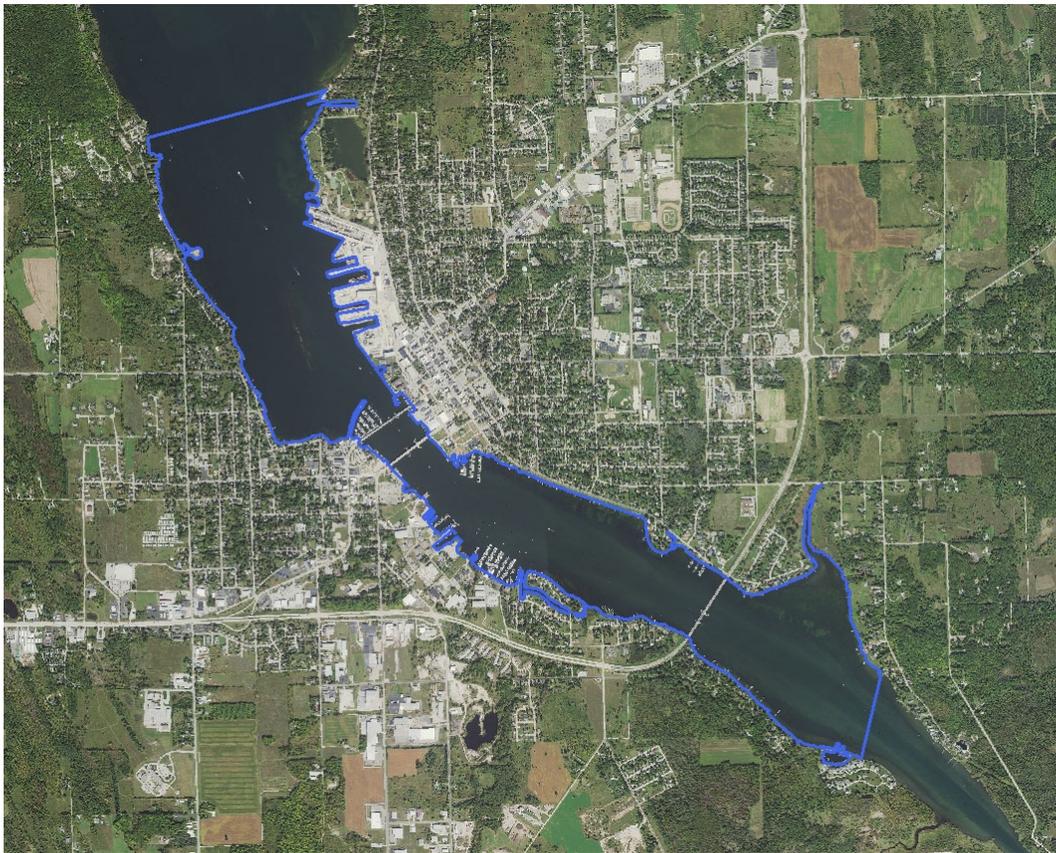

Sturgeon Bay

Door County, Wisconsin

Aquatic Plant Management Plan

December 2019

Updated Maps 4-6: March 31, 2021



Sponsored by:

City of Sturgeon Bay

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Door County, Wisconsin
Aquatic Plant Management Plan
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Funded by: City of Sturgeon Bay

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INTRODUCTION

Sturgeon Bay is an approximate 4,945-acre bay of Green Bay which cuts across the Door County peninsula and is artificially connected to Lake Michigan proper by the Sturgeon Bay Ship Canal (Figure 1). Sturgeon Bay is home to shipyards and many marinas and sees a high volume of both commercial and recreational watercraft traffic on an annual basis.

Since the mid-1980s, the City of Sturgeon Bay and private citizens have been working to manage nuisance levels of aquatic plant growth within the bay using a combination of mechanical harvesting and herbicide applications to maintain ease of navigation. The City of Sturgeon Bay now owns and operates three of its own mechanical harvesters which work to maintain open areas for navigation. Herbicide applications are also employed to control nuisance-level plant growth within and around the docking slips at marinas.

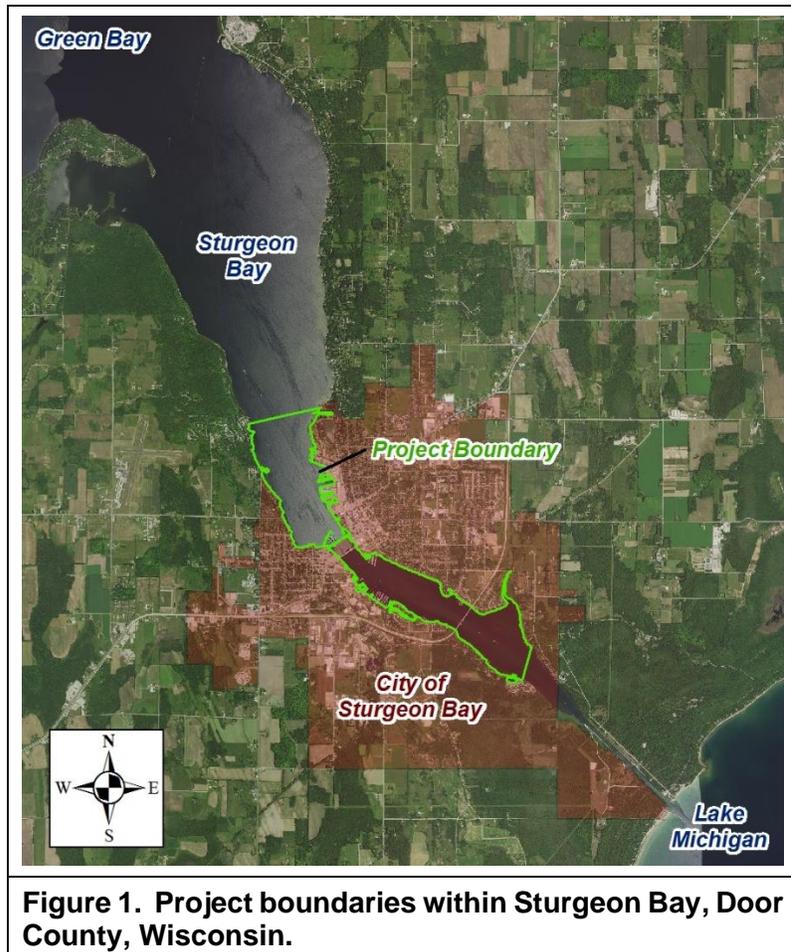


Figure 1. Project boundaries within Sturgeon Bay, Door County, Wisconsin.

Having an aquatic plant management plan that was over 10 years old, the City of Sturgeon Bay contracted with Northern Environmental Technologies (NET) in 2003 to develop an updated aquatic management plan for Sturgeon Bay. During their surveys, NET ecologists noted that the native aquatic plant common waterweed (*Elodea canadensis*), and the non-native, invasive plants Eurasian watermilfoil (*Myriophyllum spicatum*; EWM) and curly-leaf pondweed (*Potamogeton crispus*; CLP), were the primary aquatic plant species creating nuisance-level conditions and hindering navigation within the bay. Northern Environmental Technologies concluded that a combination of mechanical harvesting within the bay and herbicide applications within the marinas should continue to alleviate problematic aquatic plant growth.

In 2016, the City of Sturgeon Bay contracted with Onterra, LLC to assist them in updating their existing aquatic plant management plan, including revisions that were made to the plan in 2007. This project was originally designed to be completed over two years, with aquatic plant studies being conducted in 2016 and a stakeholder participation component being completed in 2017. In 2016, Onterra ecologists completed three aquatic plant studies within the project boundaries illustrated in Figure 1 to assess the aquatic plant community within this area. Following

discussions in early 2017, additional aquatic plant monitoring surveys and field visits were added to the project for 2017 and 2018. The intent of extending the project was two-fold; 1) to monitor the effectiveness of new aquatic plant management options on the bay, including updated herbicide treatment areas and dosing strategies and reconfigured harvesting areas; and 2) to provide further training to City of Sturgeon Bay staff on monitoring and implementing the updated aquatic plant management plan.

Surveys completed by Onterra staff with city staff during 2017 and 2018 indicated that the new herbicide treatment areas and dosing were meeting expectations by reducing nuisance conditions throughout the summer boating season. The additional site visits also allowed for city staff to be familiarized with the use of a Garmin GPS unit that had been preloaded by Onterra with a map showing all possible treatment areas and harvest areas contained in the updated aquatic plant management plan.

This document is broken into three primary sections detailing the full results of the multiple aquatic plant surveys conducted by Onterra ecologists in 2016, a summary of the three stakeholder surveys that were completed as a part of the project, and finally, the updated aquatic plant management plan approved by the Wisconsin DNR in April 2018 and first implemented by the City of Sturgeon Bay that summer.

AQUATIC PLANTS

Importance in the Aquatic Community

Although the occasional lake user considers aquatic plants (macrophytes) to be weeds and are often considered as a nuisance to the recreational use of the lake, these plants are an essential element in a healthy and functioning lake ecosystem (Photo 1). It is very important that lake stakeholders understand the importance of lake plants and the many functions they serve in maintaining and protecting a lake ecosystem. With increased understanding and awareness, most lake users will recognize the importance of the aquatic plant community and their potential negative effects on it.

Diverse aquatic vegetation provides habitat and food for many kinds of aquatic life, including fish, insects, amphibians, waterfowl, and even terrestrial wildlife. For instance, wild celery (*Vallisneria americana*) and sago pondweed (*Stuckenia pectinata*) both serve as excellent food sources for ducks and geese. Emergent stands of vegetation provide necessary spawning habitat for fish such as northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*). In addition, many of the insects that are eaten by young fish rely heavily on aquatic plants and the periphyton attached to them as their primary food source.



Photo 1. The native aquatic plant water stargrass found in Sturgeon Bay. Photo credit Onterra.

Aquatic plants also provide cover for feeder fish and zooplankton, stabilizing the predator-prey relationships within the system. Furthermore, rooted aquatic plants prevent shoreland erosion and the resuspension of bottom sediments and nutrients by absorbing wave energy and locking sediments within their root masses. In areas where plants do not exist, waves can resuspend bottom sediments decreasing water clarity and increasing nutrient levels that may lead to phytoplankton blooms. Lake plants also produce oxygen through photosynthesis and use nutrients that may otherwise be used by phytoplankton, which helps to minimize nuisance phytoplankton blooms.

Because most aquatic plants are rooted in place and are unable to relocate in the wake of environmental change, they are often the first aquatic community to indicate that changes may be occurring within the system. For this reason, aquatic plants are used as indicators of environmental health. Aquatic plant communities can respond in variety of ways; there may be increases or reductions in the occurrence of sensitive species, or a complete loss. Or, certain growth forms, such as emergent and floating-leaf communities may disappear from certain areas of the waterbody. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide relevant information for making management decisions.

Under certain conditions, a few species may grow to levels which can interfere with the use of the lake. Excessive plant growth can limit recreational use by deterring navigation, swimming, and fishing activities. It can also lead to changes in fish population structure by providing too much

cover for feeder fish resulting in reduced predation by predator fish, which could result in a stunted pan-fish population. Exotic plant species, such as EWM and CLP can also upset the delicate balance of a lake ecosystem by out competing native plants and reducing species diversity. These invasive plant species can form dense stands that are a nuisance to humans and provide low-value habitat for fish and other wildlife.

When plant abundance negatively affects the lake ecosystem and limits the use of the resource, plant management and control may be necessary. The management goals should always include the control of invasive species and restoration of native communities through environmentally sensitive and economically feasible methods. No aquatic plant management plan should only contain methods to control plants, they should also contain methods on how to protect and possibly enhance the important plant communities within the lake. Unfortunately, the latter is often neglected and the ecosystem suffers as a result.

Aquatic Plant Survey Methods

Three aquatic plant surveys were completed by Onterra ecologists in Sturgeon Bay in 2016: two whole-lake aquatic plant point-intercept surveys (June and August) and an emergent and floating-leaf aquatic plant community mapping survey (August). All aquatic plant species located during the 2016 surveys were collected, pressed, and sent to the University of Wisconsin-Stevens Point herbarium for confirmation of correct identification. The aquatic plant point-intercept survey method as developed by the Wisconsin Department of Natural Resources (WDNR) Bureau of Science Services (Hauxwell et al. 2010) was used in Sturgeon Bay in 2016. Based upon guidance from the WDNR, sampling locations were spaced 73 meters apart resulting in a total of 772 sampling locations (Map 1).

The **Littoral Zone** is the area of the lake where sunlight is able to penetrate to the sediment providing aquatic plants with sufficient light to carry out photosynthesis.

At each point-intercept location within the *littoral zone*, information regarding the depth, substrate type (soft sediments, sand, or rock/gravel), and the plant species sampled along with their relative abundance on the sampling rake was recorded (Figure 2). A pole-mounted rake was used to collect the plant samples, depth, and sediment information at point locations of 15 feet or less. A rake head tied to a rope (rope rake) was used at sites greater than 15 feet. Depth information was collected using graduated marks on the pole of the rake or using an onboard sonar unit at depths greater than 15 feet. Also, when a rope rake was used, information regarding substrate type was not collected due to the inability of the sampler to accurately feel the bottom with this sampling device. The point-intercept survey produces a great deal of information about a lake's aquatic vegetation and overall health. These data are analyzed and presented in numerous ways; each is discussed in more detail the following section.

A key component of any aquatic plant community assessment is the delineation of the emergent and floating-leaf aquatic plant communities within each lake as these plants are often underrepresented during the point-intercept survey. This survey creates a snapshot of these important communities within each lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with future surveys. Examples of emergent plants include cattails, rushes, sedges, grasses, bur-reeds, and arrowheads, while examples of floating-leaf species include the water lilies. The emergent and floating-leaf aquatic

plant communities in Sturgeon Bay were mapped using a Trimble Global Positioning System (GPS) with sub-meter accuracy.

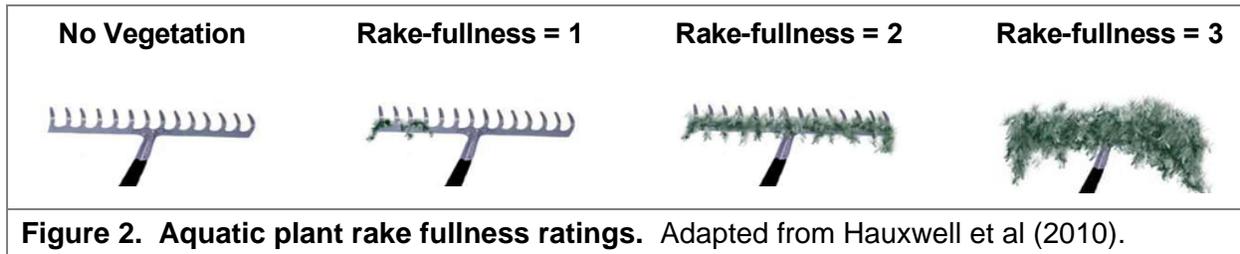


Figure 2. Aquatic plant rake fullness ratings. Adapted from Hauxwell et al (2010).

Data Interpretation

Species List

The species list is simply a list of all of the aquatic plant species, both native and non-native, that were located during the surveys completed in Sturgeon Bay in 2016. The list also contains the growth-form of each plant found (e.g. submergent, emergent, etc.), its scientific name, common name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in growth forms that are present, can be an early indicator of changes in the ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain aquatic plant species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of the whole-lake point-intercept survey completed on Sturgeon Bay, plant samples were collected from plots laid out on a grid that covered the lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. The occurrence of aquatic plant species is displayed as the *littoral frequency of occurrence*. Littoral frequency of occurrence is used to describe how often each species occurred in the plots that are within the maximum depth of plant growth (littoral zone), and is displayed as a percentage.

Floristic Quality Assessment

The floristic quality of a lake's aquatic plant community is calculated using its native *species richness* and their *average conservatism*. Species richness is the number of native aquatic plant species that were physically encountered on the rake during the point-intercept survey. Average conservatism is calculated by taking the sum of the coefficients of conservatism (C-values) of the native species located and dividing it by species richness. Every plant in Wisconsin has been assigned a coefficient of conservatism, ranging from 1-10, which describes the likelihood of that species being found in an undisturbed environment. Species which are more specialized and require undisturbed habitat are given higher coefficients, while species which are more tolerant of environmental disturbance have lower coefficients.

For example, algal-leaf pondweed (*Potamogeton confervoides*) is only found in nutrient-poor, acid lakes in northern Wisconsin and is prone to decline if degradation of these lakes occurs. Because of algal-leaf pondweed's special requirements and sensitivity to disturbance, it has a C-value of 10. In contrast, sago pondweed (*Stuckenia pectinata*) with a C-value of 3, is tolerant of disturbance

and is often found in greater abundance in degraded lakes that have higher nutrient concentrations and low water clarity. Higher average conservatism values generally indicate a healthier lake as it is able to support a greater number of environmentally-sensitive aquatic plant species. Low average conservatism values indicate a degraded environment, one that is only able to support disturbance-tolerant species.

On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality. The floristic quality is calculated using the species richness and average conservatism value of the aquatic plant species that were solely encountered on the rake during the point-intercept surveys (equation shown below). This assessment allows the aquatic plant community of Sturgeon Bay to be compared to other lakes within the region and state.

$$\text{FQI} = \text{Average Coefficient of Conservatism} * \sqrt{\text{Number of Native Species}}$$

Species Diversity

Species diversity is often confused with species richness. As defined previously, species richness is simply the number of species found within a given community. While species diversity utilizes species richness, it also takes into account evenness or the variation in abundance of the individual species within the community. For example, a lake with 10 aquatic plant species that had relatively similar abundances within the community would be more diverse than another lake with 10 aquatic plant species where 50% of the community was comprised of just one or two species.

An aquatic system with high species diversity is more stable than a system with a low diversity. This is analogous to a diverse financial portfolio in that a diverse aquatic plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. A lake with a diverse plant community is also better suited to compete against exotic infestations than a lake with a lower diversity. The diversity of a lake's aquatic plant community is determined using the Simpson's Diversity Index (1-D):

$$D = \sum (n/N)^2$$

where:

n = the total number of instances of a particular species

N = the total number of instances of all species and

D is a value between 0 and 1

If a lake has a diversity index value of 0.90, it means that if two plants were randomly sampled from the lake there is a 90% probability that the two individuals would be of a different species. The Simpson's Diversity Index value from Sturgeon Bay is compared to data collected by Onterra and the WDNR Science Services on 77 lakes within the Southeast Wisconsin Till Plain ecoregion and on 392 lakes throughout Wisconsin.

Aquatic Plant Survey Results

During the three aquatic plant surveys completed by Onterra ecologists in Sturgeon Bay in 2016, a total of 36 aquatic plant species were located, five of which are considered to be non-native, invasive species: Eurasian watermilfoil, curly-leaf pondweed, starry stonewort, purple loosestrife, and giant reed (Table 1). Because of their importance, these invasive species will be discussed in the subsequent Non-Native Aquatic Plants Section.

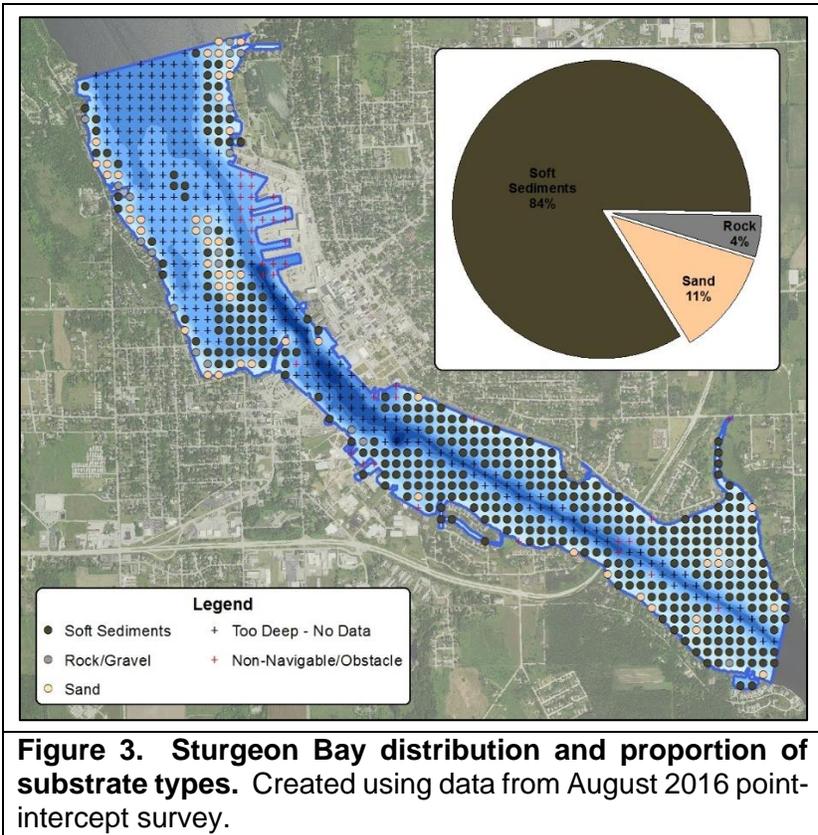
Table 1. Aquatic plant species located in Sturgeon Bay during the 2016 aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism	2016 Onterra
E	<i>Bolboschoenus fluviatilis</i>	River bulrush	5	I
	<i>Calla palustris</i>	Water arum	9	I
	<i>Juncus arcticus</i>	Arctic rush	5	I
	<i>Lythrum salicaria</i>	Purple loosestrife	Exotic	I
	<i>Phragmites australis</i> subsp. <i>australis</i>	Giant reed	Exotic	I
	<i>Sagittaria latifolia</i>	Common arrowhead	3	I
	<i>Schoenoplectus acutus</i>	Hardstem bulrush	5	I
	<i>Sparganium acaule</i>	Short-stemmed bur-reed	8	I
	<i>Sparganium eurycarpum</i>	Common bur-reed	5	I
FL	<i>Nuphar variegata</i>	Spatterdock	6	I
	<i>Nymphaea odorata</i>	White water lily	6	I
	<i>Persicaria amphibia</i>	Water smartweed	5	I
Submergent	<i>Ceratophyllum demersum</i>	Coontail	3	X
	<i>Chara</i> spp.	Muskgrasses	7	X
	<i>Elodea canadensis</i>	Common waterweed	3	X
	<i>Elodea nuttallii</i>	Slender waterweed	7	I
	<i>Heteranthera dubia</i>	Water stargrass	6	X
	<i>Myriophyllum sibiricum</i>	Northern water milfoil	7	I
	<i>Myriophyllum spicatum</i>	Eurasian water milfoil	Exotic	X
	<i>Najas flexilis</i>	Slender naiad	6	X
	<i>Najas guadalupensis</i>	Southern naiad	7	X
	<i>Nitellopsis obtusa</i>	Starry stonewort	Exotic	X
	<i>Potamogeton crispus</i>	Curly-leaf pondweed	Exotic	X
	<i>Potamogeton foliosus</i>	Leafy pondweed	6	I
	<i>Potamogeton friesii</i>	Fries' pondweed	8	X
	<i>Potamogeton gramineus</i>	Variable-leaf pondweed	7	X
	<i>Potamogeton praelongus</i>	White-stem pondweed	8	X
	<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	5	X
	<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	6	X
	<i>Ranunculus aquatilis</i>	White water crowfoot	8	X
	<i>Stuckenia pectinata</i>	Sago pondweed	3	X
	<i>Utricularia vulgaris</i>	Common bladderwort	7	X
<i>Vallisneria americana</i>	Wild celery	6	X	
<i>Zannichellia palustris</i>	Horned pondweed	7	X	
S/E	<i>Sagittaria cuneata</i>	Arum-leaved arrowhead	7	X
FF	<i>Spirodela polyrhiza</i>	Greater duckweed	5	I

FL = Floating-leaf; FL/E = Floating-leaf/Emergent; S/E = Submergent/Emergent; FF = Free-floating
 X = Located on rake during August point-intercept survey; I = Incidentally located species

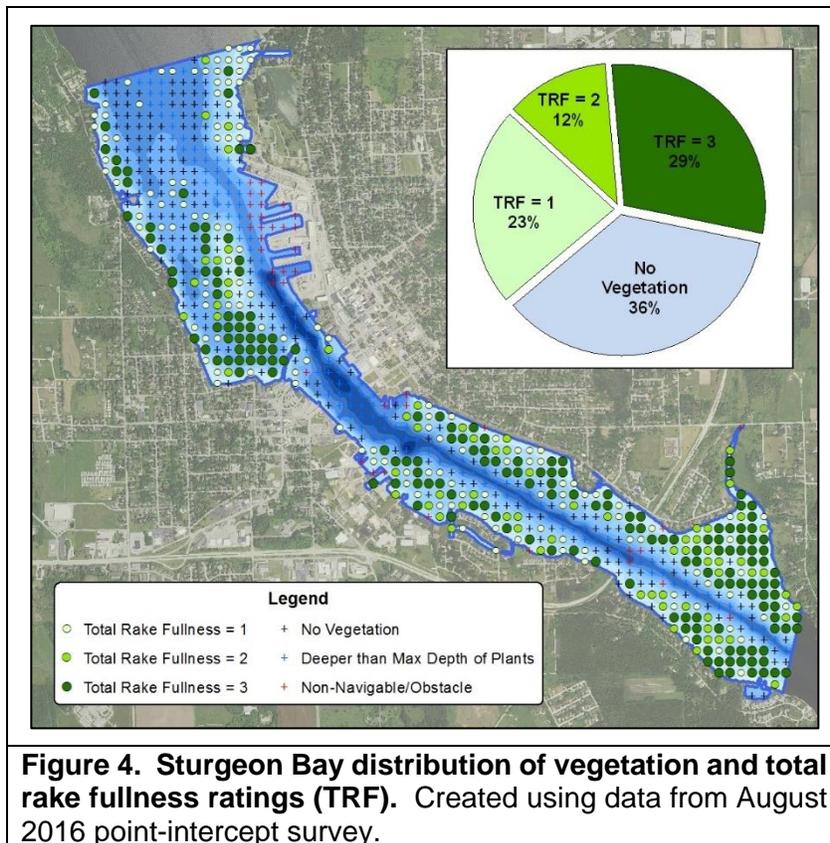
Lakes in Wisconsin vary in their morphology, water chemistry, substrate composition, and recreational use, and all of these factors influence aquatic plant community composition. Like terrestrial plants, different aquatic plant species are adapted to grow in certain substrate types; some species are only found growing in soft substrates, others only in sandy/rocky areas, and some

can be found growing in either. The combination of both soft sediments and areas of harder substrates creates different habitat types for aquatic plants, and generally leads to a higher number of aquatic plant species within the lake. During the August 2016, whole-lake point-intercept survey, information regarding substrate type was collected at locations sampled with a pole-mounted rake (less than 15 feet). These data indicate that the majority (84%) of the point-intercept locations less than 15 feet deep contained soft sediments, 11% contained sand, and 4% were found to contain rock (Figure 3). Areas with harder substrates were primarily located near shore or in northcentral area of the study area.



During the August 2016 point-intercept survey, aquatic plants were found growing to a maximum depth of 20 feet, a testament to the higher water clarity within the bay. Of the 608 point-intercept locations that fell within the maximum depth of plant growth, or within the littoral zone, approximately 64% contained aquatic vegetation. Approximately 73% of the point-intercept sampling locations that contained vegetation were within 5.0 to 12.0 feet of water. Figure 4 displays the distribution of aquatic vegetation in Sturgeon Bay as determined from the August 2016 point-intercept survey. Approximately 23% of the littoral point-intercept locations contained aquatic vegetation with a rake fullness rating of 1, 12% contained a rake fullness rating of 2, and 29% contained a rake fullness rating of 3. The higher proportion of sampling locations with a total rake fullness ratings of 2 and 3 indicates that where vegetation is present, it is relatively dense.

Of the 36 aquatic plant species located during the 2016 surveys, 20 species were physically sampled on the rake during the August point-intercept survey and the remaining 15 species were located *incidentally*. An incidentally-located species means the plant was not directly sampled on the rake during the point-intercept survey but was observed in the lake by Onterra ecologists and was recorded/collected. The majority of incidentally-located plants typically include emergent species growing along the lake’s margins and submersed species that are relatively rare within the lake’s plant community. Of the 20 species encountered on the rake in August 2016, common waterweed, muskgrasses, wild celery, and coontail were the four-most frequently encountered (Figure 5). Common waterweed, the most frequently encountered aquatic plant, with a littoral frequency of occurrence of approximately 30%, is found throughout lakes in Wisconsin and North America. It prefers growing in soft sediments and can often grow in dense beds that mat on the surface. In Sturgeon Bay, it was most abundant between 4.0 and 15.0 feet of water. Its dense



foliage provides valuable aquatic habitat while its ability to derive nutrients directly from the water improves water quality.

Muskgrasses, the second most frequently encountered aquatic plants in Sturgeon Bay had a littoral frequency of occurrence of approximately 29% (Figure 5) and were abundant between 5.0 and 10.0 feet of water. A genus of macroalgae, muskgrasses are not true vascular plants, and are often abundant in waterbodies that are clear with higher alkalinity. While several species of muskgrasses occur in Wisconsin, the muskgrasses in Sturgeon Bay were not identified to the species level.

Often growing in dense beds, muskgrasses stabilize bottom sediments, provide excellent structural habitat for aquatic organisms, and are sources of food for fish, waterfowl, and other wildlife (Borman et al. 2007).

With a littoral frequency of occurrence of approximately 19%, wild celery was the third-most frequently encountered aquatic plant in Sturgeon Bay in 2016 (Figure 5). The long, tapering leaves of wild celery provide excellent structural habitat for numerous aquatic organisms while its extensive root systems stabilize bottom sediments. Additionally, the leaves, fruit, tubers, and winter buds are food sources for numerous species of waterfowl and other wildlife.

Coontail, arguably the most abundant aquatic plant in Wisconsin, was the fourth-most frequently encountered aquatic plant in Sturgeon Bay with a littoral frequency of occurrence of approximately 17% (Figure 5). Unlike most of the submersed plants found in Wisconsin, coontail does not produce true roots and is often found growing entangled amongst other aquatic plants. Because it lacks true roots, coontail derives most of its nutrients directly from the water (Gross et al. 2013). This ability in combination with a tolerance for low-light conditions allows coontail to become more abundant in waterbodies with higher nutrients. While coontail has the capacity to form dense beds which mat on the surface and can hinder recreation, the majority of the coontail located in Sturgeon Bay was found growing in 10.0 to 15.0 feet of water.

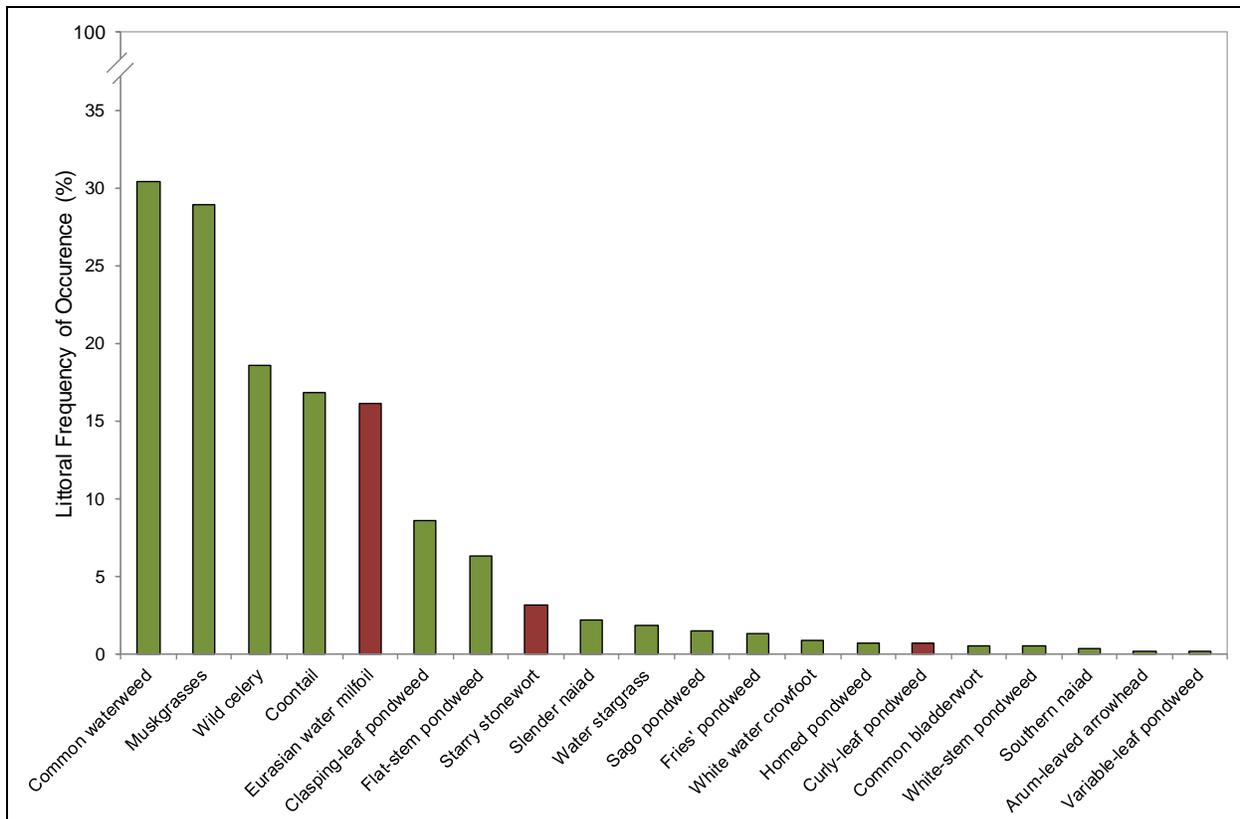


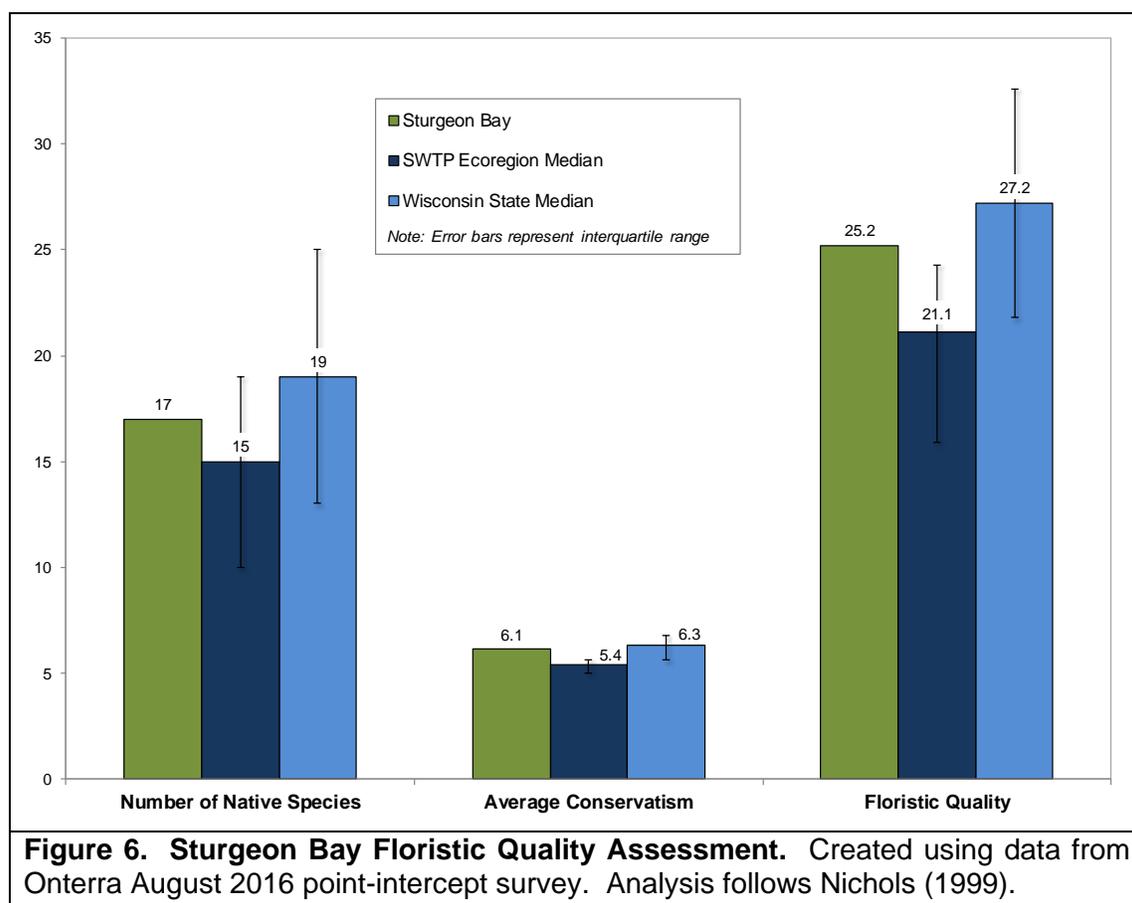
Figure 5. Littoral frequency of occurrence of aquatic plant species in Sturgeon Bay in August 2016. Exotic species indicated with red. Created using data from Onterra August 2016 point-intercept survey.

As discussed in the primer section, the calculations used to create the Floristic Quality Index (FQI) for a lake’s aquatic plant community are based on the aquatic plant species that were encountered on the rake during the point-intercept survey and does not include incidentally located species. The native species encountered on the rake during the August 2016 point-intercept survey and their conservatism values were used to calculate the FQI of Sturgeon Bay’s aquatic plant community.

Figure 6 compares the FQI components of Sturgeon Bay to median values of lakes within the Southeastern Wisconsin Till Plains (SWTP) ecoregion and to lakes throughout Wisconsin. The number of native aquatic plant species sampled on the rake was 17, which exceeds the median value for lakes in the SWTP ecoregion (15) but is slightly lower than the median for lakes state-wide (19). Similarly, Sturgeon Bay’s average conservatism value of 6.1 exceeds the SWTP ecoregion median value of 5.4 but falls slightly below the state median value of 6.3. Sturgeon Bay’s average conservatism value indicates that when compared to other lakes within the ecoregion, it contains a larger number of aquatic plant species with higher coefficients of conservatism.

Using Sturgeon Bay’s native species richness and average conservatism, its FQI was calculated to be 25.2 (Figure 6). This FQI value is higher the median value for lakes within the SWTP ecoregion (25.5) and slightly lower than the median value for lakes throughout Wisconsin (27.2). This analysis indicates that Sturgeon Bay’s aquatic plant community is of higher quality than the

majority of waterbodies within the SWTP ecoregion in terms of native aquatic plant species composition. However, its aquatic plant community is of slightly lower quality when compared against waterbodies throughout Wisconsin.



While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Sturgeon Bay's diversity value ranks. Using data collected by Onterra and WDNR Science Services, quartiles were calculated for 77 lakes within the SWTP Ecoregion (Figure 7). Using the data collected from the August 2016 point-intercept survey, Sturgeon Bay's aquatic plant community was found to have a Simpson's Diversity Index value of 0.86. In other words, if two individual aquatic plants were randomly sampled from Sturgeon Bay in 2016, there would be an 86% probability that they would be different species. Sturgeon Bay's species diversity value exceeds the median value for lakes within the SWTP ecoregion and is even with the median diversity value for lakes throughout Wisconsin.

As explained earlier, the littoral frequency of occurrence analysis allows for an understanding of how often each of the plants is located during the point-intercept survey. Because each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). For instance, while common waterweed was found at 30% of the littoral sampling locations in Sturgeon Bay, its relative frequency of occurrence was 22% (Figure 8). Explained another way, if 100 plants were randomly sampled from Sturgeon Bay, 22 would be common

waterweed, 21 would be muskgrasses, 13 would be wild celery, etc. As illustrated in Figure 8, approximately 80% of Sturgeon Bay’s aquatic plant community is comprised of five species.

The emergent and floating-leaf aquatic plant community mapping survey was completed by Onterra ecologists on August 22, 2016. This survey indicates that approximately 1.4 acres of the project area contain floating-leaf and emergent aquatic plant communities (Table 2 and Map 2). Thirteen emergent and floating-leaf aquatic plant species were located in 2016 (Table 1). These plant communities provide valuable fish and wildlife habitat important to the ecosystem of the lake. The low occurrence of emergent and floating-leaf aquatic plant communities in this area of the bay is likely due to the high degree of shoreland development and high volume of watercraft traffic.

Emergent and floating-leaf aquatic plant communities are an important component of the lake ecosystem as they provide valuable structural habitat, reduce sediment resuspension, and reduce shoreline erosion. Continuing the analogy that the community map represents a ‘snapshot’ of the important emergent and floating-leaf plant communities, a replication of this survey in the future will provide a valuable understanding of the dynamics of these communities within this area of Sturgeon Bay. This is important, because these communities are often negatively affected by recreational use and shoreland development. Radomski and Goeman (2001) found a 66% reduction in vegetation coverage on developed shorelines when compared to undeveloped shorelines in Minnesota Lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelines.

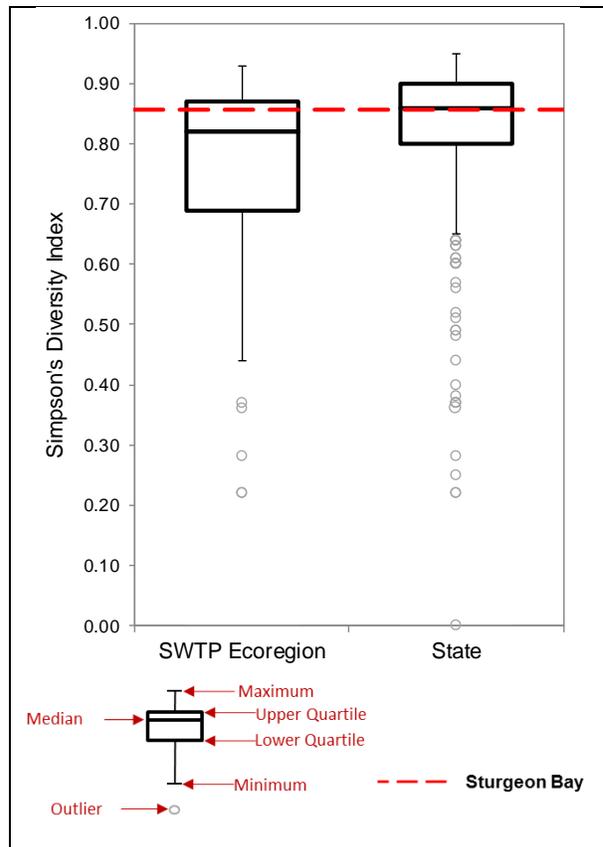
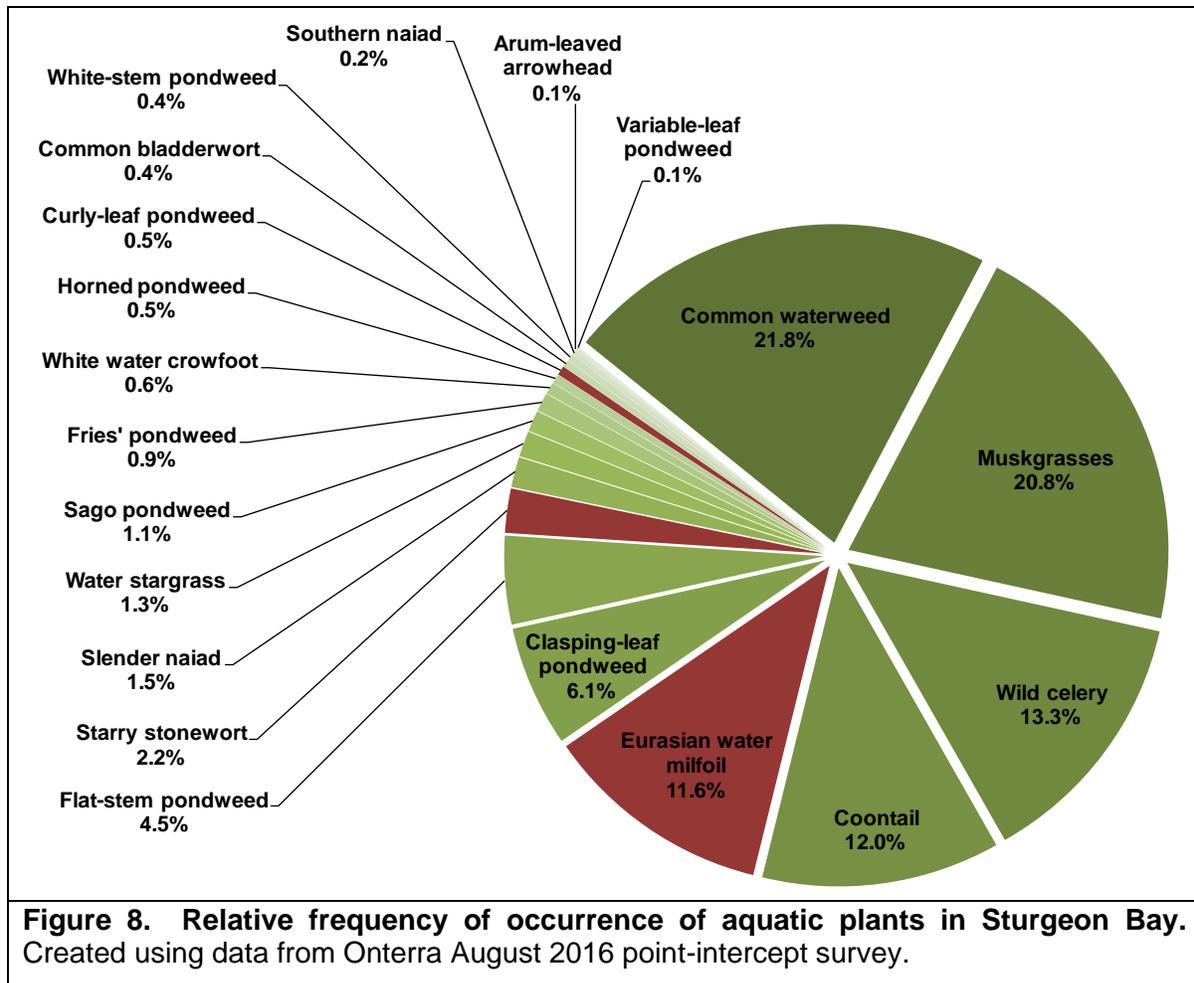


Figure 7. Sturgeon Bay aquatic plant community Simpson’s Diversity Index. SWTP = Southeastern Wisconsin Till Plain. Created using data from Onterra August 2016 point-intercept survey.

Table 2. Acres of emergent and floating-leaf aquatic plant communities in Sturgeon Bay in 2016. Created using data from Onterra August 2016 community mapping survey.

Plant Community	2016 Acres
Emergent	1.3
Floating-leaf	0.0
Mixed Emergent & Floating-leaf	0.1
Total	1.4



Non-Native Aquatic Plants in Sturgeon Bay

Curly-leaf pondweed

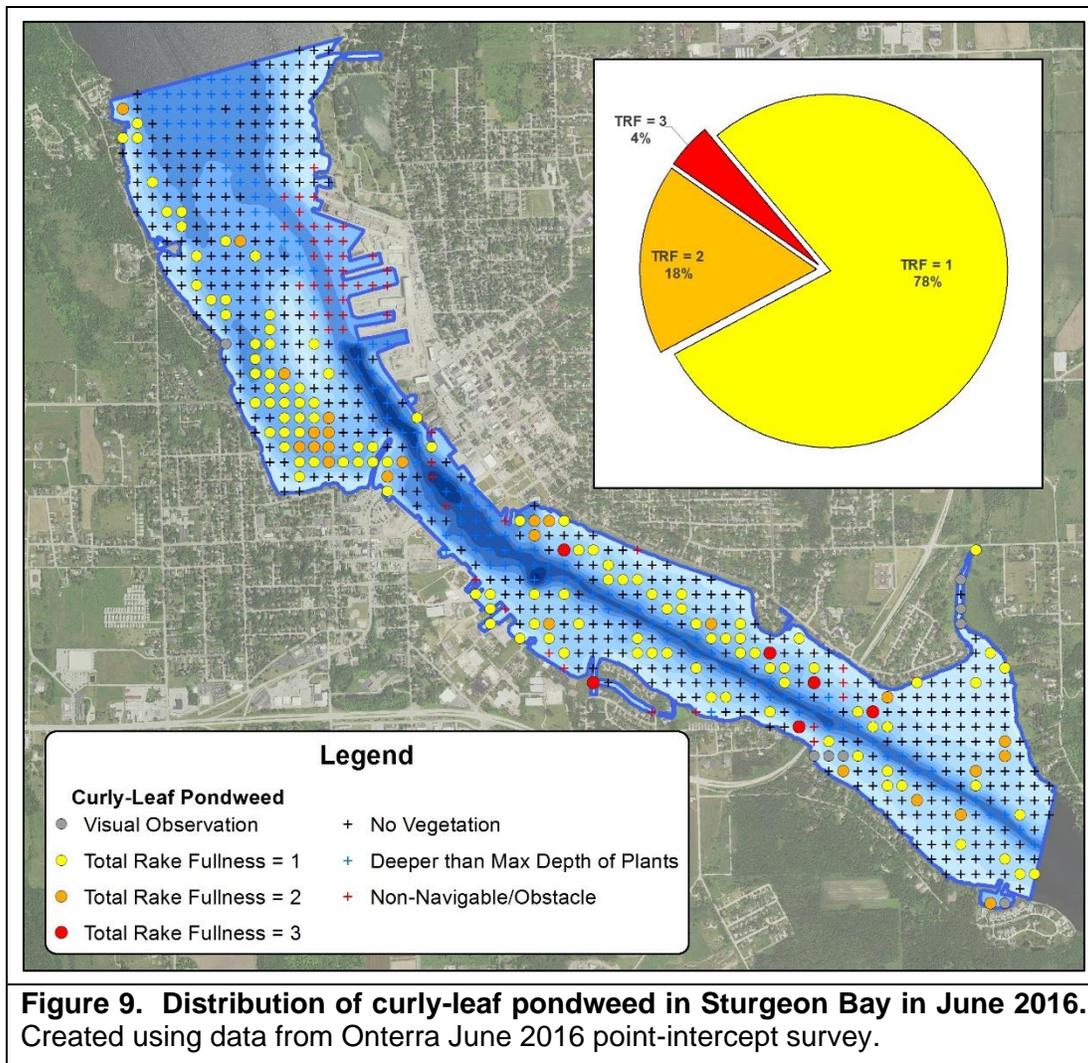
Curly-leaf pondweed (Photo 2) is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. Curly-leaf pondweed begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment.

The turions lie dormant until fall when they germinate to produce winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced in early May, giving the plant a significant jump on native vegetation. Like other invasive plants, curly-leaf pondweed can become so abundant that it hampers recreational activities within the lake. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.



Photo 2. Curly-leaf pondweed, a non-native, invasive aquatic plant. Photo credit Onterra.

Because of its odd life-cycle, a point-intercept survey was conducted early in the growing season on June 20, 2016 to gain an understanding of the distribution of curly-leaf pondweed within the study area of Sturgeon Bay when it was at its peak growth. Curly-leaf pondweed was the second-most frequently encountered aquatic plant during the June point-intercept survey with a littoral frequency of occurrence of approximately 25%. Figure 9 illustrates the distribution of CLP in Sturgeon Bay as determined from the point-intercept survey. This plant is widespread and abundant throughout most of the study area, with the exception of deeper areas and the northeastern portion of the study area. It was most abundant between 6.0 and 17.0 feet of water, but was also observed growing in some of the marinas. While CLP is widespread, the majority (78%) of the point-intercept locations containing CLP had a CLP rake fullness rating of 1, indicating that in most areas it is not overly dense. During the August point-intercept survey, CLP had a littoral frequency of occurrence of <1%, indicating that the majority of the population had died back by this time.



Eurasian watermilfoil

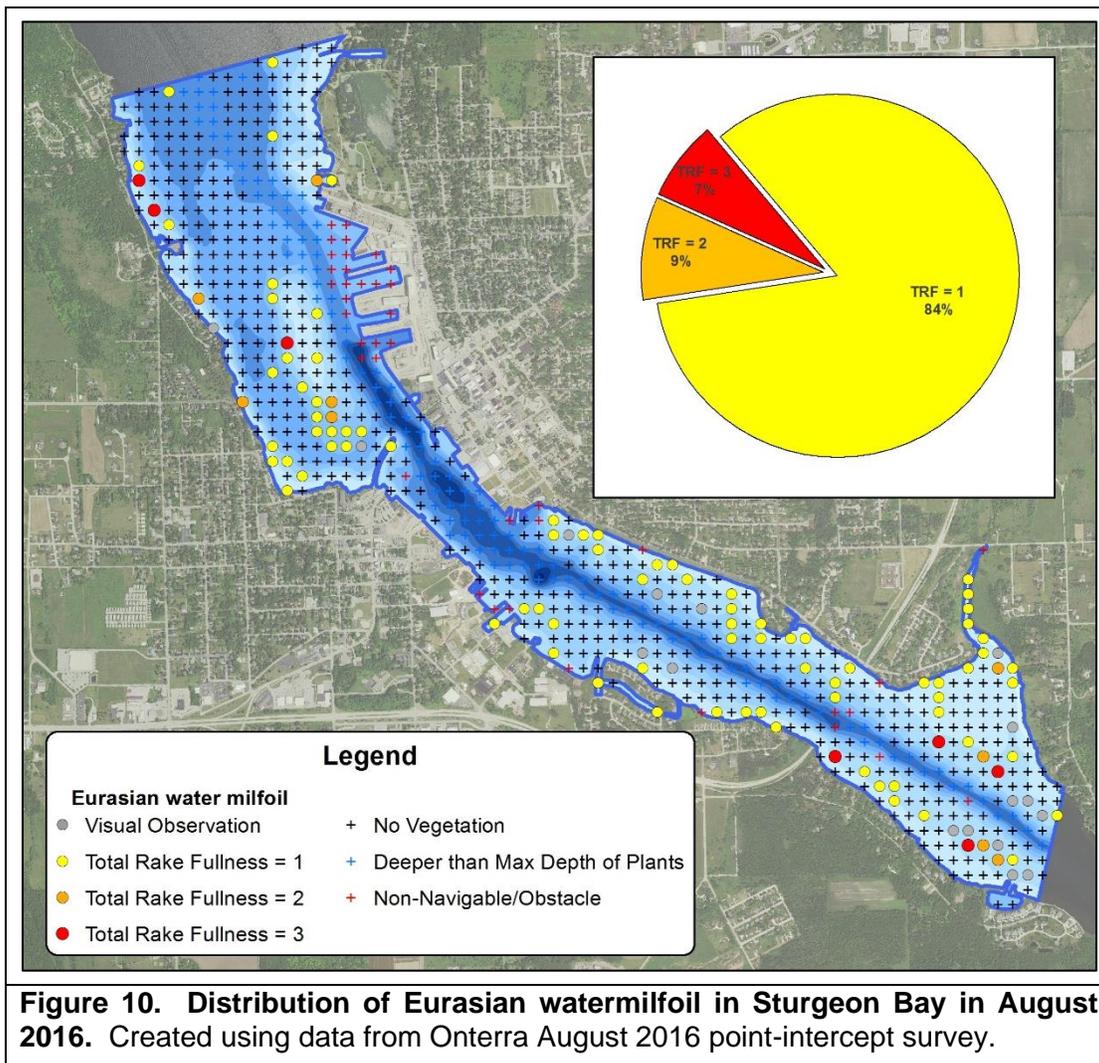
Eurasian watermilfoil (Photo 3) is an invasive species, native to Europe, Asia and North Africa, that has spread to most Wisconsin counties. Eurasian watermilfoil (EWM) is unique in that its primary mode of propagation is not by seed. It actually spreads by shoot fragmentation, which has supported its transport between lakes via boats and other equipment. In addition to its propagation method, EWM has two other competitive advantages over native aquatic plants: 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian water-milfoil can create dense stands and dominate submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating.

Unlike CLP, EWM reaches its peak growth in mid- to late-summer, and assessments are usually completed in July through September to capture populations at their peak. Figure 10 illustrates the distribution of EWM in the study area of Sturgeon Bay as determined from the point-intercept

survey completed by Onterra. During this survey, EWM had a littoral frequency of occurrence of approximately 16%, making it the fifth-most frequently encountered aquatic plant. It was most abundant between 4.0 and 14.0 feet of water. Total rake fullness data indicate that approximately 84% of the point-intercept sampling locations that contained EWM had an EWM total rake fullness rating of 1. Like CLP, while EWM is widespread throughout the study area, in most locations it is not overly dense. Onterra ecologists did note EWM growing within some of the marinas.



Photo 3. Eurasian watermilfoil, a non-native, invasive aquatic plant. Photo credit Onterra.



Starry stonewort

Starry stonewort (*Nitellopsis obtusa*; SSW; Photo 4) is a non-native, invasive macroalgae that was first observed in the United States in 1978 within the St. Lawrence River. It was recently discovered in a southeastern Wisconsin lake in 2014, and has since spread to six lakes within three counties in southeastern Wisconsin. The discovery of starry stonewort in Sturgeon Bay in 2016 marks the first record of its occurrence in Lake Michigan.



Photo 4. Starry stonewort, a non-native, invasive macroalgae.
Photo credit Onterra.

Like other invasive species, starry stonewort has been shown to quickly dominate aquatic plant communities, in some cases growing to nuisance levels and hindering recreation. During the August 2016 point-intercept survey on Sturgeon Bay, SSW had a relatively low littoral frequency of occurrence of approximately 3%. Figure 11 illustrates that SSW is widespread within the study area, but it was most frequently encountered within the southern portion of the study area. Starry stonewort was most abundant between 6.0 and 10.0 feet in Sturgeon Bay. Since its discovery in Sturgeon Bay, the WDNR has verified the presence of Starry Stonewort in Green Bay near Brussels, Fish Creek, and Little Sturgeon Bay.

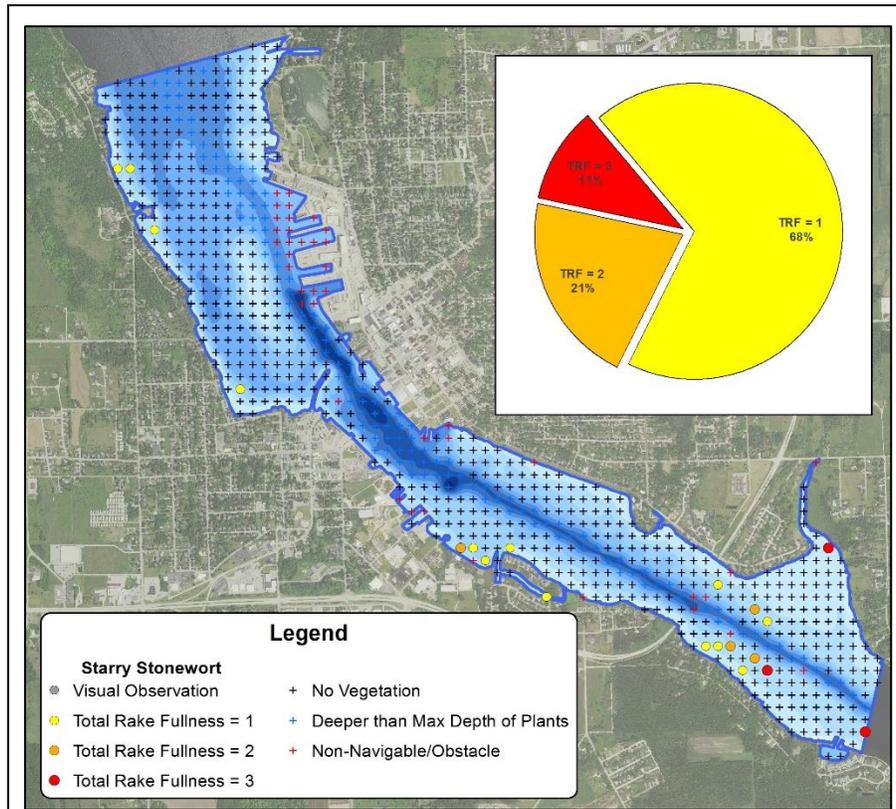


Figure 11. Distribution of starry stonewort in Sturgeon Bay in August 2016. Created using data from Onterra August 2016 point-intercept survey.

Purple loosestrife

Purple loosestrife (Photo 5) is a perennial herbaceous plant native to Europe and was likely brought over to North America as a garden ornamental. This plant escaped from its garden landscape into wetland environments where it is able to out-compete our native plants for space and resources. First detected in Wisconsin in the 1930's, it has now spread to 70 of the state's 72 counties. Purple loosestrife largely spreads by seed, but also can vegetatively spread from root or stem fragments.

Numerous purple loosestrife occurrences were located growing along portions of Sturgeon Bay's shoreline (Map 2). All of these occurrences were comprised of a single or few plants, and no large monotypic colonies were observed. There are a number of effective control strategies for combating this aggressive plant, including herbicide application, biological control by native beetles, and manual hand removal.



Photo 5. Purple loosestrife, a non-native, invasive wetland plant.
Photo credit Onterra.

Giant Reed (aka Phragmites)

Giant reed (*Phragmites australis* subsp. *australis*) is a tall, perennial grass that was introduced to the United States from Europe. While a native strain (*P. australis* subsp. *americanus*) of this species exists in Wisconsin, the plants located along the shorelines and in shallow water in Sturgeon Bay are the non-native, invasive strain. Giant reed forms towering, dense colonies that overtake native vegetation and replace it with a monoculture that provides inadequate sources of food and habitat for wildlife.

Giant reed was found growing in multiple locations in Sturgeon Bay in 2016 (Map 2). Because this species has the capacity to displace the valuable wetland plants along the exposed shorelines, it is recommended that these plants be removed by cutting and bagging the seed heads and applying herbicide to the cut ends. This management strategy is most effective when completed in late summer or early fall when the plant is actively storing sugars and carbohydrates in its root system in preparation for over-wintering. A permit issued by the WDNR will likely be needed to place herbicide on plants that are located within the water.

Summary and Conclusions

The goal of the 2016 aquatic plant studies on Sturgeon Bay were designed to assess the study area's aquatic plant community, both in terms of its native and non-native populations. These surveys revealed that Sturgeon Bay harbors a higher number of native aquatic plant species when compared to Wisconsin's inland lakes within the Southeastern Wisconsin Till Plains ecoregion. In addition, the surveys indicate that Sturgeon Bay's aquatic plant community has higher floristic quality when compared to inland lakes within the ecoregion. However, disturbance to the plant community is evident through the presence of five non-native species and a low occurrence of emergent and floating-leaf plant communities.

Curly-leaf pondweed and Eurasian watermilfoil were found to be widespread throughout the study area, but in most places where they occur, they were not overly dense. The discovery of starry stonewort in Sturgeon Bay represented the first documented occurrence of this plant in Lake Michigan, and given its widespread nature within the study area (and subsequently in Green Bay) indicates that this plant has likely been present for some time eluding detection. Purple loosestrife and giant reed were also found to be widespread along the shorelines of the study area.

In 2017, information pertaining to stakeholder use, perceptions, and concerns will be gathered to further aid in the development of an updated management plan for the City of Sturgeon Bay. Following the collection of this information, Onterra ecologists will work with the city to develop realistic and implementable management goals that will focus on aquatic plant protection, restoration, monitoring and nuisance growth management.

STAKEHOLDER SURVEY RESULTS

As a part of this project, the city and WDNR identified three stakeholder groups that are important in the development of an aquatic plant management plan. A stakeholder survey was distributed to private riparian property owners, marine owners/managers, and recreational boaters utilizing the bay through public landings around Sturgeon Bay. Each stakeholder group received a survey specifically designed to most efficiently and effectively reach that group. The surveys were designed by Onterra staff and reviewed by a WDNR social scientist. During March 2017, these surveys were distributed and conducted through Survey Monkey, written form, and an in-person questionnaire for stakeholders.

Of the 199 resident stakeholders who had the opportunity to complete the online survey, 27% were completed. Two written boat landing surveys were collected and 67% of the Marina interviews were conducted. Please note that a benchmark of a 60% response rate is required to portray population projections accurately, and make conclusions with statistical validity. The data were analyzed and summarized by Onterra staff for use at the planning meetings and within the management plan. All surveys and results can be found in Appendices B, C and D while discussion of those results is provided in a general summary below.

Residence Stakeholder Survey

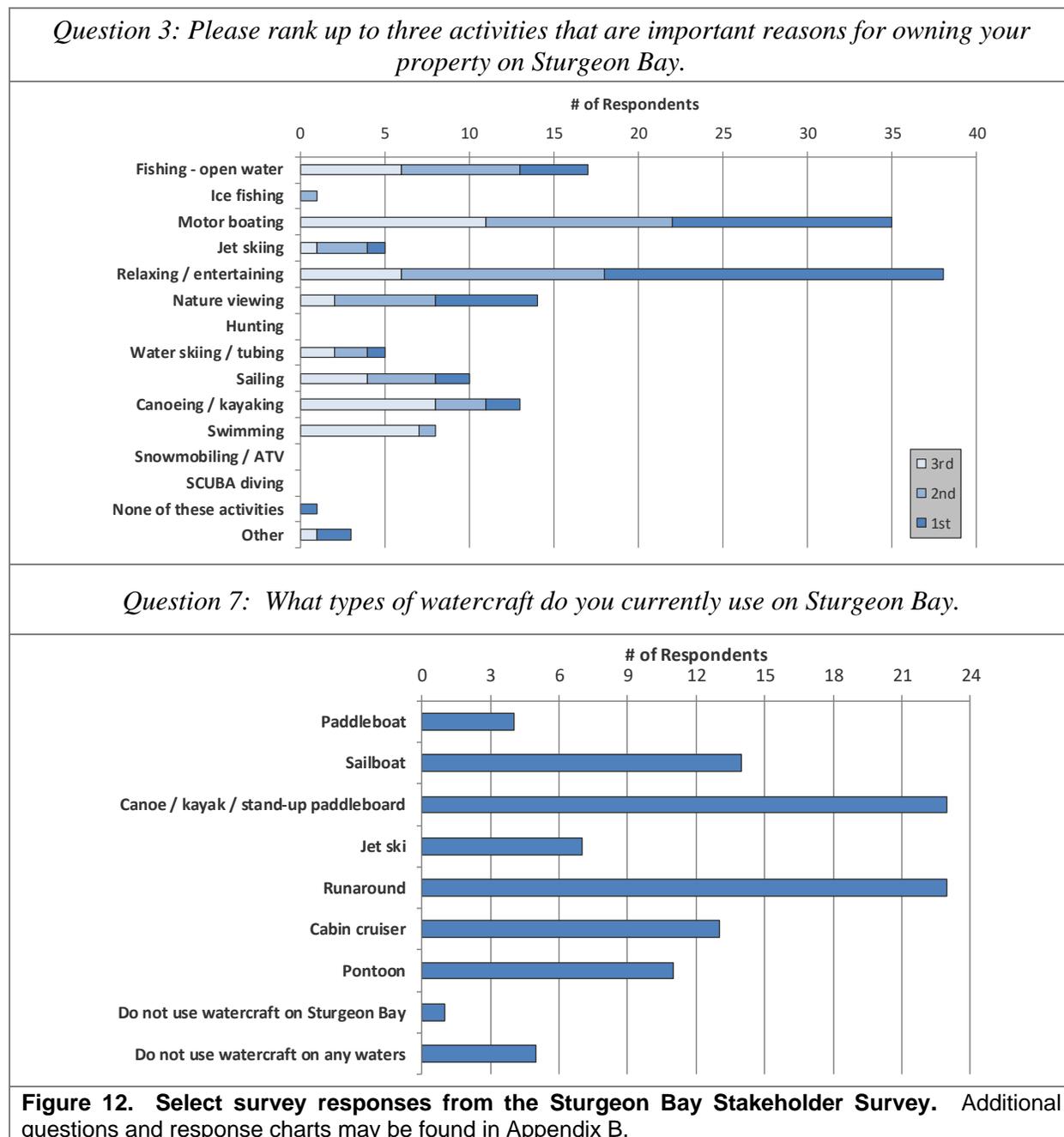
It is important to note, based on the survey results described above, the results of residence Stakeholder Survey, cannot be used to portray population projections accurately as the response rate was below 60%. However, a summary of the data received from the 53 online survey responses is provided below.

A distribution list of the qualified stakeholders was compiled by the city. During the five-week survey availability three reminder postcards were sent to residents with instructions on how to access the online survey. Figures 12 and 13 highlight questions within this survey particular to Sturgeon Bay utilization, aquatic plant management, and fisheries. Based upon the results of the online Stakeholder Survey, much was learned about the people who use and care for Sturgeon Bay.

The majority of respondents (64%) live on the bay year-round while 15% have a seasonal residence property, 14% visit on weekends throughout the year, and 2% have undeveloped property. Almost half of survey respondents indicate that they use either a runaround boat, canoe/kayak/stand-up paddleboard, or a combination of these vessels on Sturgeon Bay (Question 7). Sailboats, cabin cruisers and pontoon boats were the next most popular options. On a highly utilized area such as Sturgeon Bay, the importance of responsible boating activities is increased. The need for responsible boating especially increases during weekends, holidays, and during times of nice weather or good fishing conditions as well, due to increased traffic on the lake. As seen on Question 3, some of the top recreational activities on Sturgeon Bay involve boat use.

As shown in Question 3, fishing – open water was the third most important reason for stakeholders to own property on Sturgeon Bay. Based on the respondents who have personally fished Sturgeon Bay in the past three years, yellow perch, smallmouth bass, northern pike and walleye were the most popular fish species to catch (Question 6). The majority, 65%, of residential stakeholders who responded to the survey believe aquatic plant management is needed in Sturgeon Bay

(Question 11). Stakeholders also showed a strong support for mechanical harvesting and/or herbicide control versus doing nothing to manage the aquatic plants (Question 12).



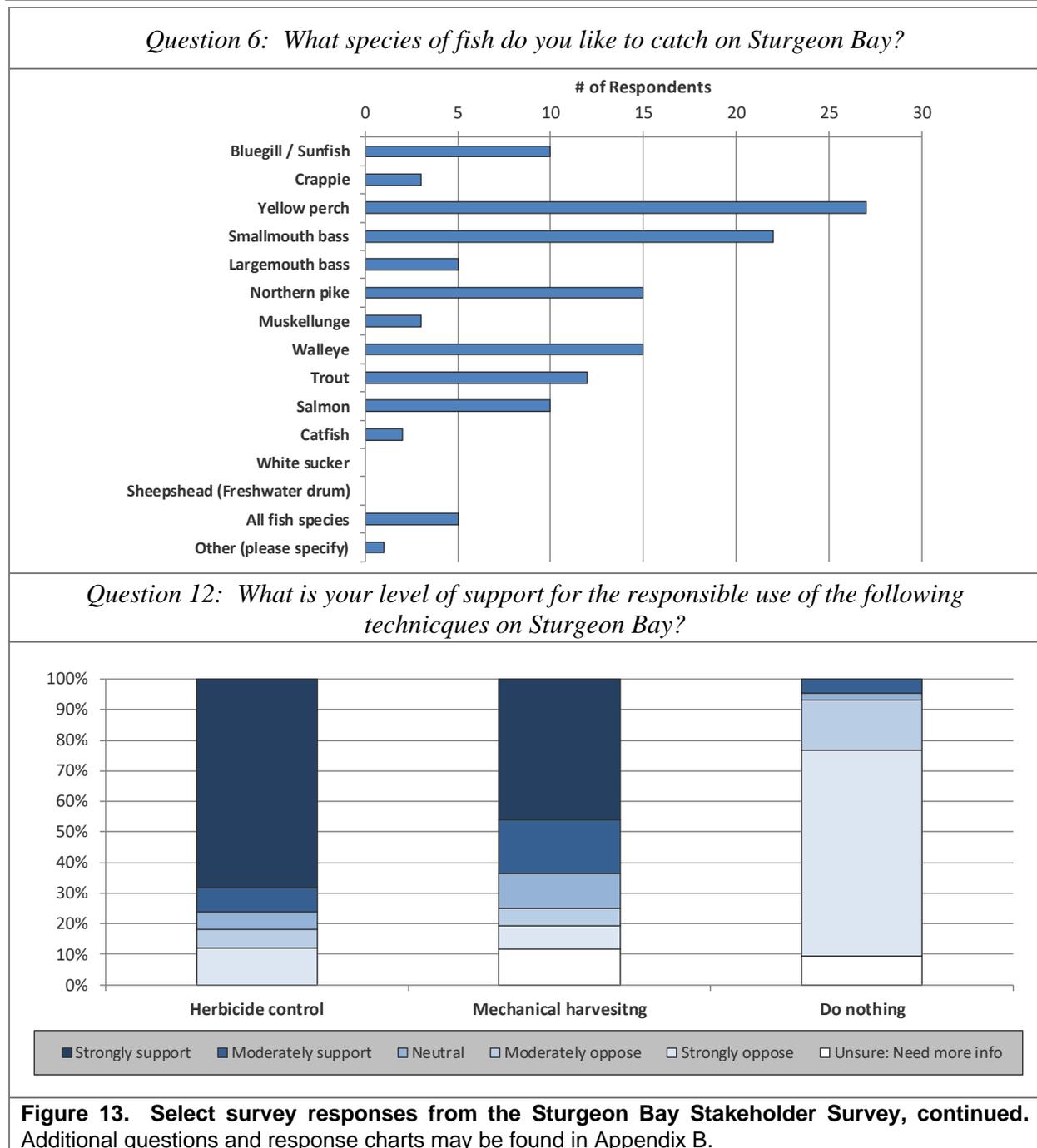


Figure 13. Select survey responses from the Sturgeon Bay Stakeholder Survey, continued. Additional questions and response charts may be found in Appendix B.

Marina Stakeholder Survey

Onterra staff contacted city officials to find interviewee contact information. Effort was made to ensure the interviewee was specifically a marine owner or boat slip manager of operations. This particular survey was designed to target the marinas not recreational boaters who use the marinas, their opportunity to take the survey were at boat landings described in the next section. Marina owners/managers were interviewed by phone or in-person by Onterra staff members.

Majority, five of the six marina owners/managers interviewed, said there are no current aquatic plant issues due to the herbicide and mechanical harvesting plan in place. These owners also feel overall if management of the aquatic plants ceased the marinas would have navigational issues. One marina said the current plan in place is not working and has a fragment problem in their marina. The majority, 65%, of residential stakeholders believe aquatic plant management is needed on Sturgeon Bay while the majority of marina owner/managers had very few if any aquatic plant concerns. This is likely due to recreational users considering the portion or portions of the canal they utilize and marina owners considering only the marinas they own/manage. Marina surveys are displayed in Appendix C.

Boat Landing Stakeholder Survey

Sunset Park and Sawyer Park boat landings are the two primary access points for recreational users to access the bay. A city staff member located at these locations asked recreational stakeholders using the boat landings to complete a written survey. Originally this survey was proposed to be an interview following a predetermined script; however, it was decided an offered written survey would reach more stakeholders. City staff were stationed at the landings May through August in 2017, one weekday every two weeks and one weekend day each month. During the aforementioned timeframe two surveys were completed both at the Sawyer Park boat landing. The low response rate may be due to how busy the boat landings can be during the summer months. Survey results showed they were fishing for yellow perch and walleye. Both stakeholders were also negatively impacted by plants in the Sturgeon Bay. Surveys are displayed in Appendix D.

AQUATIC PLANT MANAGEMENT PLAN

As a part of this project, the City of Sturgeon Bay and the WDNR requested that the updated management plan be shorter and easier to use than the previous plan created in the early 2000s, which was hundreds of pages long. To meet that request, Onterra presented the aquatic plant management plan in a simple, outlined form. Only two maps were recreated, one showing the mechanical harvesting areas and the other showing the potential herbicide treatment areas. Both of these maps are completely updated compared to earlier versions with the most recent bathymetry and accurate acreages and volumes. These maps were loaded on to a Garmin GPSMap 78 for use by city staff for setting up and monitoring the aquatic plant control strategy each year.

Four versions of the aquatic plant management plan, including maps, were created during the process of gaining approval from both the WDNR and City of Sturgeon Bay. Version 4 was approved by WDNR fisheries and lake staff in April 2018 and first implemented by the city that summer.

Mechanical Harvesting (Map 3)

Harvest Areas

- Cut to half the water depth or 4', whichever is shallower
- All harvest areas end at the pier face and no cutting can be completed between piers or within the City of Sturgeon Bay Pierhead Line, with the exception of the access lanes harvested in Purves and Ashers Lagoon
- All gamefish and yellow perch should be returned to the water immediately.
- If moderate numbers of gamefish or young-of-year perch are encountered while harvesting, harvest operations in that area will cease for at least 24 hours. After 24 hours, the area will be checked for presence of fish before harvesting resumes.
- Purves and Ashers Lagoons will be cut to create a 20' wide lane, if needed for navigation.

Mooring Areas

- These areas will be harvested following the same guidelines as above

Access Lanes

- 30' wide access lanes will be maintained following the same harvesting guidelines as above
- The access lanes may not be needed in all years

Floater Harvesting

- Floaters can be harvested in all areas of the bay, including marinas, public boat launches, Purves Lagoon, and Ashers Lagoon
- Floaters cannot be harvested in No Harvest Areas or within the City of Sturgeon Bay Pierhead Line, except for the areas designated above.
- During floater harvesting, the cutter head will not be lower than 2' below the surface

Business and Residential Dockside Pick Up

- Harvesting crews will pick up aquatic plants harvested by business and private pier owners
- Harvested plants should be placed on dock furthest away from shore to allow easiest access for harvesting crew

No Harvest Area

- This area would not be harvested without permission from the WDNR

Herbicide Control in Marina Areas (Map 4, insets on Map 5 & Map 6)

Herbicide Treatment Areas & Timing

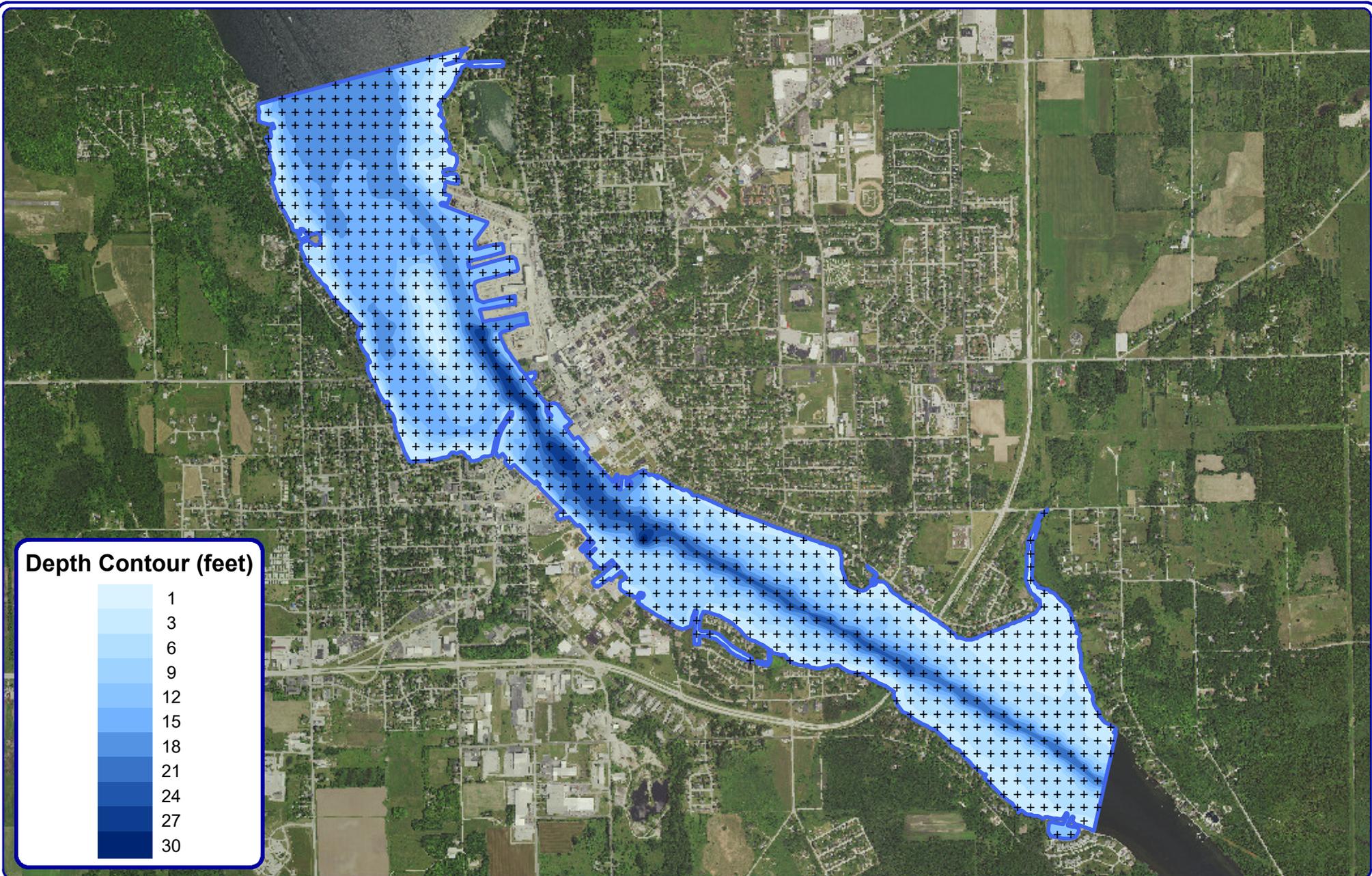
- Marina treatment areas extend from shore to approximately 10' of water depth
- Prior to each herbicide treatment, the city will inspect the treatment areas to determine if a treatment is warranted depending on the abundance of target species present
 - The surveyor would use a GPS loaded with a basemap that delineates the extents of the blocks available for treatment.
 - The surveyor would indicate if the average condition of the block is a 1) *current nuisance*, 2) *anticipated nuisance*, or 3) *not current issue*. The first two categories would be slated for treatment
- The treatment areas are small; therefore, to assure the best opportunity to obtain necessary concentration and exposure times, either the entirety of the area will be treated or it will not be treated at all. There would NOT be an option to only treat part of the site block.
- Treatments will occur when wind speeds at the Door County/Cherryland Airport are 10 mph or less
- A single herbicide treatment would occur each growing season

Mid-Season Herbicide Treatment

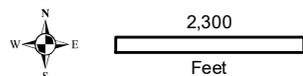
- Herbicides requiring short exposure times would be used to target Eurasian watermilfoil, curly-leaf pondweed, and nuisance natives
 - Diquat, copper, flumioxazin, etc.
- If starry stonewort is found to be a *current nuisance* or an *anticipated nuisance*, the treatment strategy would also integrate best management practices for this non-native macro-algae (currently involving the use of copper herbicide/algaecide)
- Treatment would occur in late June to early July

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- Nichols, S.A. 1999. Floristic quality assessment of Wisconsin lake plant communities with example applications. *Journal of Lake and Reservoir Management* 15(2): 133-141
- Radomski P. and T.J. Goeman. 2001. Consequences of Human Lakeshore Development on Emergent and Floating-leaf Vegetation Abundance. *North American Journal of Fisheries Management*. 21:46–61.



Depth Contour (feet)



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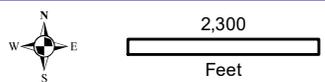
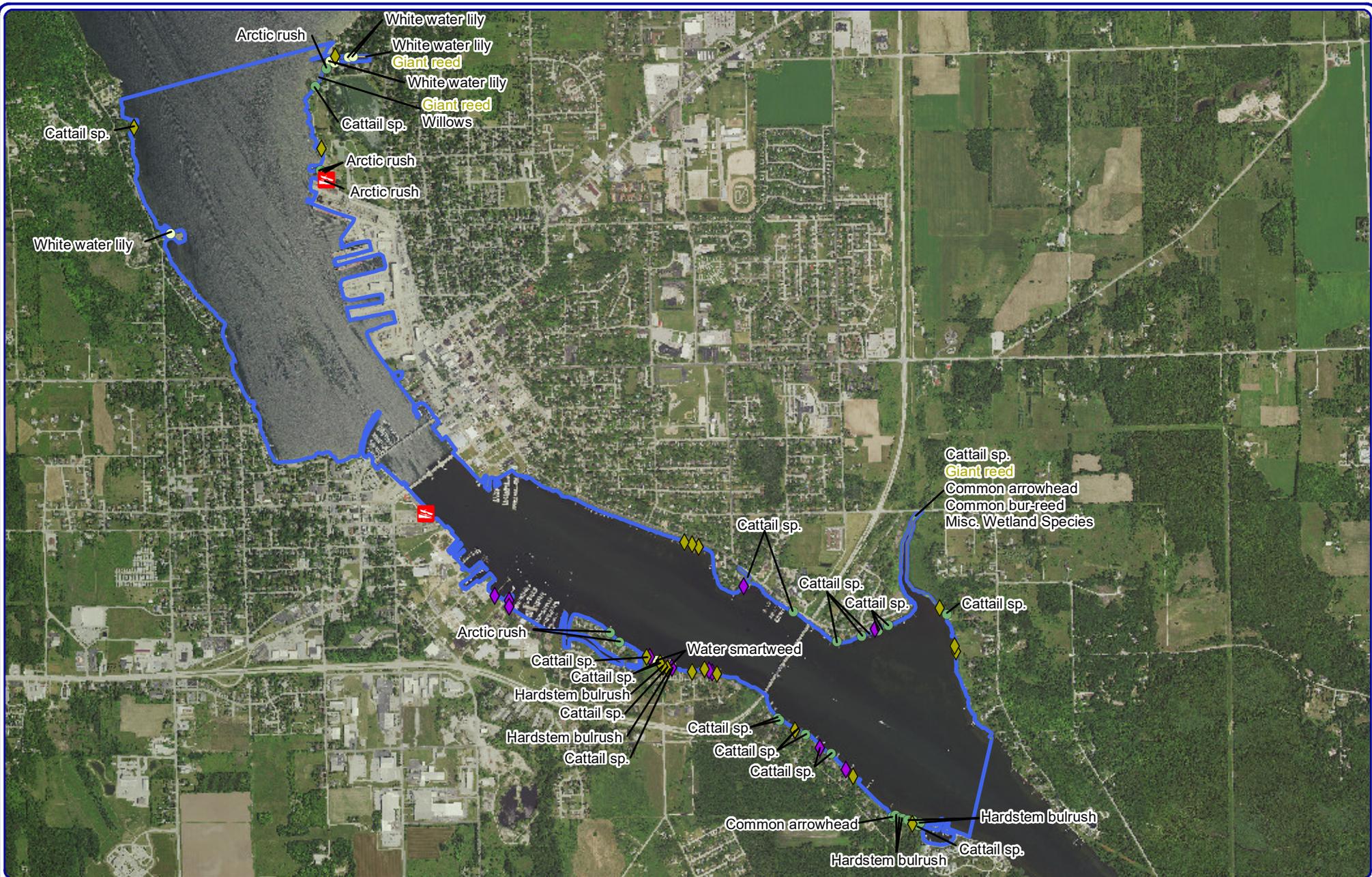
Sources:
 Orthophotography: NAIP, 2015
 Bathymetry: Onterra, 2016
 Map Date: November 30, 2016
 Filename: Map1_SturgeonBay_Location.mxd



Project Location in Wisconsin

- Legend**
-  Project Boundary (~1,013 acres)
 Max Depth: 34 feet
 Calculated Volume: ~12,800 acre-feet
 - + Point-Intercept Survey Location
 73 meter spacing; 772 total points

Map 1
 Sturgeon Bay
 Door County, Wisconsin
**Project Location &
 Boundaries**



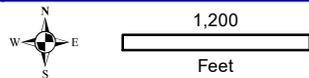
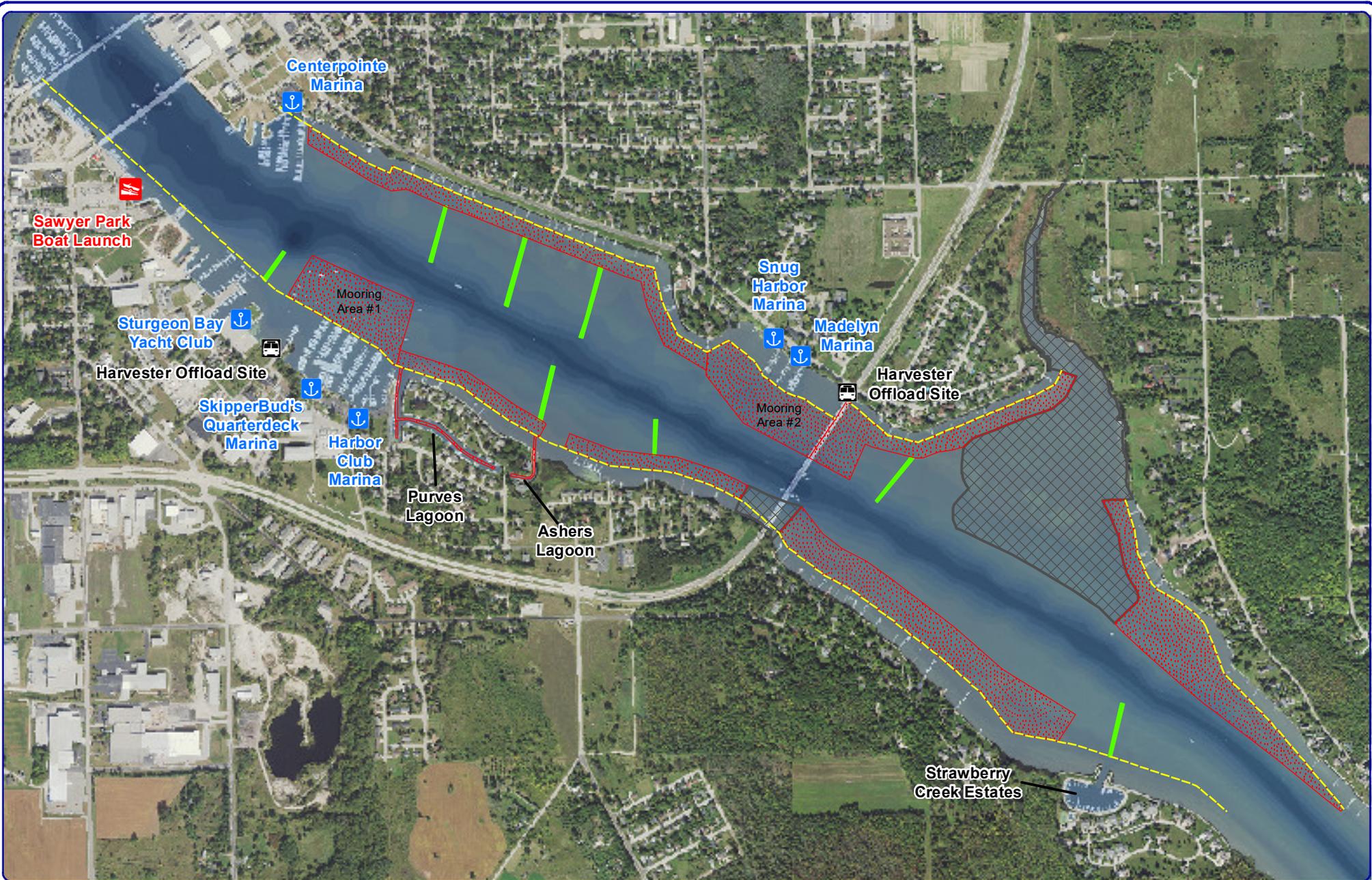
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Sources:
 Roads and Hydro: WDNR
 Plant Survey: Onterra, 2016
 Map Date: October 24, 2016
 Filename: SturgeonBay_Comm_Summer16.mxd

Project Location in Wisconsin

Small Plant Community	Large Plant Community	Exotic Plant Community
● Emergent	Emergent	◆ Purple Loosestrife
● Floating-Leaf	Floating-Leaf	◆ Giant Reed
● Mixed Emergent & Floating-Leaf	Mixed Emergent & Floating-Leaf	

Map 2
Sturgeon Bay
 Door County, Wisconsin
Emergent & Floating-Leaf
Aquatic Plant Communities



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Sources:
 Hydro and Roads: WDNR
 Orthophotography: NAIP, 2017
 Bathymetry: Modeled by Onterra, 2016
 Pierhead Line: City of Sturgeon Bay
 Map Date: June 13, 2018 - EJM
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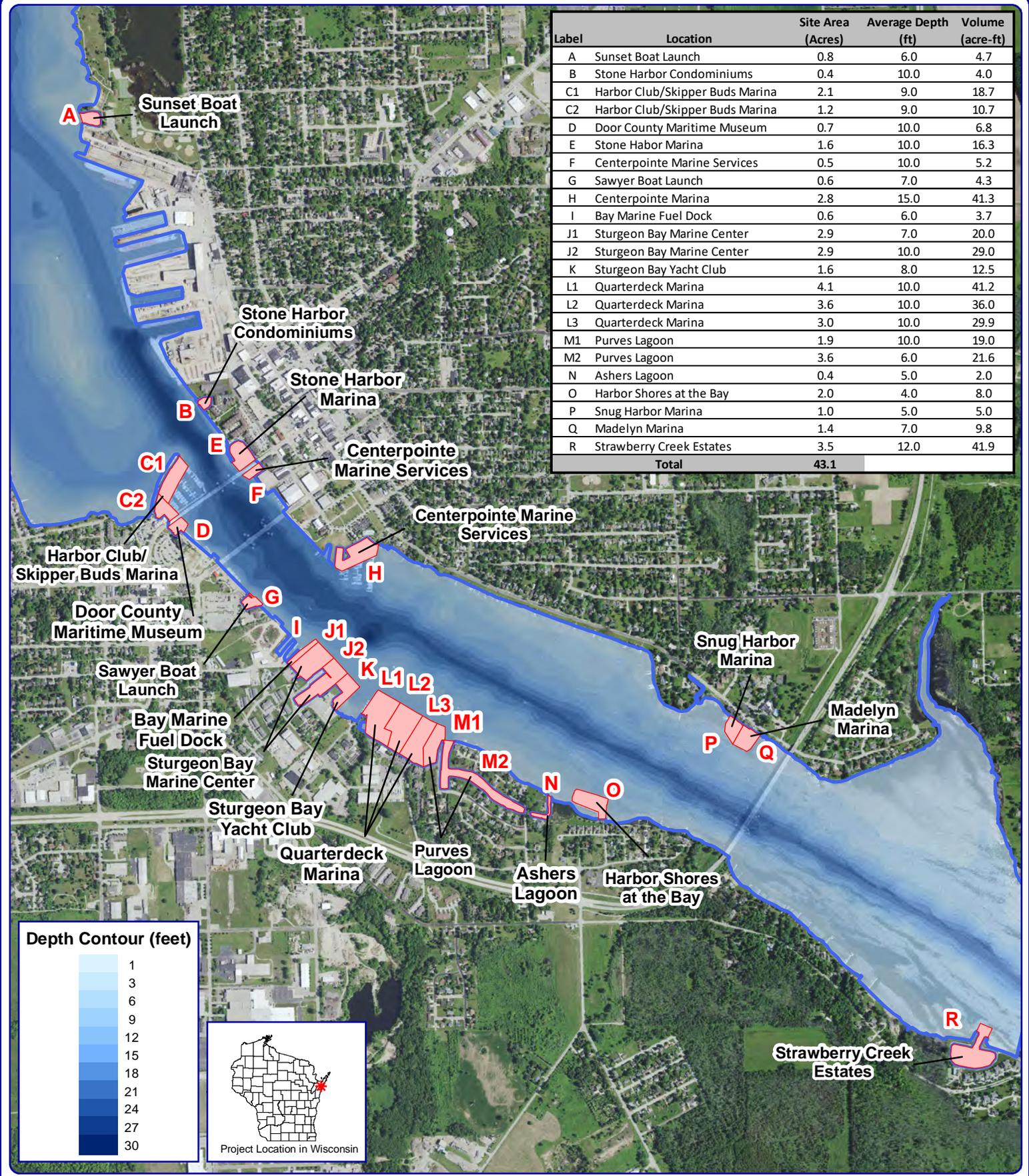


Project Location in Wisconsin

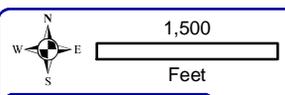
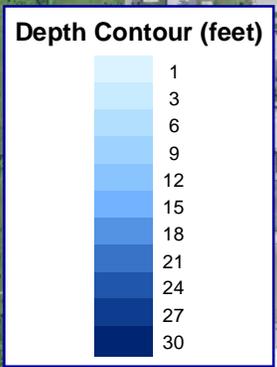
Legend

- Pierhead Line
- Harvest Area (~116 Acres)
- Access Lane (30 ft wide, ~3 Acres)
- No Harvest Area (~64 Acres)

Map 3
 Sturgeon Bay
 Door County, Wisconsin
Mechanical Harvesting Strategy



Label	Location	Site Area (Acres)	Average Depth (ft)	Volume (acre-ft)
A	Sunset Boat Launch	0.8	6.0	4.7
B	Stone Harbor Condominiums	0.4	10.0	4.0
C1	Harbor Club/Skipper Buds Marina	2.1	9.0	18.7
C2	Harbor Club/Skipper Buds Marina	1.2	9.0	10.7
D	Door County Maritime Museum	0.7	10.0	6.8
E	Stone Harbor Marina	1.6	10.0	16.3
F	Centerpointe Marine Services	0.5	10.0	5.2
G	Sawyer Boat Launch	0.6	7.0	4.3
H	Centerpointe Marina	2.8	15.0	41.3
I	Bay Marine Fuel Dock	0.6	6.0	3.7
J1	Sturgeon Bay Marine Center	2.9	7.0	20.0
J2	Sturgeon Bay Marine Center	2.9	10.0	29.0
K	Sturgeon Bay Yacht Club	1.6	8.0	12.5
L1	Quarterdeck Marina	4.1	10.0	41.2
L2	Quarterdeck Marina	3.6	10.0	36.0
L3	Quarterdeck Marina	3.0	10.0	29.9
M1	Purves Lagoon	1.9	10.0	19.0
M2	Purves Lagoon	3.6	6.0	21.6
N	Ashers Lagoon	0.4	5.0	2.0
O	Harbor Shores at the Bay	2.0	4.0	8.0
P	Snug Harbor Marina	1.0	5.0	5.0
Q	Madelyn Marina	1.4	7.0	9.8
R	Strawberry Creek Estates	3.5	12.0	41.9
Total		43.1		



Legend

Potential Herbicide Control Block

Map 4
Sturgeon Bay
Door County, Wisconsin

Potential Herbicide Control Blocks

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Sources:
Roads & Hydro: WDNR
Orthophotography: NAIP, 2020
Bathymetry: Onterra, 2016
Map Date: March 31, 2021



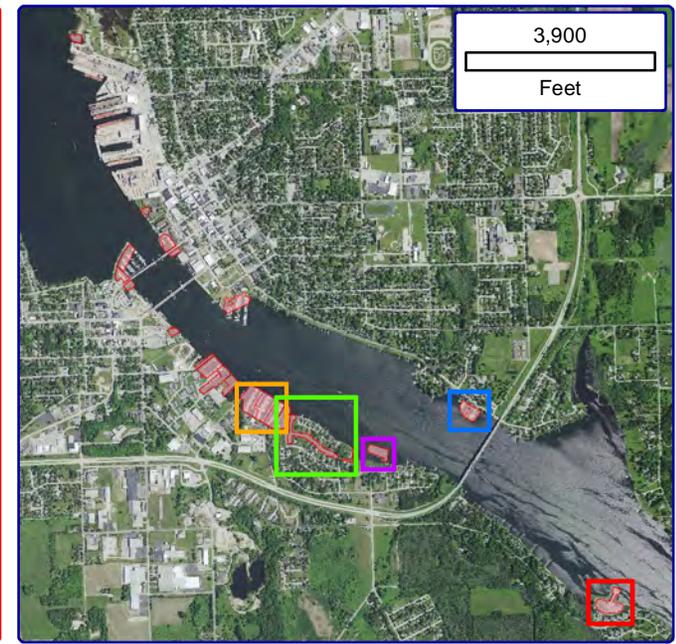
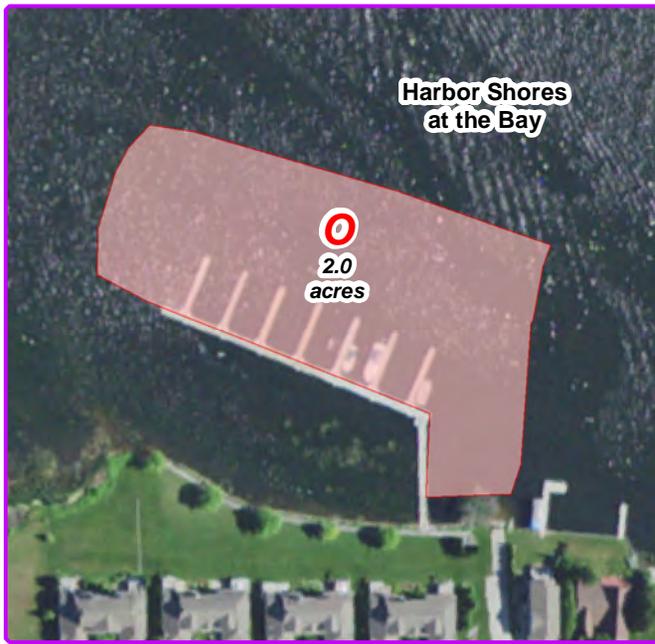
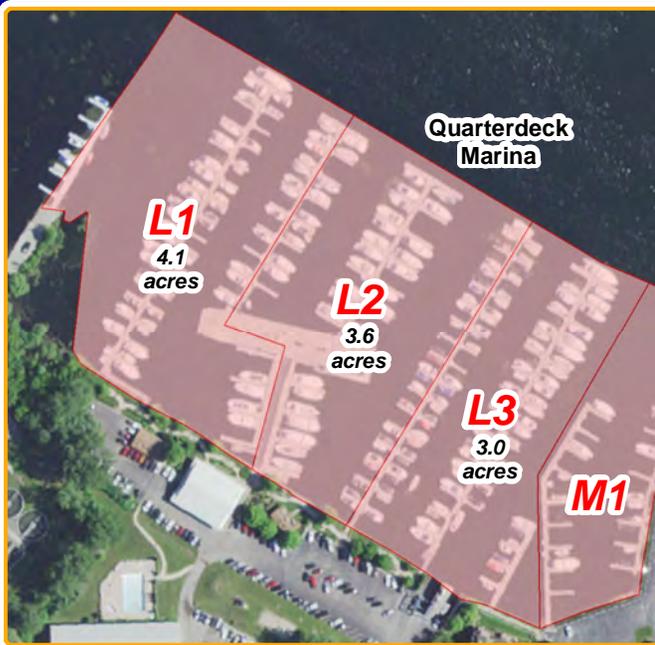
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Sources:
Hydro and Roads: WDNR
Orthophotograph: NAIP, 2020
Map Date: March 31, 2021



Legend
 Potential Herbicide Control Block

Map 5
Sturgeon Bay
Door County, Wisconsin
Potential Herbicide Control Blocks - Detailed View



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Sources:
 Hydro and Roads: WDNR
 Orthophotograph: NAIP, 2020
 Map Date: March 31, 2021



Legend

Potential Herbicide Control Block

Map 6
 Sturgeon Bay
 Door County, Wisconsin
Potential Herbicide Control Blocks - Detailed View

A

APPENDIX A

2016 Aquatic Plant Survey Data

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	NOTES	NUSIANCE	TRF	Myriophyllum spicatum	Potamogeton crispus	Celastris	Ceratophyllum demersum	Chara spp.	Eloea canadensis	Eloea nuttallii	Heteranthera dubia	Myriophyllum abricum	Najas guadalupensis	Niletila spp.	Nuphar variegata	Potamogeton foliosus	Potamogeton friesii	Potamogeton praelongus	Potamogeton richardsonii	Potamogeton zosterifolius	Ranunculus aquatilis	Stuckenia pectinata	Utricularia vulgaris	Vallisneria spiralis	Filamentous algae	Zannichellia palustris							
559	-87.354897	44.8224344		Sturgeon Bay	Door	6/21/2016	JLW & CMB	559	0			OTHER	marked off with buoys. Construction barges and																																
560	-87.347518	44.8222632		Sturgeon Bay	Door	6/20/2016	JLW & NLS	560	4	Muck	Pole	SAMPLED			2	2																													
561	-87.346595	44.8222417		Sturgeon Bay	Door	6/20/2016	JLW & NLS	561	5	Sand	Pole	SAMPLED			1																														
562	-87.345673	44.8222203		Sturgeon Bay	Door	6/20/2016	JLW & NLS	562	4	Muck	Pole	SAMPLED			2	2																													
563	-87.344751	44.8221988		Sturgeon Bay	Door	6/20/2016	JLW & NLS	563	4	Sand	Pole	SAMPLED			3	1	1																												
564	-87.370607	44.8221403		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	564	6	Muck	Pole	SAMPLED			3	V	3																												
565	-87.369685	44.8221191		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	565	7	Muck	Pole	SAMPLED			2																														
566	-87.366918	44.8220553		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	566	4	Muck	Pole	SAMPLED			0																														
567	-87.365995	44.822034		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	567	5	Muck	Pole	SAMPLED			1																														
568	-87.365073	44.8220127		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	568	6	Muck	Pole	SAMPLED			1																														
569	-87.364151	44.8219914		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	569	9	Muck	Pole	SAMPLED			3																														
570	-87.363228	44.8219701		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	570	11	Muck	Pole	SAMPLED			0																														
571	-87.362306	44.8219488		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	571	11	Muck	Pole	SAMPLED			0																														
572	-87.361383	44.8219274		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	572	17		Rope	SAMPLED			0																														
573	-87.360461	44.8219061		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	573	23			DEEP																																	
574	-87.359539	44.8218848		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	574	24			DEEP																																	
575	-87.358616	44.8218634		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	575	14	Muck	Pole	SAMPLED			1	1																													
576	-87.357694	44.8218421		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	576	12	Muck	Pole	SAMPLED			0																														
577	-87.356772	44.8218207		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	577	11	Muck	Pole	SAMPLED			3	3																													
578	-87.355849	44.8217994		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	578	9	Muck	Pole	SAMPLED			1																														
579	-87.354927	44.8217778		Sturgeon Bay	Door	6/21/2016	JLW & CMB	579	0			OTHER	Construction occurring, no boats allowed																																
580	-87.354004	44.8217566		Sturgeon Bay	Door	6/21/2016	JLW & CMB	580	5	Muck	Pole	SAMPLED			3	1																													
581	-87.353082	44.8217352		Sturgeon Bay	Door	6/21/2016	JLW & CMB	581	5	Sand	Pole	SAMPLED			1																														
582	-87.350315	44.821671		Sturgeon Bay	Door	6/20/2016	JLW & NLS	582	4	Sand	Pole	SAMPLED			3	1	1																												
583	-87.349393	44.8216496		Sturgeon Bay	Door	6/20/2016	JLW & NLS	583	5	Sand	Pole	SAMPLED			1																														
584	-87.34847	44.8216282		Sturgeon Bay	Door	6/20/2016	JLW & NLS	584	5	Sand	Pole	SAMPLED			1																														
585	-87.347548	44.8216067		Sturgeon Bay	Door	6/20/2016	JLW & NLS	585	5	Sand	Pole	SAMPLED			1																														
586	-87.346625	44.8215853		Sturgeon Bay	Door	6/20/2016	JLW & NLS	586	5	Muck	Pole	SAMPLED			1	1																													
587	-87.345703	44.8215638		Sturgeon Bay	Door	6/20/2016	JLW & NLS	587	5	Muck	Pole	SAMPLED			2	1																													
588	-87.344781	44.8215424		Sturgeon Bay	Door	6/20/2016	JLW & NLS	588	4	Sand	Pole	SAMPLED			1																														
589	-87.365103	44.8213562		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	589	5	Muck	Pole	SAMPLED			3																														
590	-87.36418	44.8213349		Sturgeon Bay	Door	6/20/2016	JMB & E.JH	590	5	Muck	Pole	SAMPLED			1																														
591	-87.363258	44.8213136		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	591	10	Muck	Pole	SAMPLED			1	1																													
592	-87.362336	44.8212923		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	592	9	Sand	Pole	SAMPLED			1	1																													
593	-87.361413	44.821271		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	593	10	Muck	Pole	SAMPLED			1																														
594	-87.360491	44.8212497		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	594	11	Muck	Pole	SAMPLED			1																														
595	-87.359569	44.8212283		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	595	21			DEEP																																	
596	-87.358646	44.821207		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	596	27			DEEP																																	
597	-87.357724	44.8211856		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	597	21			DEEP																																	
598	-87.356802	44.8211643		Sturgeon Bay	Door	6/21/2016	JMB & E.JH	598	16		Rope	SAMPLED			0																														
599	-87.355879	44.8211429		Sturgeon Bay	Door	6/21/2016	JLW & CMB	5																																					

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	NOTES	NUSANCE	TRF	Myriophyllum spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Eriocaulon canadense	Heteranthera dubia	Najas flexilis	Najas guadalupensis	Potamogeton friesii	Potamogeton gramineus	Potamogeton praelongus	Potamogeton richardsonii	Potamogeton zosteriformis	Ranunculus aquatilis	Stuckenia pectinata	Utricularia vulgaris	Vallisneria spiralis	Sagittaria arifolia	Freshwater sponge	Filamentous algae	Niletilapia obtusa	Zannichellia palustris			
217	44.8395689	-87.385516	217	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	217	0			OTHER																												
218	44.8391234	-87.3947724	229	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	218	5	Rock	Pole	SAMPLED			1			1						1																
219	44.8391023	-87.3938497	228	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	219	11	Muck	Pole	SAMPLED			3				1				3																	
220	44.8390813	-87.3929271	227	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	220	18		Rope	SAMPLED			0																									
221	44.8390602	-87.3920044	226	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	221	19		Rope	SAMPLED			0																									
222	44.8390391	-87.3910817	225	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	222	18		Rope	SAMPLED			0																									
223	44.839018	-87.390159	224	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	223	16		Rope	SAMPLED			3					1																				
224	44.8389969	-87.3892364	223	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	224	5	Sand	Pole	SAMPLED			0																									
225	44.8389758	-87.3883137	221	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	225	6	Sand	Pole	SAMPLED			2				1	1																				
226	44.8389547	-87.387391	220	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	226	12	Muck	Pole	SAMPLED			1	1																								
227	44.8389335	-87.3864683	219	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	227	0			DEEP																												
228	44.8389124	-87.3855457	218	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	228	0			OTHER																												
229	44.838849	-87.3827777	222	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	229	0			OTHER																												
230	44.8384459	-87.3938793	230	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	230	4	Rock	Pole	SAMPLED			0	V																								
231	44.8384248	-87.3929567	231	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	231	16		Rope	SAMPLED			0																									
232	44.8384037	-87.392034	232	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	232	18		Rope	SAMPLED			0																									
233	44.8383826	-87.3911113	233	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	233	19		Rope	SAMPLED			0																									
234	44.8383615	-87.3901887	234	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	234	16		Rope	SAMPLED			2		1	1										2												
235	44.8383404	-87.389266	235	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	235	9	Muck	Pole	SAMPLED			2			1																						
236	44.8383193	-87.3883434	236	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	236	4	Rock	Pole	SAMPLED			1			1																						
237	44.8382982	-87.3874207	237	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	237	9	Muck	Pole	SAMPLED			3				3																					
238	44.8382771	-87.386498	238	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	238	19		Rope	SAMPLED			0																									
239	44.8382559	-87.3855754	239	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	239	0			DEEP																												
240	44.8377683	-87.3929863	257	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	240	15	Muck	Pole	SAMPLED			3			1		3																				
241	44.8377472	-87.3920636	256	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	241	18		Rope	SAMPLED			0																									
242	44.8377261	-87.391141	253	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	242	18		Rope	SAMPLED			0																									
243	44.837705	-87.3902183	252	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	243	16		Rope	SAMPLED			3		1	1											3											
244	44.8376839	-87.3892957	249	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	244	8	Sand	Pole	SAMPLED			3	3			1																					
245	44.8376628	-87.388373	248	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	245	3	Rock	Pole	SAMPLED			0																									
246	44.8376417	-87.3874504	245	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	246	7	Muck	Pole	SAMPLED			3																									
247	44.8376206	-87.3865277	244	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	247	15	Muck	Pole	SAMPLED			0																									
248	44.8375995	-87.3856051	242	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	248	0			DEEP																												
249	44.8375783	-87.3846824	243	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	249	0			OTHER																												
250	44.8375572	-87.3837598	241	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	250	0			OTHER																												
251	44.837536	-87.3828371	240	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	251	0			OTHER																												
252	44.8371118	-87.3930159	258	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	252	10	Muck	Pole	SAMPLED			3		1		3																					
253	44.8370908	-87.3920933	255	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	253	18		Rope	SAMPLED			0																									
254	44.8370697	-87.3911706	254	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	254	18		Rope	SAMPLED			2				2																					
255	44.8370486	-87.390248	251	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	255	17		Rope	SAMPLED			1				1																					
256	44.8370275	-87.3893253	250	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	256	10	Muck	Pole	SAMPLED			3	1			3																					
257	44.8370064	-87.3884027	247	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	257	5	Sand	Pole	SAMPLED			2				1																					
258	44.8369852	-87.3874801	246	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	258	5	Sand	Pole	SAMPLED			1	1				1																				
259	44.8369641	-87.3865574	266	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	259	8	Sand	Pole	SAMPLED			0																									
260	44.836943	-87.3856348	267	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	260	0			DEEP																												
261	44.8369218	-87.3847122	268	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	261	0			OTHER																												
262	44.8369007	-87.3837895	269	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	262	0			OTHER																												
263	44.8364343	-87.3921229	259	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	263	17		Rope	SAMPLED			0																									
264	44.8364132	-87.3912003	260	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	264	18		Rope	SAMPLED			0																									
265	44.8363921	-87.3902776	261	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	265	17		Rope	SAMPLED			1	1																								
266	44.836371	-87.389355	262	Sturgeon Bay	Door	8/22/2016	EEH & C/JF	266	13	Muck	Pole	SAMPLED			3			3		1																				
267	44.8363499	-87.3884324	263	Sturgeon Bay	Door	8/22/																																		

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	NOTES	NUSANCE	TRF	Myriophyllum spicatum	Potamogeton crispus	Carotophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Najas flexilis	Najas guadalupensis	Potamogeton friesii	Potamogeton gramineus	Potamogeton praelongus	Potamogeton richardsonii	Potamogeton zosteriformis	Ranunculus aquatilis	Stuckenia pectinata	Utricularia vulgaris	Vallisneria spiralis	Sagittaria arifolia	Freshwater sponge	Filamentous algae	Nileopsis obtusa	Zannichellia palustris			
433	44.8267143	-87.3694758	131	Sturgeon Bay	Door	8/22/2016	EJH & JMB	433	13	Muck	Pole	SAMPLED			1		1																							
434	44.8266931	-87.3685533	120	Sturgeon Bay	Door	8/22/2016	EJH & JMB	434	12	Muck	Pole	SAMPLED			3		1									1														
435	44.8266718	-87.3676308	115	Sturgeon Bay	Door	8/22/2016	EJH & JMB	435	10	Muck	Pole	SAMPLED			3	1	1																							
436	44.8266505	-87.3667084	101	Sturgeon Bay	Door	8/22/2016	EJH & JMB	436	7	Muck	Pole	SAMPLED			2		1	2																						
437	44.8266292	-87.3657859	98	Sturgeon Bay	Door	8/22/2016	EJH & JMB	437	9	Muck	Pole	SAMPLED			2		1																							
438	44.8266079	-87.3648635	83	Sturgeon Bay	Door	8/22/2016	EJH & JMB	438	5	Muck	Pole	SAMPLED			1	1																								
439	44.8265866	-87.363941	82	Sturgeon Bay	Door	8/22/2016	EJH & JMB	439	5	Muck	Pole	SAMPLED			1			1																						
440	44.8265653	-87.3630186	62	Sturgeon Bay	Door	8/22/2016	EJH & JMB	440	4	Muck	Pole	SAMPLED			1				1																					
441	44.8262019	-87.347337	77	Sturgeon Bay	Door	8/22/2016	TWH & CMB	440	4	Muck	Pole	SAMPLED			2	1	1																							
442	44.8262489	-87.3778077	202	Sturgeon Bay	Door	8/22/2016	EJH & JMB	442	0																															
443	44.8262277	-87.3768853	199	Sturgeon Bay	Door	8/22/2016	EJH & JMB	443	10	Muck	Pole	SAMPLED			1																									
444	44.8262065	-87.3759628	201	Sturgeon Bay	Door	8/22/2016	EJH & JMB	444	9	Muck	Pole	SAMPLED			1																									
445	44.8261853	-87.3750404	196	Sturgeon Bay	Door	8/22/2016	EJH & JMB	445	10	Muck	Pole	SAMPLED			3		3									1														
446	44.8261641	-87.3741179	190	Sturgeon Bay	Door	8/22/2016	EJH & JMB	446	10	Muck	Pole	SAMPLED			3		1										1													
447	44.8261429	-87.3731955	176	Sturgeon Bay	Door	8/22/2016	EJH & JMB	447	12	Muck	Pole	SAMPLED			3		1										1	1												
448	44.8261216	-87.372273	164	Sturgeon Bay	Door	8/22/2016	EJH & JMB	448	13	Muck	Pole	SAMPLED			0																									
449	44.8261004	-87.3713505	152	Sturgeon Bay	Door	8/22/2016	EJH & JMB	449	21																															
450	44.8260791	-87.3704281	138	Sturgeon Bay	Door	8/22/2016	EJH & JMB	450	24																															
451	44.8260579	-87.3695056	130	Sturgeon Bay	Door	8/22/2016	EJH & JMB	451	21																															
452	44.8260366	-87.3685832	121	Sturgeon Bay	Door	8/22/2016	EJH & JMB	452	14	Muck	Pole	SAMPLED			0																									
453	44.8260153	-87.3676607	114	Sturgeon Bay	Door	8/22/2016	EJH & JMB	453	12	Muck	Pole	SAMPLED			3																									
454	44.8259941	-87.3667383	102	Sturgeon Bay	Door	8/22/2016	EJH & JMB	454	12	Muck	Pole	SAMPLED			3	V	1																						2	
455	44.8259728	-87.3658158	97	Sturgeon Bay	Door	8/22/2016	EJH & JMB	455	10	Muck	Pole	SAMPLED			1		1																							
456	44.8259515	-87.3648934	84	Sturgeon Bay	Door	8/22/2016	EJH & JMB	456	7	Muck	Pole	SAMPLED			3			3																						
457	44.8259302	-87.3639709	81	Sturgeon Bay	Door	8/22/2016	EJH & JMB	457	5	Muck	Pole	SAMPLED			1			1																						
458	44.8259089	-87.3630485	63	Sturgeon Bay	Door	8/22/2016	EJH & JMB	458	6	Muck	Pole	SAMPLED			1			1																						
459	44.8258876	-87.3621261	61	Sturgeon Bay	Door	8/22/2016	EJH & JMB	459	6	Muck	Pole	SAMPLED			3	1		3																						
460	44.8258662	-87.3612036	44	Sturgeon Bay	Door	8/22/2016	EJH & JMB	460	5	Muck	Pole	SAMPLED			3			2								1														
461	44.8258455	-87.3473671	76	Sturgeon Bay	Door	8/22/2016	TWH & CMB	461	4	Muck	Pole	SAMPLED			3	1		1																						
462	44.8258273	-87.3769151	200	Sturgeon Bay	Door	8/22/2016	EJH & JMB	462	0																															
463	44.8258066	-87.3759926	193	Sturgeon Bay	Door	8/22/2016	EJH & JMB	463	0																															
464	44.8258288	-87.3750702	195	Sturgeon Bay	Door	8/22/2016	EJH & JMB	464	9	Muck	Pole	SAMPLED			2	1																								
465	44.8258076	-87.3741477	191	Sturgeon Bay	Door	8/22/2016	EJH & JMB	465	10	Muck	Pole	SAMPLED			1	1		1																						
466	44.8254864	-87.3732253	175	Sturgeon Bay	Door	8/22/2016	EJH & JMB	466	11	Muck	Pole	SAMPLED			3			3																						
467	44.8254652	-87.3723028	165	Sturgeon Bay	Door	8/22/2016	EJH & JMB	467	11	Muck	Pole	SAMPLED			1																									
468	44.8254439	-87.3713804	151	Sturgeon Bay	Door	8/22/2016	EJH & JMB	468	11	Muck	Pole	SAMPLED			1																									
469	44.8254227	-87.370458	139	Sturgeon Bay	Door	8/22/2016	EJH & JMB	469	14	Muck	Pole	SAMPLED			0																									
470	44.8254014	-87.3695355	129	Sturgeon Bay	Door	8/22/2016	EJH & JMB	470	21																															
471	44.8253802	-87.3686131	122	Sturgeon Bay	Door	8/22/2016	EJH & JMB	471	24																															
472	44.8253589	-87.3676906	113	Sturgeon Bay	Door	8/22/2016	EJH & JMB	472	22																															
473	44.8253376	-87.3667682	103	Sturgeon Bay	Door	8/22/2016	EJH & JMB	473	15	Muck	Pole	SAMPLED			0																									
474	44.8253163	-87.3658458	96	Sturgeon Bay	Door	8/22/2016	EJH & JMB	474	12	Muck	Pole	SAMPLED			3		3	1	1								1													
475	44.825295	-87.3649233	85	Sturgeon Bay	Door	8/22/2016	EJH & JMB	475	12	Muck	Pole	SAMPLED			3			2																						
476	44.8252737	-87.3640009	80	Sturgeon Bay	Door	8/22/2016	EJH & JMB	476	9	Muck	Pole	SAMPLED			2	V		1										1												
477	44.8252524	-87.3630785	64	Sturgeon Bay	Door	8/22/2016	EJH & JMB	477	6	Muck	Pole	SAMPLED			3			3																						
478	44.8252311	-87.362156	60	Sturgeon Bay	Door	8/22/2016	EJH & JMB	478	9	Muck	Pole	SAMPLED			3	1																								
479	44.8252098	-87.3612336	45	Sturgeon Bay	Door	8/22/2016	EJH & JMB	479	7	Muck	Pole	SAMPLED			3																									
480	44.824889	-87.3473972	75	Sturgeon Bay	Door	8/22/2016	TWH & CMB	480	4	Muck	Pole	SAMPLED			3	1			3	1																				
481	44.8249148	-87.3769449	194	Sturgeon Bay	Door	8/22/2016	EJH & JMB	481	11	Muck	Pole	SAMPLED			3	1	1	2																						
482	44.8248724	-87.3751	192	Sturgeon Bay	Door	8/22/2016	EJH & JMB	482	9	Muck	Pole	SAMPLED			3			3																						
483	44.8248512	-87.3741776	173	Sturgeon Bay	Door	8/22/2016	EJH & JMB	483	9	Muck	Pole	SAMPLED			1																									

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	NOTES	NUSANCE	TRF	Myriophyllum spicatum	Potamogeton crispus	Carotophyllum demersum	Chara spp.	Eriocaulon canadense	Heteranthera dubia	Najas flexilis	Najas guadalupensis	Potamogeton friesii	Potamogeton gramineus	Potamogeton praelongus	Potamogeton richardsonii	Potamogeton zosteriformis	Ranunculus aquatilis	Stuckenia pectinata	Utricularia vulgaris	Vallisneria spiralis	Sagittaria arifolia	Freshwater sponge	Filamentous algae	Niletilapia obtusa	Zannichellia palustris			
487	44.8247662	-87.3704878	140	Sturgeon Bay	Door	8/22/2016	EJH & JMB	487	12	Muck	Pole	SAMPLED			1		1																							
488	44.8247449	-87.3695654	128	Sturgeon Bay	Door	8/22/2016	EJH & JMB	488	12	Muck	Pole	SAMPLED			0																									
489	44.8247237	-87.368643	123	Sturgeon Bay	Door	8/22/2016	EJH & JMB	489	13	Muck	Pole	SAMPLED			0																									
490	44.8247024	-87.3677205	112	Sturgeon Bay	Door	8/22/2016	EJH & JMB	490	23			DEEP																												
491	44.8246811	-87.3667981	104	Sturgeon Bay	Door	8/22/2016	EJH & JMB	491	26			DEEP																												
492	44.8246598	-87.3658757	95	Sturgeon Bay	Door	8/22/2016	EJH & JMB	492	21			DEEP																												
493	44.8246386	-87.3649532	86	Sturgeon Bay	Door	8/22/2016	EJH & JMB	493	14	Muck	Pole	SAMPLED			0																									
494	44.8246172	-87.3640308	79	Sturgeon Bay	Door	8/22/2016	EJH & JMB	494	12	Muck	Pole	SAMPLED			3											1														
495	44.8245959	-87.3631084	65	Sturgeon Bay	Door	8/22/2016	EJH & JMB	495	13	Muck	Pole	SAMPLED			0																									
496	44.8245746	-87.362186	59	Sturgeon Bay	Door	8/22/2016	EJH & JMB	496	8	Muck	Pole	SAMPLED			3	1	1	3																						
497	44.8245533	-87.3612636	46	Sturgeon Bay	Door	8/22/2016	EJH & JMB	497	9	Muck	Pole	SAMPLED			1		1	1																						
498	44.824532	-87.3603411	43	Sturgeon Bay	Door	8/22/2016	EJH & JMB	498	7	Muck	Pole	SAMPLED			1	1	1	1																						
499	44.8242325	-87.3474273	74	Sturgeon Bay	Door	8/22/2016	TWH & CMB	499	4	Muck	Pole	SAMPLED			2	1		1	2																					
500	44.8242159	-87.3751298	174	Sturgeon Bay	Door	8/22/2016	EJH & JMB	500	3	Muck	Pole	SAMPLED			2		1	2																						
501	44.8241735	-87.373285	170	Sturgeon Bay	Door	8/22/2016	EJH & JMB	501	10	Muck	Pole	SAMPLED			1		1	1																						
502	44.8241522	-87.3723625	169	Sturgeon Bay	Door	8/22/2016	EJH & JMB	502	10	Muck	Pole	SAMPLED			1		1																							
503	44.824131	-87.3714401	149	Sturgeon Bay	Door	8/22/2016	EJH & JMB	503	10	Muck	Pole	SAMPLED			2		2	1								1														
504	44.8241097	-87.3705177	141	Sturgeon Bay	Door	8/22/2016	EJH & JMB	504	10	Muck	Pole	SAMPLED			3		2	1								1														
505	44.8240885	-87.3695953	127	Sturgeon Bay	Door	8/22/2016	EJH & JMB	505	11	Muck	Pole	SAMPLED			1		1																							
506	44.8240672	-87.3686728	124	Sturgeon Bay	Door	8/22/2016	EJH & JMB	506	11	Muck	Pole	SAMPLED			2		2	1									2													
507	44.8240459	-87.3677504	111	Sturgeon Bay	Door	8/22/2016	EJH & JMB	507	12	Muck	Pole	SAMPLED			1												1													
508	44.8240247	-87.366828	105	Sturgeon Bay	Door	8/22/2016	EJH & JMB	508	16		Rope	SAMPLED			0																									
509	44.8240034	-87.3659056	94	Sturgeon Bay	Door	8/22/2016	EJH & JMB	509	22			DEEP																												
510	44.8239821	-87.3649832	87	Sturgeon Bay	Door	8/22/2016	EJH & JMB	510	24			DEEP																												
511	44.8239608	-87.3640608	78	Sturgeon Bay	Door	8/22/2016	EJH & JMB	511	22			DEEP																												
512	44.8239395	-87.3631383	66	Sturgeon Bay	Door	8/22/2016	EJH & JMB	512	13	Muck	Pole	SAMPLED			1											1														
513	44.8239182	-87.3622159	58	Sturgeon Bay	Door	8/22/2016	EJH & JMB	513	12	Muck	Pole	SAMPLED			3	1	2	3																						
514	44.8238968	-87.3612935	47	Sturgeon Bay	Door	8/22/2016	EJH & JMB	514	14	Muck	Pole	SAMPLED			1	1																								
515	44.8238755	-87.3603711	42	Sturgeon Bay	Door	8/22/2016	EJH & JMB	515	9	Muck	Pole	SAMPLED			3	1		3																						
516	44.8238542	-87.3594487	30	Sturgeon Bay	Door	8/22/2016	EJH & JMB	516	5	Muck	Pole	SAMPLED			1		1																							
517	44.8238328	-87.3585263	29	Sturgeon Bay	Door	8/22/2016	EJH & JMB	517	4	Muck	Pole	SAMPLED			1	1		1																						
518	44.8238115	-87.3576039	16	Sturgeon Bay	Door	8/22/2016	EJH & JMB	518	5	Muck	Pole	SAMPLED			3	1										1														
519	44.8235546	-87.3465351	73	Sturgeon Bay	Door	8/22/2016	TWH & CMB	519	3	Muck	Pole	SAMPLED			3	1		1	2																					
520	44.823517	-87.3733148	171	Sturgeon Bay	Door	8/22/2016	EJH & JMB	520	9	Muck	Pole	SAMPLED			3	1		1																						
521	44.8234958	-87.3723924	167	Sturgeon Bay	Door	8/22/2016	EJH & JMB	521	10	Sand	Pole	SAMPLED			2																									
522	44.8234745	-87.37147	148	Sturgeon Bay	Door	8/22/2016	EJH & JMB	522	12	Muck	Pole	SAMPLED			1		1																							
523	44.8234533	-87.3705475	142	Sturgeon Bay	Door	8/22/2016	EJH & JMB	523	5	Muck	Pole	SAMPLED			1			1																						
524	44.823432	-87.3696251	126	Sturgeon Bay	Door	8/22/2016	EJH & JMB	524	5	Muck	Pole	SAMPLED			2																									
525	44.8234107	-87.3687027	125	Sturgeon Bay	Door	8/22/2016	EJH & JMB	525	5	Muck	Pole	SAMPLED			3																									
526	44.8233895	-87.3677803	110	Sturgeon Bay	Door	8/22/2016	EJH & JMB	526	11	Muck	Pole	SAMPLED			3	V	1									1														
527	44.8233682	-87.3668579	106	Sturgeon Bay	Door	8/22/2016	EJH & JMB	527	11	Muck	Pole	SAMPLED			0																									
528	44.8233469	-87.3659355	93	Sturgeon Bay	Door	8/22/2016	EJH & JMB	528	11	Muck	Pole	SAMPLED			0																									
529	44.8233256	-87.3650131	88	Sturgeon Bay	Door	8/22/2016	EJH & JMB	529	18		Rope	SAMPLED			0																									
530	44.8233043	-87.3640907	77	Sturgeon Bay	Door	8/22/2016	EJH & JMB	530	23			DEEP																												
531	44.823283	-87.3631683	67	Sturgeon Bay	Door	8/22/2016	EJH & JMB	531	23			DEEP																												
532	44.8232617	-87.3622459	57	Sturgeon Bay	Door	8/22/2016	EJH & JMB	532	18		Rope	SAMPLED			0																									
533	44.8232404	-87.3613235	48	Sturgeon Bay	Door	8/22/2016	EJH & JMB	533	13	Muck	Pole	SAMPLED			1												1													
534	44.823219	-87.3604011	41	Sturgeon Bay	Door	8/22/2016	EJH & JMB	534	12	Muck	Pole	SAMPLED			2		1	1																						
535	44.8231977	-87.3594787	31	Sturgeon Bay	Door	8/22/2016	EJH & JMB	535	12	Muck	Pole	SAMPLED			0																									
536	44.8231764	-87.3585563	28	Sturgeon Bay	Door	8/22/2016	EJH & JMB	536	7	Muck	Pole	SAMPLED			3			3																						
537	44.823155	-87.35763																																						

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	NOTES	NUSIANCE	TRF	Myriophyllum spicatum	Potamogeton crispus	Caratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Najas flexilis	Najas guadalupensis	Potamogeton friesii	Potamogeton gramineus	Potamogeton praelongus	Potamogeton richardsonii	Potamogeton zosteriformis	Ranunculus aquatilis	Stuckenia pectinata	Utricularia vulgaris	Vallisneria spiralis	Sagittaria arifolia	Aquatic Moss	Freshwater sponge	Filamentous algae	Niletilopsis obtusa	Zannichellia palustris									
757	44.8137282	-87.3479092	93	Sturgeon Bay	Door	8/22/2016	TWH & CMB	757	6	Muck	Pole	SAMPLED			3				3	1																											
758	44.8137078	-87.346987	58	Sturgeon Bay	Door	8/22/2016	TWH & CMB	758	6	Muck	Pole	SAMPLED			3				3																												
759	44.8136864	-87.3460647	53	Sturgeon Bay	Door	8/22/2016	TWH & CMB	759	7	Muck	Pole	SAMPLED			3	2	1	3																													
760	44.8136649	-87.3451425	26	Sturgeon Bay	Door	8/22/2016	TWH & CMB	760	7	Muck	Pole	SAMPLED			3	1		1	3																												
761	44.8136435	-87.3442203	23	Sturgeon Bay	Door	8/22/2016	TWH & CMB	761	7	Muck	Pole	SAMPLED			0																																
762	44.813622	-87.343298	5	Sturgeon Bay	Door	8/22/2016	TWH & CMB	762	12	Muck	Pole	SAMPLED			0																																
763	44.8130942	-87.3488615	56	Sturgeon Bay	Door	8/22/2016	TWH & CMB	763	3	Muck	Pole	SAMPLED			3		3					1																									
764	44.8130728	-87.3479393	57	Sturgeon Bay	Door	8/22/2016	TWH & CMB	764	4	Muck	Pole	SAMPLED			3		3	1								1																					
765	44.8130514	-87.3470171	55	Sturgeon Bay	Door	8/22/2016	TWH & CMB	765	4	Rock	Pole	SAMPLED			1		1																														
766	44.8130299	-87.3460949	54	Sturgeon Bay	Door	8/22/2016	TWH & CMB	766	6	Muck	Pole	SAMPLED			3		3																														
767	44.8130085	-87.3451726	25	Sturgeon Bay	Door	8/22/2016	TWH & CMB	767	7	Muck	Pole	SAMPLED			3	V	3																														
768	44.812987	-87.3442504	24	Sturgeon Bay	Door	8/22/2016	TWH & CMB	768	7	Muck	Pole	SAMPLED			3	V	3																														
769	44.8129655	-87.3433282	4	Sturgeon Bay	Door	8/22/2016	TWH & CMB	769	7	Muck	Pole	SAMPLED			3		1																														
770	44.8123305	-87.3442806	3	Sturgeon Bay	Door	8/22/2016	TWH & CMB	770	5	Sand	Pole	SAMPLED			2		2																														
771	44.811717	-87.3461551	2	Sturgeon Bay	Door	8/22/2016	TWH & CMB	771	12	Muck	Pole	SAMPLED			0																																
772	44.8116956	-87.3452329	1	Sturgeon Bay	Door	8/22/2016	TWH & CMB	772	12	Muck	Pole	SAMPLED			0																																

B

APPENDIX B

Riparian Property Owner Stakeholder Survey Responses

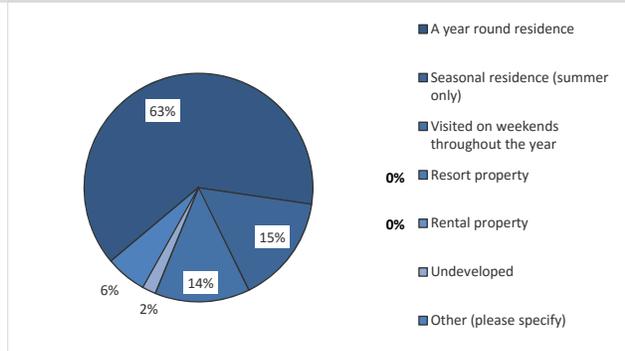
Sturgeon Bay - Anonymous Stakeholder Survey

Surveys Distributed: 199
Surveys Returned: 53
Response Rate: 27%

Recreational Activity on Sturgeon Bay

1. How is your property on the Sturgeon Bay ship canal utilized? Please select one choice.

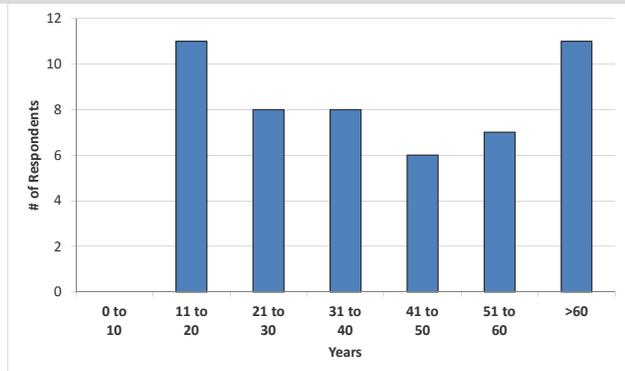
Answer Options	Response Percent	Response Count
A year round residence	63.5%	33
Seasonal residence (summer only)	15.4%	8
Visited on weekends throughout the year	13.5%	7
Resort property	0.0%	0
Rental property	0.0%	0
Undeveloped	1.9%	1
Other (please specify)	5.8%	3
answered question		52
skipped question		1



Number	Other (please specify)
1	year round residence
2	It is a secondary residence that we use year round, but mostly in the summer
3	SIX MONTH RESIDENCE

2. How many years ago did you first visit Sturgeon Bay?

Answer Options	Response Count
	51
answered question	51
skipped question	2

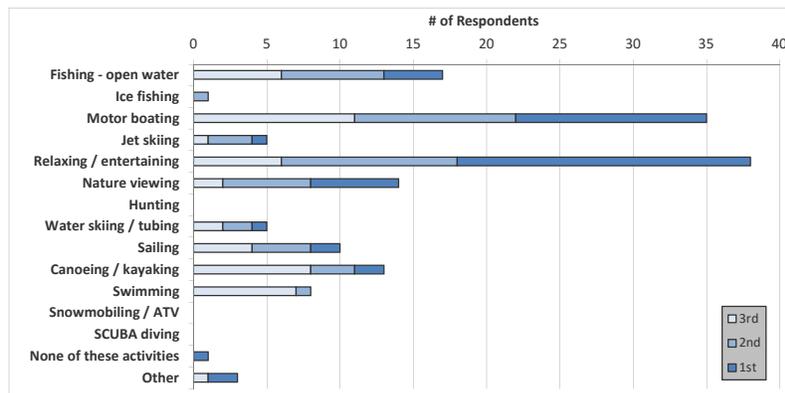


Category (# years)	Responses	% Response
0 to 10	0	0%
11 to 20	11	22%
21 to 30	8	16%
31 to 40	8	16%
41 to 50	6	12%
51 to 60	7	14%
>60	11	22%

3. For the list below, rank your top three activities that are important reasons for owning your property on the Sturgeon Bay Ship Canal, with 1 being the most important activity.

Answer Options	1st	2nd	3rd	Rating Average	Response Count
Fishing - open water	4	7	6	2.12	17
Ice fishing	0	1	0	2.00	1
Motor boating	13	11	11	1.94	35
Jet skiing	1	3	1	2.00	5
Relaxing / entertaining	20	12	6	1.63	38
Nature viewing	6	6	2	1.71	14
Hunting	0	0	0	0.00	0
Water skiing / tubing	1	2	2	2.20	5
Sailing	2	4	4	2.20	10
Canoeing / kayaking	2	3	8	2.46	13
Swimming	0	1	7	2.88	8
Snowmobiling / ATV	0	0	0	0.00	0
SCUBA diving	0	0	0	0.00	0
None of these activities are important to me	1	0	0	1.00	1
Other (please specify below)	2	0	1	1.67	3
answered question					52
skipped question					1

- Number "Other" responses**
- 1 N/A
 - 2 rowing
 - 3 Stand Up Paddle Boarding
 - 4 living in a historic waterfront community
 - 5 Residential water view with water access
 - 6 rowing racing single and double sculls



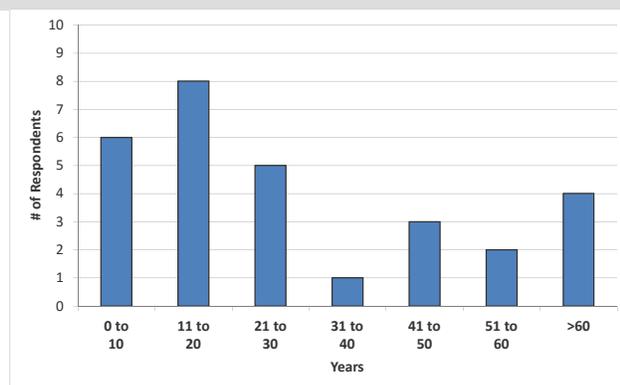
4. Have you personally fished on the Sturgeon Bay ship canal in the past three years?

Answer Options	Response Percent	Response Count
Yes	63.5%	33
No	36.5%	19
answered question		52
skipped question		1

5. For how many years have you fished Sturgeon Bay?

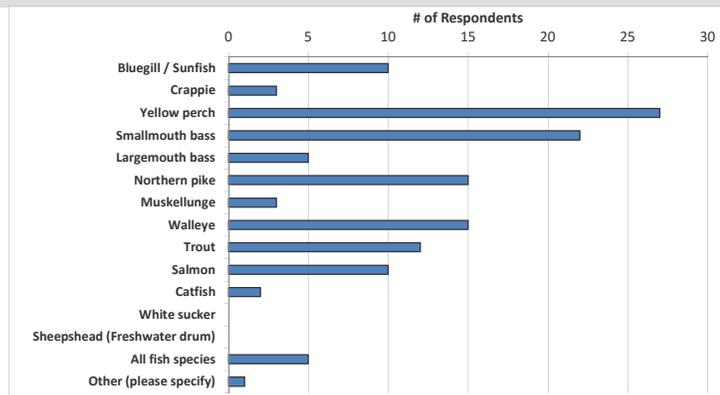
Answer Options	Response Count	
	29	
answered question		29
skipped question		24

Category (# of years)	Responses	% Response
0 to 10	6	21%
11 to 20	8	28%
21 to 30	5	17%
31 to 40	1	3%
41 to 50	3	10%
51 to 60	2	7%
>60	4	14%



6. What species of fish do you like to catch on Sturgeon Bay?

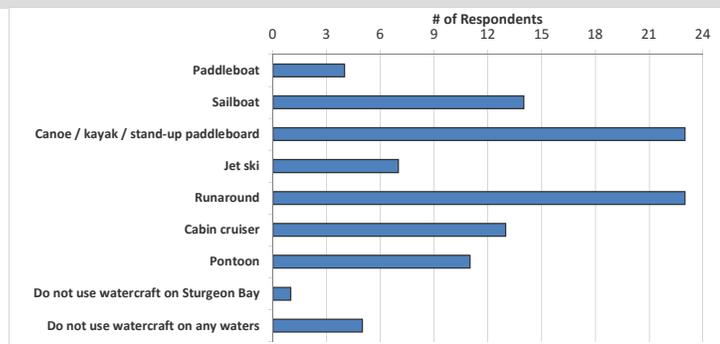
Answer Options	Response Percent	Response Count
Bluegill / Sunfish	30.3%	10
Crappie	9.1%	3
Yellow perch	81.8%	27
Smallmouth bass	66.7%	22
Largemouth bass	15.2%	5
Northern pike	45.5%	15
Muskellunge	9.1%	3
Walleye	45.5%	15
Trout	36.4%	12
Salmon	30.3%	10
Catfish	6.1%	2
White sucker	0.0%	0
Sheepshead (Freshwater drum)	0.0%	0
All fish species	15.2%	5
Other (please specify)	3.0%	1
answered question		33
skipped question		20



Number "Other" responses
1 carp

7. What types of watercraft do you currently use on the Sturgeon Bay ship canal?

Answer Options	Response Percent	Response Count
Paddleboat	7.7%	4
Sailboat	26.9%	14
Canoe / kayak / stand-up paddleboard	44.2%	23
Jet ski (personal water craft)	13.5%	7
Runaround	44.2%	23
Cabin cruiser	25.0%	13
Pontoon	21.2%	11
Do not use watercraft on Sturgeon Bay	1.9%	1
Do not use watercraft on any waters	9.6%	5
answered question		52
skipped question		1



If you answered runaround in Question 7, please list boat type and/or motor size:

Answer Options	Response Count
	25
answered question	25
skipped question	28

Number	Response Text
1	redundant
2	21 foot yamaha jet boat
3	Alumacraft 14', 30 hp
4	18' Lund 115 hp
5	18 foot center console 150HP
6	dinghy 20hp ranger 250 hp deckboat 270 hp
7	21' Inboard/outboard
8	Fishing boat 50hp
9	Sea Ray 19.5' , inboard/outboard 140hp
10	sea ray 100hp
11	Aluminum boat, 15 hp
12	23' Cruisers open bow runabout - 5.0 liter IO
13	Welcraft Excel 150
14	24' Chris Craft center console; 250 hp outboard
15	StarCraft 70 horsepower motor
16	20 foot ski/fishing boat with 175 hp motor
17	14 Mirro Fishing boat with a 15HP Johnson motor
18	silverton 33 375hp crusier caddilac 14 ft 25hp runabout
19	We do not own any motor boats, only kayaks, however, we rent the motor boats
20	14' Boston Whaler with 60hp Mercury
21	Center Counsel - Boston Whaler 18'/150HP Center Counsel - Pursuit 30' "2" 225HP, Baja Islander 23' - 454
22	bass boat 19' 115hp
23	Center Console, Bost Whal, 18' 150HP Center Console, Pursuit, 30' (2) 225HP
24	Center Console with twin 300HP outboards
25	16 ft. Lund 35 Hp 22 ft. Scout 200 Hp

If you answered cabin cruiser in Question 7, please list boat type and/or motor size:

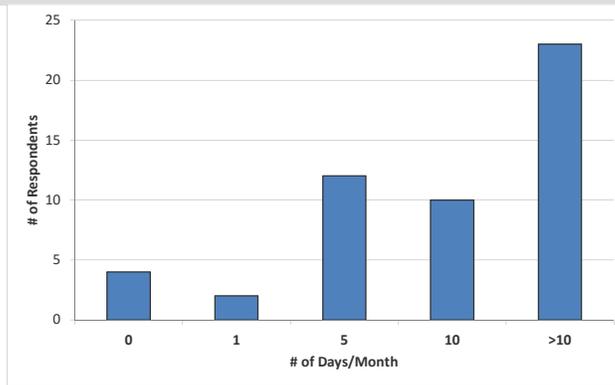
Answer Options	Response Count
	12
answered question	12
skipped question	41

Number	Response Text
1	50' powerboat. 360hp Diesel engines.
2	42' Sabre 2 550hp
3	we boated for many years but now because of age we have sold our boat
4	30' sport cruiser
5	31 Tiara Open with twin 454's
6	motoryacht diesel 900hp
7	36 ft. w/ 400 h.p.
8	silverton 33 375hp crusier caddilac 14 ft 25hp runabout
9	40 formula 2/425's
10	32' inboard twin 260 hp
11	Carver 52 Sport Coupe
12	Nordic tug 34 / 270 Cummins Diesel

8. In a typical year, how often do you use or access the Sturgeon Bay ship canal from Memorial Day or Labor Day?

Answer Options	Response Count
	51
<i>answered question</i>	51
<i>skipped question</i>	2

Category (# of days/month)	Responses	% Response
0	4	8%
1	2	4%
5	12	24%
10	10	20%
>10	23	45%



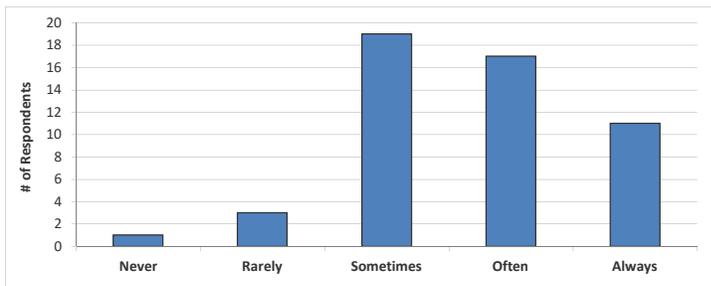
9. Do you use your watercraft on waters not directly connected to Sturgeon Bay, i.e. inland lakes in Wisconsin?

Answer Options	Response Percent	Response Count
Yes	13.7%	7
No	86.3%	44
<i>answered question</i>		51
<i>skipped question</i>		2

Sturgeon Bay Current and Historic Condition, Health and Management

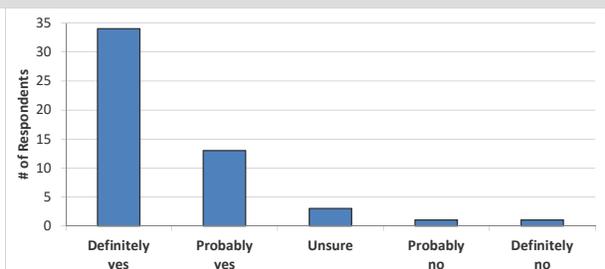
10. During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of the Sturgeon Bay ship canal?

Answer Options	Never	Rarely	Sometimes	Often	Always	Response Count
	1	3	19	17	11	51
<i>answered question</i>						51
<i>skipped question</i>						2



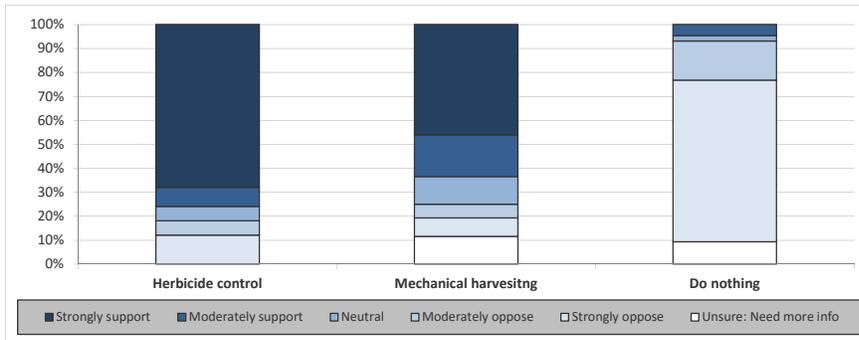
11. Considering your answer to the question above, do you believe aquatic plant control is needed on the Sturgeon Bay ship canal?

Answer Options	Definitely yes	Probably yes	Unsure	Probably no	Definitely no	Response Count
	34	13	3	1	1	52
<i>answered question</i>						52
<i>skipped question</i>						1



12. Aquatic plants can be managed using many techniques. What is your level of support for the responsible use of the following techniques on the Sturgeon Bay ship canal?

Answer Options	Strongly oppose	Moderately oppose	Neutral	Moderately support	Strongly support	Unsure: Need more info	Rating Average	Response Count
Mechanical harvesting	6	3	3	4	34	0	4.14	50
Herbicide (chemical) control	4	3	6	9	24	6	3.54	52
Do nothing (do not manage plants)	29	7	1	2	0	4	1.26	43
answered question								52
skipped question								1

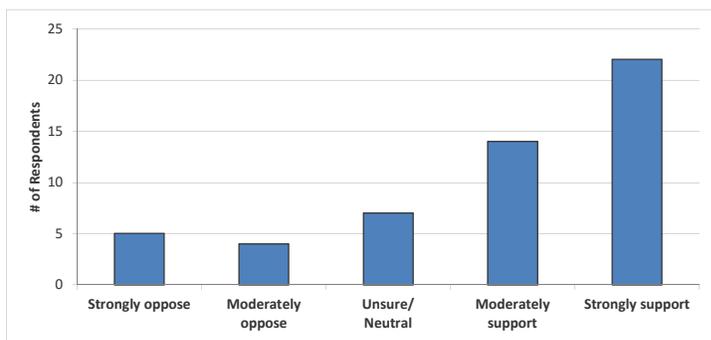


13. The City of Sturgeon Bay completed an Aquatic Plant Management Plan in 2003, with revisions in 2007, and is currently in the process of updating the plan. In implementing the plan, the city has utilized herbicide application and mechanical harvesting as aquatic plant management techniques. Prior to reading this information, did you know that aquatic herbicides were being applied in the Sturgeon Bay ship canal to help control aquatic plants?

Answer Options	Response Percent	Response Count
Yes	45.1%	23
I think so but can't say for certain	15.7%	8
No	39.2%	20
answered question		51
skipped question		2

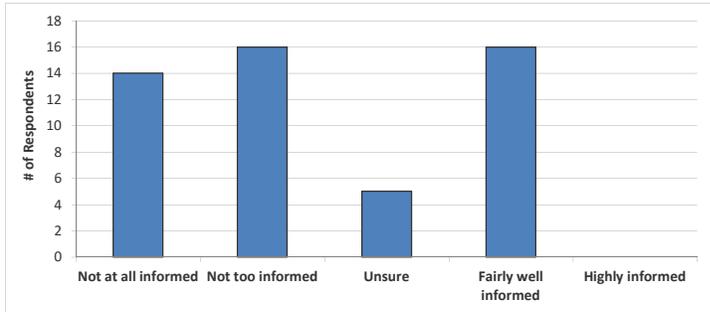
14. How do you feel about the use of herbicides to treat aquatic plants?

Answer Options	Strongly oppose	Moderately oppose	Unsure/ Neutral	Moderately support	Strongly support	Response Count
	5	4	7	14	22	52
answered question						52
skipped question						1



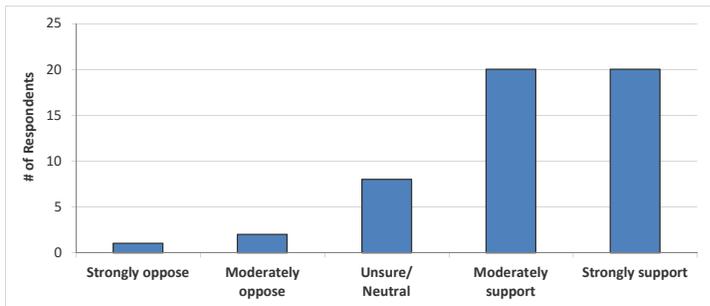
15. How informed has the City of Sturgeon Bay kept you regarding issues with the Sturgeon Bay ship canal and its management?

Answer Options	Not at all informed	Not too informed	Unsure	Fairly well informed	Highly informed	Response Count
	14	16	5	16	0	51
<i>answered question</i>						51
<i>skipped question</i>						2



16. What is your level of support or opposition for the City's current herbicide and mechanical harvesting strategy?

Answer Options	Strongly oppose	Moderately oppose	Unsure/ Neutral	Moderately support	Strongly support	Response Count
	1	2	8	20	20	51
<i>answered question</i>						51
<i>skipped question</i>						2



17. Do you believe the current herbicide and mechanical harvesting strategy is sufficiently meeting your recreational needs in the Sturgeon Bay ship canal?

Answer Options	Response Percent	Response Count
Yes	15.4%	8
I think so but can't say for certain	32.7%	17
No	51.9%	27
<i>answered question</i>		52
<i>skipped question</i>		1

18. Please feel free to provide written comments concerning Sturgeon Bay, its current and/or historic condition and its management.

Answer Options	Response Count
	33
answered question	33
skipped question	20

Number	Response Text
1	Need to attack weeds and cut more deeply into water when the weeds explode, as they do every year. Need to start earlier than 8:00 when that happens and work later.
2	what are you referring to- ?harvesting program? Its current program is not well organized nor implemented.
3	Use herbicides!!!! Get RID of mechanical harvesters!!!! They are a joke!!!! It's too bad that Sturgeon Bay is widely known for our WEED problem!!!!!!!!!!!! Sturgeon Bay is beautiful except for the water weeds!!!
4	Due to high water conditions the environment for aquatic plant growth has been altered. With shallow conditions sunlight got to the bay bottom easier and promoted strong plant growth. Mechanically harvesting is akin to heading plants in your garden. It makes them more robust and thick. There are plenty of herbicides that are non toxic and widely used on Western rivers in the US where water is scarce and purity sacred. We can easily use these chemicals to effectively treat the bay without causing accompanying health concerns. The modern practice of fertilizing lawns causes a lot of this fertilizer to run off and into the bay. This also promotes very healthy weed populations which are beyond "normal" from the old days. Call me I'd love to provide information on non toxic herbicides that I know of. Also my sister is a limnologist in Washington State and she is a great resource of info and would be glad to provide input. Jim Michaud 920 621 0119
5	The problem that we have is primarily the drift from the mechanical harvesting. The weeds collect along our shoreline and our piers and are terrible. The cutters are unable to collect the material and during late summer we have rotting weeds along the shoreline.
6	both methods should be used but the harvesting should be cutting the plants much shorter
7	I have been happy with the current mechanical weed harvesting with the weed cutters.
8	The bay, lake and SB canal are Sturgeon Bay's biggest asset. SB is a "real" American city with historical significance and strong potential for growth through existing and entrepreneurial investment.
9	We need to remain aggressive with the weed control program. I believe the City has slacked off the past few years. The Bay is an important resource that needs to be maintained at the highest level possible.
10	We are new residents to Sturgeon Bay ship canal area and have little to no history. We are very interested in knowing more about this issue and plan to be involved with it once we get settled.
11	Regarding the Westside Waterfront Development. No matter what ultimately becomes of the land, please remove the unsightly dirt piles and use the area for the farmers' market which needs a larger space, even if it is just temporary.
12	don't understand why sturgeon bay so much worse than other harbors. far too weedy.
13	I am most concerned about the fish and other wildlife on the channel.
14	Mechanical cutting leaves floating globs of weeds that are often undetectable until they are hit and cause a mess, collect garbage, dead fish, etc. when they are blown onto shore or into marinas.
15	Sturgeon Bay is the only area that has such a weed problem. Everywhere I boat, nobody else has a weed problem like us. Boaters from MI. don't like to come here because of all the weeds. The city needs to address the root cause of the weeds. Sewage run off?? The marina's. are horrible to get in and out of. My boat sucked up so many weeds last year, it overheated and damaged somethings along with being broke down from 4th. of July until 14th. of July. Many of the downtown waterfront business suffer financially in some form, such as the marinas, fuel docks, restaurants, bars,etc. as local and out of town boaters can't or won't dock in Sturgeon Bay due to the weeds. Clean up the problem!
16	Keep up the aquatic plant management. It is needed. The weeds around my dock can be overwhelming! It makes it harder all the time to get my boat in and out.
17	Would support mechanical harvesting if there were a way to catch the "clippings" so they didn't end up on my dock and boat lift.
18	The harvesters do a terrible job. They focus on certain areas while ignoring us (until we call to complain). We constantly have weeds floating in front of our property and so thick most of the time, preventing us from using the waterfront. It is unsightly, smelly, and prevents water flow which causes algae and swimmers itch (which our grandchildren have gotten when boating). I feel it decreases the value of our property, and we are tired of raking and hauling weeds to clear our beach every day. We are paying high taxes for waterfront property that we can seldom use. Herbicides hopefully will be the answer because harvesting is totally inadequate for the amount of weeds in the bay and because of their method of operation.
19	When using our motor boat, we have had seaweed tangled in our prop. It also grows near our dock and by then end of the summer seems to overwhelm the area. Also the cut seaweed washes up on our shoreline and rots.
20	I think the City is well run. It is becoming more of a tourist attraction and center for fishing contests.
21	Sturgeon Bay is doing a good job
22	SELDOM see any help East of the 57 bridge. Weed control is needed
23	I think Sunset park and Lama Wamah Lagoon should be included in the treated area.
24	The mechanical program is poorly managed. More needs to be done on all fronts
25	You can't lump herbicide and mechanical harvesting in the same category. One can be opposed to herbicide treatment and in favor of harvesting.
26	Need more herbicide and less cutting. When the weeds are cut they are not retrieved and wash up on my shore. Then I have to dispose of them !
27	We appreciate your willingness to continue with your efforts, please continue
28	The cost of the program should be a city wide expense since everyone in the community benefits, not just the commercial waterfront property owners. A guy who lives near the fairgrounds with a trailerable fishing boat benefits as much as a condo owner at Strawberry Creek.
29	Seaweed harvesting negatively impacts the enjoyment & use of our waterfront. We are constantly cleaning up after the cutter. Our area (Utopia Circle inlet) collects a disproportionate amount of the uncollected harvesting. Last year, the harvesters did a better job of collecting near the shoreline but it still impacted us especially on weekends when we had company. Also our immediate neighbors have invasive phragmites that are slowly invading our waterfront.
30	You need to do a much better job controlling the plant growth it is killing boating fishing and transient use

Number	Response Text
31	I very much appreciate the City's efforts to make the bay usable and attractive for residents and visitors. We definitely need a strong plan to keep the weeds in check and keep the bay the attraction that it is. I wish that the weed cutters were able to capture more of the weeds they cut as some end up as floaters, but I understand that it is a difficult task and that we are doing the best you can with the tools at your disposal. Thank you!
32	Mechanical harvesting is a waste of time and manpower; does not address shore owners; no weed pickup after harvest; cutting ineffective.
33	Over the years aquatic weeds have impaired the use of our dock for most activities including sailing, power boating, and even swimming. Mechanical harvesting is very limiting as marinas are served first.

C

APPENDIX C

Marina Stakeholder Survey Responses

Sturgeon Bay Marina Survey

Date:	Time:	Initials:
Marina:		

1. In total, how many years have you worked in the marina industry in Door County? _____

2. How long have you owned or operated this marina? _____

3. In the years you have owned or operated this marina, what changes in water quality or aquatic plants have you observed?

4. How have aquatic plants and the management of aquatic plants affected your business?

5. What are you observing about boater behavior when your renters' boats leave the water? In other words, what are the typical boat cleaning routines you observe from your renters?

Sturgeon Bay – Marina Survey

Interviews Requested: 9
Interviews Conducted: 6
Response Rate: 67%

Marina surveys were conducted over the phone and responses were summarized and recorded by hand by Onterra staff. Only questions answered by marina operators are displayed below.

Survey 1	Date: 3/28/2017
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How have aquatic plants and the management of aquatic plants affected your business?

Not affected, aquatic plants are not a problem.

What concerns, if any, do you have as a marina owner or operator in regards to aquatic plant management and herbicide use in marinas?

No concerns, aquatic plants are not a problem for our business. Wave Pointe and Stone Harbor can be bad, you can see the plants as you come in. We only have small herbicide applications and the City decides how much is going to be treated and then we give the okay for the treatment.

Survey 2	Date: 3/28/2017
----------	-----------------

In total, how many years have you worked in the marina industry in Door County

16 years

How long have you owned or operated this marina?

16 years

In the years you have owned or operated this marina, what changes in water quality or aquatic plants have you observed?

Weed harvesting within the channel is a challenge every year.

Water levels play a role in the weed growth.

How have aquatic plants and the management of aquatic plants affected your business?

The spraying of aquatic plants is great. It works, after the spray the weeds go down.

Mechanical harvesting out in the channel is problematic. It has a learning curve. It affects navigation of all boats but it seems to affect the sailboats the worse.

What are you observing about boater behavior when your renters' boats leave the water? In other words, what are the typical boat cleaning routines you observe from your renters?

We have signs up at the boat landing.

People are well practiced in removing hitchhikers from their boats. Most of the invasive species problems come from the main boat launch.

We have transient boaters who will trailer at the launch.

What concerns, if any, do you have as a marina owner or operator in regards to aquatic plant management and herbicide use in marinas?

I have no concerns with the herbicide use.

There is a learning curve to the harvesting. The harvesters cannot cut the weeds in certain areas due to spawning fish. After spawning is done, the weeds are very overgrown. There is a lot of boat traffic in these areas which causing fragments and spreading of the aquatic plants. I have kids with pitchforks pull out the weeds that wash up after harvesting.

Have your renters informed you that they are concerned about water quality or aquatic plants?

No

What suggestions can you offer for future aquatic plant management?

Harvesting plan is not the best.

Is there anything more you would like to tell us that we have not yet discussed?

The weeds get stuck in the intake valves of boats after mechanical harvesting. It causes a lot of navigation issues for boaters. Sailboats have the hardest time because once they have plants sucked up they lose all navigation – sailboats have run into the bridges due to loss of navigation. People from Milwaukee or further south will call ahead and ask if the harvesting has happened. They will not come up until August so they can avoid the weed balls caused by harvesting.

Survey 3	Date: 5/8/2017
----------	----------------

In total, how many years have you worked in the marina industry in Door County

~6 years

How long have you owned or operated this marina?

~9 years

In the years you have owned or operated this marina, what changes in water quality or aquatic plants have you observed?

Not, dramatic no. It's the same herbicide plan every year and it works well, treatment in the spring and cutting through the summer.

How have aquatic plants and the management of aquatic plants affected your business?

No, not really.

What concerns, if any, do you have as a marina owner or operator in regards to aquatic plant management and herbicide use in marinas?

No concerns.

What suggestions can you offer for future aquatic plant management?

No suggestions, satisfied with the current management.

Survey 4	Date: 5/15/2017
----------	-----------------

In total, how many years have you worked in the marina industry in Door County

Since 2009, coast guard before that.

In the years you have owned or operated this marina, what changes in water quality or aquatic plants have you observed?

When I started, they sprayed every year but in either 2012 or 2013 the WDNR stopped spraying. I spoke with the WDNR last year [2016] and said they needed to spray [herbicide treatment] and they did.

What concerns about water quality or aquatic plants have your renters informed you about?

Renters want the area sprayed every year. They have issues backing boats out because of the plants.

What suggestions can you offer for future aquatic plant management?

Keep spraying [herbicide treatment]. I keep in contact with the city 2 or 3 times a week. They hook up a combine to a boat and collect the weeds so that they don't get pushed out to the channel. They should spray earlier than they have been, they currently wait until the plants are fully engulfed before they spray them.

Is there anything more you would like to tell us that we have not yet discussed?

The people that worked before me pushed the weeds out to the channel. This area also pays the highest property taxes within the city.

Survey 5	Date: 5/15/2017
----------	-----------------

In total, how many years have you worked in the marina industry in Door County

12 years

How long have you owned or operated this marina?

Same, been a marine biologist for 25 years.

In the years you have owned or operated this marina, what changes in water quality or aquatic plants have you observed?

There are a lot of plants (milfoil)

What concerns, if any, do you have as a marina owner or operator in regards to aquatic plant management and herbicide use in marinas?

The treatments/cutting may not be working – we have beautiful clear water and great fish populations but we need to do something with the excess plants

The marina is deluged with so many boats during the summer and there are so many plants that the boaters take up a lot of the fragments from harvesting into their intake valves and it causes problems.

Fragments from cutting as well as plants living within the marina fill up the marina and make it extremely hard to navigate.

Used to take hundreds upon hundreds of hours to get the plant fragments/plants out of the marina. Have bubblers, devisers, machines and people with pitchforks trying to get the weeds out of the marina.

Have your renters informed you that they are concerned about water quality or aquatic plants?

Yes, to the aquatic plants

What concerns about water quality or aquatic plants have your renters informed you about?

See question 6. Customers are mad about how many weeds they have to deal with trying to leave the marina.

What suggestions can you offer for future aquatic plant management?

Find some new products that work. Don't want the herbicide treatments to stop because the fish need the weeds, it's the circle of life, but the current chemicals are not working.

The cutters (mechanical harvesters) seem to cut well but they don't collect the plant they're cutting well. All the fragments float downwind and end up in staying in places like our marina.

10. Is there anything more you would like to tell us that we have not yet discussed?

109 slip marina

He doesn't remember a day they didn't pay to be sprayed (herbicide application) and would be scared to see what the marina would look like without being sprayed.

It is a constant battle to keep the weeds out of the marina and the current program does not seem to working.

This area will lose money if they don't do something.

People are not coming up because of the amounts of weeds within portions of the ship canal.

Survey 6	Date: 5/15/2017
----------	-----------------

In total, how many years have you worked in the marina industry in Door County

25 years

In the years you have owned or operated this marina, what changes in water quality or aquatic plants have you observed?

I have 100% seen changes. When I first started, you couldn't launch a canoe off the shore because of the aggressive weeds [cutting?]. After a treatment, the weeds are 100% gone, some floaters but the plants are gone.

How have aquatic plants and the management of aquatic plants affected your business?

It has positively affected the business.

What concerns, if any, do you have as a marina owner or operator in regards to aquatic plant management and herbicide use in marinas?

For the herbicide treatments, I assume someone who knows what they are doing checked this out and knows that it's okay.

For the floaters, there is a very short memory in this community and the difference is staggering. People get mad at seeing one or two floaters now but it is nothing like it used to be. I used to spend 20-30 hours a week trying to get people into our slips and you could walk on the plants close to shore. The change is a result of 20-30 years of the city managing the problem. Prior to 1992 cutting was happening and around 1993 the cutting stopped and it was impossible to navigate.

What suggestions can you offer for future aquatic plant management?

Don't stop the cutting or we will be back to where it was before if we stop. Cutting takes the veg out and prevents seedlings. I'm afraid of what will happen if they stop, it won't return to where it was in a year or two but eventually it will.

D

APPENDIX D

Boat Landing Stakeholder Survey Responses

6. Do you use watercraft on waters other than the Sturgeon Bay ship canal?

- a. Yes
- b. No

7. Have you heard of aquatic invasive species (AIS)?

- a. Yes
- b. No

8. How do you clean your boat after being on the water? Please circle all that apply.

- a. Remove aquatic hitch-hikers (ex. - plant material, clams, mussels)
- b. Drain bilge
- c. Rinse boat
- d. Power wash boat
- e. Apply bleach
- f. Do not clean boat
- g. Other (please specify): _____

9. During your boating on or through the Aquatic Plant Management Area (map) in the Sturgeon Bay ship canal in the last week, have aquatic plants negatively impacted your enjoyment on the water?

- a. Yes - skip to Question 11
- b. No

10. Have aquatic plants ever negatively impacted your enjoyment within the Aquatic Plant Management Area (map) in the Sturgeon Bay ship canal?

- a. Yes
- b. No - skip to Question 14

11. What were you doing when the aquatic plants impacted you? Please circle all that apply.

- a. Fishing
- b. Swimming
- c. Boating
- d. Other (please specify): _____

12. How were the plants impacting your recreation? Please circle all that apply.

- a. General unsightliness
- b. Snagging on fishing lines
- c. Wrapping around the prop
- d. Made swimming less fun
- e. Other (please specify): _____

13. Where were you within the Sturgeon Bay ship canal when the plants impacted you? See map on back.

- a. I don't know
- b. Circled on back

14. We would like to determine the average distance Sturgeon Bay users travel. What is the zip code of your primary residence and/or how many miles it is one-way from your primary residence?

54235

Thank you for your time, your input is valued.

Survey Facilitator Use Only		
Date: <u>6-21-2017</u>	Time: <u>8:40 AM</u>	Survey #: <u>1</u>

6. Do you use watercraft on waters other than the Sturgeon Bay ship canal?

- a. Yes
- b. No

7. Have you heard of aquatic invasive species (AIS)?

- a. Yes
- b. No

8. How do you clean your boat after being on the water? Please circle all that apply.

- a. Remove aquatic hitch-hikers (ex. - plant material, clams, mussels)
- b. Drain bilge
- c. Rinse boat
- d. Power wash boat
- e. Apply bleach
- f. Do not clean boat
- g. Other (please specify): W/High Pressure

9. During your boating on or through the Aquatic Plant Management Area (map) in the Sturgeon Bay ship canal in the last week, have aquatic plants negatively impacted your enjoyment on the water?

- a. Yes - skip to Question 11
- b. No

10. Have aquatic plants ever negatively impacted your enjoyment within the Aquatic Plant Management Area (map) in the Sturgeon Bay ship canal?

- a. Yes
- b. No - skip to Question 14

11. What were you doing when the aquatic plants impacted you? Please circle all that apply.

- a. Fishing
- b. Swimming
- c. Boating
- d. Other (please specify): _____

12. How were the plants impacting your recreation? Please circle all that apply.

- a. General unsightliness
- b. Snagging on fishing lines
- c. Wrapping around the prop
- d. Made swimming less fun
- e. Other (please specify): W/High Pressure

13. Where were you within the Sturgeon Bay ship canal when the plants impacted you? See map on back.

- a. I don't know
- b. Circled on back

14. We would like to determine the average distance Sturgeon Bay users travel. What is the zip code of your primary residence and/or how many miles it is one-way from your primary residence?

App 35 mi

Thank you for your time, your input is valued.

Survey Facilitator Use Only		
Date: <u>5-1-2017</u>	Time: <u>10:00 AM</u>	Survey #: <u>1</u>