represents the Tompkins County Health Department, SWCD, Attorney, and Sheriff State Parks, Southern Cayuga Lake Intermunicipal Water Commission (Bolton Point drinking water plant) and consulting scientists. This subgroup works with the Management Sub-Group and the State Task Force to make final decisions about the management of the hydrilla infestation, provides local implementation of the management actions, communicates directly with concerned citizens and stakeholders and participates in outreach efforts. The Local Task Force also provides official communication to public regarding management implementation aspects that may involve public notice or have impacts on stakeholders, and provides a safety net when unexpected needs arise that must be addressed immediately.

Description of 2011 Management Efforts

Background

Upon discovery of the hydrilla infestation in the Inlet in late summer of 2011, the Hydrilla Task Force was formed to a) research the risks posed by hydrilla and the possible responses, b) involve agencies at all levels of government and other interested parties c) make recommendations to the entities that could carry out actions and d) do extensive outreach and education in the Cayuga Lake Watershed.

Herbicides
The Hydrilla Task Force recommended that the quick-acting herbicide endothall (trade name Aquathol K) be used in the inlet to stop or slow the growth of turions. The Tompkins County Soil & Water Conservation District applied for a DEC permit to apply the herbicide. Formal notification of affected landowners occurred on September 14, 2011.

The City of Ithaca declared an emergency, which led to the Sheriff of Tompkins County to close the Inlet for a period of ten days (October 5th – October 14th) to prevent the spread of hydrilla and allow herbicide application to occur.

The herbicide was applied by Allied Biological. Use of the water in the Inlet for drinking (including by animals or homeless residents of the "Jungle", a campsite community along the southern end of the Inlet) was restricted for 14 days. The restrictions on water use applied within 600 feet of the site of application. The Bolton Point water intake was monitored carefully, even though it was considered well outside the affected area. Some lake house owners who draw their water from the lake were notified, although none of the lake houses were within 600 feet of the site of application, and all had access to municipal water lines. Signs and other outreach materials notified dog walkers, homeless residents of the Jungle, and others of the restrictions. There was a one-day restriction on swimming and bathing in Cayuga Inlet, as a safety precaution.

The Tompkins County Department of Health, in cooperation with the City of Ithaca, monitored endothall levels in the Inlet after the herbicide was applied, again after 3 days, again after 7 days, and then every 7 days after that until endothall concentrations were undetectable.

Hand harvesting
Additional growth (dense patches and isolated plants) of Hydrilla verticillata was discovered in the Inlet south of the Route 79 Bridge after the herbicide permit application had been submitted to the NYSDEC in September 2011, and therefore could not be included in the herbicide treatment area. Those areas of the Inlet remained closed after other Inlet sections re-opened, due to the risk of plant fragmentation. Reproductive vegetative turions were found to be developing in late October on the untreated hydrilla plants. Canada geese removed plant biomass reachable from the surface via feeding. Consultation with John McPhedran of the Maine DEP, indicated that late fall efforts to remove tubers could be successful. The Hydrilla Task Force was hopeful that complete removal of all plants and reproductive structures could be achieved from the dense bed of hydrilla along the west shore of the South Inlet.

The management group of the Hydrilla Task Force discussed possible removal options. Diver assisted suction harvesting (DASH) and hand raking were determined to be possible options since they would address fragmentation concerns, halt development of turions, and stop possible bird dispersal. The management group determined a pilot DASH would be conducted. The effectiveness of DASH to remove tubers was tested on October 25th. Comparison of the materials collected by divers with sediment cores

collected to estimate tuber density revealed that diver efforts removed approximately 1% of hydrilla tubers from the sediment. DEC's OISC funded hand-removal efforts targeting above sediment vegetation only because the objective was to prevent turions from being released. Aquatic Invasives Inc. was awarded the project and completed the work between November 29th and December 5th of 2011.

Dredging

Navigational dredging of Cayuga Inlet has taken place since the 1860s and has resulted in significant alteration of the Inlet and connected waterways over the intervening 150 years, including construction of the Flood Control Works in the 1960s. Cayuga Inlet and lower Cascadilla Creek will likely be dredged by the state Canal Corporation and the City of Ithaca starting in 2014. The proposed project has significant implications for the long-term control of hydrilla, both due to the potential removal of hydrilla tubers and biomass within the dredged channel, and the risk of spread of hydrilla through dredged spoils disposal and dislodged hydrilla reproductive structures (and subsequent transport to downstream segments of the Cayuga Inlet system) during the dredging operation.

Prevention and Outreach

The City of Ithaca strongly discouraged the use of boats of any kind in the Inlet. Crew teams from Cornell University and Ithaca College relocated their base of operations outside the Inlet, as did the Floating Classroom. A local tour boat, the MV Columbia hired a diver to periodically check the boat and docking area for hydrilla. The City's paddle boat docks, the Farmers' Market dock, informal launches and the Treman Boat Launch were all closed prior to and during the herbicide treatment for a period ten days (October 5th – October 14th). The entire Inlet was also closed during this period. Boat traffic was controlled by the County Sheriff. The upper Inlet remained closed for several more weeks until the DASH removal project could be completed.

Public Outreach (Continuous): Various public meetings and public education and outreach were conducted. These activities are viewed as a component of "prevention" and will further reduce the ecological threat from Hydrilla by educating the public on Hydrilla and how to prevent its spread. Three groups are involved in education and outreach efforts.

- **Cornell Cooperative Extension of Tompkins County (CCE)**: Statewide CCE has been contracted to provide DEC with services related to coordination, development, and delivery of a statewide IS education and outreach program. State Cooperative Extension served as the initial contact for outreach and created the 'Not Wanted' handout educating about hydrilla. State personnel realized the local need was greater than they could meet early on and passed the lead role to the local Extension office. TC CCE serves as the lead in education/outreach efforts. This included development and updating of the StopHydrilla.org website, leading public outreach meetings, and serving as the point of contact for hydrilla questions.
- **Cayuga Lake Watershed Network (CLWN)**: The Cayuga Lake Watershed Network (Network) provided public workshops that led to widespread public understanding of and participation in the hydrilla eradication plan proposed by the Task Force. In addition to the workshops CLWN conducted additional

publicity, outreach and education work as needed, in cooperation with the Task Force and Tompkins County Cornell Cooperative Extension.

- **Floating Classroom (FC)**: Public cruises provided a venue for public updates on the eradication effort and the plant in general.
- **Other**: The Hydrilla Task Force of the Cayuga Inlet Watershed (HTF) sponsored public educational venues through plant identification and training workshops, in cooperation with CCE, CLWN and FC. Members of the task force also gave numerous media interviews (print, radio and TV), prepared press releases, responded to individual stakeholders concerns and prepared both position statements for regulatory/agency staff and articles for news outlets. Dr. Holly Menninger organized volunteers to staff information booths at the Ithaca Farmer's Market every weekend from the beginning of September to the end of treatment in mid-October.

Description of Public Involvement in 2011-

Providing public access to the eradication effort was a high priority for the Hydrilla Task Force. Public support was needed to allow the chosen treatment to move forward at an accelerated pace. Public awareness of the danger posed by hydrilla provided the support needed to close the Inlet, cancel water portions of local festivals and gain the cooperation of local schools, businesses and clubs who temporarily moved their operations out of the Inlet during the height of the boating season.

Public access was provided via training workshops, presentations, media interviews and public meetings. Contact information was shared with the public. Task force members were supported by an expert in crisis communications in how to maintain transparency and build trust during a fast moving situation where the information was often incomplete.

The effort was considered an unqualified success. There was broad based support for the management actions that were taken in 2011 despite the fact that they were both highly disruptive of normal Inlet activities and that the use of herbicides runs counter to the general community sentiments.

Description of 2012 Management Efforts

Background

External aquatic plant experts were consulted over the winter preceding the 2012 growing season to develop a treatment plan. The experts represent researchers and resource managers from across the country with extensive knowledge about hydrilla. Two of the larger aquatic herbicide companies were also invited to submit proposals and information for consideration. Local input regarding site conditions (flow, temperatures, light, water quality, etc.) was distributed to assist in plan development. A two herbicide approach was the final recommendation.

Herbicides

Herbicide was applied to approximately 166 acres of the Inlet. Aquathol K was applied on June 26th. The application date was determined by emergence of hydrilla shoots. Sonar Genesis (liquid) and Sonar One (pellet) application began on July 12th. The dual chemical application provided treatment across asynchronous hydrilla tuber growth patterns. Using two different chemicals also reduces the likelihood of the plants developing chemical resistance. The Sonar liquid formulations were applied in staged drip applications to maintain a steady fluridone exposure of 3-5 parts per billion (ppb) throughout the infestation zone, while minimizing dosage of and transport to uninfected areas, including the south end of Cayuga Lake.

Sonar pellet formulations were applied to areas within the infestation zone where sufficient liquid Sonar contact could not be assured, included shallow and backwater areas, and within the Robert Treman State Park pen. Chemical concentration monitoring determined the timing for re-application of Sonar pellet formulations.

A total of four (4) Sonar One treatments occurred. The areas that were treated multiple times included the Allen H. Treman Marina, the upper portion of the Inlet and "donut" area, the flood relief channel behind Wegman's, and downstream portions of Cascadilla Creek. Figure 4 shows the 2012 fluridone pellet treatment areas.

A description of each of the four treatments follows.

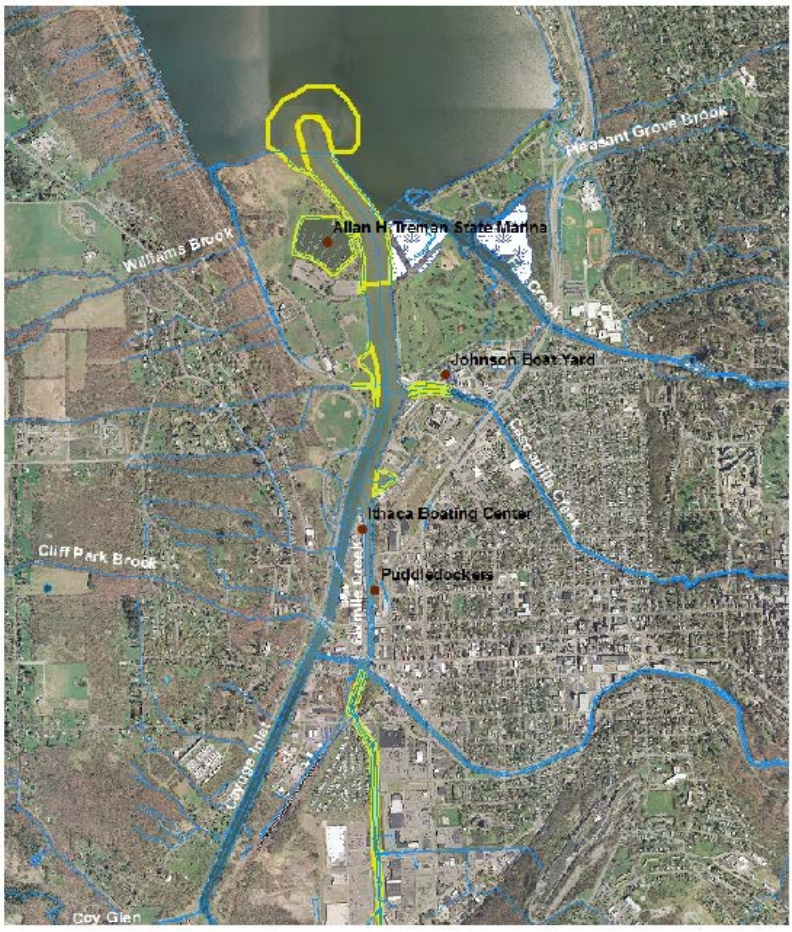

Figure 4- Map of Sonar Pellet Treatment Areas

1st: The initial application applied pellets to 60 acres including the upper portion of the Inlet that discharges to the lake ("donut" area), Allen H Treman Marina, Linderman Creek, portions of Cascadilla Creek, Cornell University Boathouse dock area, and the flood relief channel behind Wegman's.

2nd: The herbicide was applied to a total of 90 acres, including the upper portion of the Inlet from the Fuertes Bird Sanctuary north, Allen H Treman Marina, Linderman Creek, portions of Cascadilla Creek,

Cornell University Boathouse dock area, and the flood relief channel behind Wegman's.

3rd: The herbicide was applied to a total of 47 acres, including the upper portion of the Inlet from the Fuertes Bird Sanctuary north and the flood relief channel behind Wegman's. A more detailed map of these areas can be found at stophydrilla.org website.

4th Treatment: The herbicide was applied to a total of 83 acres, including the upper portion of the Inlet from the Allan H. Treman State Marine Park boat launch ramps north, the Marina itself and the flood relief channel behind Wegman's. A more detailed map of these areas can be found at stophydrilla.org website.

There were some regulatory issues regarding the use of the chemicals- the use of fluridone pellets in shallow water, potential swimming restrictions associated with continuous fluridone drip treatments- which the Hydrilla Task Force addressed with the NYSDEC. The resolution of the issues included the issuance of an emergency rule allowing shallow water fluridone pellets due to rapid breakdown of the pellets and lack of public access to the treatment zone, local determinations about the lack of any swimming within the treatment area, and state DOH clarification of the differences between water contact and swimming.

Water quality monitoring was conducted both during and post herbicide treatment. Monitoring during herbicide treatment determined chemical concentrations within the treatment area. This data was used by the hydrilla task force, Allied Biological, and SePro to ensure proper concentrations of chemical were present and to alter dosing, as appropriate. Post-treatment monitoring was used to determine spread of the chemical outside the treatment area, degradation of the chemical, and compliance with public notification requirements. We did not see much movement of any of the chemicals outside of the treatment area.

Detailed water quality monitoring information is posted at StopHydrilla.org

Experience and knowledge gained from the 2011 and 2012 herbicide treatments and plant monitoring, as well as knowledge and advice from aquatic plant experts, will be used to develop a treatment plan for 2013.

Dredging

The Hydrilla Task Force continues to evaluate the role of navigational dredging in the long-term plans for the eradication of hydrilla in Cayuga Inlet. Although most of the dredging project activities will be staged and implemented independently of the hydrilla eradication project, it is anticipated that this Plan will be updated as additional guidance and recommendations about the application of navigational dredging tools for hydrilla eradication are developed.

Prevention and Outreach

Contingency plans and funding were in place for the use of benthic mats at boat docks if accelerated plant growth in the spring resulted in the potential to spread hydrilla. Inlet users were also told to anticipate the possibility of a closure that could last up to 4 days to

give the chemical applicators ample time in case of equipment failure, weather delays or other unexpected events. In the end, treatment of the Inlet began shortly after plant emergence, eliminating the need for extended Inlet closure or disruption of boating activities.

Public Outreach (Continuous): Initial efforts were continued and expanded on in 2012.

- **Cornell Cooperative Extension of Tompkins County (CCE)**: Led education/outreach efforts. This included maintenance of the StopHydrilla.org website, leading public outreach meetings, and serving as the point of contact for hydrilla questions. CCE also worked with two CU Communications classes to develop an Outreach and Communication Plan.
- **Cayuga Lake Watershed Network (CLWN)**: The Cayuga Lake Watershed Network (Network) expanded the number of public workshops around Cayuga Lake in 2012. Three 3-hour training events for the public and professionals were held in May, reaching well over 100 people. The Steward also gave six presentations reaching another 100 people directly. Most of the people attending the training events were community members from Tompkins County municipalities, including Caroline, Dryden, Ithaca, Ulysses, and Lansing; Cayuga County municipalities, including Union Springs, Aurora, and Auburn; and in Seneca County, Fayette and Seneca Falls. The Network also worked directly with the Cayuga Lake's West Shore Homeowners Association, which has several hundred members. Several members from this organization attended the training events as well. As in 2011, the CLWN conducted additional publicity, outreach and education work as needed, in cooperation with the Task Force and Tompkins County Cornell Cooperative Extension. The CLWN also took the lead in coordinating volunteers to staff an information booth at the Ithaca Farmer's Market every weekend from June through October.
- **Floating Classroom (FC)**: Cruises were offered to the public to assist in plant monitoring in the lake. The FC also printed and distributed educational material to the public. The FC and other volunteers created a 'float' for the Ithaca Festival Parade depicting the eradication effort and the importance of clean boating practices.
- **Other**: Funding for the Finger Lakes Institute Watercraft Steward Program was awarded through the Great Lakes Restoration Initiative from the US Fish and Wildlife Service and coordinated by the NY Department of Environmental Conservation, Cayuga County, and the Finger Lakes-Lake Ontario Watershed Protection Alliance to provide Boat Stewards on the seven easternmost Finger Lakes. NYSDEC, OPRHP, and various municipalities authorized this Steward program at the launches under their authority. One Steward was stationed at Allan H. Treman Marina throughout the height of the boating season. Stewards provided guidance to boaters on clean boating practices. By season end, the Stewards were noticing a clear change in behavior of regular boaters who now sought out stewards before and after boating for assistance in checking for invasives. As in 2011, the HTF sponsored public educational venues through plant identification and training workshops, in cooperation with CCE, CLWN and FC. The HTF also

continued to give interviews (print, radio and TV), prepare press releases, responded to individual stakeholders concerns and prepared both position statements for regulatory/agency staff and articles for news outlets. The crews conducting mechanical harvesting in both Seneca and Cayuga counties in the northern part of Cayuga Lake attended ID workshops. They have committed to ceasing their operations to limit spread if hydrilla is found during a harvesting run

Description of Public Involvement in 2012-

Providing public access to the eradication effort remains a priority for the Hydrilla Task Force. Public support for the eradication effort is high. Public awareness of the danger posed by hydrilla translated into support for local legislation in Tompkins and Schuyler counties on clean boating practices, a positive response to boat stewards at launches and at least one home owner's association began their own training workshops enlisting volunteer plant 'spotters'.

Public access was provided in the same manner as 2011 with the addition of 'Hydrilla Happy Hours' – informal presentations made by various task force members at a local restaurant/bar on the Inlet dubbed 'Hydrilla Happy Hours'.

The effort remains a success, but is taxing on Task Force members. The Outreach group will review the 2011-2012 efforts to determine if there are opportunities to be more efficient. The Outreach group will also use the newly developed Communication Plan to guide future efforts.

Evaluation of Successes and Failures, and Lessons Learned-

The success of the 2011 and 2012 hydrilla eradication efforts are continuously evaluated by the Hydrilla Task Force of the Cayuga Inlet Watershed, through a combination of plant and tuber surveys, chemical residual data, public outreach efforts, and evaluation of hydrilla spread outside of the eradication zone.

Evaluation of 2011 eradication project:

Plant and tuber survey results:

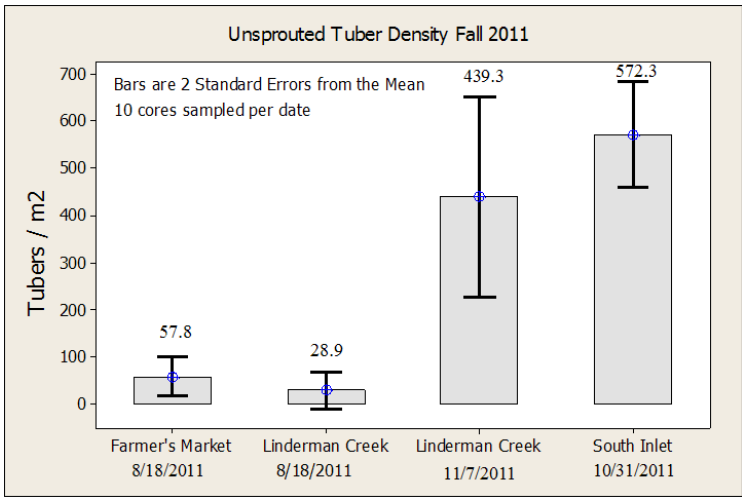

Figure 5- 2012 Hydrilla Tuber Densities, Cayuga Inlet

The application of endothall in 2011 killed approximately 95% of the hydrilla biomass above the soil level, but the remaining hydrilla had strong re-growth, probably in part due to the unusually warm fall and the late timetable for the treatment. The Cayuga Inlet locations of 2011 hydrilla found by rake-toss survey are listed on the IMAP invasive database and shown in Figure 2. A large rake toss survey of the south end of Cayuga Lake occurred over the Labor Day Holiday in 2011 and no hydrilla was found rooted in the lake. In that, survey we did find fragments of hydrilla at seven locations in the Cayuga Inlet south of the Red Light House, the entrance into the lake. Tuber densities were estimated through the fall of 2011 with Figure 5 showing three locations in Inlet. Linderman Creek shows a dramatic increase in tubers from 8/18/2001 to 11/7/2011 suggesting that tuber growth in the Cayuga Inlet occurs primarily in the fall.

Chemical residual results:

The Tompkins County Soil and Water Conservation District collected water samples from the shore at six locations upstream and downstream of treatment areas as well as upstream of Cascadilla and Six Mile Creek. The Ithaca Area Waste Water Treatment Facility (IAWWTF) provided a boat for grab samples from six in-lake locations. Water samples required for DEC were taken 24, 48 and 72 hours after the first and second endothall applications. Endothall was still present at detectable levels after 72 hours, so sampling continued every seven days until there was a “no detect” reading. This was achieved on Oct. 26, 2011. Water samples were also taken at the Bolton Point water intake on October 13th, 17th, 24th, and November 18th. There were positive detections on October 17th and the 24th at the minimum detection level of 9 ppb. This was not a concern as the maximum contaminate level for endothall is 50 ppb. More information is available at http://ccetompkins.org/sites/all/files/8/endothall-monitoring-results2011.pdf.

Alternative methods results:

It was determined from the pilot study that removal of visible biomass by divers was unsuccessful. Environmental conditions at the site and the specific characteristics of the hydrilla hampered the removal effort. Suspension of silt and clay particles by hand harvesting created zero-visibility work conditions. Cold waters required use of heavy neoprene gloves decreasing the ability to detect plants for removal. The end result was inefficient hydrilla removal and some trampling/breakage of plants. Hydrilla is naturally very brittle and similar to Elodea, a native plant species. Hydrilla is not tough like

Eurasian watermilfoil (*Myriophyllum spicatum*) and coontail (*Ceratophyllum demersum*) a common native; both latter species do not break up as much in the collection onion bags. As a result, the mechanical removal process was too 'aggressive' for hydrilla – though it is a standard process that is widely used and accepted for removal of other aquatic invasive species. The operation requires water pumps to move a large volume of water to maintain adequate suction of materials. The material placed by the divers into the suction hose along with the water is deposited into onion bags with water leaving through the holes in the bag mesh. The bags must have a large enough 'mesh' size so that silts, clay, leaves and other plant material being collected do not immediately clog the bags and block water movement. This process resulted in the fragmentation of hydrilla and contributed to washing small plant particles back into the recently cleared area.

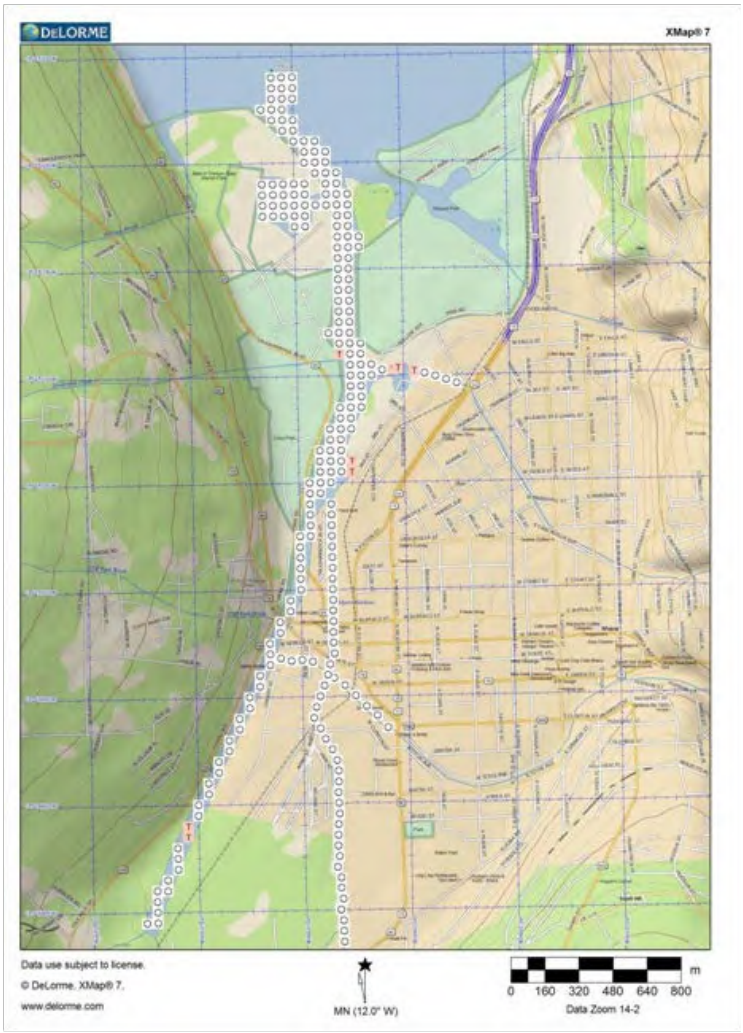

Figure 6- Distribution of 2012 Hydrilla densities, Cayuga Inlet

In summary, DASH was tried and rejected as a useful management technique in this situation. It broke the hydrilla into fragments that were impossible to capture, resulting in a potential spread, rather than eradication, of the hydrilla. This may also have been a function of the high clay content in the Inlet. The poor visibility in the Inlet also contributed to difficulty in finding plants and would ultimately impact distinguishing hydrilla from other plants. The use of diver assisted harvesting, however, may have some applicability for other sites in the Inlet or in the lake, should hydrilla be found growing in beds within the lake or in locations not manageable by herbicides in the Inlet.

Evaluation of 2012 eradication project:

Plant and tuber survey results:

The endothall was deemed to be 100% effective at killing hydrilla vegetation within three days within the eradication zone, except for the area by the fish ladder where plant material died within 7 days. Fluridone dosing began on July 11th. The first post hydrilla growth was observed on July 27th in the form of pink stems near the Farmer's Market. Within 2 weeks these stems were gone. No other hydrilla growth was found in the main treatment area for the rest of the season, with the exception of one healthy stem fragment located on August 17th on the east side of the west break wall leading to the red lighthouse. Repeated dives and rake surveys in that area resulted in no other hydrilla findings.

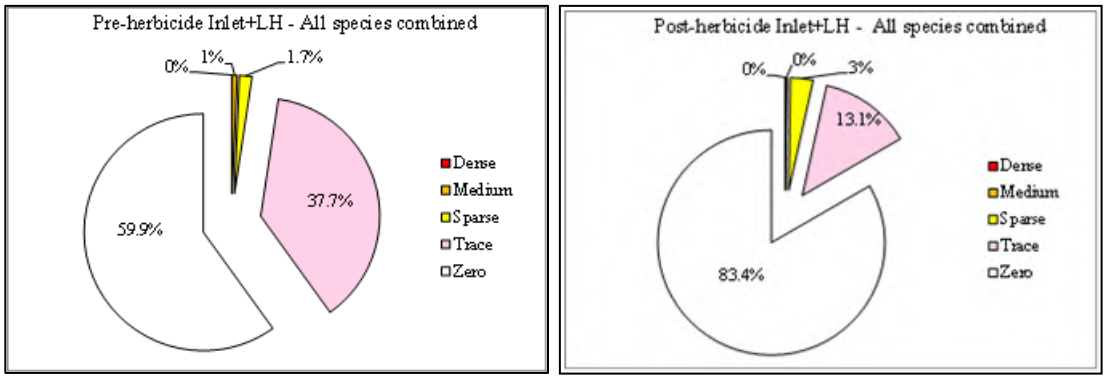

Figure 7- Change in Percentage of Plant Density Ratings For All Plant Species in Inlet

Figure 7 shows the results of the rake-toss survey from the Cayuga Inlet for 203 locations described as the Inlet plus 29 locations at the entrance to Cayuga Lake and known at the Lighthouse area. The pie charts show results of plant densities determined by 406 and 58 rake tosses in the Inlet and Lighthouse areas respectively. Detailed monitoring procedure will be described in the 2012 Cayuga Inlet monitoring plan (reference). Figure 7 shows the percentage of plant density ratings for all plant species combined (native and non-native) for the pre-herbicide survey in late June and the post-herbicide survey in November

Figure 8 shows only the 58 rake tosses for the Lighthouse area of the Inlet, that part at the entrance to Cayuga Lake. This suggests that a greater percentage of the rake tosses results with more plant growth in this area. This is likely due to less turbid waters influenced by clear lake water intrusion but may also indicate less herbicide effect of the Inlet treatment. Additionally, it is likely that the late fall survey, the post herbicide evaluation, is missing native plants that naturally die back in mid-summer and would not be found in fall. One example is *Potamogeton pusillus* that grows in the inlet in the spring but not in fall. Another positive influence on these graphs is the loss of the target plant species *Hydrilla verticillata*, that was present on 15 of the rake-tosses of the Inlet pre-herbicide survey but was not found in the November survey due to the 2012 herbicide treatments

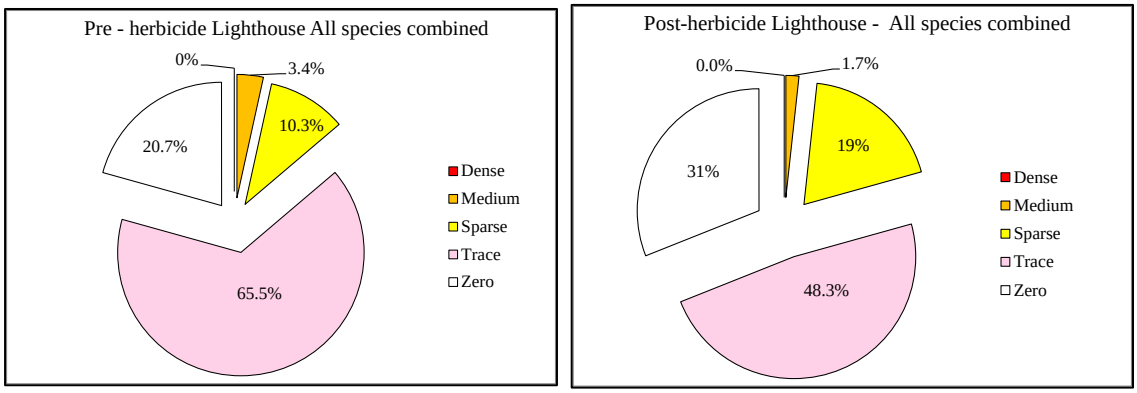

Figure 8- Change in Percentage of Plant Density Ratings For All Plant Species at Lighthouse

Figure 7 and 8 shows that other plant communities, comprised of both native and non-native plants (the latter comprised of Eurasian watermilfoil, curly leafed pondweed, and starry stonewort) survived the treatment throughout the treated area, even though some of these plants can be susceptible to both fluridone and endothall. The high turbidity and seasonal flow variability associated with the Inlet may suppress all plant growth, so the presence of at least trace plant growth throughout much of the monitored sites suggests minimal impacts to the native plant communities.

Figure 9 depicts extensive habitat and adequate growth conditions in support of macrophyte growth in the south end of Cayuga Lake. **However, no hydrilla was found in any of the 1090 surveyed locations in 2012 at the southern end and along the southeastern and southwestern shores of Cayuga Lake**. Figure 9 as well as Figure 8 (the light house area) also suggests that any diluted migration of fluridone or endothall into the south end of the lake did not appear to substantially affect aquatic plant growth overall or native plants susceptible to fluridone, including common waterweed (*Elodea* sp) and coontail (*Ceratophyllum demersum*).

Chemical residual results:

Chemical residual monitoring was conducted to evaluate concentrations and persistence of the applied herbicides to protect public health and to assure adequate dosage and distribution to assure efficacy. Fluridone residual rates were continuously evaluated to modify the drip discharge rate and to determine if any additional spot (pellet) applications would be needed. Chemical residual sampling results have been posted on the StopHydilla.org web page.

The endothall monitoring- conducted in 16 locations (DEC, Tompkins County DOH, and Local Task Force chosen sites)- indicated that endothall levels dropped below the MCL (maximum contaminant levels) of 50 ppb within the treatment area sometime between 7 and 14 days after treatment. Endothall levels were not detectable at the Bolton Point water intake at any time during or after the 2012 applications.

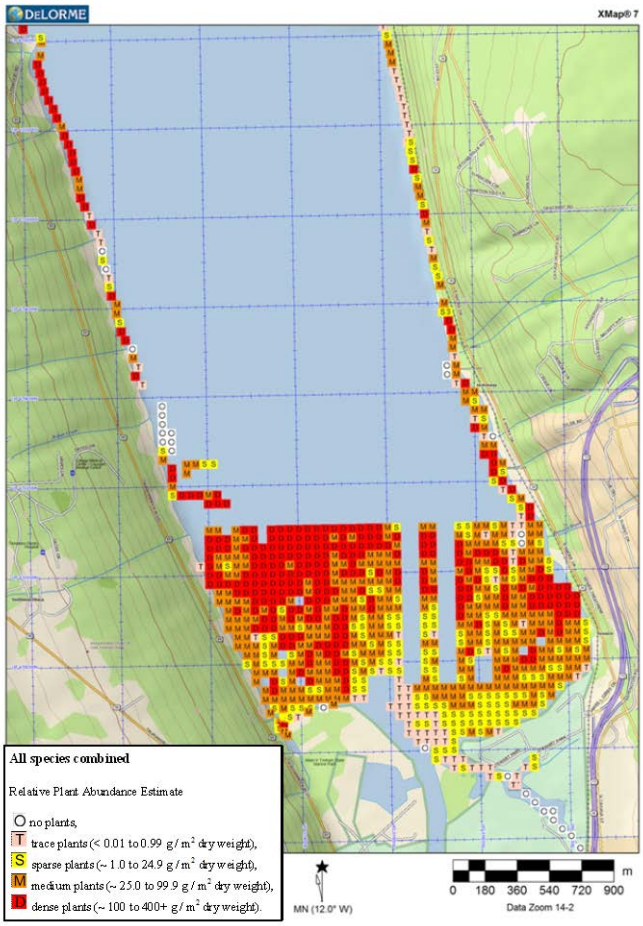

Figure 9- 2012 All species combined densities, southern Cayuga Lake

Fluridone sampling- conducted in 28 locations (DEC, Tompkins County DOH, and Local Task Force chosen sites)- showed fluridone levels in all locations and at all times below the allowable application rate of 50 ppb and the labeled maximum allowable rate of 20 ppb in potable water supplies in New York State. For this application, the maximum allowable rate was 8 ppb, with a target rate of 3-5 ppb. The seasonal total was not to exceed 150 ppb.

Alternative methods results:
No alternative methods were used in 2012. The aquatic herbicide treatments were shown to be effective at minimize biomass production, and the combination of pellet and metered liquid herbicide treatments were adequate to penetrate all areas of hydrilla growth within the infestation zone, and to maintain a high enough concentration of herbicide to achieve the eradication objectives of the project.

Context of Aquatic Plant Management

As noted above, a formal aquatic plant management plan for Cayuga Inlet or Cayuga Lake has not been developed, and therefore the eradication of hydrilla from Cayuga Inlet and connected waterways is not explicitly cited as an objective. The Inlet and Lake support a variety of uses, and the plan to eradicate hydrilla has explicitly addressed these uses. Aquatic herbicide permitting and application will ultimately enhance those uses through the removal of an invasive plant and ultimately protect the lake's ecology and aesthetic appeal. .

Management Objectives

Extent of Preferred Management-

In most cases, the objective of an aquatic plant management plan is to restore uses impacted by nuisance or invasive plant growth while balancing other potentially conflicting uses. As inferred by the name, Aquatic Plant Management usually does not include eradication. Eradication is considered to be the removal of an entire population of an invasive species and all its propagules from an area of infestation. It is only feasible if pioneering species are discovered soon after introduction, which rarely happens. Also, not all invasive species pose equal threats to the local ecosystem. Hydrilla verticillata was discovered in the Inlet within the first 1-2 years of introduction and is one of the most aggressive and damaging invasive species known. Therefore, as noted in the Problem Statement articulated in the beginning of this Plan, the primary objective of the Cayuga Inlet hydrilla management plan is to eradicate hydrilla from the Inlet and surrounding waterways. By necessity, this requires application of management tools throughout the infestation zone, partial or selective control is not consistent with eradication. The asynchronous nature of hydrilla tuber germination, the longevity of the reproductive cycle for tubers and turions, and the seasonal nature of both aquatic plant biomass growth and hydrologic transport within the Cayuga Inlet system further necessitates the use of both seasonal (short-term) and extended management tools, as manifested in the use of contact and systemic herbicides, based on the 2011 and 2012 plant and tuber growth dynamics. However, this need may be re-evaluated in the future as dictated by plant and tuber growth response to the efficacy of the eradication effort. The persistence of tubers and the risk of tuber germination several years after management is initiated, or if management is suspended while tuber banks are still viable, also necessitate the application of eradication tools for many years. The combination of all of these challenges requires the development of a comprehensive, long-term strategy for eradicating hydrilla in the Cayuga Inlet watershed and preventing the spread of hydrilla outside of the present infestation zone.

Expected Use Benefits-

It is anticipated that the successful eradication of hydrilla from the Cayuga Inlet watershed will prevent the spread of this highly invasive plant to Cayuga Lake, the surrounding Finger Lakes and the larger Great Lakes region. This will allow this critically important ecosystem to maintain biological integrity and water-based recreational uses, property values, and otherwise support the ecology and economy of the Great Lakes region. The more immediate and localized benefit will be to restore and enhance the ecological integrity of Cayuga Inlet and surrounding waterways by eliminating surface canopies and submergent beds of hydrilla in heavily trafficked areas, improve aesthetic and recreational quality, and sustain recreationally-driven economic uses of these waterways.

Critical Areas to Protect

The successful eradication of hydrilla will serve to protect a variety of uses of the Inlet and Cayuga Lake, including water intakes, shoreline areas subject to epiphytic algae growth, upper waters of boating channels susceptible to propeller clogging and navigational impediments, fisheries habitats, and other ecologically important areas within Cayuga Inlet and Cayuga Lake. The proposed eradication actions are intended to minimize potential impacts to areas that warrant special protection.

Management Alternatives

There are a wide variety of aquatic plant management tools available for the New York state lake manager. Some of these tools require permits from the NYSDEC or other state or local agencies, some require detailed review and approval of proposed actions, and others are largely allowed without the use of a rigid permitting or evaluation program. A summary of these options is available in several publications, including Diet for a Small Lakes: The Expanded Guide to New York State Lake and Watershed Management (http://www.dec.ny.gov/chemical/82123.html). This publication summarizes the physical, mechanical, chemical, and biological control options available in New York State, divided into "local" and "lakewide" management options. The governing principle, primary advantages and disadvantages, target plants, expected costs, and regulatory issues for each option are discussed at length. The pertinent sections for each of these options are discussed below.

Management Alternatives -

The management alternatives identified below can be evaluated in the abstract—based on information in the open literature, through case studies in other states or other regions in New York state for which hydrilla control was the target, through evaluation of proposals from aquatic plant managers, and through feedback from an external peer review team. All of these processes for evaluating hydrilla management alternatives were deployed for this project. The open literature has very little information about the most appropriate management actions for eradicating monecious hydrilla. There are limited case studies from California, Maine, New York, and other states with monecious hydrilla infestations. The primary means for evaluating management alternatives is through the evaluation of proposals provided to the Hydrilla Task Force, and especially working with a team of external peer reviewers to identify the most appropriate actions to meet the project objectives.

In 2012, an external peer review team of monecious hydrilla experts from the University of Florida, the US Army Corps of Engineers (Florida and Vicksburg), Mississippi State University, North Carolina State University, and the University of California were recruited by the Task Force to review proposals and supporting materials provided by the Task Force. The external peer review team provided recommendations to the Task Force, and will be recruited to provide additional review and support in the future.

A monecious hydrilla literature search commissioned by the Northeast Aquatic Nuisance Species Panel was recently completed and will provide important insights for hydrilla eradication in the Inlet in the coming years.

Local Control-

The following plant management options are used for "local" control—a small infestation that constitutes only a portion of an infected waterbody, or the control or eradication of a portion of a larger infestation.

Hand harvesting:

The management option, whether conducted solely by hand or augmented with the use of divers and/or suction harvesting equipment, involves the removal of plant biomass and (ideally) all rooted material and reproductive structures. It is limited in scope to very small

infestations, generally less than 1000 square feet by hand. Large scale operations involving multiple divers and plant transport systems have been deployed at several New York state lakes, most often when larger scale plant management options are not available or not appropriate. This option did not require a permit from the NYSDEC, for the specific infestation zone addressed in this Plan at the time of the infestation.

As noted above in the evaluation of the diver-assisted hand harvesting operation used for a small hydrilla infestation south of the Rt 79 bridge in Cayuga Inlet, the highly fragile nature of the plant, the "blunt" nature of hand removal operations, the high turbidity and clay substrate, poor water visibility and flowing water, and the very high cost of the operation (appx. $16,000 per acre) restricts the use of this tool, at best, to very small infestations not manageable by other techniques, such as very small beds in very shallow water. It is also likely, given the persistence of the hydrilla tubers, that any hand harvested beds would need to be harvested multiple times per year over at least several years (or be transitioned into eradication using some other management tool). In addition, in aquatic plant beds with multiple species of plants, including some hydrilla lookalikes common to Cayuga Lake, targeted hydrilla removal can be very challenging.

Benthic mats

Benthic barriers, sometimes called benthic screens or bottom mats, prevent plant growth by blocking the light required for growth. The barriers also provide a physical barrier to growth by reducing the space available for expansion and by preventing plants from germinating. Most aquatic plants under these barriers will be controlled if they are deprived of light for at least 30 days. If the mats are not secured to the bottom using sand or other "smothering" materials and are removed within a well defined timeframe, NYSDEC permits are not required.

However, as with hand harvesting, the use of benthic mats is limited to but can be very effective for small populations. Plant surveys conducted in the fall of 2011 identified more than 9 acres of dense infestations. The use of benthic barriers to eradicate these infestations, but not the remaining 150+ acres of more sparsely populated areas of the Inlet, would be very expensive (also on the order of $15,000-20,000 per acre) and would require either permanently sited mats or the logistic challenge of siting and removing these mats at multiple times and sites throughout the Inlet system.

Rotovating or Hydroraking

Rotovating or rototilling is a form of mechanical control for aquatic vegetation. It uses a rototilling machine to cut aquatic plant roots from the sediment and remove them from the water body. Hydroraking is essentially the same technique, but it uses a mechanical rake to collect and remove some of the cut material.

Given the great risk of spreading hydrilla through fragmentation, the high likelihood of hydrilla regrowing from small fragments, and the primary goal of eradicating rather than managing hydrilla in Cayuga Inlet and surrounding waterways, rotovating and hydroraking are not recommended control strategies.

Lakewide Control

The following options refer to “lakewide” (or “Inlet-wide”) infestations. These may not constitute the entirety of a waterbody, but rather represent control or management of most to the entirety of an infestation zone.

Physical/Mechanical controls

Physical control measures impact the physical growth patterns of the weeds by disturbing the sediment, altering light transmission through the water or to the plants, or water-level manipulation. Mechanical control strategies remove the plants and root systems, such as cutting, harvesting, and rotovating

Drawdown

Drawdown involves winter manipulation of water levels to expose rooted aquatic vegetation and sediments to the freezing and drying action of cold air. Snow cover may insulate the sediment and prevent freezing in mild winters. Freezing can help control weeds by loosening roots and loose organic material on the exposed sediments. Drawdown usually occurs between December and April in New York State.

The water level in Cayuga Inlet and surrounding waterways is partially controlled by the state Canal Corporation, as part of regulating the state Barge Canal. While there is some latitude in controlling water levels for the purpose of affecting positive change in hydrilla levels- water levels in Cayuga Lake were dropped earlier than usual in 2011- the allowable drop and water level usually achieved in March is dictated by a rule curve established to meet several objectives. Moreover, since hydrilla has been found rooted in the middle of the Inlet channel, the Inlet would have to be completely drained -- water from tributaries as well as lake water would have to be kept out of the Inlet channel. In practical terms, this is not physically possible.

Shading

Shading involves the use of non-toxic, vegetable dyes to inhibit light penetration throughout the water column. This limits the growth of nuisance aquatic vegetation in water depths greater than two to four feet. The dye absorbs certain wavelengths of light, which further limits plant photosynthesis. Shading is used to treat an entire waterbody and is most often used in farm ponds. The chemicals used do not work as pesticidal agents, since they are not absorbed or otherwise taken in by aquatic plants or animals.

However, shading is rarely used on large water bodies, and would not be a very effective tool for a highly flowing system such as Cayuga Inlet, due to rapid and heavy dilution. There is little evidence that shading could effectively control, and certainly not eradicate, hydrilla, since there has been little use of this tool or a large scale. Recent research by North Carolina State indicates that hydrilla can grow in complete darkness for at least 56 days, eliminating shading as a tool to remove hydrilla.

Mechanical harvesting

Mechanical harvesting physically removes the upper portion of rooted aquatic plants, using a machine to cut and transport the vegetation to shore for proper disposal. It is often described

as underwater lawn mowing. This common method of aquatic vegetation control can be used for clearing boat channels, launch sites, swimming areas, and other high use areas where weeds pose the greatest nuisance. It is often done to improve recreational use, which can be resumed immediately after harvesting. Harvesting also removes the nutrients, primarily phosphorus, stored in the plant structure, thus controlling one contributor that causes excessive rooted vegetation growth.

However, the same risks cited for rototilling and hydroraking apply to mechanical harvesting, due to the prolific generation of fragments and very high risk for spread of reproductive structures. Mechanical harvesting is also not an eradication tool, and thus does not fit with the primary objectives of the hydrilla control efforts to be achieved in Cayuga Inlet.

Dredging

Dredging is planned in the Cayuga Inlet to restore the navigation channel and the capacity for storage and transport of flood waters away from downtown Ithaca. The Army Corps of Engineers determined that the Inlet no longer met requirements as a functioning flood control channel (FCC) in August of 2011. Until that function can be restored, the availability of FEMA funds is uncertain in the event of a flood. Maintenance of the navigation channel is the responsibility of the NYS Canal Corporation. The FCC is the responsibility of the NYS Department of Environmental Conservation (DEC). The City of Ithaca was charged to find a location for dredged materials to be dewatered and did so in July of 2010. The Canal Corporation has sufficient funding to dredge the navigation channel and can begin work as soon as the dewatering facility is operational, possibly as early as the fall of 2013. The DEC does not have this work budgeted and is in discussions with the Army Corps of Engineers regarding the extent of dredging required to restore the FCC. In an effort to control costs, they are hoping that they will not be required to return the FCC to its original design dimensions.

Dredging is considered a management tool for removal of hydrilla. It is usually most applicable to waterways that are enclosed or can be contained and are usually shallow. The Inlet does not meet these conditions but as dredging is already planned during the same time frame as hydrilla eradication efforts will be underway, coordinating the efforts could result in a more certain removal of the plant and possibly shorten the number of years herbicide has to be used. Unfortunately, the process of dredging will also fragment small plants and redistribute tubers, which could reduce the effectiveness of the herbicide and lead to a protracted need to treat for hydrilla.

Important components of the dredging project that make the difference between it being helpful or harmful to hydrilla eradication are:

- Length of time to dredge the Inlet
- Extent of dredging
- Coordination of dredging components (navigation channel and FCC)
- Handling of dredged materials

The optimal blend of the dredging project with hydrilla eradication would include a shortened duration (<5 years as an initial estimate), bank-to-bank dredging including bays and contributing streams, coordination of Canal Corporation and DEC efforts so that

dredging occurs upstream to downstream, and addressing the need for a larger area to hold dredged materials as well as finding ways to inactivate or isolate tubers in the dredged material. $13 million in State funding has been made available. Consultants have been tasked to specifically investigate ways to dredge and enhance the hydrilla eradication effort – and ways to dredge to minimize the threat of further spread.

Biological control- this broad category refers to biological control agents- organisms purposefully stocked into a waterbody to prey on target pests.

Grass carp-
Grass carp (*Ctenopharyngodon idella*), also known as white amur, remove vegetation in a lake by consuming it at a rate of 20 to 100 percent of their body weight each day. This physical removal of vegetation is a type of biomanipulation, altering the food web in order to change lake conditions or give advantage to a desired species. Use of grass carp is one of the few biomanipulation tools shown to control excess levels of nuisance aquatic plants. The grass carp is the most extensively studied and most frequently stocked fish used for aquatic plant management in North America. They were originally imported to Arkansas and Alabama from Malaysia in 1962. Only sterile grass carp, called triploid carp, are presently allowed for stocking in New York State. The fish have been stocked at a rate of about 10 to 40 per vegetated acre of lake surface, with lower rates (usually 6-10 fish) more acceptable in recent years within a NYSDEC permitting program.

Sterile carp have been used to stop hydrilla in water bodies that can be isolated, such as ponds; they eat any submergent vegetation, regardless of whether it is invasive or not. There is strong evidence that grass carp prefer hydrilla over many other aquatic plants, including other plants native to Cayuga Inlet and Cayuga Lake. However, since the Inlet cannot be isolated or contained, grass carp applied directly to the Inlet would be likely escape into Cayuga Lake, causing extensive habitat damage. This renders the grass carp an inappropriate hydrilla management option for the Inlet.

Herbivorous insects
At least 25 herbivorous insect species have been found that feed on aquatic plants. The milfoil moth (*Acentria ephemerella*) and the milfoil weevil (*Euhrychiopsis lecontei)* are the most studied, and perhaps the most promising, of these herbivorous insects. Both of these insects have been demonstrated to target Eurasian watermilfoil, and the moth has been implicated in significant reductions in Eurasian watermilfoil populations in the north and south end of Cayuga Lake for many years. These organisms have been cultivated in the laboratory and introduced into several New York state lakes to evaluate their effectiveness as an augmented biological control agent.

Unfortunately, these insects appear to be limited to control of Eurasian watermilfoil (or perhaps other milfoil species), and do not prey on hydrilla. There is some active research on the potential for several species of herbivorous insects—particularly *Hydrellia pakistanae* (Asian hydrilla leaf mining fly), *Hydrellia balciunasi* (Australian hydrilla leaf mining fly), *Bagous affinis* (hydrilla tuber weevil), and *Bagous hydrillae* (hydrilla stem weevil)—but the present research has not been sufficiently developed for large scale field trials in the northeast.

Chemical control-

Aquatic herbicides are chemicals that kill macrophytes or inhibit their normal growth through direct toxic reactions or by hampering their photosynthetic ability. Some chemicals are species-specific and others affect a broad spectrum of plants. The herbicide is usually applied to the water directly above the nuisance weed bed and the plants are left to die and degrade within the lake.

Several herbicides can be used to effectively control hydrilla, but one of the most significant problems associated with chemical control of any submersed species is dilution. An acre of water that is 1 foot deep comprises 325,800 gallons of water, which results in tremendous dilution of herbicides. In addition, water flow or movement greatly reduces the amount of time hydrilla is exposed to the herbicide. These factors can make it difficult to control hydrilla using chemical methods, so treatments should be designed to take dilution and water movement into consideration.

Fast-acting contact herbicides – including copper, diquat and endothall formulations – are taken up quickly by hydrilla and result in rapid plant death and decay. These herbicides are generally used for spot treatments, strip treatments along shorelines and where water movement would limit use of slower-acting systemic herbicides.

Slow-acting systemic herbicides – including fluridone, imazamox and triclopyr – control hydrilla by inhibiting enzyme activity or otherwise interrupt biological functioning. These herbicides are usually applied as whole-lake treatments and provide control of hydrilla only when a long period of contact is possible. An advantage to systemic herbicides is that they are effective at low rates – usually concentrations of less than 100 ppb or even less than 10 ppb in the cases of fluridone. These herbicides slowly kill plants by starving them over a long period of time, but usually provide 1 to 2 years of control. Slow plant decay resulting from systemic herbicide treatments minimizes possible oxygen depletion and reduces the potential for fish mortality. The disadvantage of systemic herbicides is that they generally require a total lake treatment, or at least treatment in coves, bays and other areas where water movement and dilution are reduced and there is little or no water exchange.

The specific evaluation of each of the herbicides available for controlling aquatic plants in New York State is as follows:

Copper products

Copper products have been used primarily to control nuisance algae, although some copper formulations have been used to control hydrilla singly or as part of a tank mix with other aquatic herbicides. The external peer review team reviewed all potential contact and systemic herbicides and determined that other herbicides would be better choices for eradicating hydrilla in Cayuga Inlet.

Diquat

Diquat is a contact herbicide that controls emergent species such as cattail; floating species such as duckweed; and submerged species such as coontail, milfoil, nitella and some varieties of pondweed. It must be applied in water less than six feet deep or closer than 200 feet from

shore, whichever provides the greater distance from shore, and maybe limited in lakes with stressed bass, walleye, or muskellunge populations. Due to potential risks to fish communities and the availability of more appropriate herbicides, and the expectation that the turbidity of the Inlet due to sediment particles that would inactivate the diquat cation, diquat was not considered for use for eradicating hydrilla in Cayuga Inlet.

Glyphosate
Glyphosate is a systemic herbicide used almost exclusively on emergent and floating plants, notably cattail and water lily. It has not been commonly used for submergent plant control in New York State, and requires significant setbacks from potable water intakes. For these reasons, it was not considered for use for eradicating hydrilla in Cayuga Inlet.

Triclopyr
Triclopyr is a systemic herbicide that targets Eurasian watermilfoil and purple loosestrife. It is a fairly selective herbicide that can be applied at higher dosage rates than some of the other registered herbicides. However, hydrilla is not considered to be strongly susceptible to triclopyr, so it was not considered for use for eradicating hydrilla in Cayuga Inlet.

2,4-D
2,4-D is a systemic herbicide used for controlling a wide variety of emergent, floating and submerged species, primarily Eurasian watermilfoil, water chestnut, coontail, and water hyacinth. It remains in the sediment for several months and cannot be used in waters used for potable water supplies when the concentrations of the chemical exceed 70 ppb. For these reasons, and due to lower susceptibility of hydrilla to 2,4-D, this herbicide was not considered for use in eradicating hydrilla in Cayuga Inlet.

Imazimox
Imazimox is a newly registered systemic herbicide in New York State, applied to submerged vegetation by broadcast spray or underwater hose application and to emergent or floating leaf vegetation by broadcast spray or foliar application. This growth inhibitor has demonstrated some success in controlling hydrilla. However, due in part to the lack of data regarding the effectiveness of this herbicide for the control of monecious hydrilla, it was not considered for use in eradicating hydrilla in Cayuga Inlet, although it may be considered in the future.

Endothall
Endotholl is a contact herbicide often used to control coontail, Eurasian milfoil, hydrilla, and most pondweeds. It stays in the water column longer than either Diquat or 2,4-D, but its breakdown products (carbon, hydrogen and oxygen) are of less concern than those from these other herbicides. The Aquathol® K formulation is preferred in New York state lakes to minimize toxicity. This herbicide has been used to control hydrilla in other states, include those in the northeastern United States (associated with the monecious variety of hydrilla), and thus is among the preferred herbicides for controlling this plant.

Fluridone
Fluridone is a systemic herbicide, known by the trade name of Sonar. In New York State it is used extensively for the control of Eurasian watermilfoil and curly-leafed pondweed, and has been used extensively in the northeastern United States to control monecious hydrilla. It has

been used at low dosage rates to attempt to manage target plants while preserving non-target plants. This herbicide has been used to control hydrilla previously in New York and in other states, and thus is among the preferred herbicides for controlling this plant.

No Action Alternative-

The "no control" option can be appropriate in some circumstances. However, while this option is discussed at length below, it is a less viable option when eradication is the goal, as in Cayuga Inlet. Factors cited by Madsen (Madsen, 2009b) that should be considered include the following:

• *Plant species* – **Is the plant invasive? Is it a native plant impairing water body uses or is it just unwanted by stakeholders**? In the case of the hydrilla infestation in Cayuga Inlet, the target plant has been well established as invasive, and the impairments (present and future) have been identified

• *Size of infestation* – **Is this a pioneer infestation consisting of a few plants? Is it an established, but stable, population? Is it an established population or starting to approach problematic thresholds?** For the Cayuga Inlet infestation, the population is established, may be spreading, and has already achieved problematic thresholds.

• *Plant location* – **Is the infestation in an isolated location? Is the location conducive to spreading the pest plant by fragmentation, flow, etc.? Are there important nearby water bodies that are prone to becoming infested?** As discussed above, the primary objective for the Cayuga Inlet hydrilla eradication project is to prevent infestation of other nearby waterbodies, particularly Cayuga Lake, other Finger Lakes, and the larger Great Lakes ecosystem.

• *Plant biology* – **Is there a likelihood of a rapid population expansion? Would "no control" permit the plant to produce viable seed or vegetative propagules that could make later control efforts more difficult and expensive?** The biological advantages associated with hydrilla- prolific production of several different reproductive structures, persistence and longevity of tubers, etc.- necessitate a management response for a hydrilla introduction, particularly when the other objectives cited above indicate a need for response.

• *Exploitation* – **Is the plant species providing an ecological service (e.g. nutrient uptake, food source for waterfowl, habitat for fisheries, etc.)?** There is no evidence that hydrilla in Cayuga Inlet is serving a valuable ecological service, and some evidence that the introduction and spread of hydrilla into Cayuga Lake would compromise ecological services already provided by the native plant community.

• *Managerial will* – **Managers may be under pressure to not control a plant because it provides benefits (perceived or real) to a user group. Stakeholders may oppose control because they are not familiar with proposed methods.** The need to eradicate the hydrilla populations in Cayuga Inlet have been well articulated to multiple stakeholders, and is a well defined goal for the state of New York for this site and region, and there has been near universal support for the management actions to date and the eradication objectives moving forward.

• *Managerial experience* – **Inexperienced resource managers are often uncomfortable with making aquatic plant management decisions (especially on a large-scale). Until a manager understands the issues and situation, the "no control" option may be viewed as the safest and least controversial.** The Hydrilla Task Force for the Cayuga Inlet Watershed and supporting managing structure have quickly developed the expertise and external framework to identify appropriate management and eradication actions, articulate these plans,

and build public support for these actions. Given that the eradication goal is shared at multiple levels by multiple stakeholders, this concern would likely be addressed even if highly qualified local resource managers were not available.

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A careful evaluation of each potential rationale for adopting the "no action alternative" determined that each was inconsistent with the objective of eradicating the hydrilla in Cayuga Inlet.

Preferred Alternative(s)-

Herbicide was chosen as the preferred alternative in 2011 due to the short time frame available to implement action and interrupt tuber formation. A small portion of the Inlet was treated using DASH later in the fall due to permit complications that could not be overcome before the end of the growing season. It was hoped that DASH would be a viable non-chemical option for future treatments, however, the method proved to be not only ineffective at removing hydrilla but also caused fragmentation of plant material potentially leading to spread of the plant.

Herbicide was again chosen as the preferred alternative to in 2012 after careful consideration of all options, site conditions and permitting requirements. Contingency plans for use of benthic mats were developed in areas where chemical mixing might be inadequate, where tuber asynchronous tuber germination might hamper chemical treatment and in locations where chemical use might not be feasible, such as in the lake. The above conditions did not materialize so the chemical treatment was all that was required.

A recommendation from the Hydrilla Task Force will be provided in early 2013 in consultation with the external peer reviewers. It is anticipated that the Hydrilla Task Force will retain the services of the external peer review team to guide management decisions throughout the duration of the eradication project.

The Hydrilla Task Force continues to evaluate the role of navigational dredging in the long-term plans for the eradication of hydrilla in Cayuga Inlet. Although most of the dredging project activities will be staged and implemented independently of the hydrilla eradication project, it is anticipated that this Plan will be updated as additional guidance and recommendations about the application of navigational dredging tools for hydrilla eradication are developed.

Integrated Management-

The selection of a preferred treatment each year does not necessarily preclude all other options. The preferred treatment for the overall project may not be the best option for small, site specific areas. Concurrent or future work projects may also impact treatment plans. Every effort is being made to consider all aspects that will impact the effectiveness of the overall treatment plan. Towards that end, below is a list of other management actions that have been discussed or used to date.

Benthic mats were considered for several boat launches (3 acres) in the Inlet for spread prevention and as a component of the eradication program. The boat launches set back from the main Inlet channel in small bays. There was a concern that the fluridone liquid being

delivered via upstream injectors might not mix adequately in those bays to treat the hydrilla. This concern was ultimately addressed by the use of pelletized fluridone.

The Task Force set aside funds and developed strategies for the use of up to 7 acres of benthic matting in the lake if hydrilla was found. Hand harvesting and chemical treatments were also options for use in the lake but due to the delay in getting the necessary permits in place for either action after a hydrilla 'find', the benthic mats were deemed the most practical treatment option. Extensive monitoring did not detect hydrilla in the lake, eliminating the need for any management actions in the lake in 2012. These options will still be considered if hydrilla is discovered in the lake in the future.

The Merrill Sailing Center and the future Ithaca College Rowing Facility both performed small dredging operations around their facilities early in 2012. The entities worked closely with DEC permit staff to adjust disposal requirements for the dredged material due to the risk of spreading hydrilla. Additional monitoring was performed around the Merrill Sailing Center which, like earlier survey work, did not indicate the presence of hydrilla in the area.

Dredging irrigation channels or small ponds is a viable treatment option for hydrilla infestations. It is not a practical option in a water body like the Inlet. However, the Inlet has been slated for navigational dredging for several years and plans to begin the work are solidifying. With that in mind, the Hydrilla Task Force is participating in development of the navigational dredging plans to minimize any disruption of the hydrilla program and potentially to use the dredging project as a means to accelerate the removal of hydrilla tubers from the system.

Pre-, During- and Post Treatment Actions

Plant Monitoring (Continuous):

As with other efforts in 2011, no framework existed for the specific actions taken. Monitoring actions were informed by work in other states on hydrilla and standard monitoring practices for aquatic plants. To the extent possible, monitoring was done in excess of accepted standards, to compensate for the overall lack of information on monoecious hydrilla and to inform development of future treatment plans. A Monitoring Plan was developed in advance of the 2012 growing season and is available on the StopHydrilla.org website.

Monitoring for hydrilla began in August of 2011 with the initial goal of mapping the extent of the infestation. A collaboration of professionals and volunteers made multiple trips in the Inlet, Fall Creek, Cascadilla Creek, limited portions of Six Mile Creek and the southern end of Cayuga Lake. No hydrilla was found in Fall Creek or Six Mile Creek. No rooted hydrilla was found in the Lake, though a few floating fragments were found. Plant response to the herbicide treatment was tracked, noting both the die off of material and subsequent re-growth. Effectiveness of the DASH treatment was also monitored based on plant material removed, buried or left behind.

Hydrilla monitoring in 2012 included both the Inlet and the southern portion of Cayuga Lake with the goals of determining plant presence/absence, location, growth, spread, and treatment

timing. Plant monitoring of the treatment area was conducted in the spring (pre-herbicide application) from June 22 – July 3, 2012 and in the fall (post treatment) from November 16 – 27, 2012. Fifty meter grids were used to determine sampling points using the point intercept method and two rake-tosses while recording GPS coordinates. 203 locations were sampled pre and post-herbicide application. In-lake monitoring, which included monitoring the lake-inlet mixing zone and into the mouth of Fall Creek, included 1119 sample points on a 50X50 meter grid and were sampled between July 10th and August 27th, 2012. Figure 9 shows native and nonnative plant densities (and by extension the sampling locations) in the southern portion of the lake. The metrics collected included plant species presence, abundance and GPS locations following time-tested methodology commonly used to evaluate herbicide efficacy. Native and rare plant presence and abundance were part of this monitoring. Measures of Hydrilla status (dead, alive, re-growth, roots, tubers, turions) were quantified after each survey to determine herbicide efficacy. Similar maps have been generated for each of the plant species identified in these surveys, and are available on at StopHydrilla.org.

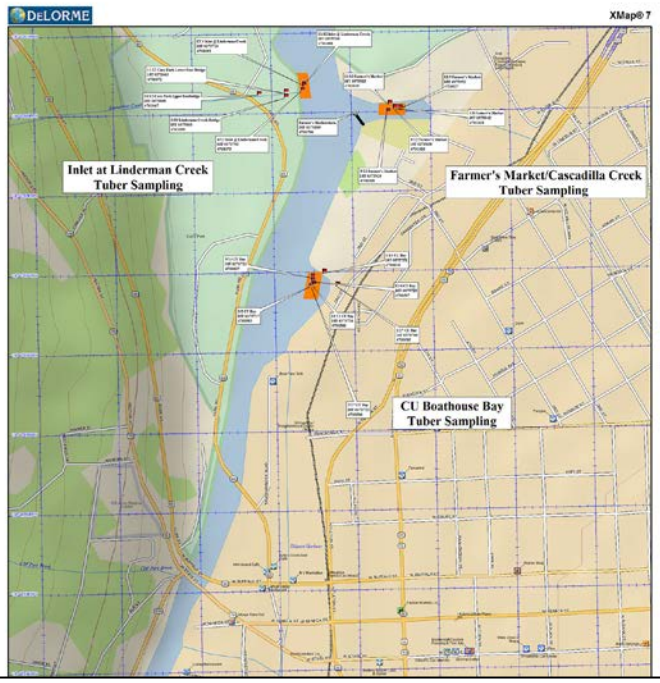
Divers were considered for use in the Southern portion of Cayuga Lake to enhance monitoring for hydrilla to determine if it has spread into the lake, and potentially as agents to deploy deepwater hand harvesting. This work was thought to be especially critical in 2012 and 2013 to make sure negative results weren't the result of too little sampling. A diver was brought in to assess the usefulness of this method. While the diver did find the only live sprig of hydrilla after chemical treatment began, it was not due to factors unique to diving. Visibility was too poor for identification of plant materials underwater. The diver was removing plant material in masse and bringing to the boat for identification. One of those grabs included the single sprig of hydrilla. Rake toss sampling uses the same process. Diver and aquatic plant specialists were consulted, and they concurred that diving is not the preferred survey method, due to the poor clarity, dangerous diving conditions, and other logistic considerations. As a result of this evaluation, diving will not be used in the future.

Monitoring for presence/absence of hydrilla in local water bodies will need to continue into the indefinite future to protect against establishment of new infestations of hydrilla.

Tuber Monitoring (Continuous):

The ultimate goal in hydrilla eradication is to remove all tubers from the system. Their size varies from roughly 1/4 to 1/2 of an inch. Tubers can remain dormant in sediment for a number of years; they can also germinate throughout the growing season. Little is known about germination cues. The length of tuber viability and lack of knowledge regarding germination cues result in the need for lengthy treatment efforts. Tuber density monitoring is key to determining the effectiveness of the treatment efforts.

Tuber monitoring began in the fall of 2011 and has continued regularly (by-monthly), except for in January and February, and will continue through the eradication effort. Four monitoring sites, shown in Figure 10, have been established (Cornell boat launch, Farmer's Market/Cascadilla kayak launch, Inlet at mouth of Linderman Creek, and south of the Route 79 Bridge).



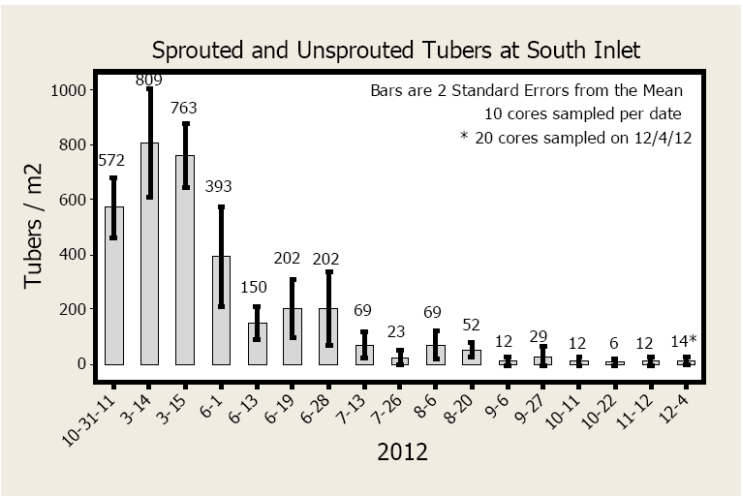


Figure 11- 2012 Hydrilla Tuber Densities, South Inlet

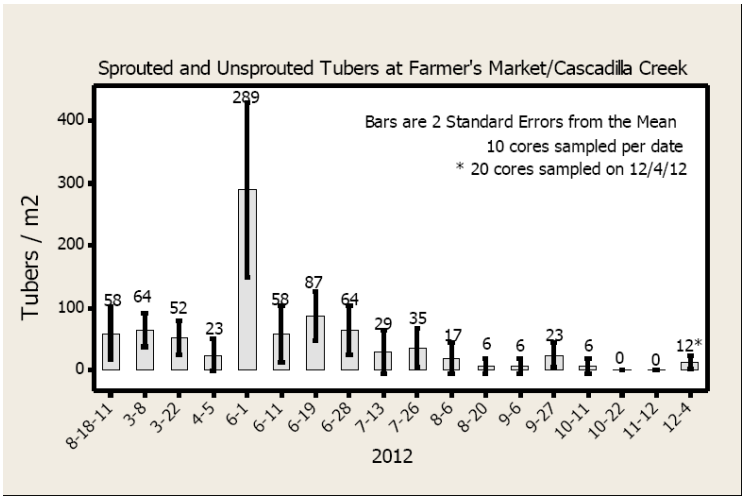


Figure 12- 2012 Hydrilla Tuber Densities, CU Boathouse

This monitoring will continue to dictate the timing of initial herbicidal application (used to determine timing of endothall treatment in 2012) and the use of both long-exposure liquid herbicides and additional spot or pelleted herbicide treatments. It will also be used to track trends in tuber densities and determine the end date for treatments.

Sampling took place generally on a bi-monthly basis other than winter months and 10 cores were collected at each location and analyzed for tuber presence or density along with measurements of any vegetative growth above or below sediment surface. A summary of the collected data shows a steep decline in tuber density from Fall 2011/Early 2012 from a range of 60 to 800 tubers per m2 depending on location decreasing to less than 10% viable tubers. These data are displayed in Figures 11 through 14 (Johnson, 2013).

Additional information about the tuber monitoring activities is can be found in the Monitoring Plan on StopHydrilla.org.

Water Quality Monitoring (Continuous during treatment seasons):

Sampling regimes are set by the Tompkins County Health Department and the Regional DEC office. Sampling is designed to meet multiple goals:

1. Determine efficacy of treatment
2. Determine timing of chemical 'bumps'
3. Track chemical drift
4. Monitor public drinking water for contamination
5. Insure permit compliance

A more detailed discussion about water quality monitoring sampling plants and results are available at StopHydrilla.org

Flow Measuring Studies

Three liquid chemical injection points were established for the 2012 treatment program. The rate of injection was determined by USGS stream gage data. Injection points were established on the Inlet, Six Mile Creek and Cascadilla Creek. The Inlet gage was relocated by the USGS in advance of the treatment to provide better stream discharge data – this will benefit all users of the data though the timing of the gage relocation was for the benefit of the eradication effort. Cascadilla Creek does not have a gage and the Six Mile Creek stream gages are located further upstream providing valuable information for pre-existing users. Calculations were made based on relative watershed size to estimate stream flow in Cascadilla Creek and in the relevant area of Six Mile Creek. These calculations were verified by in stream flow measurements taken three times during the treatment season. No high flow events occurred, or were measured, in 2012. Flow measurements may be taken at high flows in future treatment years to confirm that the calculations being used are valid across a range of stream flows.

Early Response-

Benthic mats were planned for several boat launches in the Inlet, and in any small areas of the lake where hydrilla might be found. Contingency funding for 7 acres of benthic matting - 3 acres in the Inlet, and 4 acres in the lake - was set aside as needed. No plants were found in the lake in 2012, eliminating the need for benthic mats. Continuing to budget for limited benthic mat use in the lake is still a prudent step to take given the extent of the lake floor that is not sampled during any given season.

The use of divers in general survey work was tested in 2012 and rejected. Practical constraints on diver effectiveness (turbidity, plant density, water temperature and safety protocols), along with feedback from both diving and aquatic plant experts, do not support the future use of divers. This feedback and "pilot" study found that diver plant surveying is a slow and costly process, and is not effective in looking for possible infestations. Divers may still be used to delineate any new finds of hydrilla.

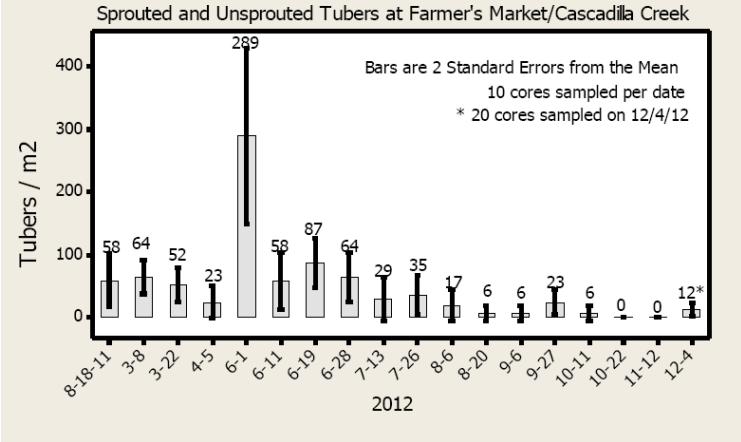


Figure 13- 2012 Hydrilla Tuber Densities, Farmers Market/Cascadilla Creek

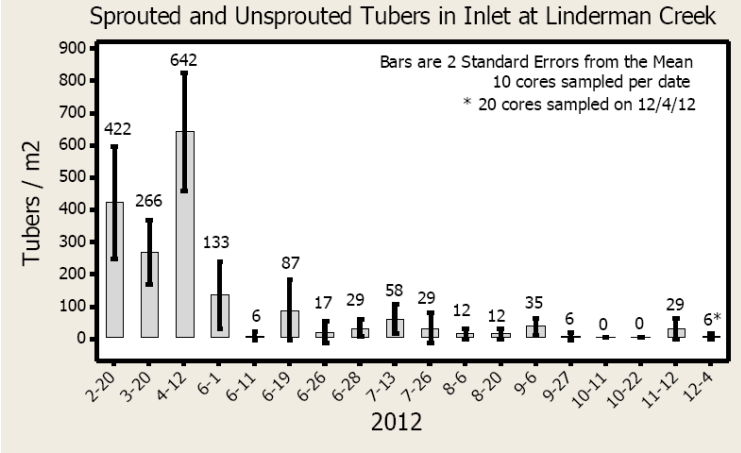


Figure 14- 2012 Hydrilla Tuber Densities, Linderman Creek

Individual plant or (very) small bed hand pulling is expected to be initiated in response to findings reported through the monitoring program or via reports from observers in the Inlet or lake. The public is urged to report any suspicious findings through the StopHydrilla.org website, and this message is emphasized during public outreach activities, plant ID workshops, and other public forums dedicated to hydrilla education. It is anticipated that any hand pulling will be initiated or overseen by the Hydrilla Task Force of the Cayuga Watershed as soon as possible after detection.

The outreach activities conducted by CCE, CLWN, FC, and the larger Task Force consistently focus on reducing spread of invasives generally and hydrilla specifically through various vectors of transport. The Task Force has worked closely with marina owners, the Allen H. Treman Park staff, the college crew teams, and others "on the ground" at public and private launch sites to impress upon boaters the importance of preventing hydrilla from leaving or entering the Inlet.

Source Management

A comprehensive plan to eradicate hydrilla must recognize and address the source(s) of the infestation. This is a particular challenge for invasive plants for several reasons:

(a) The "cause" of invasive plant growth is not well understood in the abstract or for specific infestations. Although nutrients, sediment, and other growth factors can significantly influence the extent of invasive plant growth, the specific limiting agents are unknown.

(b) Reducing or eliminating these factors- intercepting nutrients or sediments before they enter an infestation zone- may not prevent future invasive plant establishment or bed formation, and may not be effective at reducing existing infestations.

(c) The actual source of most invasive plant infestations - the "seed"- is not known. The source or vector of transport for the initial hydrilla fragment, turion, or tuber for the Cayuga Inlet infestation is not known and almost certainly cannot be determined.

However, expending significant time and resources into eradicating an existing population would be inappropriate without expending some time and resources into some source management and preventative measures. These include intercepting and (where possible) eliminating new hydrilla inputs, education to keep Inlet and Lake residents and visitors on the lookout for new hydrilla sources, and minimizing nutrient and sediment sources that can provide a more hospitable habitat for new infestations and a less hospitable habitat for native plant communities.

The following strategies have been employed to address source management issues:

Transit:

Tompkins County recently passed a boat transit law which prohibits entering or exiting a waterbody with visible plants or animals attached to the watercraft, or transport of invasives within the county. The impetus for this 2012 law was the Cayuga Inlet infestation. More information about the law can be found at- http://ccetompkins.org/sites/all/files/8/20120725105425422%20%281%29.pdf

Education

There are a number of outreach and education activities conducted as part of this project, as cited previously in this Plan. A letter was sent to all local marina owners outlining sound practices for preventing transport of hydrilla. Generic invasive species pamphlets created by the state Office of Invasive Species Coordination and hydrilla-specific materials available on the state Cornell Cooperative Extension website have been distributed at a number of public events, and are available to boaters at launch sites in the area and within the infestation zone. Marina/Boat launch/Boat Owner education materials can be found at http://ccetompkins.org/environment/invasive-species/hydrilla-information-marina-owners.

Weed disposal

CCE has provided guidance to lake residents and others about the proper disposal methods for any aquatic plants pulled from their property. Although it is anticipated that any hydrilla plants found within the lake will be verified by experts and removed under the guidance of the Task Force, some incidental aquatic weed removal may occur that will "inadvertently" include hydrilla. This guidance can be found at http://ccetompkins.org/environment/invasive-species/disposing-water-weeds. The Tompkins County Solid Waste accepts any weeds removed by individuals (and materials collected as part of any formal hand harvesting overseen by the Task Force).

The Task Force has also encouraged the construction and use of invasive species (IS) disposal stations at marinas and any other private or public launching sites.

Signage and Inspections:

Signage developed in cooperation with the state Office of Invasive Species Coordination has been placed at each of the local launches within the Inlet, southern Cayuga Lake and many of the adjacent waterbodies. Hydrilla-specific signage was also developed by the Schuyler County SWCD for use in Cayuta Lake. Infested water signs were also posted at boat launches

along the Inlet. Boat inspections are conducted at the Allen H. Treman Marina State Park by OPRHP staff, trained as part of the Finger Lakes Institute stewardship program. Stewards generate annual reports identifying the number of boats, boaters, and frequency of finding organisms on inspected boats.

Sediment/Nutrient Control

The south end of Cayuga Lake is the subject of significant water quality studies and evaluation due to water quality issues predating the hydrilla infestation in Cayuga Inlet, and the loading of nutrients (particularly phosphorus) to the south end of the lake is a significant component of these studies. These studies may culminate in the development of a total maximum daily load (TMDL) assessment for the lake in support of evaluating use impairment documented on the federal impaired waters listing for the lake. The identification and eventual management of these sources of nutrients may ultimately result in a reduction in sediment nutrients in the Inlet and south end of the lake that may contribute to a favorable habitat for hydrilla colonization. For those nutrient sources associated with sediment loading, such as eroding materials entering the lake through non-point source pollution sources, the activities resulting in nutrient reduction may also serve to reduce sediment loading to the lake. This will also help to favorably influence the aquatic plant habitat in the areas where hydrilla is growing or could eventually grow.

Evaluation of Efficacy

The efficacy of the management plan will be evaluated in several ways. The 2012 Cayuga Inlet Hydrilla Monitoring Plan (available on StopHydrilla.org) will serve several purposes, but will mostly be used to evaluate the efficacy of treatment and therefore the efficacy of the management plan. The public outreach conducted throughout the process provides a mechanism for feedback. The external peer reviewers will focus on a few key "indicators" of success:

1. Did the management (plan) eradicate or make significant progress toward eradication of the target plants?
2. Did the management (plan) minimize the impact to non-target organisms, particularly protected plants and animals, critical environmental areas, and important fisheries resources?
3. Did the management (plan) adversely affect water quality, as evaluated by state water quality standards?
4. Did the management (plan) impact potable water uses?
5. Did the management (plan) improve or maintain recreational uses?
6. Were there any unintended consequences from the management actions?
7. Did the public think the management was successful?
8. Was the management (plan) cost effective?
9. Was the management (plan) sustainable (logistically and economically)?
10. Should the management actions be modified?

The first four questions will be answered through the plant, tuber and water quality monitoring program, as articulated in the Cayuga Inlet Hydrilla Monitoring Plan. The feedback about impacts to recreational uses, unintended consequences, and public support of and response to the management plan will be generated from the public outreach activities. The cost

effectiveness, sustainability, and need for modifying the plan will be provided through interaction with the external peer review team.

It is anticipated that the result of these evaluations will be an update to this Management Plan in subsequent years.

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