Aquatic Plant Management Plan

For

McCaslin Lake

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McCaslin Lake Aquatic Plant Management Plan

McCaslin Lake is a shallow drainage lake located in the Township of Silver Cliff (T34N, R17E, S33) in Marinette County, Wisconsin (figure 1). The lake covers 74 acres and has 26 homes located on the shore. The purpose of this report is to develop a long-term sustainable plan for the management of aquatic plants in McCaslin Lake with an emphasis on the control of floating leaf vegetation and aquatic invasive species prevention.

McCaslin Lake District

The McCaslin Lake District was formed in 1980 to explore aquatic plant management options on the lake and address low winter dissolved oxygen levels. Currently the District operates a weed harvester and an aeration system to improve water quality on the lake. In 1996 the district received a Wisconsin DNR Lake Management Planning grant to characterize water quality and the lakes aquatic plant community and develop a lake management plan to protect and improve McCaslin Lake. The district also received a Lake Protection grant to purchase 72 acres with more than 1200 feet of undeveloped shoreline on McCaslin Lake.

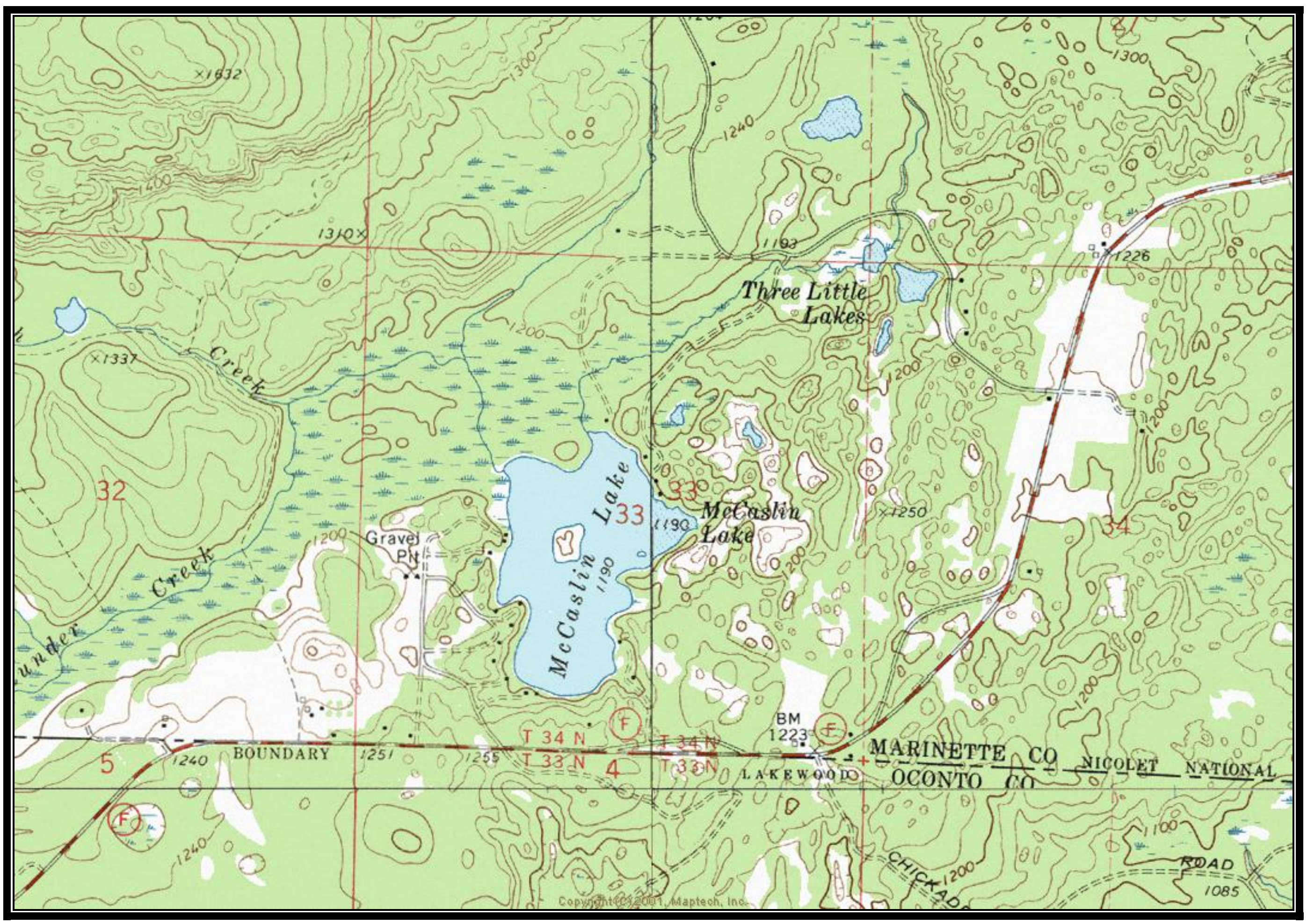


Figure 1. McCaslin Lake

Overview of Physical & Chemical Characteristics of McCaslin Lake

McCaslin Lake is a soft water drainage lake. The water is light brown in color due to staining and transparency is moderate. Water quality monitoring conducted as part of the 1996 lake management plan shows the trophic state index (TSI) for phosphorus was 51.3. The Secchi disk TSI was 49.3 during the same period. A TSI of 50 indicates moderately elevated nutrient levels, sufficient to support occasional nuisance algae blooms and/or abundant aquatic plant growth. The nutrient levels seen in McCaslin Lake are average for drainage lakes in Wisconsin.

McCaslin Lake has a maximum depth of 10 feet and more than 75% of the lake is less than 6 feet deep (figure 2). Due to its shallow depth, the lake remains mixed throughout the year and the water column remains well oxygenated throughout the open-water season. Prolonged periods of calm hot weather may lead to periods of low oxygen near the bottom of the lake. Winter oxygen stress has been a problem in the past.

McCaslin Lake receives most of its water from overland drainage via Smith Creek, which drains much of the southern slope of McCaslin Mountain. The watershed drains approximately 1,140 acres of land, most of which is forest (981 acres) and wetland (133 acres). Low-density development and roads cover approximately 26 acres. The outlet flows northeast to Three Little Lakes, a series of small lakes that have no outlet.

Lake sediment type and depth varies considerably throughout the lake. In the very near shore area sediment is primarily sand and gravel. Within a few feet of shore however, a deep layer of flocculent organic muck covers the lakebed. This layer of muck exceeds 20 feet in thickness in many locations.

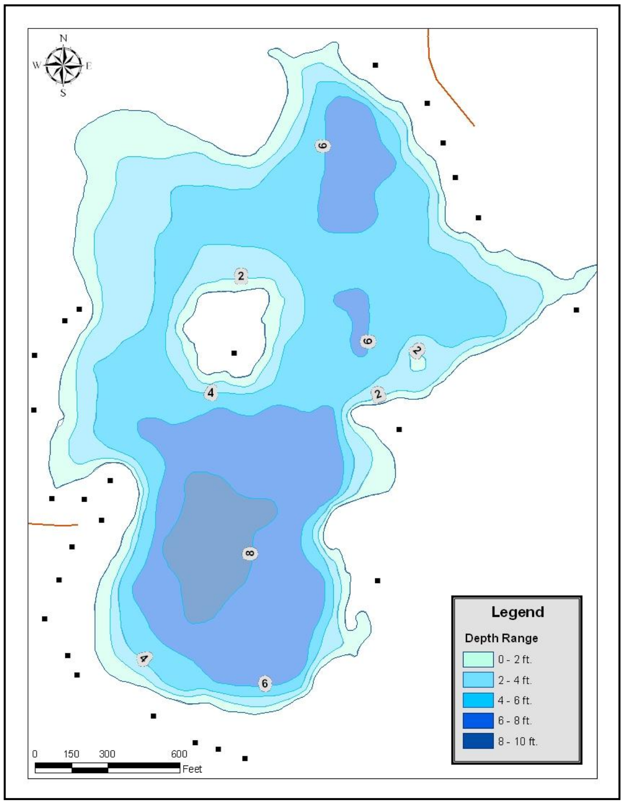


Figure 2. McCaslin Lake hydrologic map.

Public Access & Recreational Use

Public access is available through a private lot on the south shore of the lake along with difficult access through property owned by the Lake District on the north shore of the lake. Boating pressure from non-residents is light and District residents adhere to a voluntary slow-no-wake policy and "ban" on personal watercraft. Due to the mucky bottom and abundant aquatic plants fishing and non-motorized boating are the primary uses of McCaslin Lake. Swimming is often restricted to swim rafts anchored in deeper water.

Fish & Wildlife Communities

Information concerning the fish community in McCaslin Lake is primarily anecdotal. A private consultant conducted the last fishery survey in 1993. At that time the bass and bluegill population had a good size structure. According to district members, bass and panfish are still plentiful and the size structure are good but somewhat lower than previous years. The McCaslin Lake District operates an aeration system in the lake to maintain dissolved oxygen during the winter months. This has eliminated winter fish kills during the last two decades.

McCaslin Lake is surrounded by abundant and diverse wildlife habitat. Forested land north and west of the lake is dominated by sugar maple, white pine, hemlock, and yellow birch. South and east of the lake soils are dryer and oak, aspen, and red pine are the dominant tree species. A large wooded wetland complex on the northwest corner of the lake is dominated by white cedar. There are also several small bays supporting emergent and shrub wetland habitat types on the lake. As a rule, shoreline development has been very "lake friendly" and most developed lots still provide excellent shoreline habitat, including a fringe of undisturbed wetland vegetation that encircles the lake. Raccoon, muskrat and mink are common and the adjoining wetlands support nesting ducks, primarily wood duck and blue-winged teal. The surrounding forests support the usual wildlife species. Black bear are especially abundant.

Aquatic Plant Community

Like many shallow, soft water lakes the aquatic plant community in McCaslin is dominated by floating-leaf vegetation (water lilies and their allies) while the submersed plant community is rather limited in diversity. Due to stained water the maximum depth of plant colonization (photic zone) is approximately 8 feet. Still, the area within the photic zone covers more than 70 acres, or 95% of the lake.

Floating leaf plants common in McCaslin Lake include water shield (*Brasenia schreberi*) and white water lily (*Nymphaea odorata*). Floating leaf plants are widespread throughout the lake in water less than 6 feet deep. They often form dense beds that restrict, or even eliminate, navigation. The submersed plant community is dominated by bushy pondweed (*Najas flexilis*), white-stem pondweed (*Potamogeton praelongus*), and ribbon-leaf pondweed (*Potamogeton epihydrus*). Submersed vegetation is sparse throughout most of the lake.

A transect survey of the lake conducted in 1995 found11 native aquatic plant species. A more thorough survey conducted in 2008 found 18 species. No exotic species have been identified in McCaslin Lake.

History of Aquatic Plant Management Efforts

Landowners on McCaslin Lake have been managing aquatic plants in an organized manner since the early 1980's. Early efforts included cutting plants with a Hockney weed cutter, which was used for several years. However, the Hockney was limited in the amount of vegetation it could cut and picking up the cut plants was a serious problem. Maintenance was also troublesome and the Hockney was later abandoned.

In 1999 the District upgraded the harvesting program with the purchase of a used Aquamarine 6-foot weed harvester. The goal of the harvesting program has been to remove floating root masses and open navigation lanes through dense water lily and watersheild beds. Trained volunteers operate the harvester, removing 15 to 20 loads each year from an area covering fewer than 5 acres on average.

Aquatic Plant Survey

The main goal of the Lake Management Planning Grant is to develop a comprehensive aquatic plant management plan for McCaslin Lake that addresses the needs of lakefront property owners while protecting fish and aquatic communities of the lake. To this end, a detailed aquatic plant survey was completed during the summer of 2008.

Survey Methodology

The Marinette County LWCD with assistance from District volunteers completed the aquatic plant survey of McCaslin Lake in July 2008. The survey used the Wisconsin DNR point/intercept sampling protocol with a point spacing interval of approximately 100 feet. Coordinates for each of the 215 sample points were loaded onto a Garmin Vista handheld GPS unit for navigation in the field.

At each sample location a special double-headed garden rake on an extendable aluminum pole was used to determine the water depth and sediment type and to sample aquatic plants. Plants were collected for identification by dragging the rake across the bottom for approximately 0.75 meters and bringing it to the surface. Each plant species was identified and a relative abundance measurement was recorded for the total amount of plant material on the rake. The location of each sample point was also recorded on a Trimble Geo XT for more accurate mapping.

Data was entered and analysis was completed in Microsoft Excel. All sample location and associated data were mapped in the Marinette County Geographic Information Systems (GIS) database. Plant community statistics and distribution maps for each species can be found in Appendix A.

Sediment Type

Sediment type was determined by "feel" at each sample location using the metal rake head attached to an aluminum pole. Data was recorded as muck, sand & gravel, or rock. Soft unconsolidated sediment was recorded as muck. Rock included everything from cobble size rock (2-3 inches) to boulders or bedrock. Sand and gravel are often mixed and difficult to distinguish by feel so they were grouped together. Analysis of the data shows that most of the sample points (99%) consisted of muck. Rock, sand, and gravel are generally limited to very shallow near-shore areas and are generally under-sampled with this survey methodology.

Sediment type is important because aquatic plants have differing sediment preferences. The very soft organic muck found in McCaslin Lake does not support a wide variety of submersed aquatic plants because it does not provide a firm substrate for rooting. The lilies and other floating-leaf plants that dominate McCaslin Lake are well adapted to the loose organic sediment. They all have large tuberous roots that anchor plants in soft sediment.

Aquatic Plant Community Structure

As mentioned, the aquatic plant community in McCaslin Lake is not especially diverse. During the survey 18 native species were identified. No exotic species were found. Aquatic plants can be grouped into three general categories, submersed plants are those that grow underwater. Floating-leaf plants are rooted underwater but have their leaves floating on the surface. Emergent plants can be rooted underwater or in wet soil but hold most of their stems and leaves above the waters surface.

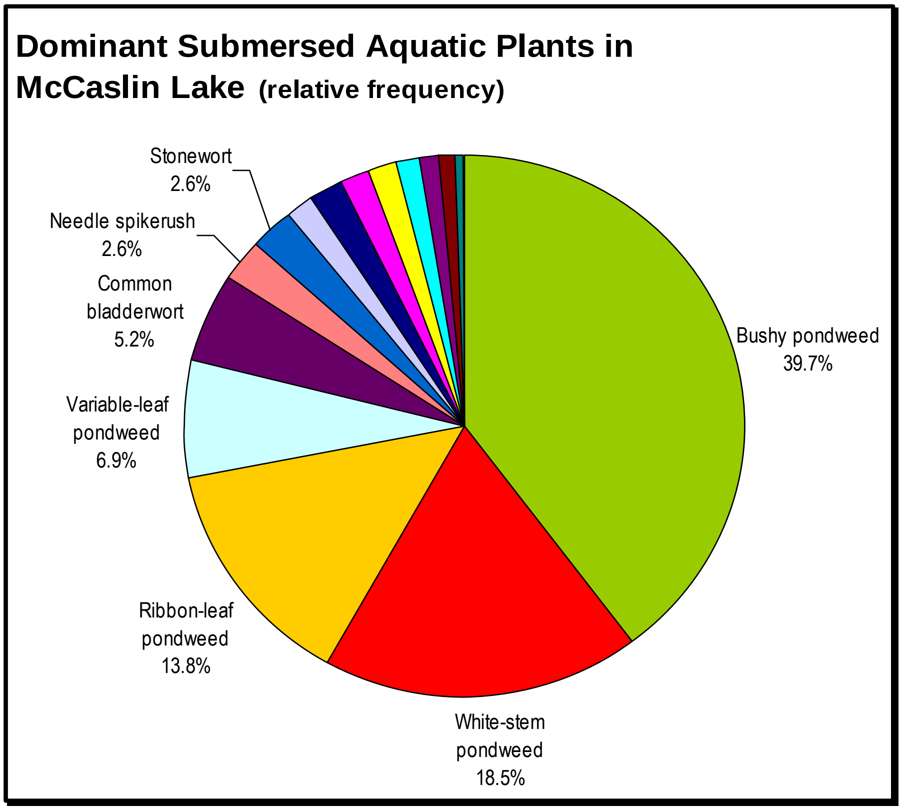


Figure 3. Dominant submersed plants.

Descriptions of the most common plants found in McCaslin Lake are adapted from *Through the Looking Glass, a Field Guide to Aquatic Plants* (Boreman 1997), a publication of the Wisconsin Lakes Partnership. Distribution maps for each species can be found in Appendix A.

Common Submersed Aquatic Plants

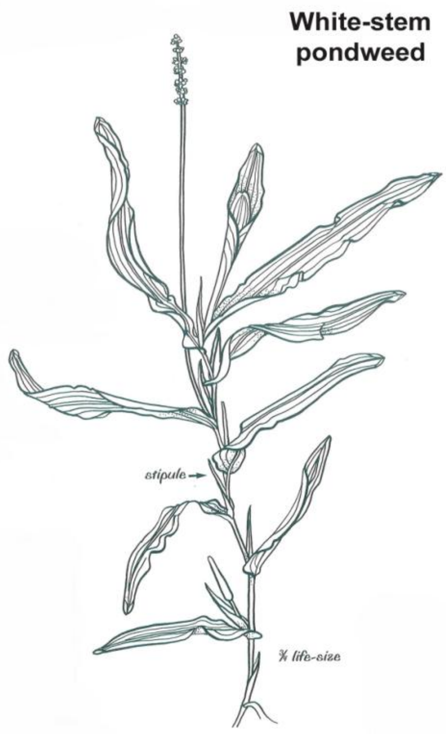
16 species of submersed plants were identified in McCaslin Lake. Bushy pondweed, white-stem pondweed, and ribbon-leaf pondweed were the dominant species, accounting for nearly three quarters of the plant population (figure 3). Four other species were found in at least 3% of the sample points.

Bushy pondweed

Bushy pondweed (*Najas flexilis*) was the most abundant submersed plant in McCaslin Lake. It was found at 44% of sample sites. This plant varies greatly in growth form, in shallow water it is typically compact and bushy. In deep water it is often wiry with widely scattered leaves. The leaves are very narrow ($1/16^{th}$ inch wide) with a broad base where they attach to the stem. Plants generally grow no more than 2 feet tall and prefer a sand or firm muck substrate.

Bushy pondweed is unique in that it's one of the few annual aquatic plants. It dies each winter and depends on seed to grow new plants each year. The plants and seeds, which are produced in great number each year, are important food for waterfowl.

In McCaslin Lake bushy pondweed shows no distinct depth preference and can be found growing in water from one to 7 feet deep. Due to its short stature bushy pondweed is seldom reported as a nuisance plant.



Graphic courtesy of Through the Looking Glass Carol Watkins Illustrator

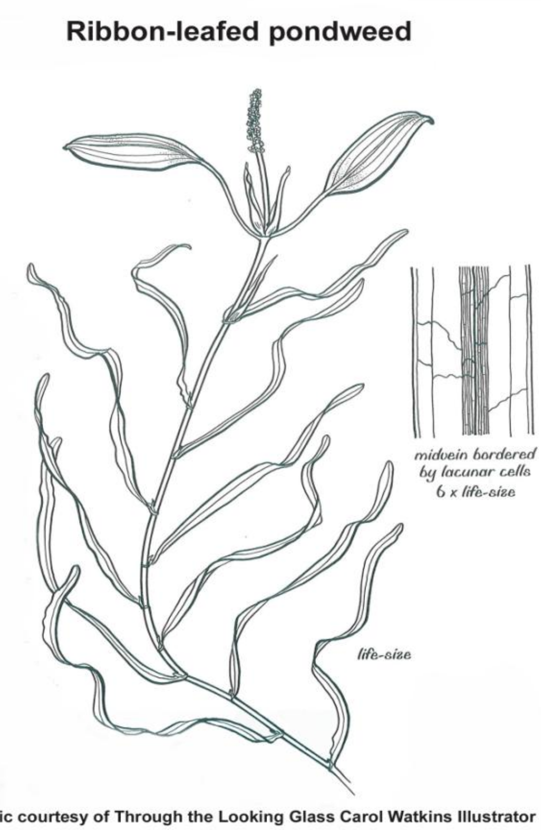
White-stem pondweed
White-stem pondweed (*Potamogeton praelongus*) was found at 20% of the sample locations and is the most abundant large pondweed in the lake. The leaves of white-stem pondweed are ½ -1½ inches wide and 8-10 inches long. The wavy leaves clasp the stem at their base and typically have a boat shaped tip that splits when pressed flat, creating a notch in the leaf tip. True to its name, the stems are typically pale white.

White-stem pondweed prefers soft sediment but is typically found in more alkaline waters. Like all large pondweeds it provides important deepwater habitat for fish. Anglers often refer to this and other large pondweeds as "cabbage" or "musky weed", alluding to its value as habitat where large predator fish can lie in wait. Waterfowl and muskrats also feed on the fruit and leaves.

Ribbon-leaf pondweed
As its name suggests, ribbon-leaf pondweed (*Potamogeton epihydrus*) has long ribbon like leaves (up to 10 inches long) attached alternately to slightly flattened stems. The leaves are narrow, typically 1/8 to 3/8 inches wide, with parallel sides and a row of pale green hollow cells along each side of the midvein. When flowering, ellipse-shaped floating leaves are produced and a short flower stalk is held above the water surface.

Ribbon-leaf pondweed prefers water with low alkalinity. It was found at 20% of the sample points and preferred water 2 to 7 feet deep. The plant is reported to show no substrate preference.

The fruit of ribbon-leaf pondweed is an important food source for ducks. Waterfowl and muskrat also graze on the vegetation. Like all large pondweeds it provides excellent deep-water fish habitat.



Graphic courtesy of Through the Looking Glass Carol Watkins Illustrator

Variable pondweed

Variable pondweed (*Potamogeton gramineus*) was found at 8% of sample points on the lake. As the name implies it varies greatly in growth form between lakes and even within a single lake depending on depth and sediment type. Typically the plant has lance shaped leaves 3-8 cm long and 3-10 mm wide. It branches repeatedly and the side braches are very bushy.

Like many pondweeds variable leaf is a perennial that dies back in the fall. It also spreads by seeds that are produced on stalks held above the water surface. When flowering it forms small floating leaves that are wider and more ellipse shaped than the submerged leaves.

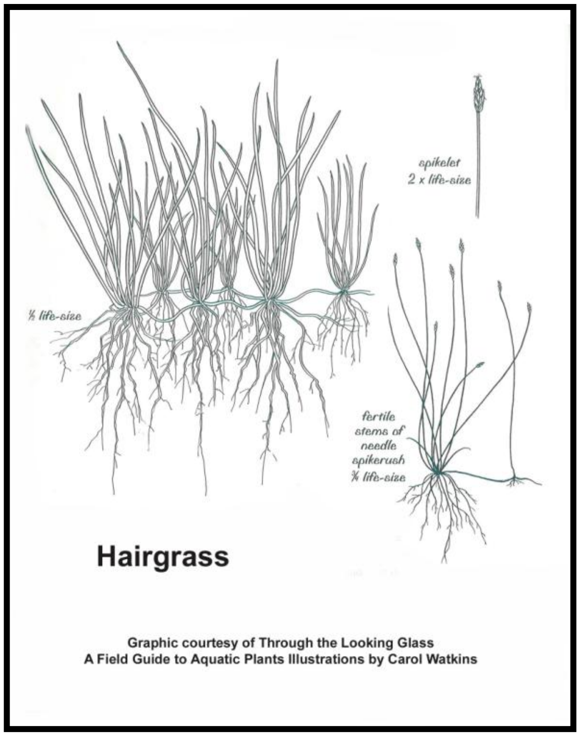
In McCaslin Lake variable pondweed was common in water less than 2 feet deep where it had small narrow leaves. It was also common in 5 to 9 feet of water where the leaves tended towards the upper range in size.

Common bladderwort

Common bladderwort (*Utricularia vulgaris*), is a carnivorous aquatic plant. It has long floating stems that are densely covered with fine leaf-like branches, each forked 3-7 times. The branches contain many bladders that are bright green when young and turn purple to black as they age. In late summer common bladderwort forms dense winter buds on the ends of the stem that fall off and lie dormant on the sediment until the following spring.

Like other green plants bladderworts are photosynthetic, but they also get energy by feeding on zooplankton or small insects. The bladders are specialized traps, activated when prey touch special trigger hairs near the bladders trap-door opening. When triggered, the trap-door snaps open and the bladder expands forcefully, drawing the surrounding water and hapless victim inside where it is digested. If you pull a bladderwort from the water you can often hear it snapping like Rice Krispies as the bladders snap open

Common bladderwort was the only bladderwort identified during the survey. It was found growing at 6% of sample points, primarily in water less than 3 feet deep.



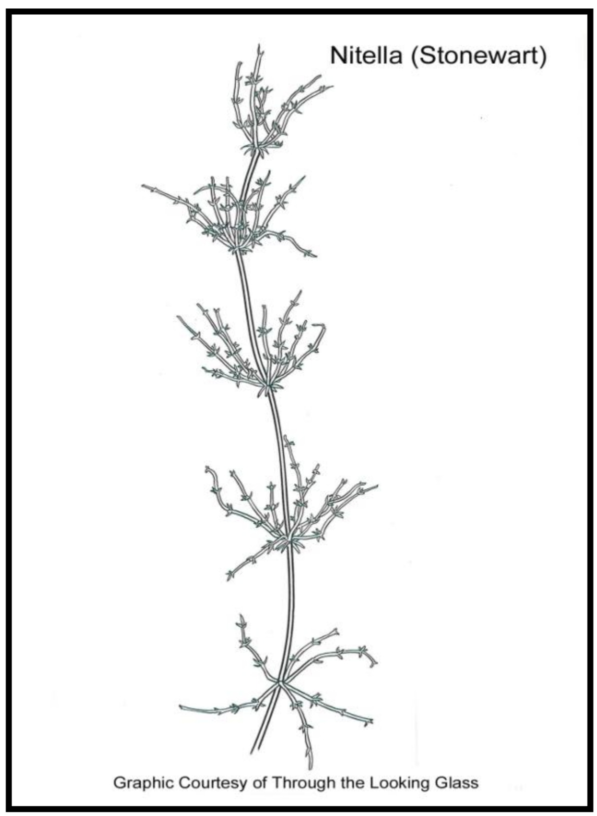
Hairgrass
Hairgrass (*Eleocharis accicularis*), also known as needle spikerush, is a slender grass-like plant common in shallow sandy areas of low alkalinity lakes. The stems are 3 to 12 inches long and emerge in tufts from fine spreading rhizomes. Plants that emerge from the water can develop fruiting structures called spikelets at the top of the stem.

In McCaslin Lake hairgrass was found at 3% of the sample points. It was primarily found in water less than 2 feet deep. Hairgrass was probably under sampled since it prefers very shallow water. It also grows well on wet shores and areas of lakebed exposed by fluctuating water levels.

Stonewort
Stonewort (*Nitella spp.*) is actually a type of algae that looks like a higher plant. It has slender branching "stems" with whorls of "leaves". The entire plant is smooth and translucent green.

Stonewort typically prefers soft sediment and deep water, often growing in very low light conditions. In McCaslin Lake stonewort was found at 3% of sample sites. It was most abundant in water over 5 feet deep

Stonewort is used by waterfowl and offers foraging opportunities for fish. Since the plant rarely grows more than 2 feet tall it seldom becomes a nuisance.



Infrequent Submersed Plants

The following aquatic plants were found at fewer than 2% of the survey points. This does not necessarily mean they are rare. The survey methodology tends to under sample some plants due to their location or their growth form. As before, descriptions are taken from *Through the Looking Glass, a Field Guide to Aquatic Plants* (Boreman 1997).

Pondweeds
Two other large pondweeds were found in McCaslin Lake, floating-leaf pondweed (*Potamogeton natans*), and large pondweed (*P. amplifolius*). The former is often viewed as a floating-leaf plant since its underwater leaves are stalk-like with no obvious leaf blade. Both provide excellent deep-water fish habitat.

Small pondweed (*P. pusillus*) was also found in the lake. It is one of the most common of a large group of fine-leaved pondweeds that are notoriously difficult to differentiate.

Other submersed aquatic plants
Several other submersed aquatic plants were identified in McCaslin Lake. Coontail (*Ceratophyllum demersum*) is a common plant that is often misidentified as the exotic Eurasian watermilfoil. Its stiff forked branches arranged in whorls on the stem help identify it. The ends of the stems are typically very dense, resembling a raccoon's tail. Wild Celery (*Valisneria Americana*) has long tape-like leaves that emerge from a central rosette. It is an important food for waterfowl. Dwarf watermilfoil (*Myriophyllum tenellum*) has short stems without discernable leaves. It resembles tiny green toothpicks poking up out of the sand.

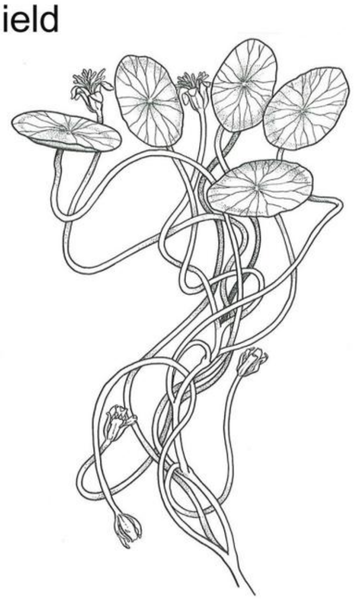
Moss
While not actually an aquatic plant, mosses can be an important part of the aquatic ecosystem. It is often found growing in deep water, beyond the range of most plants. In McCaslin Lake aquatic moss was found at 2% of the sites.

Muskgrass
Although it resembles a higher plant, muskgrass (Chara sp.), like stonewort, is actually a type of algae. Each "stem" segment and "leaf" is actually an algal cell. Muskgrass looks similar to stonewort but the plant is very coarse with ridged stems. When crushed the plant has a distinct skunk-like odor.

Floating-Leaf Plants

Floating-leaf plants include those with underwater stems and leaves that float on the water surface. While many pondweeds also produce floating leaves when they flower, their primary leaves are under water. Floating leaf plants found in McCaslin Lake include White pond lily (*Nymphaea odorata*), spatterdock lily (*Nuphar variegata*), and watershield (*Brasenia schreberi*).

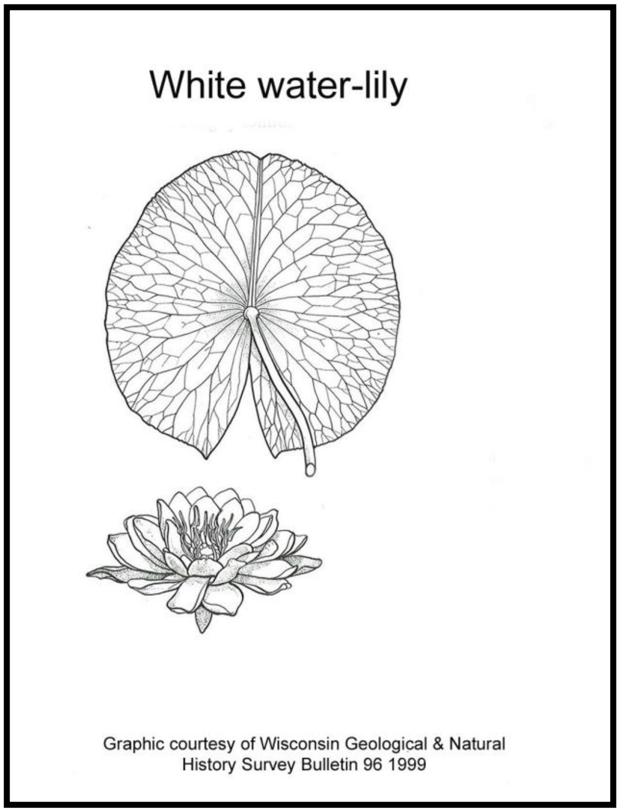
Water-shield



Graphic courtesy of WI Geological and Natural History Survey - Bulletin 96 1999

Floating leaf plants in general provide important fish habitat, providing shade, escape cover for small fish and ambush cover for bass and other predators. While they appear dense from the surface, under the floating canopy the water can be quite open.

Watershield
Watershield (*Brasenia schreberi*), is the dominant floating leaf plant in McCaslin Lake. It was found at 36% of sample points. Watershield can be distinguished from the lilies by its small (2-5 in) football shaped leaves attached at the center to long spaghetti-like stems. The stems and underside of the leaves are typically covered with a thick clear jelly-like coating. Below the sediment surface watershield has an extensive system of rhizomes that anchor the plant and provide stored energy in the spring. The rhizomes are also the primary method by which watershield expands. During each growing season the rhizomes elongate, forming multiple



Graphic courtesy of Wisconsin Geological & Natural History Survey Bulletin 96 1999

daughter plants along their length. Watershield also produces buds along the rhizome that can break free and float to new areas, and nut-like seeds that are also dispersed by water. Studies have shown that watershield exhibits some allelopathic properties and may inhibit the germination of other aquatic plants.

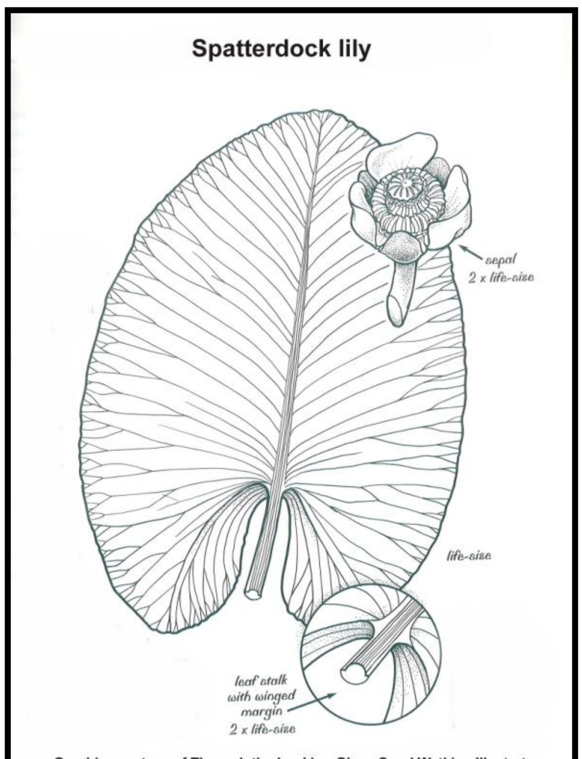
Like most floating leaf plants, watershield is restricted to relatively shallow water. In McCaslin watershield was most abundant in 2 to 5 feet of water but could be found out to a depth of 7 feet. Watershield prefers low alkalinity water and while it prefers muck it can grow well in sand.

In shallow, soft-water lakes watershield is especially aggressive and can and becoming a nuisance. This has been the pattern in McCaslin Lake. The main issue is their densely packed floating leaves and numerous, wiry, propeller-clogging stems. In the soft organic sediment of McCaslin Lake the extensive system of rhizomes often break free and float to the surface.

White water lily
Of the two lily species found on McCaslin Lake white water lily (*Nymphaea odorata*) is the most abundant. It was found at 26% of the sample locations.

White water lily has large (4-10 in) floating leaves attached to round flexible stalks. The leaves are fleshy, nearly round, and split to the center where the stalk is attached. In the summer it produces large white flowers on separate stalks that float on the surface of the lake. Like water shield it produces large tuberous rhizomes in the sediment. However, the tubers of white water lily are not as aggressive as watershield and serve more as a nutrient storage organ.

While it is found over the same depth range as watershield, white water lily is more abundant in the deeper water (4 to 7 feet). It shows the same habitat preferences as watershield, and the two are often found growing together.



Graphic courtesy of Through the Looking Glass Carol Watkins Illustrator

Spatterdock lily
Spatterdock (Nuphar variegate) is often called yellow water lily. It can be identified by its large yellow flowers or by its oval leaves with rounded corners where the leaf is split. Spatterdock also has large fleshy stems that are winged.

Spatterdock was only found at 2% of survey sites on the lake. It prefers soft sediment and is more abundant in high alkalinity waters.

Floating-Leaf Plant Abundance and Distribution

While water lilies and watershield were found in a significant number of sample points, the survey methods actually do a poor job of sampling the floating-leaf community. The point grids tend to under-sample very shallow areas where they grow best. Also, due to their growth form and tough stems the sampling gear often fails to collect the plants. To better describe the floating-leaf plant community, areas containing floating-leaf plants were mapped and described. Figure 4 shows the results of the floating leaf plant mapping effort.

Approximately 16 acres of the lake had dense or very dense floating-leaf plant coverage. Most of this area (12 acres) was dominated by watershield. The balance (4 acres) consisted of mixed watershield and white water lily. An additional 2 acres of the lake was characterized as supporting moderate to light floating-leaf vegetation, primarily a mix of water lilies and watershield. In addition to those areas identified and mapped, floating-leaf plants can be found scattered throughout the lake in water less than 8 feet deep.

All of the floating-leaf plants in McCaslin have large fleshy rhizomes that help anchor the plants in soft sediment and store nutrients. When these rhizomes break loose and float to the surface where they decay and become rather unsightly. Many areas mapped as dense plant beds consisted of these "floaters", particularly north and east of the island.

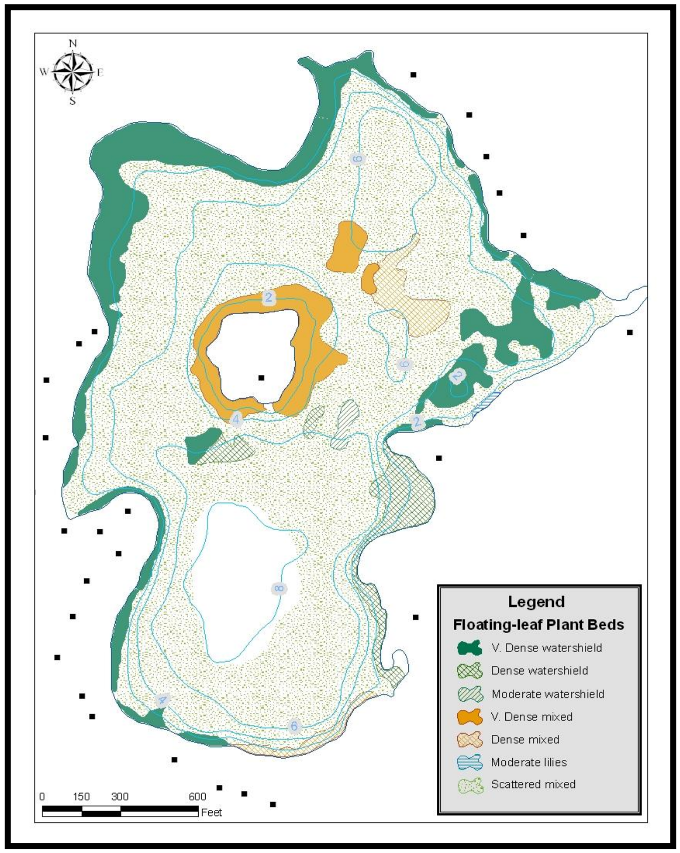


Figure 4. Floating-leaf plant abundance on McCaslin Lake.

Emergent Vegetation

Plants such as cattails, bulrushes and others that reach above the surface of the lake are known as emergent vegetation. Many of these plants grow in the lake or in saturated soil on the shoreline. Most are adapted to fluctuating water levels and are unharmed, or actually stimulated, by low water periods.

Due to their location on the shoreline emergents are under-sampled in grid surveys. Those found on the lake include broad-leaved cattail (*Typha lattifolia*), creeping spikerush (*Eleocharis palustris*), common rush (*Juncus effuses*), common arrowhead (*Sagittaria lattifolia*) and three-way sedge (*Dulichium arundinaceum*). A more intensive survey of shoreline vegetation would certainly show even more species including many sedges and other wetland vegetation.

In general the emergent plant community on McCaslin Lake is healthy. Much of the shoreline, even in developed areas, supports a narrow band of emergent vegetation. Many small bays on the east side of the lake and the large wetland complex near the inlet support high quality, diverse emergent plant communities.

Emergent plants are important in the lake ecosystem because of the habitat they provide for many fish and amphibians that spawn on and amongst their underwater stems. Invertebrates (insects) and amphibians living in the shoreline fringe form the base of the aquatic food web and are vital for a healthy lake.

Floristic Quality Index

One measure of the "health" of a lakes' plant community is the Floristic Quality Index (FQI), a measure based on the number of native species and their "coefficient of conservatism". A coefficient of conservatism is assigned to every aquatic plant in the State and represents how typical the plant is in pristine conditions. The FQI is based solely on the presence of a plant, not its abundance or dominance. Statewide, the average FQI for lakes is 22.2. The FQI for McCaslin Lake was 27.2, indicating a high quality aquatic plant community.

Aquatic Plant Distribution

Each species of aquatic plant has habitat preferences that determine where it grows or potentially can grow. These include such factors as depth, light exposure and sediment type. A discussion of these factors and their effect on the plant community of McCaslin Lake follows.

Depth
The area of a lake where aquatic plants can grow is called the littoral zone and is determined by water clarity and light penetration. Field investigation reveals that the maximum depth of plant colonization in McCaslin Lake is approximately 9 feet, although plant growth is limited in 8 feet of water. This means the littoral zone covers most of the lake (95%).

The extent of the littoral zone is determined by light penetration (water clarity), which is controlled by suspended sediment, algae, and color. In McCaslin Lake color is primarily responsible for limiting light penetration. The water in McCaslin Lake typically has a light brown color caused by tannins in the water. Tannins are naturally occurring dissolved organic compounds that come from decomposing plants in the lakes watershed.

Within the littoral zone each species has a depth preference and a maximum depth at which it can grow. In some cases the maximum depth is limited by growth form such as water lilies that have floating leaves attached at the end of long underwater stalks, or emergent plants that must stand above the surface. Submersed plants are limited by the amount of available light, which decreases rapidly as depth increases. Most aquatic plants are perennials that die back to the sediment surface each year. Others sprout anew from specialized plant fragments (winter buds) lying on the lake bottom. These plants use energy stored in the roots or winter buds to extend upward towards the light each year. They must grow high enough and fast enough to reach the sunlight then grow and export nutrients to the roots to start next year's growth. Different species vary in their ability to grow in low light conditions and fewer species are typically found at greater depth.

Of the dominant species found in McCaslin Lake, common bladderwort, and hairgrass show a strong preference for shallow water. White-stem pondweed, ribbon-leaf pondweed, and stonewort showed a definite preference for deeper water. The other species are more widespread in their distribution.

Among the floating-leaf plants watershield is most abundant in water less than 6 feet deep. White water lily is most abundant in water less than 3 feet deep and more than 5 feet deep. Spatterdock lily also shows a preference for deeper water (more than 4 feet).

Sediment

Sediment type plays a major role in aquatic plant distribution and abundance. Sediment preference can be related to physical properties of the sediment (coarseness, grain size, compaction) or in the chemical properties of the sediment such as pH, or nutrient availability.

Most rooted aquatic plants get their nutrients from the sediment, not the overlying surface water. Because of this, even lakes with low to moderate nutrient levels in the water column can support abundant aquatic plants if sediment nutrient levels and water clarity is sufficient.

Nutrient availability is closely tied to sediment coarseness. What most people refer to as muck is typically silt with a high percentage of organic particles from decomposing plant material. Organic sediment is typically high in nutrients. Sand, by itself can be very nutrient poor, however there is typically sufficient fine silt and organic matter mixed in to provide good growing medium for plants. Rock by itself will not support plant growth but it is often found mixed with sediment that will.

The widespread flocculent organic sediment found in McCaslin Lake has a major impact on the plant community. Plants such as watershield and white water lily are adapted to growing in the flocculent sediment so they flourish. Others, such as many of the common pondweeds prefer firmer sediment and are rare or absent from McCaslin Lake. Plants that prefer a sand substrate such as dwarf watermilfoil and harigrass are limited to very shallow near-shore areas.

Changes in the Aquatic Plant Community

One-time aquatic plant surveys are useful for describing the aquatic plant community but by themselves do not describe changes in the community. To identify changes the plant community needs to be tracked over time. The only other aquatic survey of McCaslin Lake was conducted in 1995 as part of a lake management planning project. Unfortunately, the earlier survey was not conducted using the same methodology as the 2008 survey. In 1995 plant data was collected along 10 transects laid out by anchoring a line perpendicular to shore. A diver swam along a line taking note of all species within 0.5 meters of the line in each of three depth ranges 0-0.5 meters, 0.5 – 1.5 meters and 1.5 – 3.0 meters. Since some transects did not reach water 3 meters in depth the actual number of survey “points” was 23.

While directly comparing the data can be difficult, there are some larger trends and qualitative assessments that can be made. In 1995 12 aquatic plant species were identified, compared to 18 species in 2008. The difference is likely due to survey methodology rather than an increase in diversity during the period. The relatively small number of sample points in the original survey would tend to under-sample uncommon plants.

A review of plant frequency data (figure 5) shows that there have been some striking changes in species dominance over the last 15 years. In 1995 the floating-leaf plant community was dominated by white water lily with a relative frequency of 16.9%. Watershield was uncommon, with a relative frequency of only 2.2%. While the relative frequency of white water lily has changed little, watershield has increased in frequency by more than 89%.

An analysis of the submersed plant community reveals that the frequency of most pondweeds has decreased substantially. Floating-leaf pondweed, large leaf pondweed, and wild celery have all experienced drastic declines. Ribbon-leaf pondweed and variable-leaf pondweed have also declined substantially. The only submersed plants that increased in frequency were white-stem pondweed and bushy pondweed.

While identifying causes for these changes in the plant community can be difficult, the current mechanical harvesting program has likely played a major role, particularly in the decline of the large pondweeds. The increase in bushy pondweed is also likely due to repeated harvesting. Bushy pondweed is an annual plant that tends to form dense tangled mats on the bottom but seldom grows tall enough to be a nuisance. Since it stays out of reach of the harvester, repeated cutting can actually stimulate its growth. This has been clearly demonstrated in Lake Noquebay, where thirty years of harvesting has lead to increased frequency of bushy pondweed and other low-growing aquatic plants (Druckrey 2009).

The drastic increase in watershield is more difficult to explain. The harvesting program might cause limited spread of watershield if the plants are uprooted and allowed to drift to new areas. However, Cutting that removed the roots should have a long lasting negative effect. Harvesting just the stems and leaves should have little effect on distribution at all since the plant can quickly send up new leaves. On the whole, harvesting should have a net negative effect on watershield.

A more likely cause of the increase is changes in weather patterns. The recent hot, dry summers and more frequent draughts have resulted in low water levels, increasing water temperatures, and longer growing seasons. Similar increased in watershield have been noted in Beecher Lake and Crane Lake, both in Marinette County.

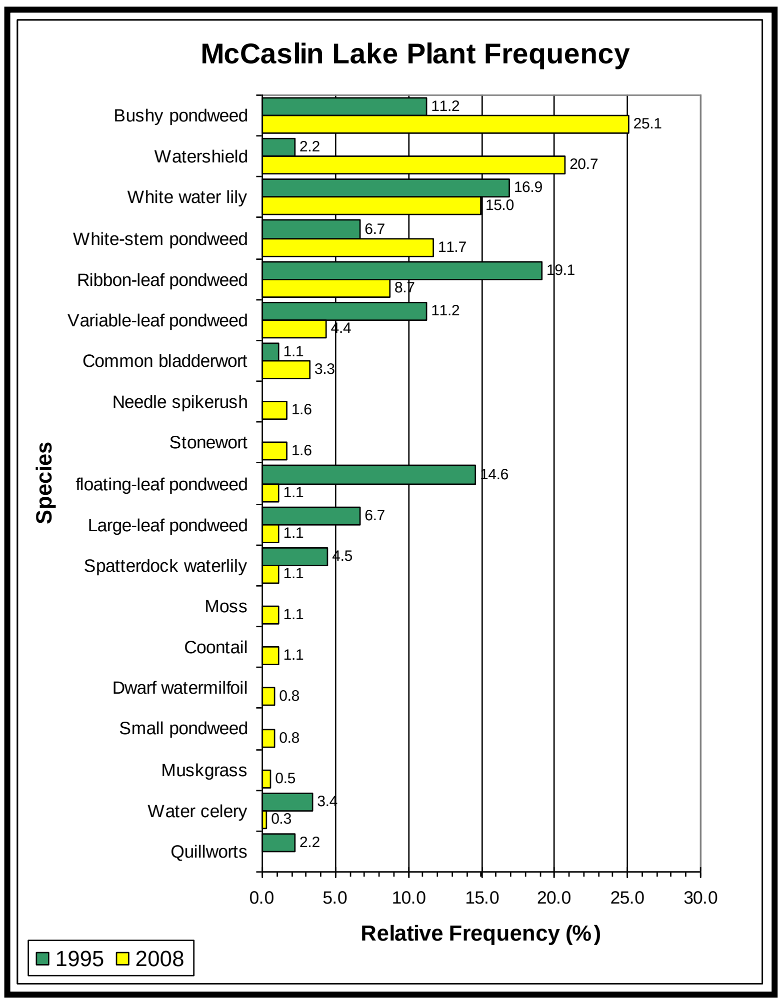


Figure 5. Changes in aquatic plant frequency from 1995 to 2008.

Identification of Problems and Threats to McCaslin Lake

The most pressing issue confronting McCaslin Lake is the excessive growth of floating-leaf vegetation, particularly watershield and white water lily as they restrict navigation and recreational use of the lake. This was clearly communicated in the 1997 landowner survey and reiterated throughout the current planning process. Future threats to McCaslin Lake include the introduction of aquatic invasive species. Currently Eurasian watermilfoil (*Myriophyllum spicatum*) and zebra mussels (*Dreissena polymorpha*) have been identified in nearby waters.

Aquatic Plant Management Goals & Objectives

The goal of the McCaslin Lake District is to: **Develop and implement a sustainable aquatic plant management program for McCaslin Lake to control excessive aquatic plant growth, restore beneficial uses of the lake, and protect fish and wildlife habitat.** To achieve this goal specific management objectives have been identified and targets have been set to gauge success and guide the selection of management options.

Goal: Develop a sustainable aquatic plant management program for McCaslin Lake.

A sustainable aquatic plant management program will be cost-effective, socially acceptable and should, as much as possible, be relatively easy to repeat as needed. In determining cost effectiveness the District needs to consider annual management cost, duration of control and permitting requirements.

Objective: Increase efficiency and effectiveness of the current aquatic plant harvesting program.
Since the District has already invested heavily in aquatic plant harvesting, emphasis should be placed on increasing the effectiveness of the program and looking for efficiencies to reduce cost and/or better meet the needs of District members. Annual evaluation of the harvesting program will be easier if adequate records are kept and presented in a clear manner.

> *Target – Collect detailed records of annual harvesting efforts and areas harvested.*

While aquatic plant harvesting is the primary aquatic plant management tool employed by the District, other alternatives should be explored.

Objective: Explore other aquatic plant management alternatives for potential effectiveness, cost, and public acceptability.
A review of common aquatic plant management alternatives is explored on page 22. The alternatives should be reviewed and updated as conditions on the lake change or new management options become available.

> *Target - Educate District members about alternative management practices, their potential effect on the lake ecosystem (pro and con), and estimated costs.*

> *Target - Implement promising management alternatives on a trial basis to evaluate effectiveness.*

An aquatic plant management program that is sustainable over the long-term also needs to adapt as environmental conditions and aquatic plant populations change. To make the required adjustments those responsible for making management decisions need current information upon which to base their decisions.

Objective: Track changes in the aquatic plant population to evaluate management efforts.
The recommended frequency of plant surveys depends on the frequency of changes in management methods. When new management methods are adopted surveys should be completed to track changes and determine management effectiveness. If, however management is routine the amount of time between plant surveys can be lengthened.

> *Target - Conduct pre and post management aquatic plant surveys to evaluate effectiveness of new management tools.*
>
> *Target - Conduct a full point/intercept survey of the lake every 10 years unless conditions change or the specific management tool calls for more frequent surveys.*

Even in the absence of formal point/intercept surveys landowners and the aquatic plant harvesting crew should be routinely monitoring the lake for early detection of new invasive species.

> *Target – Train volunteers and aquatic plant harvester operators in aquatic plant identification and aquatic invasive species monitoring methods.*
>
> *Target - Conduct annual surveys of the lake for new aquatic invasive species according to DNR AIS monitoring protocol.*

For any management program to be sustainable District members need to understand and take ownership of the program. Good communication is essential so members are realistic about the expected outcomes and understand what they as landowners can do to help.

Objective: Communicate effectively with District members.
The district Board currently does a good job communicating with District members and keeping them informed about lake and plant management measures.

> *Target – Continue publishing a regular newsletter to keep members informed about management practices and outcomes, and to share success stories.*
>
> *Target – Develop a website to help disseminate information.*
>
> *Target – Improve membership knowledge of water quality protection and improvement practices and aquatic invasive species prevention.*

Goal: Control excessive aquatic plant growth in McCaslin Lake and restore beneficial uses.

The main focus of aquatic plant management efforts on McCaslin Lake is the control of floating-leaf plants, primarily watershield and white water lily. Submersed plants are mainly a problem where they interfere with swimming. Since the District recognizes the value of a diverse aquatic plant community the objective is to reduce the abundance of nuisance aquatic plants to allow for improved navigation on the lake, open up large dense plant beds to improve access for fishing, and provide relief in swimming areas.

Objective: Target watershield and other floating-leaf plants for control while maintaining "beneficial" plants.

A plant can be "controlled" by reducing its frequency (where it is found in the lake) and/or by reducing its abundance (the amount, or density of plants at a location). Various management strategies differ in method of control and in the potential to selectivity control watershield and other floating-leaf plants. These differences can be found in the review of aquatic plant management alternatives on page 22. The current harvesting program works primarily by reducing watershield abundance and creating room for native plants to grow. Many of the native plants, including bushy pondweed and variable pondweed tend to be shorter and less likely to cause nuisance conditions. Increasing the frequency and density of these good aquatic plants will alleviate nuisance conditions while preserving habitat.

> *Target - Decrease watershield frequency and abundance in the lake.*
>
> *Target - Increase the frequency and abundance of bushy pondweed and other species where experience shows them to be beneficial (or at least less of a nuisance).*

Objective: Improve navigation and fishing access in areas with widespread dense plant growth.

Historically, the northern half of the lake experiences the densest aquatic plant growth, particularly the large bay northwest of the island and east of the island. In these areas floating-leaf plants made navigation nearly impossible. Since inception of the current harvesting program navigation and fishing has improved considerably in these areas.

> *Target –Prevent floating-leaf plants from returning to pre-harvest frequency and density levels.*
>
> *Target – Prevent floating leaf plants from rendering large areas of the lake inaccessible to boats and anglers.*
>
> *Target – Decrease size and number of floating root masses that disrupt navigation and fishing access.*

Objective: Improve areas for swimming and access to docks.

Since most of the lake bottom is covered with flocculent muck, most people swim from rafts anchored offshore in deeper water or from pontoon boats anchored in deeper water. However, since 95% of the lake supports aquatic plants there are few "weed free" areas. Access to docks is also difficult in some areas due to dense floating-leaf vegetation.

> *Target – Maintain "weed free" areas around swim rafts*
>
> *Target – Maintain navigation lanes between docks and open water.*

Goal: Protect fish and wildlife habitat on McCaslin Lake.

The Landowners on McCaslin Lake have done an excellent job of preserving shoreline habitat and limiting their impact on the lake. District members also follow a voluntary slow-no-wake rule and prohibition on personal watercraft. As a result, the lake supports a quality warm water fishery featuring largemouth bass, bluegill, and crappie. Waterfowl also make use of the lake and surrounding wetlands for breeding.

Objective: Protect important natural habitat on McCaslin Lake.
Since aquatic vegetation is such an important habitat component on McCaslin Lake, aquatic plant management options should be evaluated for their potential effects on fish and wildlife populations. Extra care should be taken when managing uncommon habitat types and/or areas known to be important fish spawning and waterfowl nesting areas.

Target – Protect stands of large pondweeds and other beneficial submersed species.

Target – Protect habitat along undeveloped shoreline areas.

Target – Maintain integrity of large wetland complexes along the lakeshore.

Aquatic Plant Management Alternatives

A successful aquatic plant management strategy must be tailored to the plants and water body in question and will typically utilize multiple control methods where appropriate. A comprehensive review of aquatic plant management alternatives follows. While each of the alternatives may be beneficial in certain situations, not all are applicable to managing aquatic plants in McCaslin Lake.

Do Nothing
Doing nothing is inexpensive, easy to do, and relatively uncontroversial. In rare cases it can also be effective. Lakes are complicated ecosystems and aquatic plant populations fluctuate within them due to a variety of factors. Large-scale climactic conditions and local weather cycles can impact water levels, temperature, and clarity, all of which effect aquatic plant growth. Plant populations also vary because of disease, species introduction, competition and other internal processes. Left to its own devices the plant community in McCaslin Lake will continue to change over time but the likely outcome is that watershield and other floating-leaf plants will continue to expand their range and increase in density.

Chemical Control
When properly planned and executed, chemical control of aquatic plants can be effective. However, if care is not taken in the selection timing, and application of aquatic herbicides the results can be less than desirable, or worse, have unintended consequences.

There are several herbicides approved for aquatic use in Wisconsin and each differs in its mode of action and the species it controls. Contact herbicides kill exposed plant material but can leave the root system intact. Plant re-growth can be problem with these types of herbicides. Systemic herbicides are transported to the roots and kill the entire plant. Systemic herbicides provide longer-term control but may act slower than contact herbicides.

Herbicides can also be divided into two general groups, “broad-spectrum” and “selective”. Broad-spectrum herbicides control a broad range of plants. Selective herbicides, as the name implies, are more-or-less selective and control fewer species while leaving many others unharmed.   Often selectivity is a function of timing of application or concentration of the herbicide.

Watershield and water lilies are susceptible to several common aquatic herbicides. They are especially susceptible to formulations of 2,4-D applied early in the season before the plants mature. Since many pondweeds and other native aquatic plants are resistant or only slightly susceptible to 2,4-D the chemical can be used to selectively control watershield and lilies while protecting pondweeds and many other submersed species. Floating-leaf vegetation can also be selectively controlled by taking advantage of their unique growth form. The floating leaves can be targeted using Glyphosate, which is sprayed on the floating leaves. Glyphosate is the active ingredient in Roundup. It is a systemic herbicide that will kill most floating-leaf or emergent plants it contacts. It is critical that an aquatic formulation of the chemical is used and that wave action or rain does not wash the chemical from the leaf surface for at least 6 hours. Since both chemicals are systemic herbicides they will kill the entire plant and should provide multi season control. However, since watershield can spread aggressively it will eventually return so even selective management will have to be repeated on a regular basis.

Improper or excessive use of aquatic herbicides can have unintended consequences. Widespread use of broad-spectrum herbicides can leave large areas of suitable habitat exposed to colonization by nuisance species. Also, the decomposition of tons of aquatic plants releases large amounts of nutrients to the water column, triggering algae blooms. For this reason, controlling vegetation in large areas is often done in stages.

Chemical treatment cost depends primarily on the chemical formulation and application rate, the distance a certified applicator has to travel, and the time and equipment involved. Current costs for treatment with granular 2,4-D in Marinette County have ranged from $700.00 to $900.00 per acre. Chemical treatment of aquatic plants in Wisconsin always requires a permit from the Wisconsin DNR. This is to ensure that the proposed chemical treatment will use appropriate chemical(s), at the correct concentration and at the proper time of the year. In almost all situations the applicator must be certified by the Wisconsin Department of Agriculture Trade and Consumer Protection.

Benthic Barriers

Benthic, or sediment barriers cover the sediment and prevent the growth of aquatic plants. The barriers work by physically disrupting plant growth or eliminating light at the sediment surface. When installed properly benthic barriers are very effective at eliminating all plant growth. However the difficulty of installing and maintaining these barriers prevent their widespread use.

Benthic barriers can be made of naturally occurring materials (sand and gravel) or artificial (synthetic plastic sheeting). Sand or pea gravel is commonly used to create weed free swim areas. However, there are several common problems with sand and gravel benthic barriers. If deposited on soft sediment it can sink in and mix with the native sediment. Also, over time new sediment is deposited on top of the barrier. Some species, including watershield can also grow in sand. All of these factors will lead to failure of the barrier.

Artificial barriers typically consist of sheets of polypropylene, polyethylene, fiberglass or nylon (Wagner 2004). All must be weighted to hold them in place against water currents, waves, and boat wake. If constructed of non-porous material benthic barriers will be subject to billowing and may float free of the sediment as gasses from decomposition build up beneath them. Porous barriers are less subject to billowing but plant fragments that settle on top are better able to root through them. Both types of barriers require annual maintenance since sediment accumulation on top of the barriers will build up and support new aquatic plant growth.

Artificial benthic barriers are relatively expensive and difficult to install and maintain. Maintenance consists primarily of annually removing accumulated sediment, which typically requires removal and replacement of the barrier. The use of any type of benthic barrier requires a Wisconsin DNR permit.

Dyes and Floating Covers
Dyes are liquid chemicals that are applied to change the color of the water. Covers physically cover the water surface. Both control aquatic plants by reducing the amount of light reaching the sediment.

Dyes typically color the water a deep blue or even black. For small ponds they are relatively inexpensive, long lasting, and effective. Effectiveness is limited in shallow water (2 feet or less) where the light reduction is seldom enough to prevent plant growth. Dyes must stay in the water throughout much of the growing season. Because of their dark color, dyes increase light absorption and can result in higher water temperatures. The increase water temperature can in-turn result in stronger stratification, lower dissolved oxygen and widespread changes in the aquatic community (Wagner 2004). Dyes are most effective against submersed plants. They are typically not an option in larger lakes and those with significant outflow.

Floating covers also disrupt plant growth by reducing light levels at the sediment surface. However, unlike dyes the floating covers prevent virtually all water use while they are in place. Floating covers can be difficult to install and effectively anchor.

Both dyes and floating covers require Wisconsin DNR permits. The main permitting issue with floating covers is the disruption of public water rights (fishing and navigation) that they cause while installed.

Harvesting
Aquatic plant harvesting is a widely accepted aquatic plant management alternative that can be effective on a large or small scale. Individual landowners often manually clear small areas around their dock or swim area. Typically this is accomplished by using one of several specially designed aquatic plant rakes and/or hand-held cutting implements. Under current Wisconsin Law landowners can manually harvest plants without a permit if the plant removal is not in a DNR designated sensitive area and is limited to a 30-foot wide area (measured parallel to shore). There is no limit on how far out into the lake a landowner can harvest by hand if they stay within the 30-foot wide corridor. The control area must be around existing piers, boat lifts, and swim rafts and the cut plants must be removed from the water.

Large scale harvesting, as practiced on McCaslin Lake, is accomplished using specially designed aquatic plant harvesters that cut and collect aquatic plants in one operation. The McCaslin Lake harvester has a 6-foot cutting width and a 5-foot maximum cutting depth.

Like most aquatic plant management alternatives harvesting seldom eliminates plants. Much like cutting your lawn, harvesting leaves the root system intact and plants will re-grow. In some cases repeated harvesting close to the sediment surface can stress plants enough to cause mortality. Species that depend on seed production for their spread may be partially controlled by harvesting if seeds are repeatedly removed. Plants that spread by fragmentation such as milfoil and coontail can actually be spread through harvesting when cut fragments escape the harvester and drift to other areas of the lake.

Repeated harvesting can have impacts on the aquatic plant community that go beyond the initial cutting. In Lake Noquebay repeated harvesting has led to measurable shifts in the aquatic plant community. When harvesting began in 1978 the lake was dominated by a variable watermilfoil, a native milfoil with growth habits similar to the Eurasian variety. After 28 years of harvesting the plant community has changed noticeably. Harvesting tonnage has gone down and bushy pondweed has increased in frequency and density in harvested areas. Bushy pondweed is a low growing native that typically stays below the maximum cutter depth of 5.5 feet.

As a management tool harvesting is not very selective and is best used where invasive or nuisance species dominate. Plant re-growth depends on the species present, timing of harvest, and cutting depth. Studies have shown that very deep cutting with specialized harvesters can even have multiple year effects on many aquatic plants. Repeated cutting of floating-leaf plants can also weaken them and eventually kill the plant.

Initial costs for a new harvester can range from $50,000 to $100,000 depending on the size of machine. Typically a truck is also required to transport plants to a disposal site and a shoreline conveyor to transfer cut plants from the harvester to the truck. Wisconsin does provide financial assistance for harvester and related equipment purchases through the Wisconsin Waterways Commission. Lakes must have adequate public access and 50 acres of harvestable area to qualify. Grants are awarded on a competitive basis and cover 50% of equipment purchase price. Operating and maintenance costs vary depending on the amount of use and the labor source. While volunteer operators are of course free, in the long run it may be best for the equipment and for the harvesting program to hire a dedicated harvesting crew to operate and maintain such expensive and complicated equipment.

Any mechanical harvesting requires a Wisconsin DNR approved aquatic plant management plan and harvesting permit.

Dredging

Typically a practice known for increasing depth to aid in navigation, dredging can also be an effective aquatic plant control technique. As a plant control measure dredging has two primary modes of action: changing sediment type, and increasing the depth to sediment.

Where a layer of nutrient rich organic sediment overlies a nutrient poor layer of mineral soil the organic layer can be removed to expose the sand or gravel layer that is less capable of supporting plant growth. Typically such removal will change the plant community structure, not eliminate all plant growth. Removing the upper layers of sediment also eliminates plant roots and most viable seeds. This may be applicable in shallow areas of McCaslin Lake but much of the lake has very deep sediment deposits. If dredged areas are small the results may be short lived as organic matter washes in from adjacent un-dredged areas.

Eliminating all submersed aquatic plants requires dredging the lake to a depth where light availability limits plant growth. In McCaslin Lake the lower limit of aquatic plant growth is about 9 feet with sparse plant growth at the 8-foot depth. Watershield is most abundant in water less than 5 feet deep and absent in water more than 7 feet deep.

There are two major types of dredging, mechanical and hydraulic. Mechanical dredging employs heavy equipment deployed on barge or shore to dig out the sediment and transfer it to trucks for removal. Mechanical dredging can be simplified if done in conjunction with a summer drawdown since less water is moved and conventional dry land excavating equipment can often be used. In hydraulic dredging, sediment and water are mixed in a slurry then pumped out of the lake to a disposal/dewatering area. Hydraulic dredging is best suited to loose organic sediment such as that found in McCaslin Lake.

It should come as no surprise that dredging is a very expensive alternative. Rough estimates for dredging range from $8.00 to $25.00 for each cubic yard (Wagner 2004). Much depends on the type of sediment, accessibility and disposal costs. On these counts McCaslin lake fares well. The sediment is very flocculent and ideal for hydraulic dredging. A potential disposal area also lies immediately east of the lake (figure 6). This area consists of a large internally drained basin or "closed depression" covering more than 18 acres. The first depression nearest the lake would hold nearly 114 acre-feet, with a total volume of nearly 535 acre-feet. This depression could serve as a settling basin and/or seepage pond. Sediment would accumulate in the basin and the water would be allowed to infiltrate. Returning clarified water to the lake would require additional pumping since the basin is at a lower elevation that the lake.

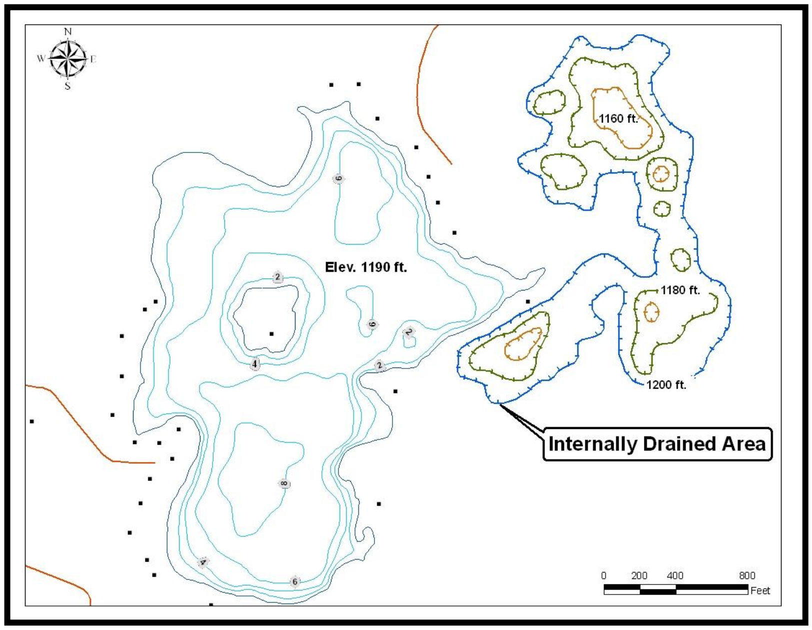


Figure 6. Potential dredge spoils disposal area.

Financial assistance for dredging is limited to navigation channels and boat landing improvements. Any type of dredging requires, at a minimum, a Wisconsin DNR and US Army Cops of Engineers permit. Permits must describe in detail the scope of the proposed dredging, dewatering and disposal of spoils, and the effects the project will have on fish, wildlife, and public water rights.

Drawdown

In impounded waters temporary drawdown can be a valuable aquatic plant management tool. Its effectiveness depends on the season and duration of the drawdown. Summer drawdown can kill some species of plants through desiccation of the root system. This is often difficult in organic sediments since they retain moisture and untimely summer rains can keep the sediment from drying. Even without complete desiccation summer drawdown can result in sediment consolidation, particularly in flocculent organic sediment, leading to increases in submersed aquatic plants. Big Muskego Lake, a shallow lake in Waukesha County, was drawn down in 1995 specifically to consolidate sediment and promote submersed plant growth. The project was effective and rooted aquatic plant density increased significantly (James, 2001). The drawdown also resulted in a temporary increase in phosphorus from the newly flooded sediment.

Winter drawdown controls plants by exposing their root systems to freezing conditions. In winter the duration of the drawdown is less important than the timing. It is important that frost penetrates to the root zone before snow insulates the lakebed. The response of aquatic plants to winter drawdown is well known for some species but not for others. To complicate matters, accounts in the scientific literature do not always agree (Cooke, 2005; Nichols, 1991). Watershield, common bladderwort, and needle spikerush are reportedly controlled by winter drawdown. Bushy pondweed, ribbon-leaf pondweed, and floating-leaf pondweed expand as a result of winter drawdown, and results are varied or unknown for white water lily, white-stem pondweed, and variable-leaf pondweed.

Typically a drawdown is only feasible in impoundments. However, the large internally drained features east of the lake would make a suitable outlet into which water could be drained. McCaslin Lake contains approximately 340 acre-feet of water. The 18 acres of closed depressions east of the lake would easily hold the entire volume of the lake with room to spare. Of course, due to the porous nature of the soil in these areas, the water would quickly seep away. While no outlet structure exists to release water from McCaslin Lake, the difference in elevation from the lake to the potential outlet area would allow for siphoning. Theoretically, not accounting for inflow or groundwater recharge, two 6-inch siphon tubes could drain a foot of water from the lake in eight days and empty the lake in 22 days.

While a winter drawdown may provided much needed relief from floating-leaf plants there would likely be unintended negative effects. Since McCaslin Lake is so shallow most of the lake volume would have to be removed, concentrating the fish in a very small, shallow pool. A drawdown of this magnitude would likely result in heavy losses to fish and other aquatic life, even with aeration. The effect on Three Little Lakes, which receive their water from McCaslin Lake, would also have to be considered. Other impacts include the loss of recreational use during the low water period (minimal with a winter drawdown) and potentially lowering water levels in shallow wells adjacent to the lake.

A Permit from the Wisconsin DNR would be required to conduct a drawdown. A study would also have to be conducted to determine discharge rates on the inlet to assess refilling time following a drawdown.

Automated Mechanical Bottom Disturbance

Several automated systems exist that control plants by physically disrupting them throughout the growing season. Modes of action include physically raking, rolling, or spraying the sediment with jets of water. The Weed Roller^{TM} is one of the more common devises. It has a central motor that attaches to a dock, boatlift or other fixed point. The motor drives a series of cylindrical rollers back and forth across the bottom of the lake in an arc of up to 270 degrees. Fins on the rollers disturb the sediment and plants, removing existing plants and preventing the establishment of new ones.

In two studies weed rollers were found to cause a significant reduction in fine sediment and a nearly complete elimination of aquatic plants (James 2004, James 2006). Sediment removed from the site was often fond to be deposited immediately outside of the impacted area. No information was available regarding their use in areas with very flocculent sediment.

These devices are only appropriate for small areas in shallow water to maintain swimming areas etc. Negative environmental impacts include sediment disturbance, which may lead to local increases in turbidity and suspended phosphorus. This may lead to major nutrient increases if the practice is widespread. While studies have not been conducted on the impact these devices have on aquatic organisms, the periodic bottom disturbance likely reduces or eliminates many aquatic insects and would surely prevent successful fish spawning in the impacted area.

Cost for the Weed Roller^{TM} starts at approximately $3,000 for motor, mounting hardware, and a 21-foot roller. Other comparable devises have similar price tags. This and other automated mechanical bottom disturbing devises require a Wisconsin DNR permit.

Control/Reduce Nutrient Inputs

Aquatic plant response to nutrient input varies by species and source of nutrients. For the most part, rooted aquatic plants absorb their nutrients through the root system so nutrient additions to the sediment can be more important than dissolved nutrients in the water column. Dissolved nutrients however can become sediment bound nutrients when they fuel algae growth that dies and sinks to the bottom.

Studies have shown that many aquatic plants are stimulated by nitrogen additions to the sediment. Rogers (1995) reported that nitrogen additions to sediment significantly increased wild celery growth. Nitrogen is a water-soluble nutrient. Septic systems intensive irrigation and excessive nitrogen fertilizer use have all been shown to cause increased nitrogen concentrations in groundwater. If landowners must use fertilizer on their lawns around the lake they should limit its use to 3-4 lbs of 27% nitrogen fertilizer per 1000 square feet of lawn. Since phosphorus is rarely in short supply in lawns, phosphorus free fertilizer should be used. Maintaining natural vegetation along the shore and limiting impervious surfaces (roofs, driveways, patios, etc.) will help prevent nutrient enriched runoff from reaching the lake.

Exotic Species Monitoring and Prevention
As is often the case, an ounce of prevention is worth a pound of cure. With exotic species this is doubly true. In most lakes, and for most exotic species the primary mode of introduction is by boat, boat trailer, or bait bucket. While public access points are a major concern, many exotic species have been introduced on lakes without any public access.

Once established in a water body it is extremely difficult to eradicate an exotic species. In the few cases where eradication has been successful the introduction was detected early. For this reason routine monitoring to detect new invasive species is an important step in any aquatic plant management effort. The Wisconsin DNR and University of Wisconsin Extension have many good publications and websites to help the layperson identify exotic species. Periodically these agencies also offer exotic species prevention and identification training to landowners.

Aquatic Plant Management Recommendations

Since the District has already invested a great deal of time and money in a successful aquatic plant harvesting program the plan should focus on increasing the efficiency of aquatic plant harvesting. At the same time, the District should explore all available options to control excessive plant growth in McCaslin Lake.

Recommendation #1 – Continue harvesting mid-lake floating-leaf vegetation to maintain the navigational potential of the lake. The current harvesting program has proven effective at providing relief from excessive aquatic plant growth. The District should continue to target floating-leaf vegetation, focusing on mid-lake plant beds that restrict navigation (zone A). This zone can be divided into two general areas. Zone A_1 (32.4 ac) is capable of supporting floating-leaf vegetation that is sufficiently dense to impede boat traffic and other recreational uses. Zone A_2 (20.0 ac) typically has scattered floating-leaf vegetation at much lower density and supports more pondweeds and other submersed vegetation (figure 7).

Currently the District harvests approximately 15 to 20 acres annually, although the total acreage is often much less since some areas are harvested twice in one season. Most of the harvest effort occurs in zone A_1. The District should continue to focus harvesting efforts on zone A_1 to maintain the navigational potential of the lake. Harvesting should focus on creating boating and fishing access lanes about 30 feet wide as shown on the aquatic plant management map (figure 7). A larger, more detailed aquatic plant harvesting map can be found in Appendix B.

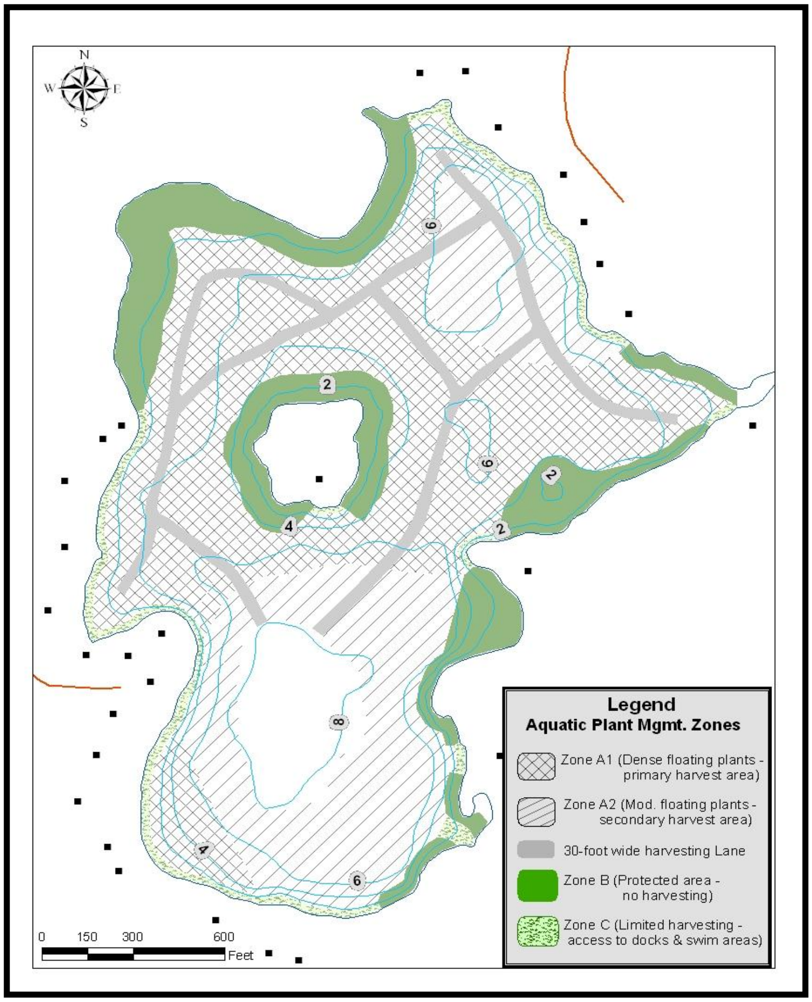


Figure 7. Aquatic plant management zones.

Recommendation #2 – Remove floating root masses as needed. Root masses that dislodge and float to the surface restrict navigation and are visually unappealing. They should be removed when they are causing a nuisance. These floating mats are most common in zone A1, particularly north and east of the island.

Recommendation #3 – Protect aquatic vegetation along undeveloped shorelines. Emergent, floating-leaf, and submersed vegetation all provide important fish and wildlife habitat. Those areas adjacent to undeveloped shorelines (zone B) should not be harvested or controlled unless they expand into zone A.

Recommendation #4 –Maintain access to docks by harvesting lanes through dense floating-leaf vegetation along the shore. Along developed shorelines (Zone C) lanes up to 30 feet wide can be maintained to allow access to open water from docks.

Recommendation #5 – Maintain swimming areas by harvesting vegetation around swim rafts and docks. Much of the vegetation removal around docks and swim rafts in zone C is done manually since harvesters are less efficient in shallow water and near obstructions. Pulling up the rhizomes and disposing of them on shore is the best method for manual control of floating-leaf plants.

Recommendation #6 – No harvesting in or adjacent to bass and bluegill spawning areas when fish are spawning. Shallow areas with a sand & gravel substrate are important spawning sites for bass and panfish. And should not be harvested during the spawning season which typically begins in May and ends by mid June.

Recommendation #7 – Protect areas dominated by large pondweeds. Large pondweeds are in short supply in McCaslin Lake and should be protected where possible as they supply valuable feeding and ambush cover for large panfish and gamefish. Large pondweeds, primarily ribbon-leaf and white-stem pondweed, were most common in four to eight feet of water south of the Island. In areas where watershield is invading pondweeds the harvesters cutting bar can be raised to remove the floating leaves of watershield but leave most of the pondweed biomass.

Recommendation #8 – Test effectiveness of repeated harvest to control watershield. Some studies suggest that repeated harvesting of watershields floating leaves can stress the plant and result in long-term control. Establish a test plot and harvest the floating leaves of watershield repeatedly beginning early in the season to evaluate this method of control.

Recommendation #9 – Consider aquatic herbicide use for targeted control of floating-leaf plants. The District should consider an early season application of 2,4-D for the targeted control of watershield and white water lily. Prior to any large-scale treatment a test plot is advisable to assess its potential for long-term control of target plants.

Recommendation #10 – Consider dredging for nuisance vegetation control. Although expensive, dredging is the only method that would provide permanent control of nuisance plant growth. The flocculent sediment and nearby dewatering area make this option particularly suitable for McCaslin Lake. Dredging should target mid-lake areas to improve navigation, the rocky area east of the island to improve fish spawning habitat, and around docks and swim areas. Most of the floating leaf plant beds forming a fringe around the lake should be left intact as it provides important habitat.

Monitoring and Evaluation Plan

In order to evaluate and make changes to the management program the District needs to keep detailed management records and track changes in the aquatic plant community. The aquatic plant management program for McCaslin Lake should be evaluated on a regular basis and changed to meet shifting needs and address new challenges.

Recommendation #1 – Improve record keeping to better evaluate the harvesting program. Improving record keeping is a quick and inexpensive way to collect important data that will allow the District to evaluate the harvesting program and make necessary changes. The following information should be collected on a daily basis:

- Size and location of all areas harvested. A GPS can be used to accurately delineate harvest areas.
- Hours spent harvesting each area
- Number of harvester loads taken from each area.

A sample harvest record sheet is included in appendix B.

Recommendation #2 – Conduct periodic aquatic plant surveys to track changes in the lakes aquatic plant community and evaluate management practices. Aquatic plant surveys are valuable tools, essential in evaluating new and ongoing aquatic plant management practices. The frequency at which aquatic plant surveys should be conducted depends on changes in management and changes in the plant community.

Survey frequency should be dictated by changes in management practices and the aquatic plant community. Assuming no invasive aquatic species introductions or obvious changes to the aquatic plant community a complete survey of the lake should be conducted every 8 to 10 years. If new aquatic invasive species are discovered, or if unexplained changes in the plant community are noticed a new survey should be conducted immediately. Likewise changes in management practices should be accompanied by aquatic plant surveys to evaluate practice effectiveness. Often these surveys can be conducted in a few representative areas where management changes are implemented.

Future lake surveys should be conducted according to Wisconsin DNR aquatic plant management protocol. Lake-wide surveys should utilize the same sample locations used in 2008. Surveys designed to evaluate new management tools should be conducted before and after treatment and should be scaled appropriately to accurately describe the plant community. DNR or County Land & Water Conservation Department staff should be consulted when designing survey methods.

Where grants are obtained to assist in aquatic plant management the cost of professional aquatic plant surveys can be included in the grant. Eventually however the District should develop this capability from within its own ranks. The DNR and Wisconsin Lakes Partnership have many aquatic plant ID resources and offer periodic aquatic plant identification training. The Marinette County Land & Water Conservation Division can also assist.

Recommendation #3 – Evaluating the harvesting program and new aquatic plant management practices on an annual basis. The District Board or designated committee should continue to review harvesting data and the plant community and recommend changes to the aquatic plant management program as needed.

Information & Education Plan

A strong information and education effort is an important part of any lake management program. Communicating effectively with District members will make implementing a flexible aquatic plant management plan much easier.

Recommendation #1 – Continue publishing a regular newsletter, provide educational materials, and update lake residents about lake and aquatic plant management efforts. The District should continue to distribute educational materials and keep members abreast of lake management issues. The District should also sign members up to receive the Lake Tides Newsletter, a free quarterly publication by the Wisconsin Lakes Partnership.

Recommendation #2 – Maintain signage at the boat access and provide educational materials to visitors to McCaslin Lake. Maintain educational signage at the boat landing to inform visitors to McCaslin Lake about the danger of AIS and how they can help prevent the spread. Signage should be clear and uncluttered. Signage and educational materials can be obtained from the Peshtigo DNR office or on line at Wisconsin Lakes Partnership or UW Extension Lakes Program websites.

Recommendation #3 – Continue as a member of the Wisconsin Association of Lakes and take advantage of their resources. The Wisconsin Association of Lakes (WAL) is a statewide lake organization that promotes sound lake policy and provides training opportunities for lake groups throughout the state. The District should send a few members each year to the annul lakes convention, a three day event featuring numerous speakers, workshops and presentations concerning lake management, operating effective lake organizations, and other current issues effecting Wisconsin Lakes.

Aquatic Invasive Species (AIS) Prevention, Monitoring and Rapid Response Plan

Recently Marinette County has experienced a surge in the spread of aquatic invasive species in lakes with and without public access. Species of concern include Eurasian watermilfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), hydrilla (*Hydrilla verticillata*), Brazilian waterweed (*Egaria densa*) and yellow floating heart (*Nymphoides peltata*). Beyond the plant world we have Zebras mussels (*Drissena polymorpha*), Rusty crayfish (*Orconenctes rusticus*), exotic zooplankton, and fish diseases such as VHS to worry about. The best way to deal with these invaders is to be proactive and prevent their introduction. The District should also adopt an exotic species monitoring plan to detect early invasions and a rapid response plan to deal with new invasive species if they are found.

Prevention

An effective AIS prevention plan should focus on the most common routes of AIS invasion, boats, and water gardens. Boats traveling between lakes can carry plant fragments or zebras mussels attached to the boat or trailer. Water in the boat or bait buckets can carry plants, zebra mussels, zooplankton, algae, and disease causing organisms.

Recommendation #1 – The District should continue to educate landowners and visitors to McCaslin Lake about the dangers of AIS and how to prevent their spread. Since the vast majority of people boating on the lake are residents efforts should be aimed at educating them about AIS. AIS signage should be maintained at the access.

Recommendation #2 – Educate District members about the dangers of water gardening and the unintentional releases associated with the hobby. A recent investigation of the water garden industry found that plants known to be invasive are available and routinely shipped around the country. Contamination of orders with other species, including invasive species, is also rampant (Maki, 2004). Mail order water garden plants were also found to be the likely source of hydrilla found growing in a Marinette County pond. The next nearest lake with hydrilla is in central Indiana and it was thought the plant could not survive this far north! On a positive note, the hydrilla was aggressively attacked and it appears to have been eliminated.

Monitoring

Effective management of AIS is much easier when the invader is detected early. In some cases it may even be possible to eradicate an invasive species if it is discovered early enough.

Recommendation #1 – The District should join the Citizen Lake Monitoring Network and train several members in AIS monitoring. While the information & education program should equip all District members with a basic knowledge of invasive species, several should be trained specifically for AIS monitoring. The Citizen Lake Monitoring Network holds training workshops to train volunteers in AIS monitoring protocol. They also provide a monitoring manual and laminated AIS identification along with reconnaissance and reporting forms. The County LWCD can assist in AIS identification and monitoring.

Recommendation #2 – Volunteer AIS monitors should conduct annual AIS surveys of the lakes. Aquatic plant surveys, although very beneficial, are not designed to find many types of aquatic invaders and may even miss pioneer plant invasions. A better method is to look specifically for different invasive species at the optimal time and in the most likely habitats. The ideal monitoring time varies by species but can typically be covered with one early season survey and one late season survey.

Trained volunteers should conduct annual invasive species surveys. Findings should be reported to the District and the Citizen Lake Monitoring Network.

Recommendation #3 – Report any suspected aquatic invasive species to local resource professionals. If any suspected exotic species are found report it immediately to the Peshtigo DNR office or the County LWCD. Collect a sample of the invasive species, keeping it wet and refrigerated until it can be positively identified.

Rapid Response

When a new invasive species is positively identified the District needs to act quickly. Depending on the species found, length of time since invasion, and where the pioneer colony is found, there may be a possibility for eradication. The following steps should be followed:

Step #1 – Notify District board and local resource agencies and explore grant funding opportunities. The District Board should immediately arrange a meeting with the Wisconsin DNR to explore control measures and determine if an AIS Rapid Response grants is appropriate. These grants were designed to deal with pioneer AIS infestations. The typical grant application process is bypassed so grant funds can be made available for quick action in hopes of eradication.

Step #2 – Notify membership of the discovery and what the Board plans to do about it. Notify Lake District members of the discovery and measures they can take to prevent its further spread within the lake or to other waters. Let them know how the Board plans on dealing with the invasion.

Step #3 – Conduct a thorough survey of the lake to determine the extent of the AIS infestation. Working with County or DNR staff, conduct a thorough survey of the lake. Map locations of the invasive species and record its density as well as any other physical data that may be important such as water depth, sediment type etc.

Step #4 – Determine if eradication is a possibility or if management is the only option. Work with local resource agencies and outside experts where necessary to determine if eradication is possible. Where eradication is not feasible begin revising the lake management plan to deal with the new species.

Step #5 - Develop an action plan based on the species and extent of invasion. Work closely with the experts to develop a customized plan aimed at eradication or control. If outside consultants are needed for things like herbicide treatment or scuba diving bring them into the process. Many consultants can also help with things like mapping and planning.

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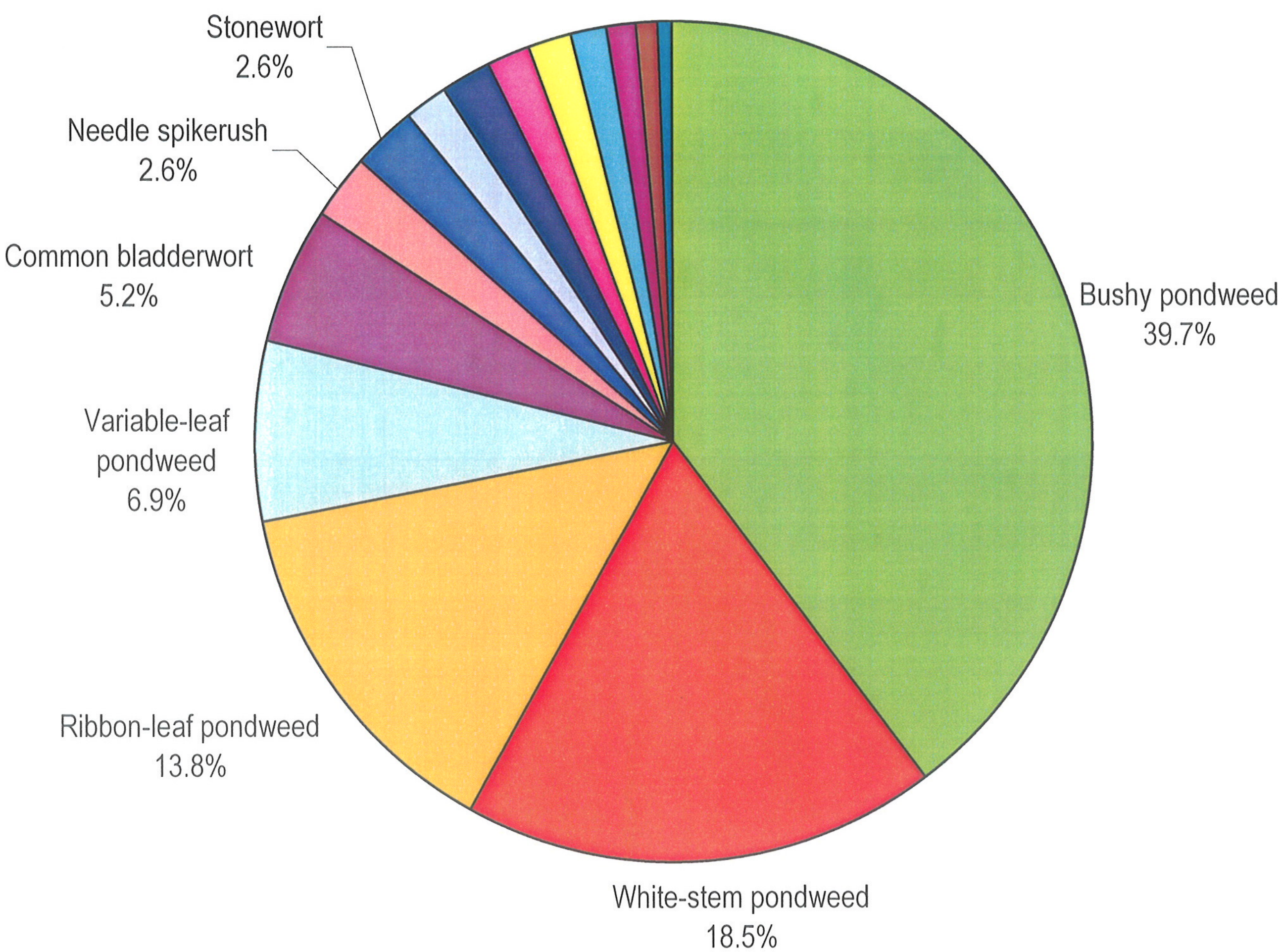
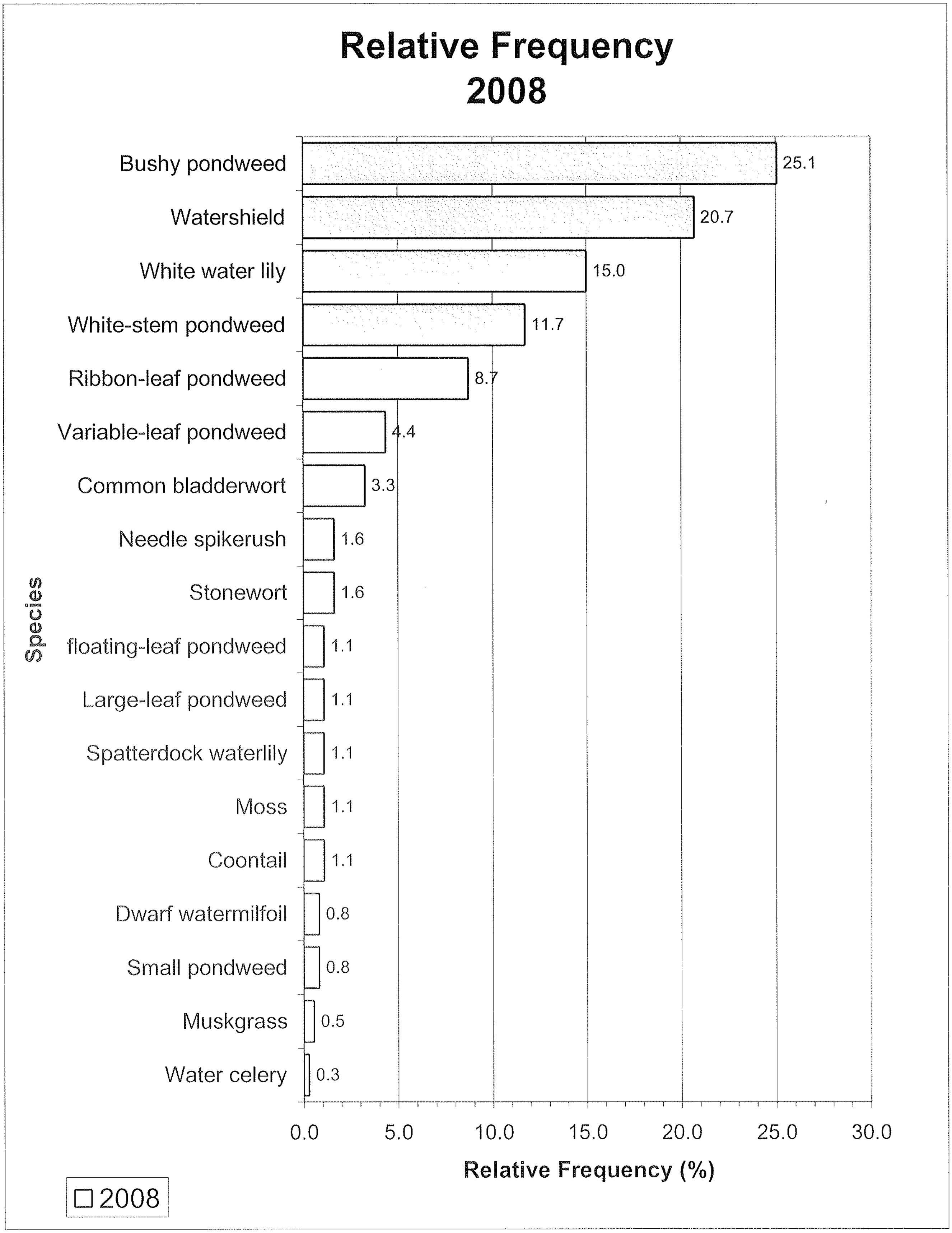
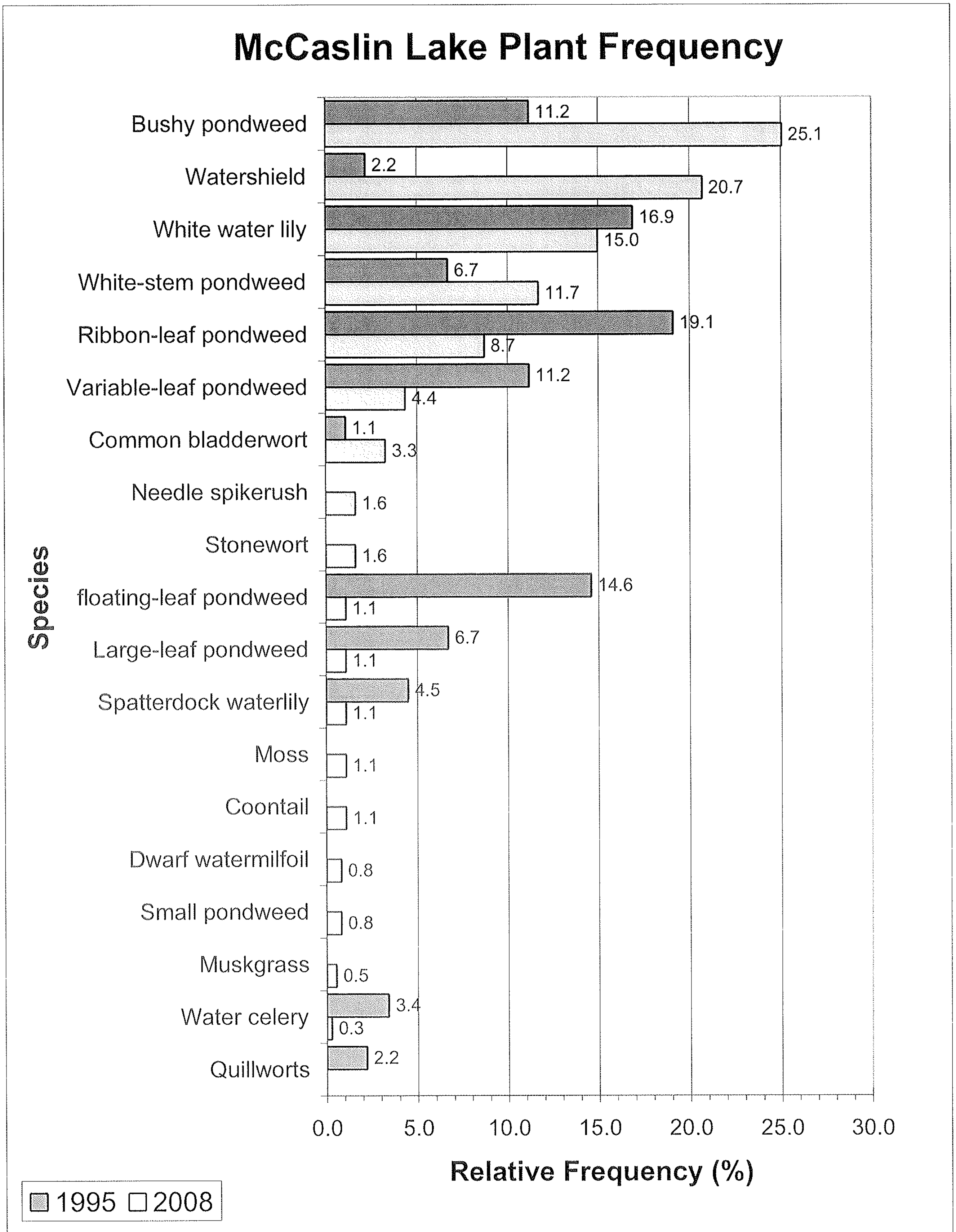
Appendix A

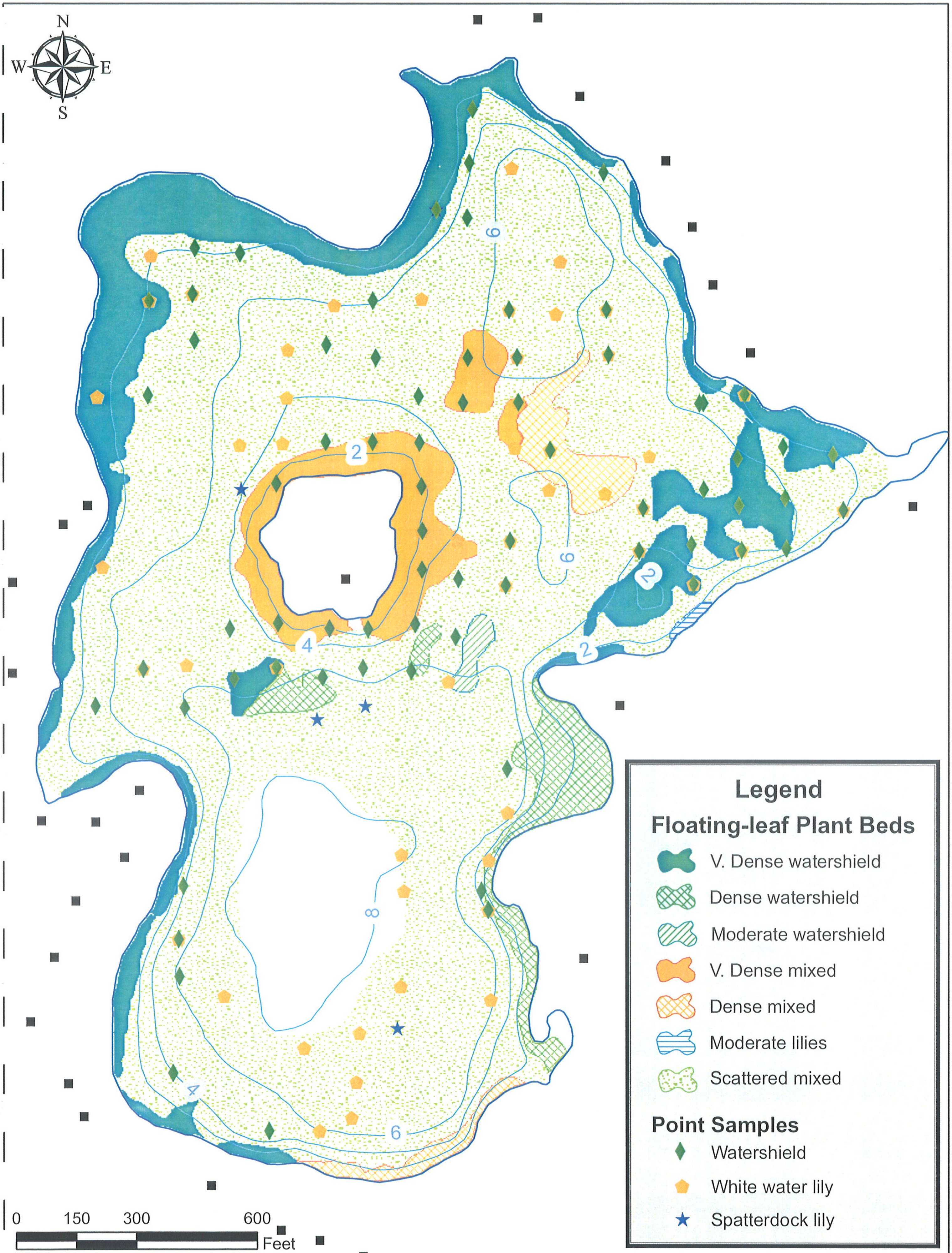
McCaslin Lake
2009
Aquatic Plant Survey Results

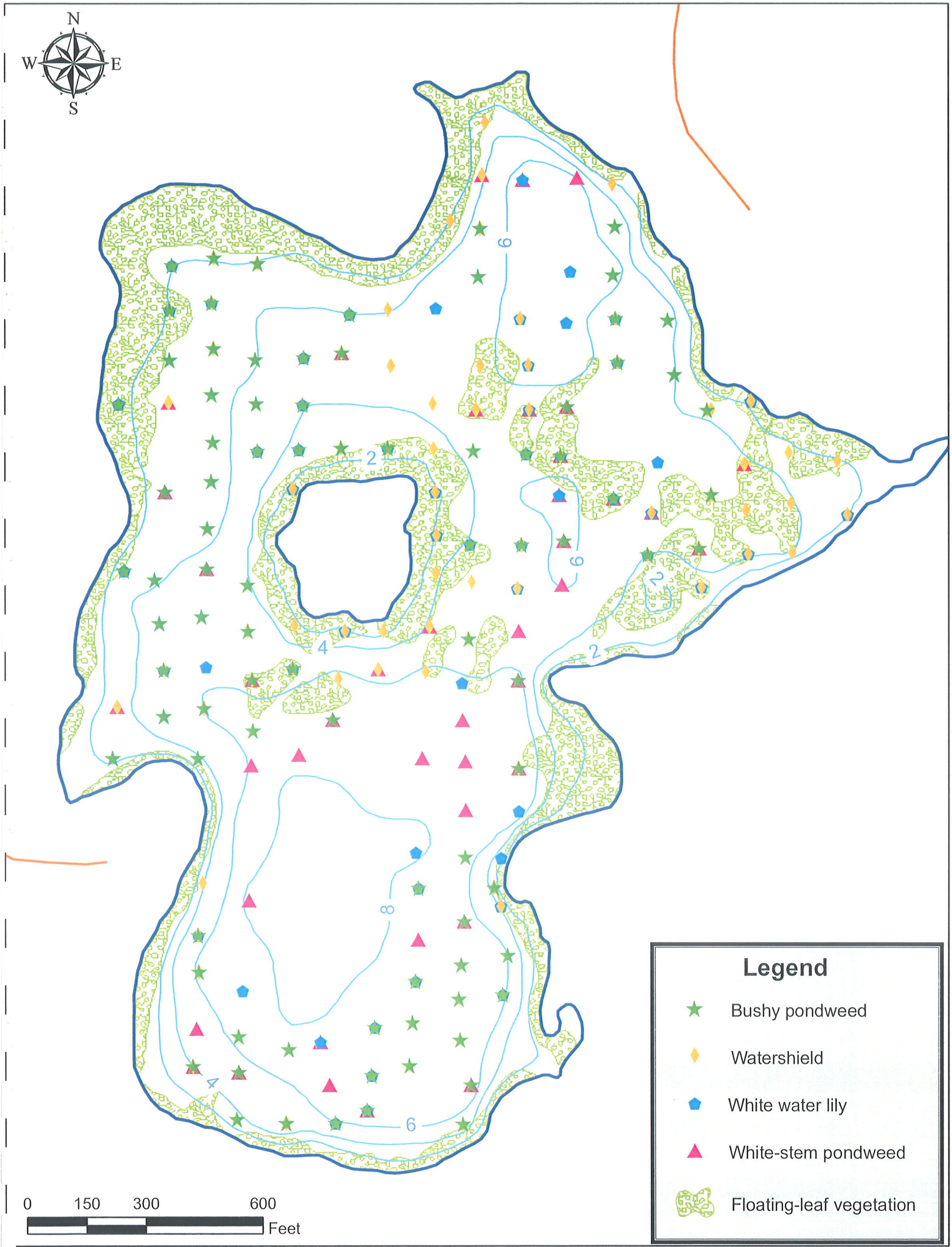
Dominant Submersed Aquatic Plants in McCaslin Lake (relative frequency)

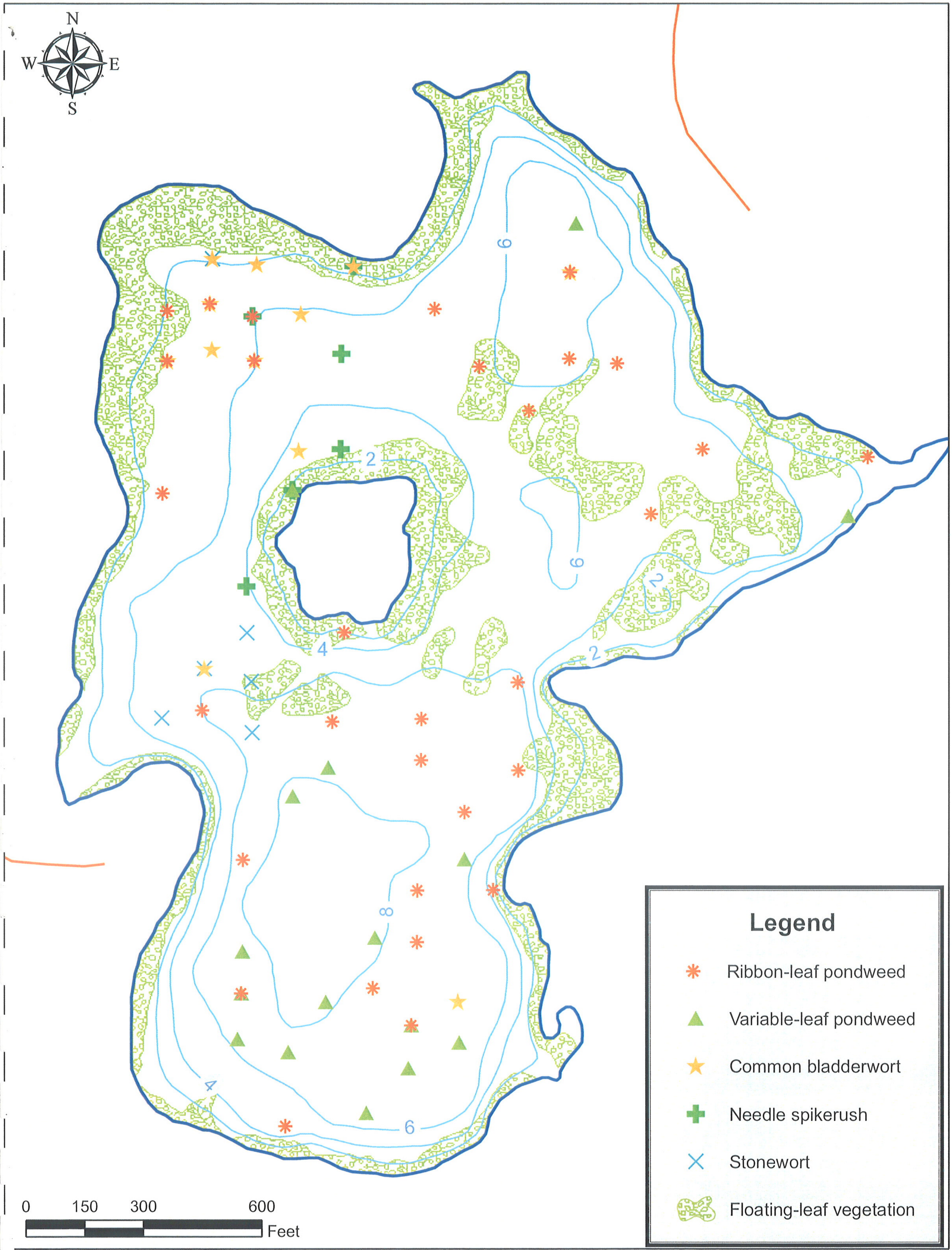


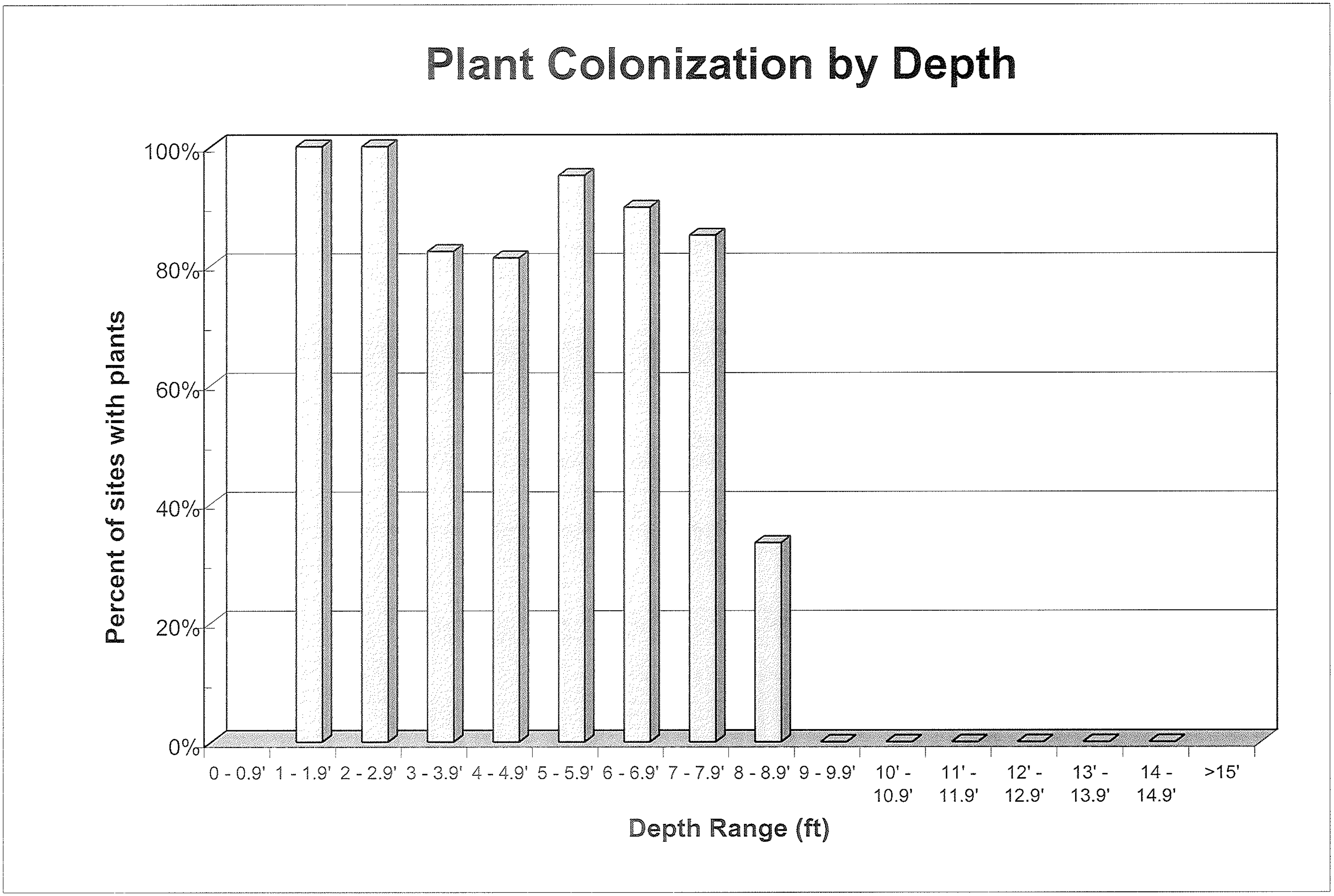

Relative Frequency
2008
Bushy pondweed
Watershield
White water lily
White-stem pondweed
Ribbon-leaf pondweed
Variable-leaf pondweed
Common bladderwort
Needle spikerush
Stonewort
floating-leaf pondweed
Large-leaf pondweed
Spatterdock waterlily
Moss
Coontail
Dwarf watermilfoil
Small pondweed
Muskgrass
Water celery
25.1
20.7
15.0
11.7
8.7
4.4
3.3
1.6
1.6
1.1
1.1
1.1
1.1
1.1
0.8
0.8
0.5
0.3
Species
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Relative Frequency (%)
2008

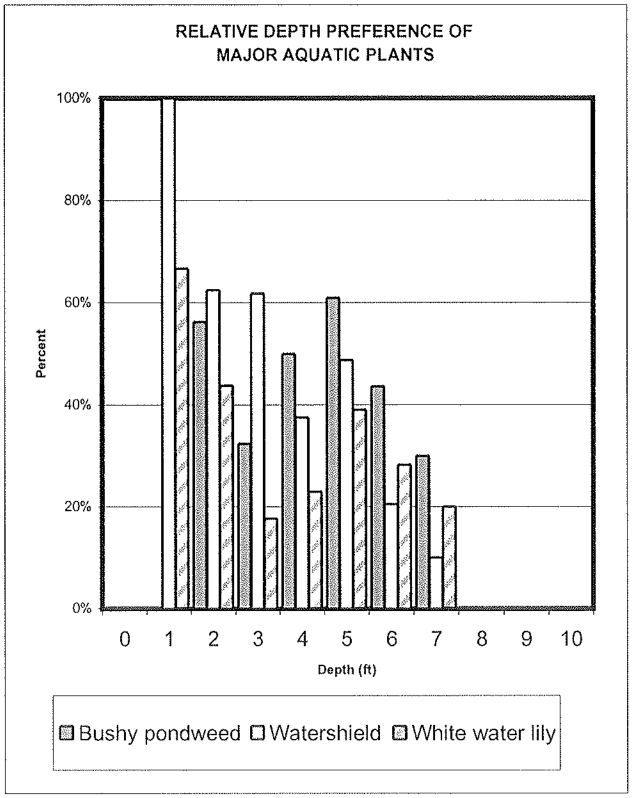

McCaslin Lake Plant Frequency
Species
Bushy pondweed
11.2
25.1
Watershield
2.2
20.7
White water lily
16.9
15.0
White-stem pondweed
6.7
11.7
Ribbon-leaf pondweed
19.1
8.7
Variable-leaf pondweed
11.2
4.4
Common bladderwort
1.1
3.3
Needle spikerush
1.6
Stonewort
1.6
floating-leaf pondweed
14.6
1.1
Large-leaf pondweed
6.7
1.1
Spatterdock waterlily
4.5
1.1
Moss
1.1
Coontail
1.1
Dwarf watermilfoil
0.8
Small pondweed
0.8
Muskgrass
0.5
Water celery
3.4
0.3
Quillworts
2.2
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Relative Frequency (%)
1995
2008

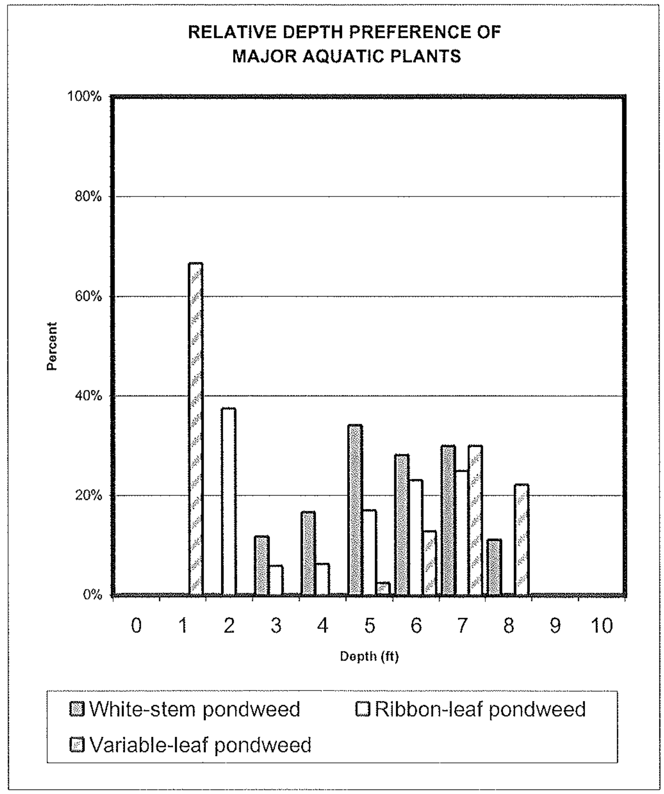

N
S
W
E
2
4
6
8
Legend
Floating-leaf Plant Beds
V. Dense watershield
Dense watershield
Moderate watershield
V. Dense mixed
Dense mixed
Moderate lilies
Scattered mixed
Point Samples
Watershield
White water lily
Spatterdock lily
0
150
300
600
Feet

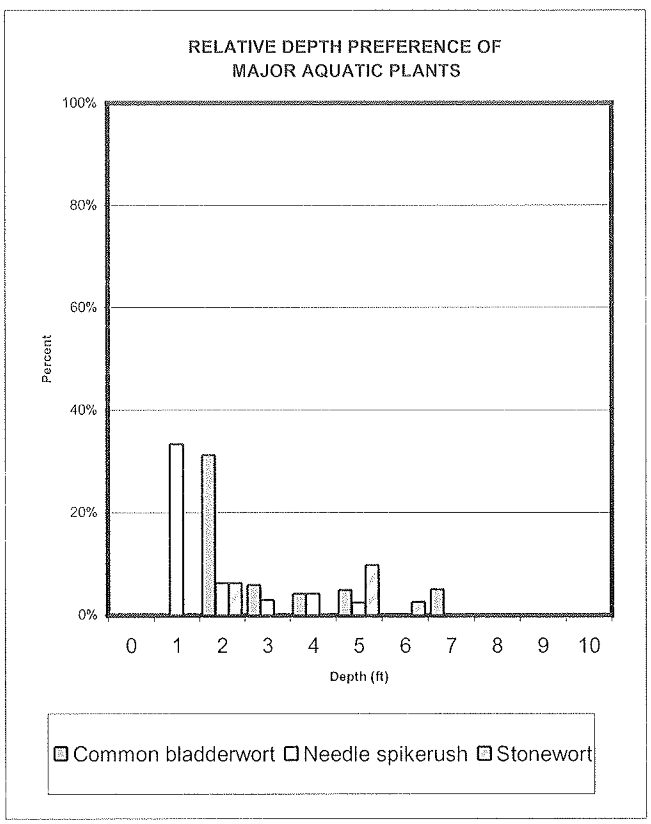

N
W
E
S
2
4
6
8
Legend
Bushy pondweed
Watershield
White water lily
White-stem pondweed
Floating-leaf vegetation
0
150
300
600
Feet

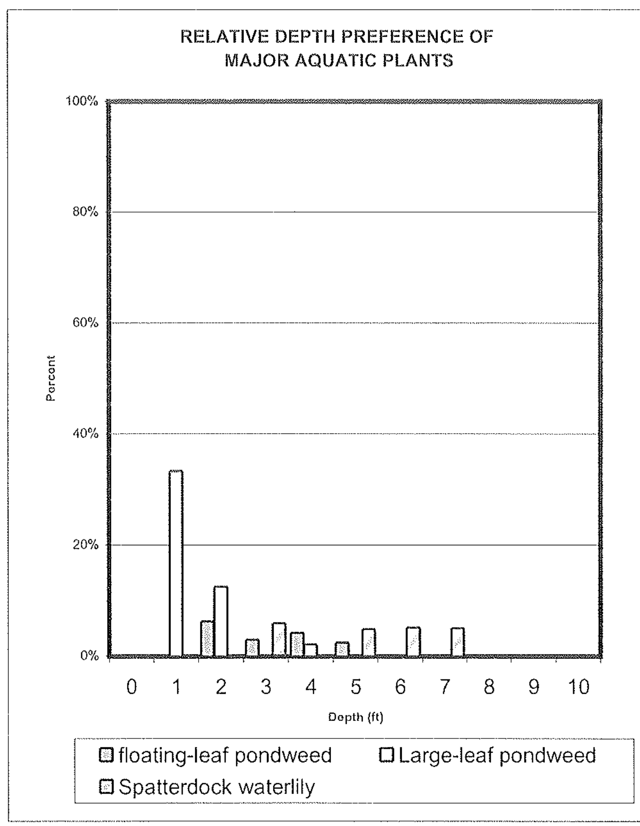

N
W
E
S
2
4
6
8
2
6
2
6
2
4
Legend
Ribbon-leaf pondweed
Variable-leaf pondweed
Common bladderwort
Needle spikerush
Stonewort
Floating-leaf vegetation
0
150
300
600
Feet

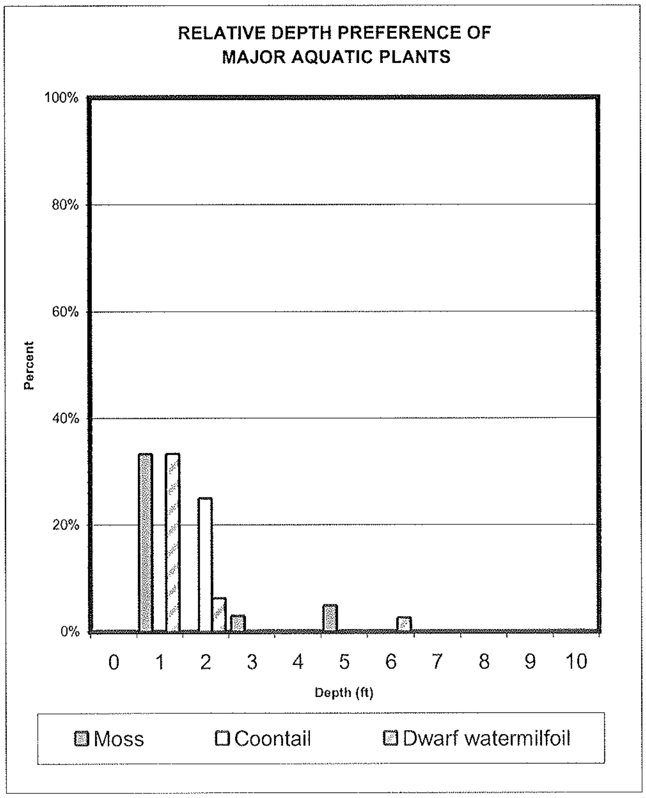

Plant Colonization by Depth
Percent of sites with plants
100%
80%
60%
40%
20%
0%
0 - 0.9'
1 - 1.9'
2 - 2.9'
3 - 3.9'
4 - 4.9'
5 - 5.9'
6 - 6.9'
7 - 7.9'
8 - 8.9'
9 - 9.9'
10' - 10.9'
11' - 11.9'
12' - 12.9'
13' - 13.9'
14 - 14.9'
>15'
Depth Range (ft)

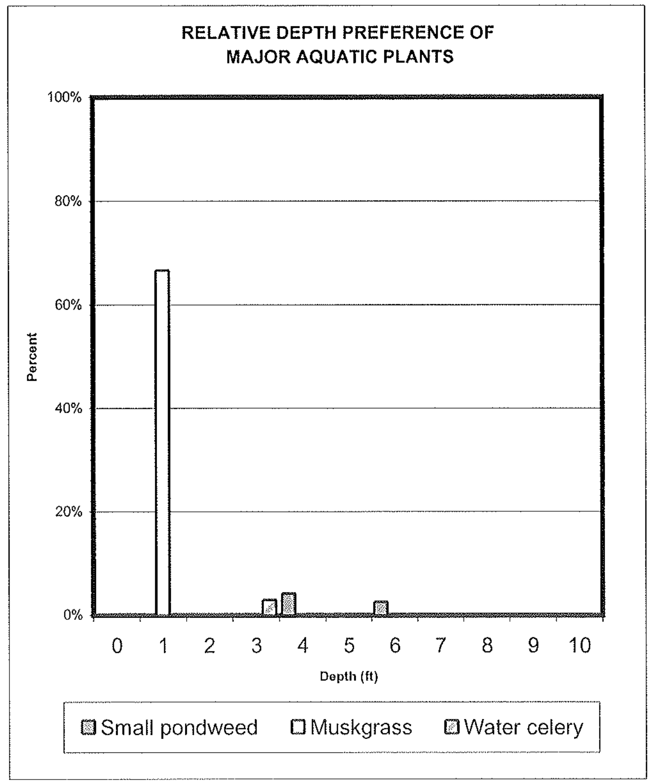

RELATIVE DEPTH PREFERENCE OF
MAJOR AQUATIC PLANTS
100%
80%
60%
40%
20%
0%
Percent
0 1 2 3 4 5 6 7 8 9 10
Depth (ft)
Bushy pondweed
Watershield
White water lily

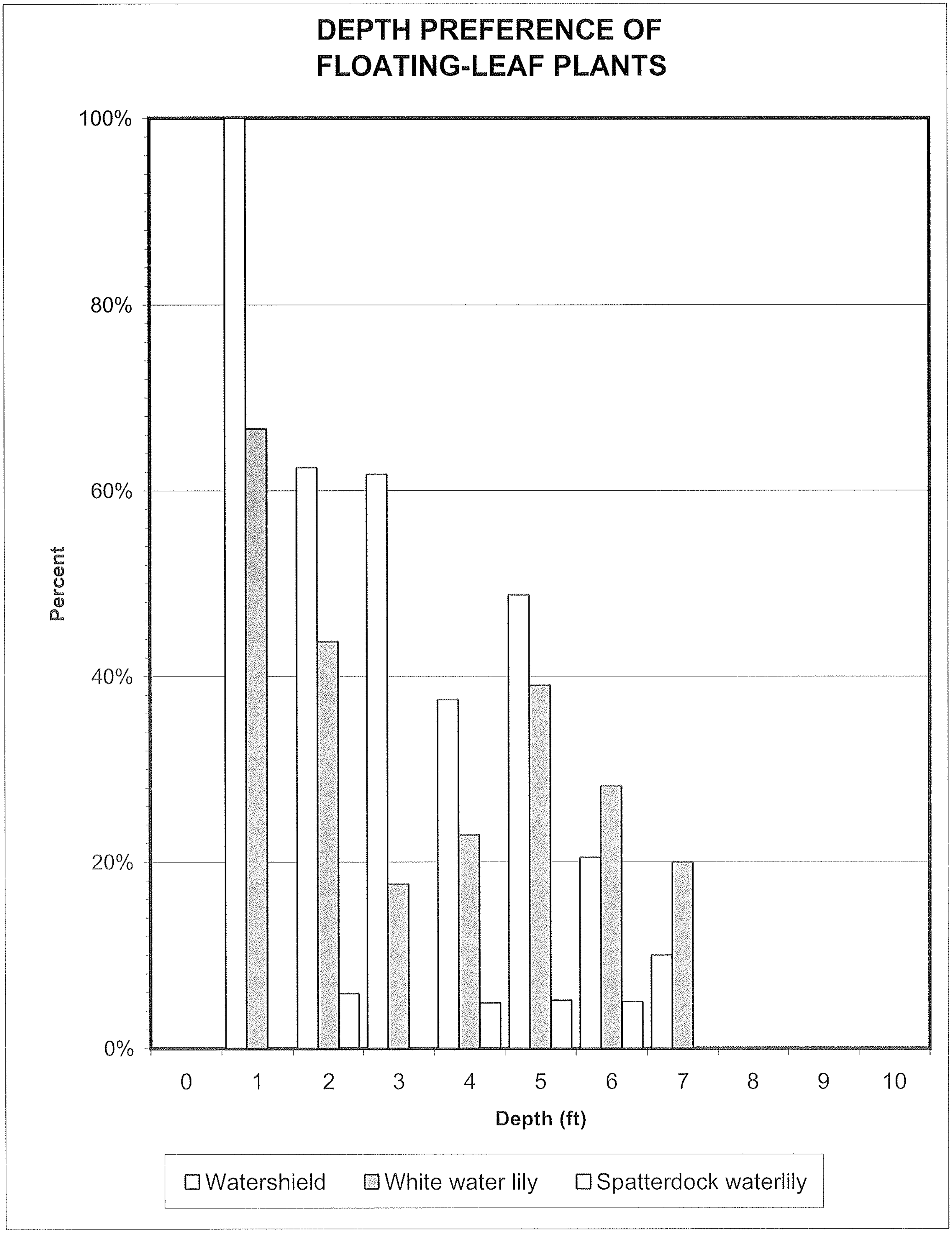

RELATIVE DEPTH PREFERENCE OF
MAJOR AQUATIC PLANTS
100%
80%
60%
40%
20%
0%
Percent
0 1 2 3 4 5 6 7 8 9 10
Depth (ft)
White-stem pondweed
Ribbon-leaf pondweed
Variable-leaf pondweed


RELATIVE DEPTH PREFERENCE OF
MAJOR AQUATIC PLANTS
100%
80%
60%
40%
20%
0%
Percent
0 1 2 3 4 5 6 7 8 9 10
Depth (ft)
Common bladderwort
Needle spikerush
Stonewort


RELATIVE DEPTH PREFERENCE OF
MAJOR AQUATIC PLANTS
100%
80%
60%
40%
20%
0%
Percent
0 1 2 3 4 5 6 7 8 9 10
Depth (ft)
floating-leaf pondweed
Large-leaf pondweed
Spatterdock waterlily

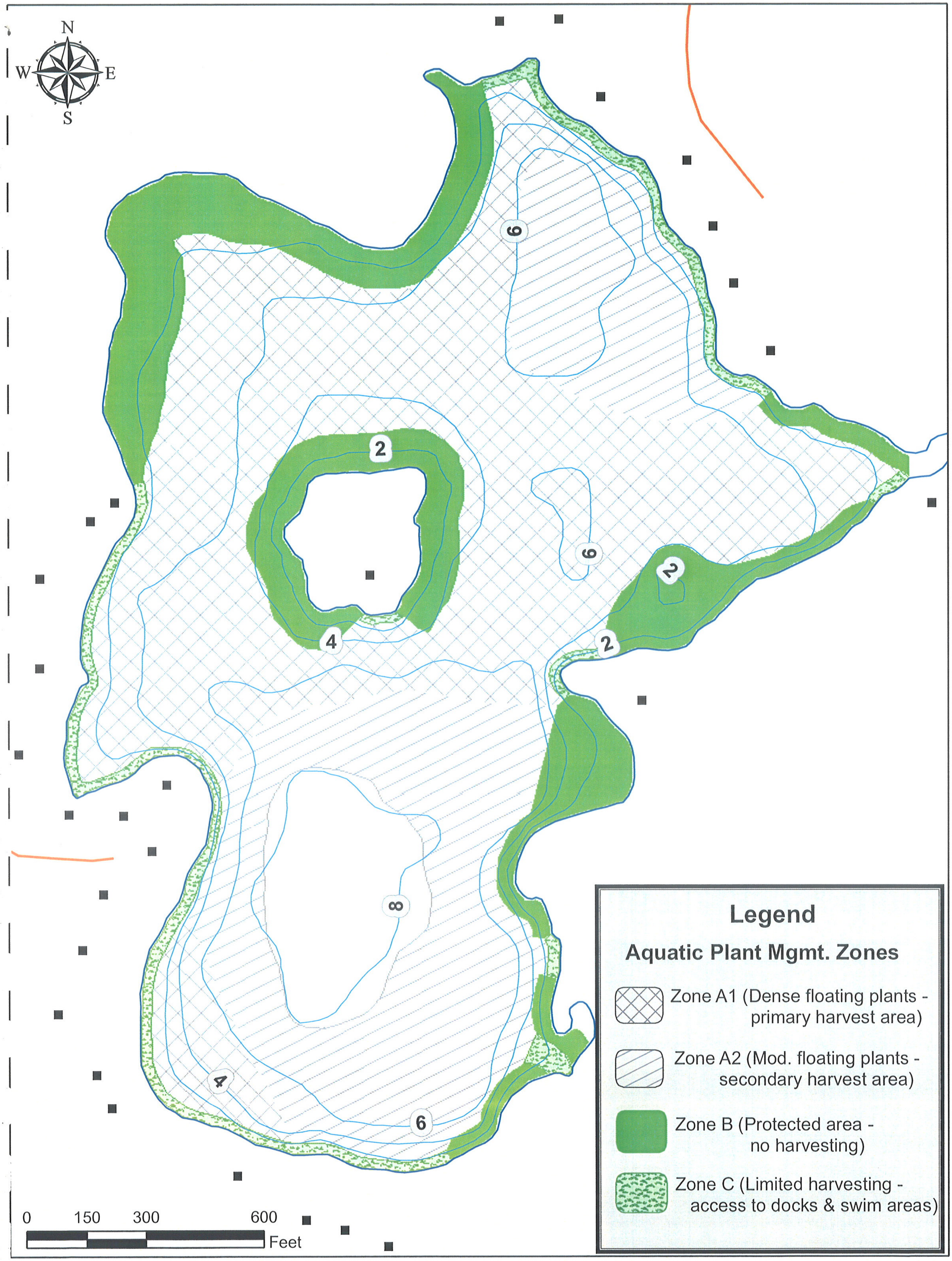

RELATIVE DEPTH PREFERENCE OF
MAJOR AQUATIC PLANTS
100%
80%
60%
40%
20%
0%
Percent
0 1 2 3 4 5 6 7 8 9 10
Depth (ft)
Moss
Coontail
Dwarf watermilfoil


RELATIVE DEPTH PREFERENCE OF
MAJOR AQUATIC PLANTS
100%
80%
60%
40%
20%
0%
Percent
0 1 2 3 4 5 6 7 8 9 10
Depth (ft)
Small pondweed
Muskgrass
Water celery


DEPTH PREFERENCE OF
FLOATING-LEAF PLANTS
100%
80%
60%
40%
20%
0%
Percent
0
1
2
3
4
5
6
7
8
9
10
Depth (ft)
Watershield
White water lily
Spatterdock waterlily

Appendix B

McCaslin Lake
2009
Aquatic Plant Harvesting Maps



N
W
E
S
6
6
2
2
2
4
8
4
6
Legend
Aquatic Plant Mgmt. Zones
Zone A1 (Dense floating plants - primary harvest area)
Zone A2 (Mod. floating plants - secondary harvest area)
Zone B (Protected area - no harvesting)
Zone C (Limited harvesting - access to docks & swim areas)
0
150
300
600
Feet

Harvest Record

No harvesting

Resticted harvesting (see harvesting plan)

Dates: ______________________

Notes: ______________________

____

____

____

____

____

____

____

Total Harvester Loads ______