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March 30, 2012

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: New License Article 401 (Condition 8 of the 401 Water Quality Certification)
Invasive Species Monitoring and Control Plan
May 18, 2011, Order Issuing New License
Badger-Rapide Croche Hydroelectric Project; FERC Project No. 2677-019
Lower Fox River; Outagamie County, Wisconsin

Dear Secretary Bose:

On May 18, 2011, the Federal Energy Regulatory Commission (Commission) issued an "Order Issuing New License for the Badger-Rapide Croche Hydroelectric Project" (FERC Project No. 2677-019) (New License). Article 401 of the New License contains a number of conditions related to the Wisconsin Department of Natural Resources (WDNR) 401 Water Quality Certification. Condition 8 states:

Kaukauna Utilities shall develop an Invasive species monitoring and control plan subject to the approval of FERC and WDNR review and approval within one year of issuance of a FERC license. The invasive species monitoring and control plan should include Japanese knotweed, garlic mustard, buckthorn, Eurasian water milfoil, purple loosestrife, phalaris, phragmites and dreissenid mussels. In addition Kaukauna Utilities must monitor for any "prohibited" species as required under NR 40, Wisconsin Administrative Code. "Prohibited invasive species" or "prohibited species" means an invasive species that the department, at the time of listing under s. NR 40.04 (2), has determined is likely to survive and spread if introduced into the state, potentially causing economic or environmental harm or harm to human health, but which is not found in the state or in that region of the state where the species is listed as prohibited in s. NR 40.04 (2), with the exception of isolated individuals, small populations or small pioneer stands of terrestrial species, or in the case of aquatic species, that are isolated to a specific watershed in the state or the Great Lakes, and for which statewide or regional eradication or containment may be feasible.

In accordance with Article 401 (Condition 8 of the 401 Water Quality Certification), Mead & Hunt, Inc. (Mead & Hunt), on behalf of the City of Kaukauna (Kaukauna Utilities), is hereby filing the above-mentioned plan.

Ms. Kimberly D. Bose, Secretary

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Thank you for your time and cooperation in this matter. Please address your comments to me. If you have any questions, please contact me at (608) 273-6380 or arie.dewaal@meadhunt.com.

Sincerely,

MEAD & HUNT, Inc.

A handwritten signature in cursive script that reads "Arie DeWaal".

Arie DeWaal

Senior Project Manager

Enclosure

cc: Attached Distribution List

Certificate of Service

I hereby certify that I, on behalf of the City of Kaukauna, Wisconsin (Kaukauna Utilities), have this day served the foregoing documents upon each person designated on the attached distribution list.

Dated this 30th day of March, 2012



Arie DeWaal
Mead & Hunt, Inc.

Distribution List
Badger-Rapide Croche Hydroelectric Licensing
FERC Project No. 2677

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Invasive Species Monitoring and Control Plan

Badger-Rapide Croche Hydroelectric Project

FERC Project No. 2677

Lower Fox River
Outagamie County, Wisconsin

Prepared for



Kaukauna, Wisconsin

Prepared by



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March 2012

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Kaukauna Utilities
Invasive Species Monitoring and Control Plan

Badger-Rapide Croche Hydroelectric Project
FERC Project No. 2677

Lower Fox River
Outagamie County, Wisconsin



Prepared by



March 2012

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1. Introduction

In July 2006, during the Federal Energy Regulatory Commission (FERC) licensing process for the Badger-Rapide Croche Hydroelectric Project (Project), Kaukauna Utilities (KU) surveyed the shorelines of the Badger and Rapide Croche impoundments for purple loosestrife (*Lythrum salicaria*) and Eurasian water-milfoil (*Myriophyllum spicatum*). The results of this survey are included in Appendix A. These two species had been identified in consultation with the agencies as being the necessary subjects of dedicated field surveys.

Subsequently, upon issuance of the FERC license for the Project (FERC Project No. 2677) on May 1, 2011, requirements for invasive species monitoring were included as part of the FERC License Article 401, requiring the filing of certain plans for FERC approval in consultation with the U.S. Fish and Wildlife Service (FWS) and the Wisconsin Department of Natural Resources (WDNR). These plans cover a number of Section 401 Water Quality Certification conditions imposed by the WDNR, of which Condition 8 specifies that KU shall develop an invasive species monitoring and control plan. This *Invasive Species Monitoring and Control Plan* has been prepared in accordance with the requirements of License Article 401 (401 Certification Condition 8), which requires KU to develop a plan to monitor and control referenced invasive species in project waters and project lands. A copy of License Article 401 (401 Certification Condition 8) is included as Appendix B.

2. Project Area Description

The Project consists of two small, low-head, run-of-river hydroelectric plants known as the Badger and the Rapide Croche projects. The Badger project is in the city of Kaukauna, Outagamie County, Wisconsin, on the Lower Fox River at river mile 23.7. The Rapide Croche project is in the town of Buchanan, Outagamie County, Wisconsin, on the Lower Fox River, 4.5 miles downstream (river mile 19.2) of the New Badger project. Approximately 19 miles downstream from the Rapide Croche project, the Lower Fox River empties into the south end of Green Bay, a large bay located along the northwest portion of Lake Michigan.

The Project area has a humid, continental-type of climate characterized by cold, snowy winters, and relatively short, warm summers, with an average annual precipitation of 30.41 inches. The area lies within the glaciated Eastern Lakes section of the Central Lowlands physiographic province. This physiographic section is generally blanketed with glacial topography, with closed basins having lakes or swamps, and watersheds having eskers, drumlins, and areas of gently rolling ground moraine.

At the Project, the Fox River lies within a moderately deep valley of limited floodplain area, with normal flows of low to moderate velocity over substrates of bedrock, cobble, and silt. Instream cover consists of varying amounts of rootmats, rootwads, boulders, and logs/woody debris with depth and cover type influenced by predominant velocities and position within the river's pool and riffle sequence. The floodplain near the Badger project is highly developed with industrial, commercial, and residential development, and vegetation is generally limited to mown areas of turf grasses. The nearest natural vegetation to the Badger project is located in the 1,000 Islands Conservancy area approximately one-quarter-mile downstream, which has forest cover with cottonwood, maple, ash, black willow, box elder, and scrub-shrub habitat dominated by red-osier dogwood and sandbar willow. Scattered emergent wetlands of cattail and river bulrush can also be found. Near the Rapide Croche project, the floodplain is generally rural in nature and is covered with grasses and sparse woodlands of oak, elm, cottonwood, ash, and silver maple. Extensive croplands are on high lands further away from the river.

3. Identified Invasive Species

Species listed in 401 Certification Condition 8 are Japanese knotweed (*Fallopia japonica*), garlic mustard (*Alliaria petiolata*), buckthorn (*Rhamnus cathartica*), Eurasian water milfoil, purple loosestrife, phalaris (*Phalaris arundinacea* or reed canary grass), phragmites (*Phragmites australis* or common reed), and dreissenid mussels (*Dreissenidae*), a family of bi-valve mollusks that includes the visually-similar quagga mussel (*Dreissena bugensis*), zebra mussel (*Dreissena polymorpha*), and false darkmussel (*Mytilopsis leucophaeata*), which all cause similar adverse habitat impacts to North America fresh-water systems.

In addition, 401 Certification Condition 8 referred to “prohibited species” under Wisconsin NR 40, of which a list is included as Appendix C. The licensee, KU, is hereby aware of the existence of these prohibited species and will remain alert for their possible presence during dedicated surveys or monitoring activities for the above-named species.

The following descriptions and life-histories of the above-named invasive species were considered pertinent to the formulation of this plan.

A. Japanese knotweed (*Fallopia japonica*)

Synonyms: *Polygonum cuspidatum*; Mexican bamboo.

In the U.S. and Europe, Japanese knotweed is widely considered an invasive species or weed and is listed by the World Conservation Union as one of the world's 100 worst invasive species. The invasive root system and strong growth can penetrate and damage foundations, dikes and retaining walls, and pavement while dense growths can reduce the flood capacity of channels and floodplains. It is a frequent colonizer of temperate riparian ecosystems, roadsides, and waste places, forming dense colonies that completely crowd out any other herbaceous species. It is now considered one of the worst invasive exotics in parts of the eastern United States. This alternate-leaved plant grows from 3 to 10 feet high, flowering in mid-to-late summer with numerous, small-flowered white to greenish-white racemes in the upper leaf axils. It has a distinctive, bamboo-like stem one-half-inch or more in diameter and turns red in the fall.

The success of Japanese knotweed has been partly attributed to its tolerance of a very wide range of soil types, pH, and salinity. Its rhizomes can survive temperatures of -31 degrees Fahrenheit (°F) and can extend 23 feet horizontally and 10 feet deep, making removal by excavation extremely difficult. The plant is also resilient to cutting, vigorously re-sprouting from the roots. The most effective method of control is by herbicide application close to the flowering stage in late summer or autumn. In some cases it is possible to eradicate Japanese knotweed in one growing season using only herbicides (glyphosate or triclopyr). Trials in the Queen Charlotte Islands (Haida Gwaii) of British Columbia using sea water sprayed on the foliage have demonstrated promising results, which may prove to be a viable option for eradication where concerns over herbicide application are too great.



Japanese knotweed in late summer.

B. Garlic mustard (*Alliaria petiolata*)

Garlic mustard was introduced in North America as a culinary herb in the 1860s and is an invasive species in much of North America. Like most invasive plants, once it has an introduction into a new location, it persists and spreads into undisturbed plant communities. In many areas of its introduction in Eastern North America, it has become the dominant under-story species in woodland and flood plain environments, where eradication is difficult because of high seed fertility and a persistent seed bank. It is an alternate-leaved biennial that grows up to about 3 feet high that blooms in the spring, with small white flowers borne in racemes at the top of the plant or upper leaf axils. The green rosettes of young plants are often the first green vegetation that can be noted during the spring in infected areas.

The insects and fungi that feed on it in its native habitat are not present in North America, increasing its seed productivity and allowing it to out-compete native plants. Garlic mustard produces allelochemicals, which suppress mycorrhizal fungi that most plants, including native forest trees, require for optimum growth. However, allelochemicals produced by garlic mustard do not affect mycorrhizal fungi from garlic mustard's native range, indicating that this has enhanced the plant's success in North America. Its success is also enhanced by preferential browsing by white-tailed deer on native plants that could otherwise compete with garlic mustard, and trampling by browsing deer encourages additional garlic mustard seed germination by disturbing the soil. Seeds contained in the soil can germinate up to five years after being produced, and the seeds are easily dispersed by human foot traffic, especially lug-soled shoes that can carry significant amounts of dirt. Raccoons are also a common vector in woodlands, causing infestations that begin at the bases of large hardwood trees that are used as day dens. The persistence of the seed bank and suppression of native mycorrhizal fungi both complicate restoration of invaded areas because long-term removal is required to deplete the seed bank and allow recovery of the mycorrhizae.

Research published in 2007 shows that, in northeastern forests, garlic mustard rosettes increased the rate of native leaf litter decomposition, increasing nutrient availability and possibly creating conditions favorable to garlic mustard's own spread. Control methods include hand-pulling of maturing plants during soft-soil conditions, applications of glyphosate, and hand-torching of young rosettes in heavily-infested areas.



Mature garlic mustard, showing typical invasive behavior.

C. Buckthorn (*Rhamnus cathartica*)

Buckthorn is a deciduous shrub or small tree that is native to Eurasia and north Africa that was introduced to North America as an ornamental shrub in the early nineteenth century. In the Upper Midwest, it grows up to 20 feet, with greyish-black bark on the mature shrubs and twigs with terminal spines. The simple, closely-alternate, dark green leaves are oval, 1 to 3 inches long, and up to 1.5 inches wide. It retains its leaves deep into the fall and even through mild winters, and is among the first woody plants to begin growth in the spring. The inconspicuous flowers yield axillary clusters of small, fleshy, black cherry-like drupes about one-quarter-inch wide that are readily eaten by birds, which disperse the seeds in their droppings. Urban-adapted songbirds such as robins are very common dispersal vectors of this shrub.

Buckthorn is shade-tolerant, fast-growing, and very tough and durable. It readily disperses to both disturbed and undisturbed, high-quality habitats. It is widely regarded as a major invasive species whose shade prevents the establishment of native trees or shrubs, with mature buckthorn stands able to completely eradicate native understory herbs. The absence of understory vegetation beneath buckthorn

can often lead to soil erosion and further degradation of habitat and water quality in downstream water bodies. Buckthorn has become the target of efforts to eradicate it from many home sites, parks, woodlands, and conservancies. It is difficult to control because it sprouts vigorously and repeatedly from the root collar following cutting, girdling, or burning. The most effective control method is a fall application of a strong, oil-based triclopyr solution to freshly-cut stumps. Once woodlands are cleared by this method, fall burns of the leaf litter may be effective in the control of buckthorn seedlings, which otherwise can be hand-pulled during moist soil periods.



Buckthorn in autumn, with mature fruits.

D. Eurasian watermilfoil (*Myriophyllum spicatum*)

Eurasian watermilfoil is a submerged aquatic plant or macrophyte that was likely first introduced to North America in the 1940s and has become an invasive species in many areas. As of 2003 Eurasian watermilfoil was found in every state of the contiguous U.S. except Wyoming and Montana, with Rhode Island, New York, New Jersey, Michigan, Minnesota, and Washington state having the largest areas of infestation. In lakes or other aquatic areas where native aquatic plants are not well established, the Eurasian plant can quickly spread and crowd out native plants, creating dense mats that interfere with recreational activity. It can even be thick enough to endanger swimmers. The plant can grow from broken off stems, which increases the rate the plant can spread and grow, especially when inadvertently transported between lakes by trailered boats. A moderate level of Eurasian watermilfoil was identified within the Badger-Rapide Croche impoundments during FERC licensing studies. The results of these studies are included in Appendix A.

Eurasian watermilfoil has slender stems up to 10 feet long. The submerged leaves (usually between 2/3 to 1-1/2 inches long) are pinnate and borne in whorls of four, with numerous axils (male above, female below) on a 1/4- to 2/3-inch spike held vertically above the water surface. Each flower is inconspicuous, orange-red and about 1/4-inch long. Eurasian water milfoil has 12-21 pairs of leaflets while northern

Section 3 Identified Invasive Species

watermilfoil (*M. sibiricum*) only has 5-9 pairs. The two can hybridize and the resulting hybrid plants can cause taxonomic confusion as leaf characters are intermediate and can overlap with the parent species. The hybrid plant, *Myriophyllum sibiricum x spicatum*, known to occur in the upper Midwest (Minnesota, Michigan, Wisconsin) and in the Northwest (Idaho, Washington) can also be invasive.

Control of Eurasian watermilfoil can be difficult. The milfoil weevil (*Euhrychiopsis lecontei*) feeds upon and damages the plant and has been used as an agent of biological pest control in North America. The aquatic water veneer moth (*Acentria ephemerella*) has also been used as biocontrol. In many Wisconsin lakes with heavy infestations, annual harvesting is often done, but accomplishes little in terms of eradication. This technique, however, has been proven to provide side-benefits in terms of reduction of internal phosphorous loading in the harvested lakes.

Since roughly 2000, hand-harvesting of invasive milfoils has shown much success as a management technique. Several organizations in the New England states have undertaken large scale, lake-wide hand-harvesting management programs with extremely successful results. Acknowledgment had to be made that it is impossible to completely eradicate the species once it is established. As a result, maintenance must be done once an infestation has been reduced to affordably controlled levels. Well trained divers with proper techniques have been able to effectively control and then maintain many lakes, especially in the Adirondack Park in Northern New York where chemicals, mechanical harvesters, and other disruptive and largely unsuccessful management techniques are banned. The Adirondack Watershed Institute (AWI) of Paul Smiths College is one organization whose research has shown the effectiveness of hand-harvesting techniques.



Typical growth habit and coloration of Eurasian watermilfoil.

E. Purple loosestrife (*Lythrum salicaria*)

Purple loosestrife is an herbaceous perennial wetland plant from Eurasia that can grow up to six feet tall, forming dense clonal colonies over large areas, with numerous erect stems growing from a single woody root mass. It is generally not shade-tolerant. The plant was introduced into temperate North America about a century ago and it is now widely naturalized and listed as a noxious or invasive weed in most locations. Purple loosestrife infestations result in:

- A dramatic disruption in water flow in river floodplains and canals
- A sharp decline in biological diversity as native food and cover plant species (even cattails) are completely crowded out
- An adverse effect to the life cycles of organisms, from waterfowl to amphibians to algae

A single plant may produce up to three million tiny seeds annually. Easily carried by wind, water, and a variety of animals including shorebirds, waterfowl, aquatic mammals and humans, the seeds germinate in moist soils after overwintering. The plant can also sprout anew from pieces of root left in the soil or water. In the earliest stages of infestation, purple loosestrife can be easily eradicated by complete removal (hand pulling or digging) of the young plants and rootstocks. However, once established, it is practically impossible to eradicate by mechanical means or herbicides, principally because of the immense quantity of fertile seed liberated during the first growing season.

The stems are green and square in cross-section. The leaves are lanceolate, 1/2 to 3 inches long and 1/4 to 3/4 inches broad, sessile, and arranged opposite or in whorls of three. The purple flowers are 1/2-inch in diameter, with six petals (occasionally five) and 12 stamens, and are clustered tightly in the leaf axils. There are three different flower types, with the stamens and style of different lengths and each flower type can only be pollinated by one of the other types, thus ensuring cross-pollination between different plants. The fruit is a small capsule containing numerous minute seeds.

In Wisconsin, purple loosestrife flowers from July into late August and, because of its preference for open habitats, the brilliant purple color is readily visible at long distances. The plant may be distinguished from similar native plants such as fireweed (*Epilobium angustifolium*), monkey flower (*Mimulus ringens*), blue vervain (*Verbena hastata*), Liatris (*Liatris* spp) and native loosestrife (*Lythrum alatum*) by its square stalks, simple, non-serrate, sessile always-opposite leaves and the flowering habit of two or more flowers in the leaf axils.

Biological control of loosestrife has been successful in suppressing established populations in North America. Five species of beetle use purple loosestrife as their natural food source and they can do significant damage to the plant. The beetles used as biological control agents include two species of leaf beetle: *Galerucella californiensis* and *Galerucella pusilla*, and three species of weevil: *Hylobius transversovittatus*, *Nanophyes breves*, and *Nanophyes marmoratus*.

In Wisconsin, *Galerucella* beetles have been very effective in controlling local populations due to a WDNR program that has provided assistance in raising and releasing the beetles in loosestrife areas. The beetles will lay eggs only on purple loosestrife and are specific feeders as well. The grazing beetles cause significant damage to the plants, inflicting a shothole feeding pattern eating small (1-2 mm) holes through foliage. Newly hatched larvae feed in growing shoot tips, killing them. Larger larvae produce a windowpane feeding pattern on the leaves, eating the softer tissues and leaving the tougher, less digestible veins.

In spring (late April or May) overwintering adult beetles emerge from soil and litter below old purple loosestrife plants to feed for several days on new foliage and then begin to reproduce. After mating, females lay eggs in masses of 2 to 20 eggs per grouping, which may be placed low on the stem, at leaf axils, or on leaves. The egg-laying period occurs from mid-May to mid-July with the peak in May and June. An individual female may lay up to 500 eggs during this period. Larvae emerge from eggs in 7-10 days and feed on tissues of developing shoots and leaves. When larvae commence feeding, adults may disperse, migrating to other nearby plants. Larvae feed for about three weeks, going through several instars before moving down into the soil or plant litter to pupate. Where water levels are higher, larvae may pupate inside the stem by burrowing into the porous internal tissues. Upon emergence the new adults harden in 7-10 days and then feed until moving into the litter or soil below to overwinter. This period of emergence occurs typically from July to September. The total maturation time from egg to adult is approximately 30-40 days.

The damage caused to growing shoots and leaves greatly reduces plant growth, inhibits flowering, and may reduce starch stores in the roots, which can result in winter plant mortality. The resultant weakening and/or death of the loosestrife plants provides an opportunity for previously out-competed native plant species such as cattails, grasses, and sedges to return.

The beetles can fly between plants or plant clusters and both larvae and adults float, allowing current or wind to move them to nearby plants. Unfortunately, long-term standing water may be detrimental to *Galerucella's* development since pupation is difficult under these conditions.

F. Reed canary grass (*Phalaris arundinacea*)

Reed canary grass is a coarse, cool-season wetland perennial grass that reaches 2 to 9 feet in height. It can also grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. It grows throughout the world's north-temperate zones and both Eurasian and native ecotypes of reed canary grass exist in the U.S. The aggressive Eurasian variety, once widely promoted as marsh hay, forage, and wildlife cover, is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype.

Reed canary grass has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. The blades are flat and have a rough texture on both surfaces and the top ligule on each stem is membranous, transparent, and long (see photo below). This is often the most helpful feature distinguishing young plants from other grasses. The green to purple flowering panicles are

Section 3 Identified Invasive Species

terminal, erect, open and slightly spreading when flowering in May to mid-June, becoming compact changing to a light beige color as the seed matures. The seeds are shiny brown and shatter readily from the ripe flower heads in mid-summer.

Reed canary grass produces leaves and flower stalks for 5 to 7 weeks after germination or emergence in early spring, and then it spreads laterally. Growth peaks in mid-June and declines in mid-August. Early season growth is enhanced under nutrient-rich conditions, especially on fine mineral soils. A second growth spurt occurs in the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems and leaves. Seeds disperse from one wetland to another by floodwaters, animals, humans, or machines.

Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites. Because of its early and aggressive growth habit, and its thick rhizome system, it can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas, overtopping native vegetation and, over time, forming large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Only dense tree cover can offer a degree of natural control and exclusion of this grass from native habitats.

The difficulty of selective control makes reed canary grass invasion of particular concern. Once dominant in any habitat, control is impossible without major disturbances, followed by intensive restoration of the native plant community. If a site is partially invaded, however, control can be accomplished by repeated and carefully-targeted applications of broad-spectrum herbicides like glyphosate or more specific herbicides like sethoxydim (Poast), fluazifop (Fusilade), and imazapyr (Habitat). Application methods vary according to site conditions and, in all cases, treatment by a licensed person with experience in native plant community management is very important.



A mid-summer stand of reed canary grass.



The diagnostic upper ligule of reed canary grass.

G. Common reed (*Phragmites australis*)

Common reed or *Phragmites* is a large perennial, warm season grass that can grow in very dense stands and is long living. It is found in open wetlands throughout temperate and tropical regions of the world. Like many grasses, *Phragmites* needs full sun and is generally not found in forested situations.

It is now known that in North America there is a native form of *Phragmites*, *Phragmites australis*, subspecies *americanus* that is markedly less vigorous than European form, subspecies *australis*. The recent marked expansion of *Phragmites* in North America is due to the more vigorous, but similar-looking European subspecies invading and permanently altering many wetlands due to its superior facility for exploiting nutrients, tolerance for salinity (as in estuaries or along winter-salted roads) and ability to alter habitats by over-topping growth and by the production of gallic acid, which is degraded by ultraviolet light to produce mesoxalic acid, both compounds that inhibit growth of native wetland plants.

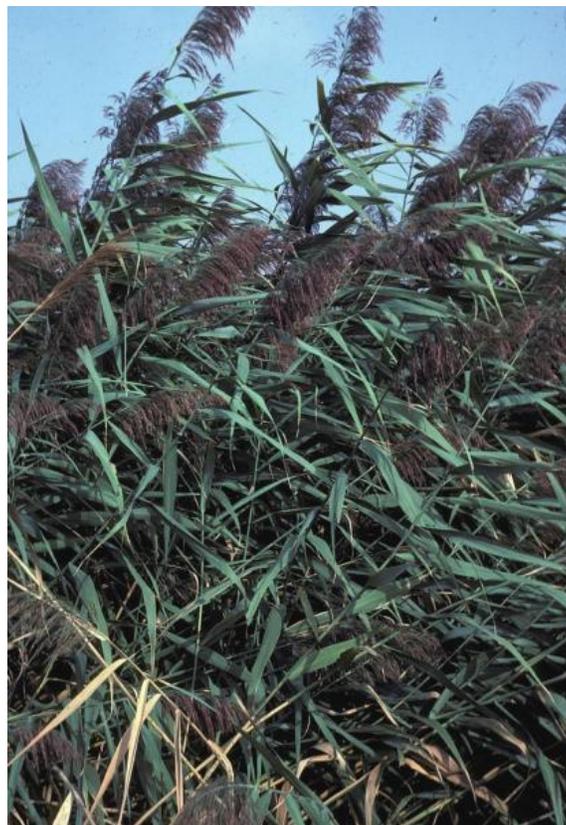
The native subspecies of *Phragmites* is difficult to distinguish from the invasive subspecies. Generally, the native strain has stems that are reddish in the spring and summer and are smooth, shiny and flexible, while nonnative *Phragmites* stems are tan and rough, dull, and rigid. Leaves of native *Phragmites* are lighter yellow-green, as opposed to the darker blue-green of the invasive Eurasian variety. One of the easiest ways to identify the native *Phragmites* is that it co-occurs with other plants, while nonnative *Phragmites* typically grows as a monoculture to the exclusion of all other plants.

The impacts of *Phragmites* on wetlands are similar to, and perhaps even more severe than, the effects of reed canary grass. This giant grass effectively crowds out all other vegetation not just by overtopping it, but by taking up all available root space with a dense and deep mat of tough rhizomes. This root and rhizome system can make up more than 80 percent of the yearly biomass. Where conditions are suitable

Section 3 Identified Invasive Species

Phragmites can spread up to 30 feet per year by these rhizomes. The stems grow from 6 to 20 feet tall and the leaves are from 8 to 20 inches long and 3/4 to 1-1/2 inches wide. The grass flowers in late summer with a dense, dark purple panicle, about 8 to 24 inches long. Phragmites turns tan in the fall and most leaves drop off, leaving only the stalk and plume-topped shoot throughout winter.

Control of Phragmites is usually attempted with a combination of herbicides (imazapyr and glyphosate) and prescribed burning, which over time weakens surviving plants and allows competition from suppressed native species. Physical removal of early-invading plants is not possible because of the strong, deeply-rooted rhizomes and the likelihood of overlooked roots and rhizomes re-sprouting. Burns are usually important when treating larger infested areas. In the setting of the Badger-Rapide Croche project impoundments, herbicide control is probably the most feasible technology to use.



Phragmites australis, subspecies australis, showing typical color and invasive growth habit.



A comparison of the general field appearance of invasive, introduced *Phragmites* versus the native subspecies.

H. Dreissenid mussels

Quagga mussel (*Dreissena bugensis*), zebra mussel (*Dreissena polymorpha*), and false darkmussel (*Mytilopsis leucophaeata*) are part of the Dreissenidae family, which is a family of small, freshwater bi-valve mollusks. They attach themselves to stones or to any other hard surface using a structure of small, thread-like filaments called a byssus. The shells of the mussels in this family range from 1 to 1-1/2 inches in their maximum dimension, and about half as wide across. They are typically marked by alternating light and dark bands (zebra stripes).

Shell patterns in the zebra mussel, however, can vary to the point of having only light or dark colored shells and no stripes. Color patterns in quagga mussels vary more, with black, cream, or white bands. They usually have dark concentric rings on the shell on their ventral side and are paler in color near the hinge. In general, the false darkmussel resembles the zebra mussel, but adults are usually brownish in color without the stripe patterns that are typical of young darkmussels and adult zebra mussels.

Temperature is a key factor in spawning and fertilization of *Dreissenid* mussels. Minimum spawning temperatures are a 48°F to 54°F. After fertilization, the very young mussels (veligers) grow for a short time as zooplankton, before precipitating on a hard surface and forming the typical bi-valve shell with byssal threads. Quagga mussels are more adapted to cold, deep-water environments lower in oxygen while the zebra and darkmussels are more adapted to warmer waters. Because zebra mussels need a good deal of calcium to form their shells, they need water containing calcium levels of 25 parts per million or greater and thrive in waters with pH levels between 7.5 and 8.7. The potential for spawning is very low—below 9 parts per million of calcium. Zebra mussels also require relatively high oxygen concentrations and the optimal water velocity for colonization is between 0.3 to 3.3 feet per second, within which lies the range of typical intake velocities for the Badger Rapide-Croche project. Colonization

potential does not decrease until velocities either exceed 1.5 meters per second or drop below 0.075 meters per second.

All three of these mussels are invasive species that threaten Wisconsin's waters. *Dreissenid* mussels are filter feeders that consume phytoplankton and zooplankton from the water column. *Dreissenid* mussels can filter up to 1 liter of water per day per individual and have the capability of filtering an entire lake's volume in a matter of days. This leads to an increase in water clarity and greater penetration of sunlight, allowing development of unwanted macrophytes. Plankton is microscopic, and if substantially removed by *Dreissenid* mussels, allows the smallest and most basic part of the food chain to be broken, which can have devastating effects on life cycles of plants, animals, and fish.

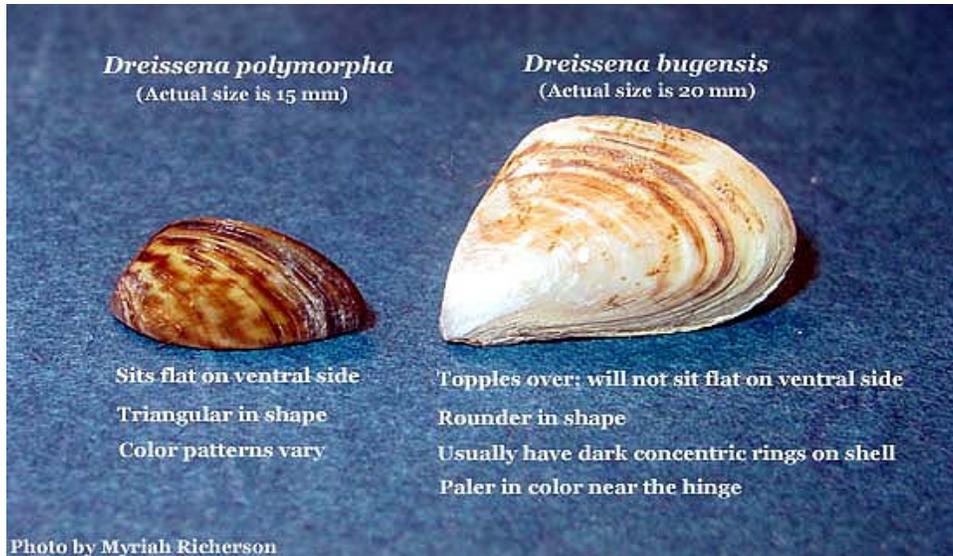
Dreissenid mussels can also pollute the water by encapsulating undesirable plankton, releasing resultant pseudofeces back into the water to rot. Impacts associated with the filtration of water include increases in water transparency, decreases in mean chlorophyll, and concentration and accumulation of pseudofeces that have been associated with poor water quality, foul odor, and taste. As the waste particles decompose, oxygen is used up, the pH becomes very acidic, and toxic byproducts are produced. The mussels also accumulate organic pollutants within their tissues to levels more than 300,000 times greater than concentrations in the environment, impacting predators who consume the mussel. Also, the pollutants are bound in the pseudofeces, which can be passed up the food chain; therefore, increasing wildlife exposure to organic pollutants.

Besides pollution, these mussels also have adverse physical effects by coating other living organisms like crayfish and turtles, and they even attach to each other, forming dense layered colonies up to one foot thick that denies use of river and lake bottoms by other species. Mussel densities of over 1 million individuals per square meter have been recorded in parts of Lake Erie. *Dreissenid* mussels typically adhere to hard surfaces such as rocks, concrete, steel, pilings, metal grates, boat motors, docks, and navigational bouys. Encrustations of mussels can have severe impacts on the function of utility plant and water-treatment intakes and make regular cleaning an expensive necessity.

Dreissenid mussels are easy to disperse at all different stages of life. They can be carried as plankton in water currents or move to new locations by attaching themselves to other organisms such as crayfish or turtles. They may also attach to legs, feet, and feathers of waterfowl and shore birds. They are most commonly transported by recreational boating or by water deliberately or inadvertently dumped from a container. This includes boat ballast systems, live wells, bait wells, bilge tanks, cooling systems, or anywhere water can be stored on a boat. Adult *Dreissenid* mussels easily attach themselves to boats and equipment and can survive several days out of the water. Some adults have been known to survive up to 27 days in the right conditions of cool temperatures and high humidity.

To date, no single *Dreissenid* mussel control technology has been identified, but a range of control methods exist that are suitable or practical for some situations. None will work in all water settings, and some can pose significant risks to the environment. Physical removal can be done by exposure and dessication (1 week at 80°F), freezing (2 days at 32°F or less), heating (>95°F) or mechanical scraping or air/water blasting. For the latter method, 2,000 to 3,000 psi is needed, with up to 10,000 psi necessary to remove all byssal threads and eliminate the threat of corrosion on metal surfaces. No bio-controls are

available at this time, although research continues at the National Energy Technology Laboratory on a bacterial toxin, *Pseudomonas fluorescens*, that has killed all zebra mussels and up to 85% of quagga mussels in laboratory settings. Chemical controls include either lethal compounds (molluscicides, copper sulfate, and certain metal ions) or oxidizing agents such as chlorine, potassium permanganate, ozone, and bromine. Any of these can adversely affect non-target species and likely require an applicator permit and performance under the auspices of a National Pollutant Discharge Elimination System (NPDES) permit.



The zebra mussel (left) and quagga mussel (right) compared.



Zebra mussels overwhelming a clam.



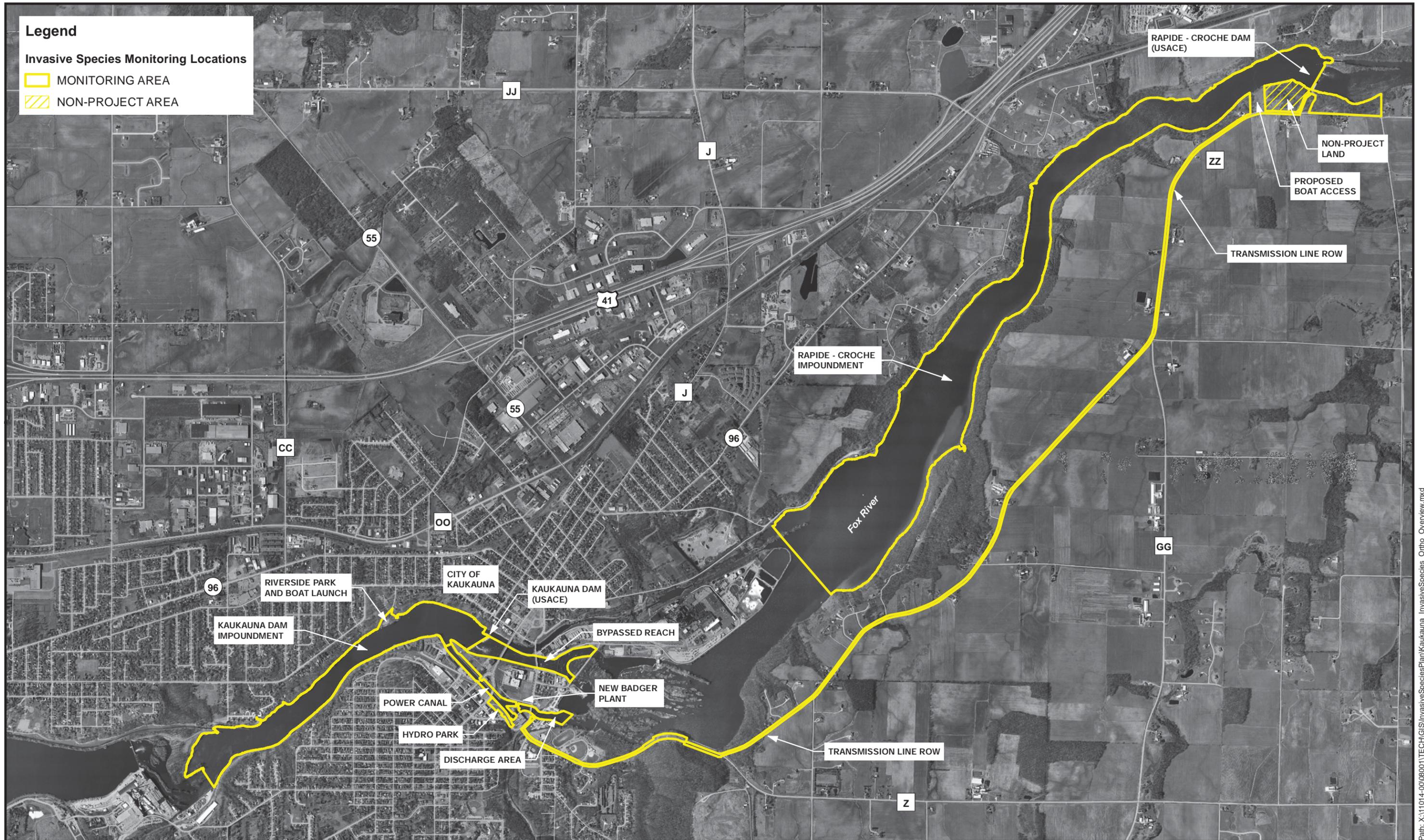
Zebra mussels overwhelming a Lake Michigan current meter.

4. Monitoring

A. Project areas subject to monitoring

The following project areas will be subject to monitoring for the species described in Section 3. Figure 1 provides an overview map showing monitoring areas and non-project areas, while Figure 2 through 4 provide closer views of the areas depicted in Figure 1.

1. The Kaukauna Dam impoundment and shoreline, to the tailrace of the Combined Locks project upstream. This includes the existing City boat landing (Riverside Park Marina).
2. The New Badger Power Canal.
3. Hydro Park.
4. The discharge area downstream of the New Badger power plant, as identified in Figures 1 and 3.
5. The bypassed reach and shoreline of the Fox River downstream of the Kaukauna Dam, to the Elm Street bridge.
6. The Badger-Rapide Croche impoundment from the line shown in Figure 1 downstream to the Badger-Rapide Croche dam.
7. The four-acre, City-owned parcel for the new Rapide Croche impoundment boat landing (as described in accordance with FERC License Article 408, Recreation Plan).
8. The 11.6-acre Rapide Croche Park.
9. The County Highway ZZ right-of-way (the location of project power transmission line).



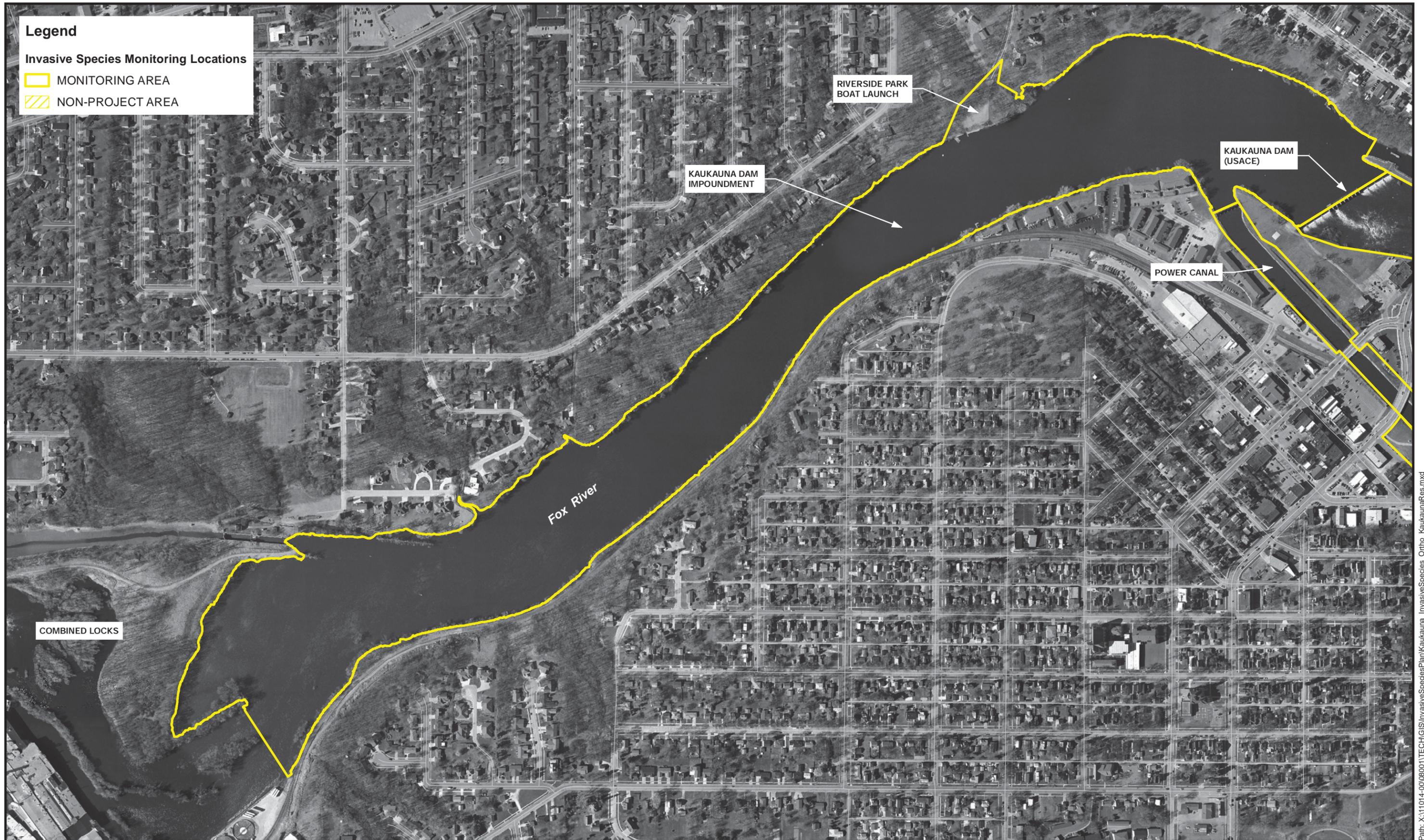
Invasive Species Area of Interest

Badger - Rapide Croche Hydroelectric Project
 FERC Project No. 2677



Figure 1
Overview Map

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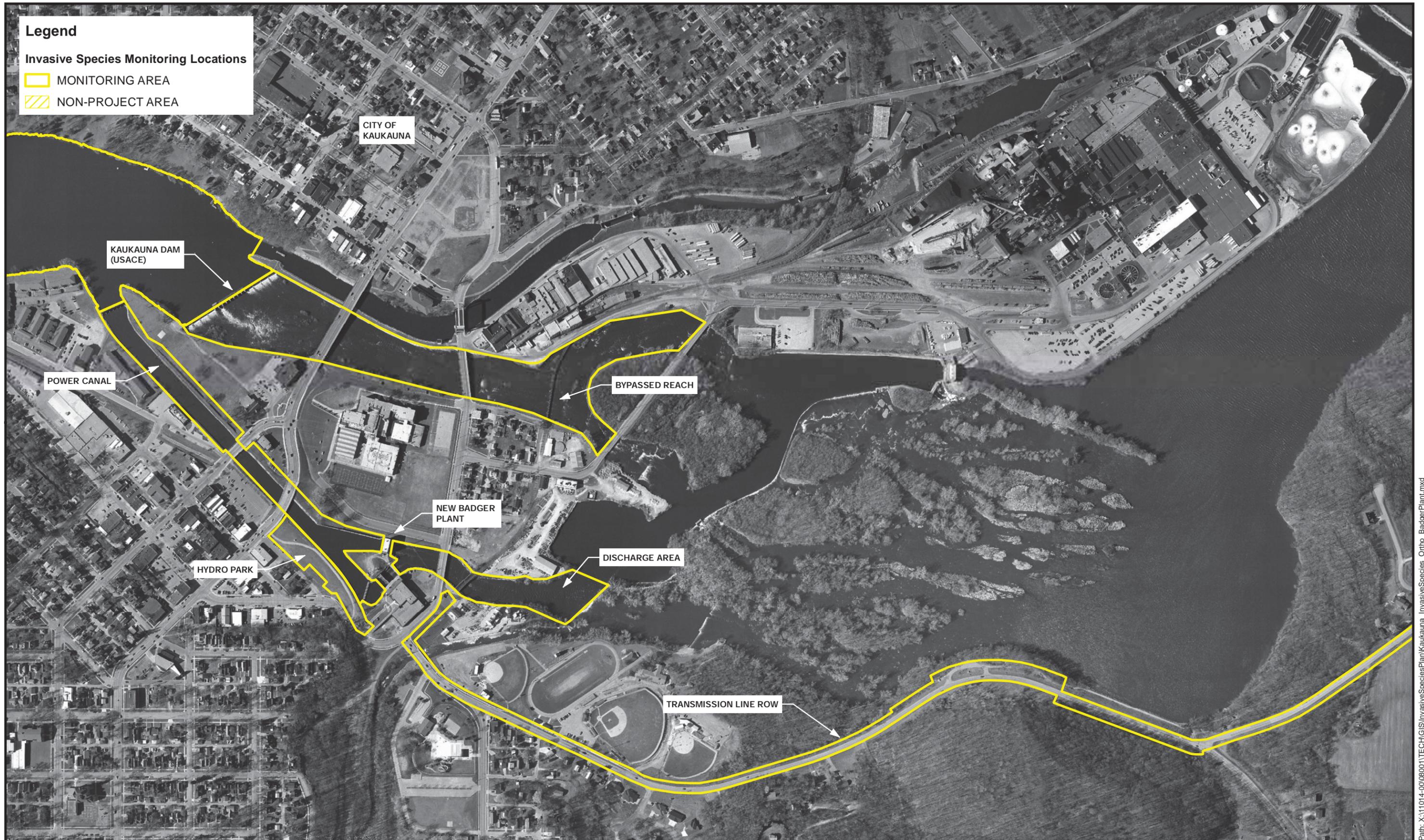


Invasive Species Area of Interest
 Badger - Rapide Croche Hydroelectric Project
 FERC Project No. 2677



Figure 2
Kaukauna Dam Map

Path: X:\11014-0008001\TECH\GIS\InvasiveSpeciesPlan\Kaukauna_InvasiveSpecies_Ortho_KaukaunaRes.mxd



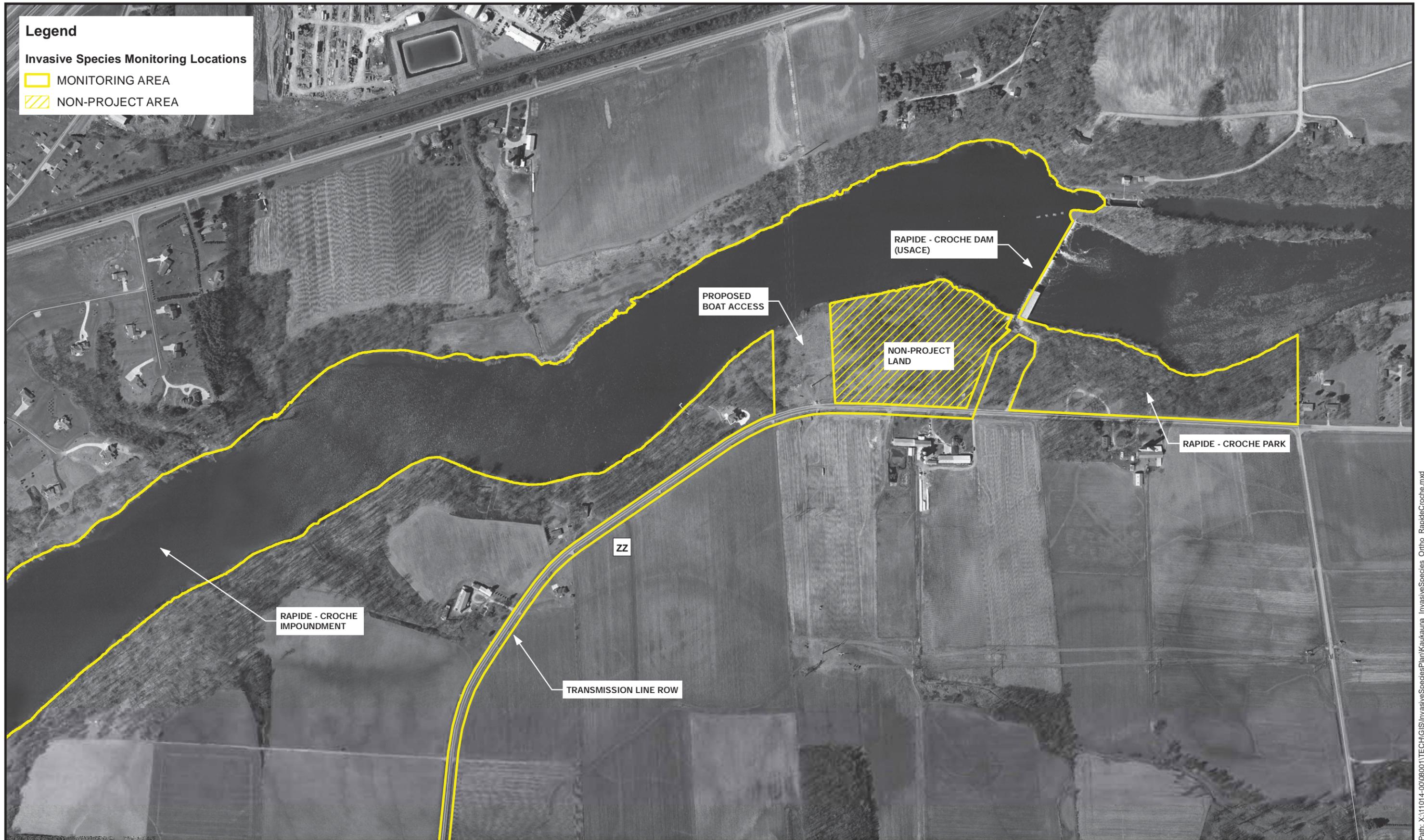
Invasive Species Area of Interest

Badger - Rapide Croche Hydroelectric Project
 FERC Project No. 2677



**Figure 3
 Badger Plant Map**

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Invasive Species Area of Interest

Badger - Rapide Croche Hydroelectric Project
 FERC Project No. 2677



Figure 4
Rapide - Croche Dam Map

B. Monitoring schedule and methods

A seasonal monitoring timeframe for each of the identified invasive species is presented in Table 1. All monitoring will be conducted by qualified ecologists familiar with the life history and visual characteristics of the invasive species. Monitoring bouts will be conducted every year from 2013 through 2015, and every other following year in accordance with the seasonal schedules of Table 1. All monitoring bouts will use recent aerial orthophotographs printed at a scale of no less than 1:3600 (1"=300') to support the mapping of invasive plant populations in the field. Data concerning the locations of all identified invasive species will also be collected using a hand-held GPS unit, with the data post-processed to a positional accuracy of 12 feet or less.

The monitoring time frames in Table 1 are based on the earliest time of year when species can be most readily identified in time for implementation of control measure (see Section 8). The monitoring times highlight when field work can be most effectively done, in terms of being able to identify more than one invasive species within the monitoring limits shown in Figures 1-4.

Table 1. Badger-Rapide Croche Invasive Species Annual Monitoring Schedule

Species	Monitoring Timeframe	Method*
a. Japanese knotweed (<i>Fallopia japonica</i>)	July	P
b. Garlic mustard (<i>Alliaria petiolata</i>)	May	P
c. Buckthorn (<i>Rhamnus cathartica</i>)	May	P
d. Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	July of every 4 th year	O
e. Purple loosestrife (<i>Lythrum salicaria</i>)	July	B
f. Reed canary grass (<i>Phalaris arundinacea</i>)	May	B,P
g. Common reed (<i>Phragmites australis</i>)	May-June	B
h. Dreissenid mussels (3 spp.)	May-July	O

* B = boat; P = pedestrian; O = other

The following field methods will be used in the relevant areas of potential habitat for the monitoring of each species in Table 1. Knotweed, garlic mustard, buckthorn, reed canary grass, and giant reed will be searched for by walking uniformly-spaced, progressive transects through KU lands on a spacing of about 30 feet until all the area is covered. Shorelines will be visually surveyed for purple loosestrife, reed canary grass, and common reed by watercraft during the appropriate season as listed above, aided by binoculars.

Mussels will be sampled for during April – September monthly rakings of the Badger and Rapide Croche plants' trash racks. This exercise is a routine maintenance item of a physical structure that intersects the entire water column. Eurasian water milfoil will monitored every fourth year using the field procedures, sampling tools, and data analysis and reporting protocols set forth in the WDNR's *Recommended Baseline Monitoring of Aquatic Plants in Wisconsin* (see Appendix D). The survey will follow a point-intercept grid with GPS coordinates set up in coordination with the WDNR prior to field work. This sample area will include the water bodies shown in Figure 1 of this plan, with the exception of the power canal of the Badger Plant and the boomed-off areas upstream of the USACE dams at each project, which are excluded for safety reasons. Field data collection and data reduction will follow the procedures of the

Aquatic Plant Survey Data Workbook, a data processing Excel file from the UW Extension at <http://www.uwsp.edu/cnr/uwexplakes/ecology/APM/Appendix-C.xls>. Reporting will follow the electronic filing and mapping procedures referenced on page 25 of Appendix D.

Spot occurrences and the outlines of the visible limits of invasive species populations will be mapped using a combination of GPS and field notes on a large-scale orthophoto of the project. A cumulative occurrence map will be produced for each year of monitoring that includes the locations of all detected species that year (*Section 7, Reporting*).

Japanese knotweed – This weed has the potential to grow in wet to mesic, open habitats, as well as in exposed joints or cracks in masonry, pavement or concrete, in which it has the potential to cause structural damage if not controlled promptly. Consequently, exposed masonry elements of the project (i.e., power canal walls and powerhouse foundations) will be visually inspected in July of each monitoring year. All shorelines of the areas identified in Figure 1 will also be inspected by boat or pedestrian survey, as well as the power line corridor along County Highway ZZ. The entire parcel areas of Hydro Park, City boat landing (Riverside Park Marina), the new Rapide Croche impoundment boat landing, and Rapide Croche Park will also be subject to pedestrian surveys for Japanese knotweed, as the plant has some facility for growing in woodland openings as well as un-mown fields.

Garlic Mustard – Garlic mustard has rapid, early spring growth and can be easily identified by persons familiar with it in May just before it flowers, by which time it is among the tallest herbs in the shady understories and edges of un-mown habitats. The areas surveyed for garlic mustard will include all shorelines within the limits shown in Figure 1, as well as all areas of Hydro Park, the new Rapide Croche impoundment boat landing, and Rapide Croche Park.

Buckthorn – Buckthorn will invade any wet-mesic to dry-mesic soil or waste area that is not subjected to regular mowing, regardless of the amount of sun exposure. Even in frequently mown areas, this plant can gain a “toehold” just outside the edges of mowing. The May buckthorn survey will therefore cover all shorelines shown in Figure 1 as well as Hydro Park, the County Highway ZZ power line corridor, and all areas of Hydro Park, City boat landing, the new Rapide Croche impoundment boat landing (Riverside Park Marina), and Rapide Croche Park.

Eurasian water milfoil – as a fully aquatic plant reaching its maximum extent in mid-summer (July), the annual milfoil survey will be limited to waters shown in Figure 1.

A survey for Eurasian water-milfoil was done by boat in July 2006 for the license application that involved the establishment of six transect lines, each with four sampling stations spaced about 100 feet apart along the line. Two transects were located in the Badger flowage and the other four were located in areas of the Rapide Croche impoundment (Figure 2). The transects were established in areas of macrophytic vegetation that existed at that time, and the beginning points were recorded using a hand-held GPS receiver. Macrophytes were identified to the species level and their percent cover was estimated to the nearest five percent within each depth class sampled.

Using a sampling rake and visual estimations of cover, Eurasian water-milfoil was found in 2006 along every transect and, where present, it occupied a large portion of the surface to the exclusion of most other macrophyte species. The results of the 2006 survey are included in Appendix A. Other macrophyte species were basically limited to coontail (*Ceratophyllum demersum*) and curly pondweed (*Potamogeton crispus*), which contributed 5 to 15 percent cover in some locations.

In order to provide an immediate value of trends analysis with the first compliance survey, these same transects and sampling format are proposed for each following July milfoil monitoring.

Purple loosestrife – This plant occurs as an invasive species in wetland habitats with seasonal to long-duration flooding. Wet soil habitats, such as are found along shorelines or the margins of wetlands, are essential for its reproduction and spread. Consequently, project wetlands and shorelines contained within the limits shown on Figure 1 will be subject to monitoring for purple loosestrife.

The bloom period for purple loosestrife in the project region extends from mid-July through August. Therefore, purple loosestrife monitoring will be done by boat at the same time as the Eurasian water-milfoil survey in order to achieve the most comprehensive and efficient coverage of project waters. The exact dates of each annual survey will be scheduled to coincide with loosestrife bloom in the project area.

During the 2006 licensing study cited above for Eurasian water-milfoil, two purple loosestrife plants were found along the project shoreline and were removed and disposed of in a secure manner. If isolated loosestrife plants are again found while monitoring, the plants will be pulled or dug out, securely bagged, and disposed of at a licensed landfill. If the age or number of the loosestrife plants makes this control method impractical, control with an appropriate over-water herbicide will be done by a state-licensed applicator.

Reed canary grass – This potentially ubiquitous invasive favors emergent wetlands with a seasonal hydrology, but can also be found in moist environments that do not qualify as wetlands. Therefore, both wetland and moist upland environments within the monitoring limits shown on Figure 1 have habitat potential for this invasive grass.

Because reed canary grass can be readily identified in spring, before flowering, it will be surveyed for every May by both boating project waters and walking through associated uplands with potentially favorable conditions. This will allow it to be identified during the early-leaf stage prior to flowering and seed-set. Since mechanical control of reed canary grass is not practicable, we anticipate that control, if required, will have to rely on applications of appropriate herbicide.

Common reed – Common reed is nearly identical to reed canary grass in terms of its hydrologic requirements and affinity for wet to moist, open environments that may or may not be wetlands. Open wetlands and shorelines or moist upland environments within the limits shown of Figure 1 all have potential for common reed occurrence.

Common reed has both an early growth habit and durable, over-wintering stems that make early season identification relatively easy. This plant will therefore be included in the May survey for plants with similar phenology.

Dreissenid mussels – These fully aquatic animals can grow and disperse continuously during favorable water temperature regimes throughout project waters shown on Figure 1. Growing on hard objects or surfaces, there are numerous locations in project waters for monitoring them.

An opportunity for continuous monitoring for Dreissenid mussels is available at the trash racks that screen the intakes for the Badger and Rapide-Croche powerhouses. Both powerhouses have 19-foot-deep steel trash racks but have very different widths. At Badger, the racks will be located in the power canal in two sections 15 feet wide separated by a concrete pier, while at Rapide-Croche the racks are in 12 sections 10.5 feet wide spanning 167 feet across the entire width of the powerhouse. Throughout the year, powerhouse operations at both plants require frequent cleaning of the trash racks using a long special-purpose rake and each cleaning event offers an opportunity to monitor for mussels either on entrained debris or the racks themselves. To this end, powerhouse operators will be given materials and training in the identification of Dreissenid mussels. If mussels are identified during any cleaning operation, the date and location will be noted and the information will be provided to the WDNR and FWS.

This monitoring will be supplemented by benthic grabs along the six milfoil transects during milfoil monitoring bouts using a ponar, eckmann, or other suitable benthic sampling device that can retrieve cobble, gravel, or other benthic objects that may harbor mussels. Two benthic grabs will be taken along each transect and the locations and results of benthic sampling noted for reporting along with the milfoil data.

5. Measures to Increase Public Awareness of Invasive Species

Kaukauna Utilities will undertake the following measures to increase public awareness of invasive species in the project area:

- Posting the new WDNR invasive species sign at the pending new Rapide Croche impoundment boat landing. This effort will include transmission of the WDNR Boat Landing Sign Survey form for the new Rapide Croche impoundment boat landing to the regional WDNR Invasive Species Coordinator so they have a record of the posting. The new invasive species sign is already in place at the existing City boat landing (Riverside Marina) upstream of Badger Dam.
- Posting alert signs for Viral Hemorrhagic Septicemia (VHS) at the above boat landings, using current available graphics used by WDNR for this alerting anglers and boaters to this issue.
- Providing the following invasive species information at the Kaukauna Utilities customer service office:
 - a. *Stop Aquatic Hitchhikers*, UW Cooperative Extension CBCW brochure WT-801
 - b. *Zebra Mussels Boaters Guide*, UW Cooperative Extension CBCW brochure WT-383
 - c. *Regulated Aquatic Invasive Plants in WI*, UW Cooperative Extension Fact Sheet WT-960
 - d. *Purple Loosestrife*, UW Cooperative Extension CBCW brochure WI-799
 - e. *Japanese Knotweed*, UW Cooperative Extension CBCW brochure ER-657
 - f. *The Facts on Eurasian Water Milfoil*, UW Cooperative Extension PUB-WT-781 2004
 - g. *Common and Glossy Buckthorn*, DNR PUB FR-216 2007
 - h. *Invasive Exotic Shrub Honeysuckles*, DNR PUB FR-448 2009
 - g. NR 40 Regulated Exotic Plant List from:
<http://dnr.wi.gov/topic/Invasives/documents/NR40plantlist.pdf>
 - h. *Garlic Mustard (Alliaria petiolata)*, DNR PUB-FR-350-2006

Examples of the new boat landing sign and each of the above-listed publications are included in Appendix E.

Because the project limits for invasive species monitoring includes the County Highway ZZ right-of-way maintained by the Outagamie County Highway Department, KU will also coordinate with the Highway Department maintenance staff concerning the presence of any of the invasive species listed in Section 3 (also see Section 8). As part of this coordination, KU will transmit the Wisconsin Council on Forestry's *Invasive Species Best Management Practices for Transportation and Utility Rights-of-Way* (January 6, 2010 version) to the Highway Department, along with the current list of NR 40 Prohibited and Restricted Species. These documents will be used as a basis for any necessary control measures brought to light on highway lands as a result of KU monitoring efforts for identified invasive species.

Section 5
Measures to Increase Public
Awareness of Invasive Species

As another measure to identify invasive species, KU will encourage public awareness and education of invasive species by coordinating with the Thousand Islands Conservancy to see that their public education program is up-to-date concerning the above educational brochures and similar materials.

6. Management Practices the Licensee Will Implement to Prevent the Spread of Invasive Species

KU will take precautions to prevent the spread of invasive species through the transportation of equipment used during the course of activities associated with the operation and maintenance of its hydroelectric projects. Equipment used for project purposes that contacts water on a regular basis will be inspected and rinsed or otherwise cleaned as necessary to remove fragments of invasive plants or dreissenid mussels.

The overall strategy of KU in control of invasive species will be Adaptive Management in consultation with WDNR or local Invasive Species Coordinator of the University of Wisconsin- Extension or Outagamie County. This Adaptive Management strategy will consist of the following sequence of events that will be followed during each monitoring year:

- Small infestations of young purple loosestrife plants that are observed within the monitoring area will be removed by hand-pulling.
- Field surveys will document the location and extent of invasive species, using hand-held GPS technology, combined with hand-drawn maps of the visible extent of invasive species using available orthophotographs at a scale of no less than 1"=50' (1:600).
- Immediately after the field identification and mapping of invasive species populations, these field data will be transmitted to the WDNR or local Invasive Species Coordinator for consultation concerning control methods, performance goals and measureable performance standards (effectiveness monitoring) in light of the field data and type of species.
- The agreed upon control measures will be executed by KU.
- The results of the control measures will be monitored as determined during consultation.
- The results of field surveys, consultation, execution of control measures and effectiveness monitoring will be reported as described in Section 7, Reporting.

7. Reporting

Two copies of the monitoring report will be transmitted to the WDNR FERC Coordinator by December 20 of each year monitored. The report will include narrative accounts of any detected presence of the species cited in Section 3, supplemented by an orthophoto-based map showing the relevant locations at a minimum scale of 1:3,600. The map will also show the locations of the aquatic milfoil monitoring transects, as well as labels for roads and other features to assist in orientation and use. Population limits or locations of invasive species will be based on GIS coordinates taken with a suitable hand-held instrument, with data post-processed to a minimum accuracy of 20 feet. These monitoring reports will also include counts of the number of brochures and informational handouts listed in Section 5 that have been taken by the public in the interim between reports.

Eurasian water milfoil surveys, following the protocols of Appendix D, will be done every fourth year and reported electronically to the WDNR FERC Coordinator, the WDNR Regional Lake Coordinator, and Outagamie County.

8. Control Measures

These control measures are compiled from references of the latest best management practices for invasive species control. Effective practices for some species, particularly Dreissenid mussels, have yet to emerge, and are the topic of continuing research. Practices for the control of other species that have been invasive for some time, such as buckthorn, are more refined and are available from a range of qualified field practitioners.

The control measures described here are intended as a reference, should the need arise for action against one or more of the invasive species. Controls using established methods for certain species that do not require permits may be initiated by KU independently. Should certain species become problematic for which effective ecosystemic controls are not yet available, KU will coordinate with agency staff on appropriate measures to take.

Japanese knotweed – Opportunities for mechanical control of Japanese knotweed are very limited, due to the rapid growth of dense, tough rhizomes that are very difficult to remove completely. Attempting mechanical control also carries a risk of increased dispersal of the species, since root and stem fragments as small as ½ inch can sprout new roots. Invisible rhizomes also typically extend from 6 to 20 feet out from any mature plant, which by itself makes physical removal impractical. Only very young plants growing in soft, moist soils can be effectively removed, very similar to the case for purple loosestrife.

Chemical control requires a broad-spectrum herbicide. Of these, glyphosate; triclopyr; 2, 4-Dichlorophenoxyacetic acid (2, 4-D); picloram; and imazapyr have proven effective but the use of any of these needs to be evaluated in light of site conditions and seasonality. For example, foliar applications during the flower bud stage can be extremely effective on deep-rooted perennials like Japanese knotweed, but when this plant flowers it is usually so tall that coverage is difficult and pesticide drift becomes hard to manage. Early season cutting, to induce flowering at a shorter height, may avoid these issues. Good results have also been achieved by injecting the hollow stems with small amounts of glyphosate solution but this method can be very labor intensive and is best limited to small populations, especially because the allowable application rate limits this treatment to no more than 1,420 stems per acre, at rate of 5ml per stem with an 8% solution.

Surveys for natural controls in Japan, where the plant is not invasive, have turned up a number of fungal pathogens and grazing insects that could offer similar control benefits on this continent. Screening studies have begun on two insect species, including the Lixus weevil, and a leafspot fungus. Any such biocontrol would have to be approved as safe for native vegetation by federal agencies before any use would be allowed.

In light of the above situation regarding control of Japanese knotweed, KU will consult with local weed control professionals and invasive species specialists in the resource agencies prior to instigating any control of identified populations of knotweed. If very young, first-year plants of Japanese knotweed are found during surveys, physical removal, bagging and secure disposal will be attempted if it appears feasible.

Garlic Mustard – As an invasive annual, garlic mustard’s life history strategy is to grow very early and set an annual crop of highly-viable seed of great longevity in the seed bank. Its rapid life cycle allows germination during the first year under favorable conditions and over-wintering as a low rosette. Unless caught very early in the invasion stage, control strategies usually have to be applied for several years until the garlic mustard seed bank is depleted. A number of methods can be effective, depending on the extent of the invasion. In order to effectively repeat treatments and not miss plants, it is helpful to mark treatment areas so they can be easily found because the vulnerable seedlings can be otherwise overlooked.

Hand Pulling

For smaller infestations where several people are involved, hand pulling or digging garlic mustard can be effective if the ground is moist. Plants must be pulled carefully by grasping at or below the root collar at the ground surface to avoid leaving a root behind that will just re-sprout. If plants are pulled or dug before budding begins, they may be scattered about the area to dry out, preferably off the ground. They cannot be left on moist soil where they can re-root and development can continue. If the plants are flowering, seed pod development begins almost immediately and the pulled plants must be bagged and securely disposed of because garlic mustard seeds can still ripen after the plants are uprooted. The plants cannot be composted because the seeds will survive this process.

Weed Torch

In damp or wet situations where there is no risk of ground fire, patches of newly-germinated seedlings in spring can be burned with a propane weed torch, which is little more than a special flame spreader attached to a retail propane container. The flames quickly kill tender seedlings, usually without permanently damaging nearby perennial plants because they are still mostly dormant. This technique is particularly suited to managed areas such as parks, where public use is high, natural fuel loads are low and garlic mustard may be surviving and spreading below a mowing elevation.

Herbicide

Herbicide application is a fall or very early spring control option that is suited to areas that are too large for manual methods. The best herbicide is a 1% or 2% solution of glyphosate, applied to the foliage of individual plants and dense patches when they are very young, green and vulnerable but adjacent native plants are dormant. Since glyphosate is a non-selective herbicide that will kill or injure non-target native plants, the herbicide has to be applied with care by personnel familiar with native plants.

Because the control methods for garlic mustard are very time- and site-specific, in terms of phenology, ecology and potential public uses, KU will consult with a qualified herbicide applicator familiar with native plant ecology as well as City officials who may be involved in management of public lands where the plant might be occurring. Kaukauna Utilities does not anticipate herbicide treatment within wetland areas, but if garlic mustard treatment is needed in such areas the agencies will be consulted.

Buckthorn – The basic methods for buckthorn control include spring-season burning, pulling by hand and herbicide application. Early identification of buckthorn, before seed production has started, is vital to controlling and eventually eliminating buckthorn.

Fire

Controlled burns will usually top-kill seedlings or small buckthorn trees, but does not eradicate them. In order to control buckthorn by controlled burning, it is essential that fire be continued annually until native (fire-resistant) vegetation has become established. Use of fire is best reserved for fire-dependent ecosystems such as prairies, oak savannas or perhaps dry-mesic hardwood forests. Because these habitats are not in the KU monitoring limits, the use of fire is probably not practicable or advisable.

Hand pulling

Small buckthorn seedlings can be readily removed by hand, or with the use of a “weed wrench.” Although effective, this method is labor-intensive and is suited only for small, localized infestations. Mechanical removal also disturbs the soil and encourages re-infestation or the colonization of other weeds. If buckthorn is pulled, the loose soil should be tamped down to make a firm surface.

Herbicide treatments

Probably the best method for buckthorn control is a late fall spraying of the trunks using a 12-15% oil solution of triclopyr, saturating at least 12” of the trunk all the way around and down to the root collar just above the soil surface. Care must be taken to minimize runoff of the herbicide solution onto the ground around the trunk, and it is useful to include a bright red or blue dye with the herbicide so that no buckthorn is missed. Each trunk or stem protruding from the ground must be treated. Because buckthorn plants retain their leaves long after native vegetation has lost its leaves, they are readily recognized in the late fall and there is little risk of non-target species being mistakenly treated. Properly done, this basal bark treatment is extremely effective and the plant will not leaf out the following growing season. Once dead, the plant can be cut and removed, or allowed to stand to rot.

An alternative treatment method is to cut the buckthorn just above the ground level and treat the cut stump with the same triclopyr oil solution. Only the cut stump should be treated, and it is necessary to wet the entire circle of the cambium around the perimeter of the stump. Because the size of the treated area is much smaller with this method, a small spray bottle is sufficient for application. A disadvantage of this method is that it is more labor-intensive than the bark spray. Advantages of the cut-stump method, however, include immediate ecological, aesthetic and public use benefits. Comparing the two methods, bark treatment is best in large infected areas, whereas cutting and treating the cut stumps is best in relatively small areas, or in areas of high interest.

It should be emphasized that cutting buckthorn without treating the cut stumps is ill advised, because cut plants will re-sprout heavily from the roots, leading to a worse situation than if the plant had not been cut at all.

Eurasian water milfoil – Many methods have been tried in the United States to contain or eliminate Eurasian watermilfoil. The control methods can be classified as chemical, physical, or biological. Chemical and physical in-water controls may require permits.

Chemical

Chemical control typically uses 2, 4-D, a broad spectrum aquatic version of the herbicide 2, 4-Dichlorophenoxyacetic acid that is used to control weeds in lawns. The use of 2, 4-D will only be considered after a Eurasian Water Milfoil monitoring report has been completed as described in *Section 7. Reporting* and the necessity of such treatment, availability of licensed contractors, and performance goals have been established via agency coordination as part of the Adaptive Management strategy described in *Section 6. Management Practices the Licensee Will Implement to Prevent the Spread of Invasive Species* and *Section 9. Procedures for Obtaining Technical Assistance*. Based on preliminary agency coordination undertaken during the writing of this plan, an early-season treatment using 2, 4-D is a likely option.

Physical

Physical control may be attempted using mechanical harvesters, underwater rototillers, and cultivators; however, the plant quickly re-grows and the creation of numerous fragments can actually enhance its spread. Harvesting may be used to open up small high-use areas such as boat launches and marinas, but is not recommended for the entire impoundment because the control is temporary. Physical barriers covering the substrate around boat launches sometimes help.

Biological

The most promising agent for long-term suppression appears to be a native weevil (*Euhrychiopsis lecontei*), which is relatively well-distributed in Canada and midwest and northeast portions of the United States. The milfoil weevil is a small, herbivorous aquatic beetle, belonging to the family Curculionidae. It is a milfoil (*Myriophyllum spp.*) specialist, meaning that it feeds and develops only on plants in this genus, and appears to show a preference for Eurasian watermilfoil.

The weevil spends all summer on submersed plants, producing 3 to 6 generations. In September to November adult weevils move to shore, where they overwinter in leaf litter at drier sites near the shoreline. They return to the water in spring and females begin to develop and lay eggs after the water temperature reaches 50-60F. Emergent larvae then feed on the plants, suppressing its growth and reducing its root biomass. Research indicates that overwintering temperatures do not appear to be a limiting factor for the milfoil weevil in Minnesota, which is not surprising because the weevil is native to northern North America. High summer water temperatures (>95 F) probably precludes establishment of the weevil in southern US lakes.

The effectiveness of this weevil in suppressing milfoil has been mixed, with good results at some sites and poor results at others. Success can best be summarized as a decline in the “equilibrium density” of the weed which can be different in one water body versus another. An established effect of weevil grazing is the reduction of total non-structural carbohydrate reserves stored in the milfoil roots, thus lowering the plant’s overwintering survival and competitive ability. However, other unknown site-specific factors can come into play and reduce effectiveness without apparent cause.

Weevils are most useful for long-term control of lower priority sites, over large areas where other management actions are less effective, while alternative methods are more suitable where rapid control is needed. If weevils are stocked, a sufficient number of weevils should be released to achieve a density of

10 per square meter within the treatment area. However, the University of Minnesota Fisheries, Wildlife and Conservation Biology does not advocate moving weevils, because a particular strain may not be native to the receiving water body.

Because of its specialized and intensive nature, Eurasian watermilfoil control can cost up to \$2,000 per acre annually. It is important to realize that harvesting or fluridone application can easily conflict with biological control using weevils because it removes the weevils from the water body. Because of these factors, the likely need for permits and the potentially-limited benefits of individual methods, KU will pursue milfoil controls only in consultation with the resource agencies.

Purple loosestrife – A variety of methods have been tried to control the spread of purple loosestrife, including hand-pulling, burning, cultivation, applying chemical agents, and biological controls. To have a reasonable chance of effectiveness, a control program would have to be an ongoing process. One-time control measures would have only a temporary effect due to new plants constantly springing up from the extensive seed bank.

Younger purple loosestrife plants (1 to 2 years old) can be hand-pulled, but should not be pulled after flowering to avoid scattering of seed. Isolated older plants, especially those in deep organic soils, can be dug out or "teased" loose with a hand cultivator. However, great care must be exercised to avoid release of fragments, which can form new roots; removed plants must be bagged and removed from the area to prevent fragment release. Plant removal is a labor-intensive control method that is cost-effective only on very small infestations of limited area. It is practically impossible to effectively remove old plants growing on mineral soils.

Chemical control typically involves the spot or sprayer application of glyphosate herbicides. Glyphosate is available under the trade names Roundup and Rodeo, but only Rodeo is registered for use over open water. Glyphosate application is most effective when plants have just begun flowering in early July. Glyphosate is non-selective so care should be taken not to let it come in contact with non-target species. Significant disadvantages to chemical control include cost, possible effects on non-target species, and the need for repeated applications.

Biological control agents include leaf-feeding beetles (*Galerucella spp.*) that are highly host-specific. Beetle releases have reduced loosestrife occurrence in a number of cases on Upper Midwest waters. Feeding by these insects at high densities can defoliate mature plants, cause seedling mortality, and destroy or prevent the formation of flower spikes. Leaf-eating beetles are believed to have the capability to establish viable populations within several years of release, because the adults over-winter in the leaf litter. If biological control is undertaken, it is recommended that a minimum of 2,000 leaf feeding beetles be released into the affected area.

Reed canary grass – Reed canary grass is another very problematic species because while there are a variety of management approaches that sometimes combine multiple strategies, there is no single approach that can eliminate it without substantial expense and labor over a period of years. This plant also has no known biological control agent that can act independently after release. Practical methods for the KU Fox River corridor are limited to digging, installing physical barriers or herbicide.

Digging

Isolated plants or small patches of RCG can successfully be removed by digging out and removing the entire root mass, a very labor-intensive process because of the need to follow rhizomes to their end. Removal is easiest when the soil is moist. If any rhizomes or roots are missed they will re-sprout. As with all invasive plants, they need to be securely bagged and landfilled to prevent re-rooting. Areas subject to weeding need annual follow-up monitoring to assure complete removal.

Physical barriers

Reed canary grass can be killed without herbicides by installing clear or black plastic or thick geotextile cloth as shade barrier over an entire area. Mowing prior to the installation of shade barriers greatly facilitates installation. The barrier material retains solar heat and essentially bakes the plant in a single growing season. In dense areas of patchy reed canary growth, this method can provide specific, targeted control. In areas where the grass is mixed-in with desirable species, the kill of those desirable species may or may not be an option. This method will kill all plants under the barrier, so re-vegetation using native plants or seeds is needed afterwards. Small patches can likely be treated using black plastic bags, if they are kept in place for the entire duration, the edges are tacked-down firmly, and the bags do not shred.

Excellent control of reed canary using this method can be done using a thick woven plastic fabric (trade names Mirafir or Amocor) brands), held in place by 7-inch gutter spikes and washers and duck-bill tree anchors. The fabric is kept in place for over one year and the anchors can hold it in place even under flood water. Shade barrier is initially expensive (approximately \$400 per 12 ft x 350 ft roll), but can be reused several times, and this method does not require follow-up visits during treatment.

Chemical Control

Reed canary can be successfully controlled by the proper use of herbicide. Small stands or clumps can be effectively killed with one application, but large infestations will likely require applications over several years to be effective. Since the grass usually grows in wet areas, only herbicides approved for aquatic habitats are allowed in many situations.

Glyphosate (Rodeo, Aquamaster, or Glypro among others) applied in a 2% solution (1.08% active ingredient (a.i.)) with a nonionic surfactant works well to kill Reed canary grass. Glyphosate is non-selective and will kill or injure nearly all plant species. Rodeo is a form of glyphosate that is labeled for aquatic use, but others are not. Sethoxydim (Vantage) is a grass-specific herbicide that has been used to kill reed canary with some success, but it is also not labeled for aquatic use.

Depending on the size and distribution of the infestation, the herbicide can be foliar-applied using a dripless wick applicator, backpack sprayer, or boom sprayer. Herbicide should be applied to foliage during the growing season, preferably in mid-spring just before flowering. The second-best time is in fall, when the grass has a second growth spurt due to the onset of cooler weather. These are the times of year when reed canary grass is most actively translocating carbohydrates (along with the herbicide) down into the root system. The vulnerability of reed canary grass can be increased by mowing to a moderate

height, which stimulates leaf area production and absorption surface. Follow-up monitoring and re-treatment of herbicide areas is necessary for several years to ensure complete kill.

Competition

Reed canary grass needs full sun for best growth and reproduction, so it can be naturally controlled by planting fast-growing shrubs or trees that will eventually overtop and shade out the grass. This is only suitable if the resulting habitat is beneficial from an ecological or recreational use.

Best Management Practice Recommendation

The best management approach to use will depend on your overall management goals and objectives, the size, distribution and location of your RCG infestation(s), your capability and willingness to use herbicides (or not), and your available resources (staff and volunteer time, money, equipment, etc). The following recommendations are not necessarily the best management methods for every situation, nor are they presented in an order of preference. The methods listed below have however, been used with some success. Also, every method will require follow-up monitoring and treatment (including replanting native species if necessary) to ensure the long-term success of your treatments.

Common reed – Phragmites control is complicated by the facts that:

- It can be mistaken for the non-aggressive native species.
- There are no biological or effective physical control agents.
- Herbicide treatments can be complicated, problematic and almost never completely effective.

In an invasive population of the Eurasian phragmites, the following herbicide measures have been found to be effective to some extent by the WDNR, based on Door County research undertaken from 2003 through 2006:

Bundle and cut treatment (mid-August)

Using binder twine, multiple stems are bound, cut off with hedge shears, and treated with Habitat (imazapyr), mixed at 6 ounces per gallon of water. The height of the cut does not matter. Although only suitable for small areas of reed, it has the advantages of effectiveness, minimal equipment needs, and accurate targeting of the application with little risk to native vegetation. The effectiveness of the application becomes apparent after a few weeks and fully apparent the following spring.

Backpack spraying

In the late summer to early fall season, a 1.25-percent solution of Habitat (imazapyr) with crop oil and dye can be applied on the foliage. It is more suited to larger areas of infestation or single stems and much quicker than the bundle/cut method, but requires more expensive equipment (a 3-gallon backpack sprayer costs \$100) and generates overspray that can kill or injure native vegetation. Once the dye has faded, the treated area looks identical to non-treated areas, because the herbicide in this case takes longer to kill the plants and the effectiveness is only apparent the following season.

Dreissenid mussels – No effective method of control exists that will reduce or eliminate mussels from any situation except from limited areas of infestation on a seasonal basis. Should any of these mussels

Section 8

Control Measures

be found invading in the monitored area, KU will coordinate with the resource agencies concerning the current status of control technologies.

Mussel infestations that might be found on project structures that compromise project operations will likely need to be cleaned by KU using mechanical methods. To the degree practicable, mussels cleaned in this manner will be collected, securely bagged and disposed of in an upland landfill. A description of the location, method and frequency of such cleanings will be included in the following invasive species monitoring report.

9. Procedures for Obtaining Technical Assistance

Some control measures identified above have the potential for negative impacts on aquatic communities and non-invasive species. The use of chemical and biological agents for Eurasian watermilfoil, in particular, will not be initiated in the absence of technical assistance or permits from appropriate resource agencies. Prior to initiating any invasive species control measures, technical assistance will be sought from control experts from the University of Wisconsin – Extension or the regional WDNR Invasive Species Coordinator as referenced in the Adaptive Management strategy described in Section 6. KU expects that a valuable outcome of this coordination will be a list from these agencies of licensed contractors experienced in the field application of current control measures.

Generally, any plans for implementation of control measures to be conducted by the KU will be determined in consultation with the WDNR or other agencies as appropriate, such as the FWS or county-based invasive species coordinators.

The need for any control measures will be evaluated based on a determination of whether the nuisance species are becoming more abundant or increasing in dominance, and on the availability, practicality and cost versus benefits of the suitable control measures. In certain instances where established control measures not requiring permits that will have immediate benefits in limited areas, KU may initiate controls that will be summarized in the following monitoring plan. For any controls, KU will utilize methods outlined in this plan or other suitable methods that may be available at a future date.

10. Documentation of Consultation

A good deal of input was received from the WDNR and FWS during the development of this Plan. Input received was via correspondence and phone calls, including a teleconference call with KU, WDNR, FWS, and Mead & Hunt held on February 29, 2012. Appendix F presents a summary of consultation between KU and the agencies during the development of this Plan.

The Invasive Species Monitoring and Control Plan is a direct reflection of comments and recommendations made by the agencies.

Appendix A. Invasive Species Monitoring Report

Invasive Species Monitoring Report

Badger-Rapide Croche Hydroelectric Project FERC Project No. 2677

**Fox River
Outagamie County, Wisconsin**

Report prepared for



Report prepared by



October 2006

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Appendix

A Project Exhibits

Tables

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2 Rapide Croche Flowage Survey Findings.....4

1. Project Area Description

Kaukauna Utilities, acting on behalf of the City of Kaukauna, Wisconsin, is in the process of preparing a new license application for the Badger-Rapide Croche Hydroelectric Project (Project), FERC Project No. 2677. Under a new license, Kaukauna Utilities proposes to rebuild the New Badger Plant and decommission the Old Badger Plant. Coordination with the Wisconsin Department of Natural Resources (WDNR) has indicated that the status of exotic species within the project needs to be studied. The scope of this specific report concerns two exotic plant species, purple loosestrife (*Lythrum salicaria*) and Eurasian water-milfoil (*Myriophyllum spicatum*).

2. Identification of Invasive Species

Utilities, acting on behalf of the City of Kaukauna, Wisconsin, has filed to amend its hydroelectric license for the Badger-Rapide Croche Hydroelectric Project (Project), FERC Project No. 2677, in order to accelerate the current expiration date of December 31, 2018. Under a new license, Kaukauna Utilities proposes to rebuild the New Badger Plant and decommission the Old Badger Plant. Coordination with the Wisconsin Department of Natural Resources has indicated that the status of exotic species within the project needs to be studied. The scope of this specific report concerns two exotic plant species, purple loosestrife (*Lythrum salicaria*) and Eurasian water-milfoil (*Myriophyllum spicatum*).

A. Purple loosestrife

Purple loosestrife is a perennial wetland plant found in wet and moist habitats such as marshes, streams, and riverbanks. Its vivid purple bloom makes it readily seen in late summer. It tolerates changes in soil moisture and temperature, and once established, tends to predominate over other plant life. As a result, its presence can significantly reduce diversity of native vegetation and associated wetland species. This plant usually invades wetlands by germinating in riparian mud flats or wet soil areas and can persist in seed banks for many years after invasion. The seeds can be easily transported on flood waters and invade downstream areas.

B. Eurasian water-milfoil

Eurasian water-milfoil is an invasive plant that tends to out-compete native aquatic plants, including native water-milfoils. Accidentally introduced to North America from Europe, it is now found in the majority of inland lakes in Wisconsin. Unlike many other plants, Eurasian water-milfoil reproduces vegetatively by producing shoot fragments and runners, rather than relying on seed for reproduction. Plant fragments and runners, which may remain viable for weeks if kept moist, can be carried downstream by water currents or inadvertently picked up and transported by boaters.

Eurasian water-milfoil can be difficult to differentiate from native water-milfoil species, as both have slender stems with feathery leaves. However, a Eurasian water-milfoil typically has 12 to 21 pairs of leaflets, while the native northern water-milfoil usually has 5 to 9 pairs. Another identifying characteristic of the Eurasian variety is its tendency to form dense mats of vegetation that crowd out other species. These dense stands threaten the integrity of diverse aquatic communities.

3. Survey Methods and Results

The Badger and Rapide-Croche flowages were inspected for purple loosestrife and Eurasian water-milfoil on July 25, 2006. A project area map is included in Appendix A. The results are summarized in Table Nos. 1 and 2. The shoreline of each flowage was examined from a canoe for the presence of purple loosestrife. Two individual plants were located growing on the shore, one on each of the flowages. Both of the locations were recorded using a hand-held GPS receiver and are shown on the map in Appendix A. The shoots and roots of each plant were carefully dug out of the ground by hand, bagged, and disposed of offsite.

The survey for Eurasian water-milfoil involved the establishment of six transect lines, each with four sampling stations spaced about 100 feet apart along the line. Two transects were located in the Badger flowage and the other four were located in areas of the Rapide-Croche flowage (see Appendix A). Transects were established in areas of macrophytic vegetation, and the beginning points were recorded using a hand-held GPS receiver. Macrophytes were identified to the species level and their percent cover was estimated to the nearest 5 percent within each depth class sampled. No macrophytes were found in waters deeper than 1.5 meters.

Highest concentrations of macrophytes occurred in shallow, slow-moving parts of the flowages. Some of the transects were entirely within shallow, stagnant backwater areas, while others started near the shore and extended towards the middle of the channel. Eurasian water-milfoil was found along every transect. Where present, it occupies a large portion of the surface and has excluded most other species. Competing species were basically limited to coontail (*Ceratophyllum demersum*) and curly pondweed (*Potamogeton crispus*), which contributed 5- to 15-percent cover in some locations.

Table 1 Badger Flowage Survey Findings		
Badger Flowage	GPS coordinates	Findings
Aquatic transect 1	N 44° 16' 25.5" W 88° 17' 42.7"	<p>Station 1: 0-.5m: <i>Myriophyllum spicatum</i> (Eurasian water-milfoil [ewm]) 5 percent, <i>Potamogeton crispus</i> (curly pondweed) 10 percent coverage of surface water 0.5-1.5m: water too shallow 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 2: 0-0.5m: ewm ½ at 30 percent, ½ at 65 percent of surface 0.5-1.5m: ewm 40 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p>

Table 1 Badger Flowage Survey Findings		
Badger Flowage	GPS coordinates	Findings
		<p>Station 3: 0-0.5m: ewm 55 percent of surface 0.5-1.5m: ewm 50 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 4: 0-0.5m: ewm 45 percent, <i>Ceratophyllum demersum</i> (coontail) 5 percent of surface 0.5-1.5m: ewm 40 percent 1.5-3m: water too shallow 3+m: water too shallow</p>
Aquatic transect 2	N 44° 16' 59.1" W 88° 16' 22.8"	<p>Station 1: 0-0.5m: ewm 10 percent, curly pondweed 5 percent of surface 0.5-1.5m: ewm 10 percent, curly pondweed 5 percent of depth 1.5-3m: no findings 3+m: no findings</p> <p>Station 2: 0-0.5m: no findings 0.5-1.5m: curly pondweed 5 percent 1.5-3m: no findings 3+m: no findings</p> <p>Station 3: 0-0.5m: no findings 0.5-1.5m: no findings 1.5-3m: no findings 3+m: no findings</p> <p>Station 4: 0-0.5m: no findings 0.5-1.5m: no findings 1.5-3m: no findings 3+m: no findings</p>
Purple loosestrife	N 44° 16' 59.8" W 88° 16' 24.8"	1 plant with two stems. Plant was uprooted and removed from the site.

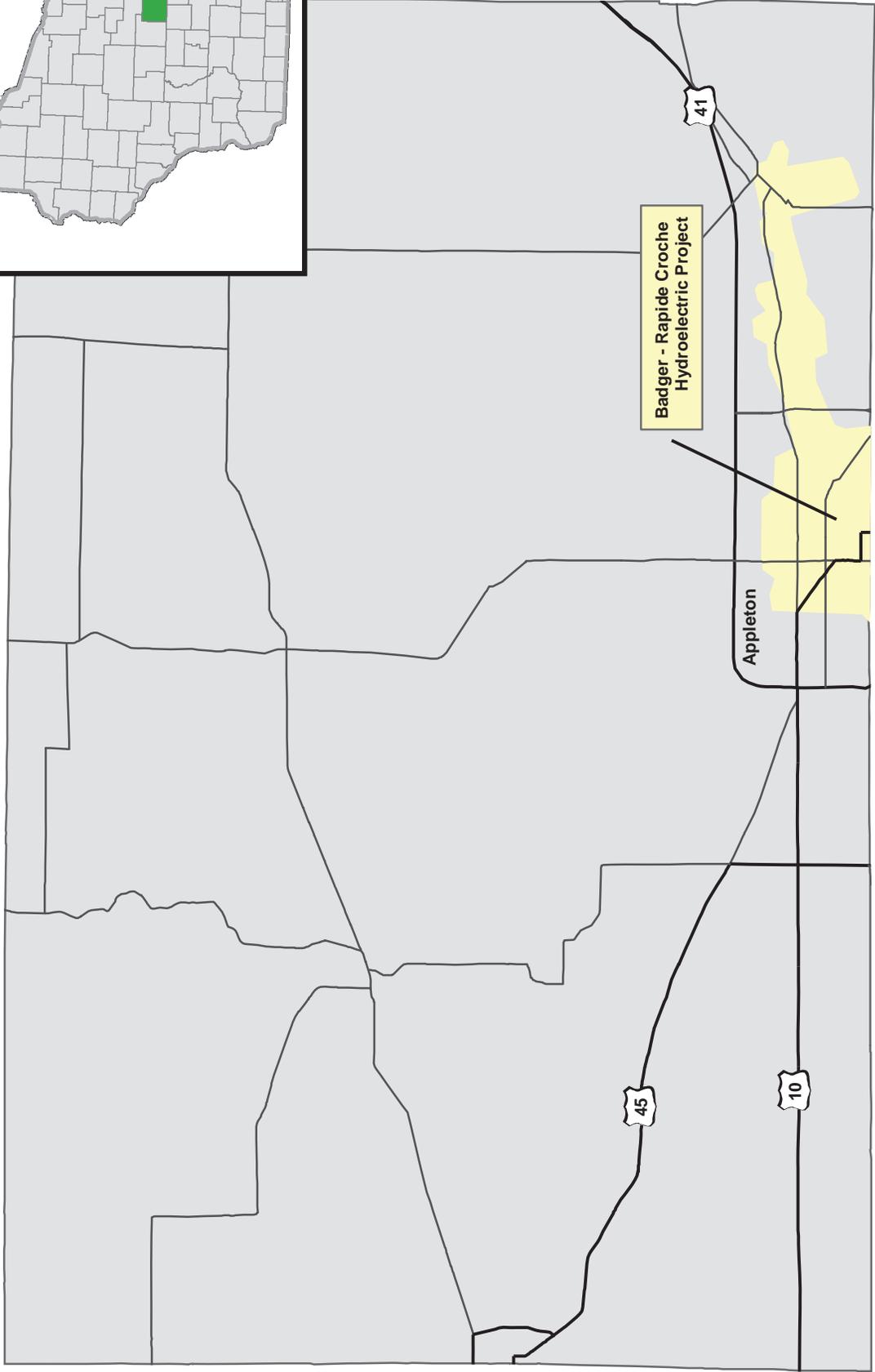
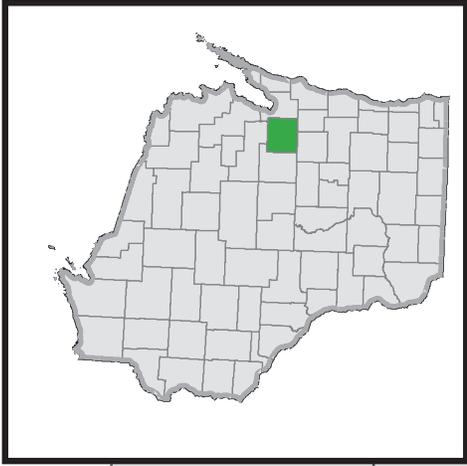
Table 2
Rapide-Croche Flowage
Survey Findings

Rapide-Croche Flowage	GPS coordinates	Findings
Aquatic transect 1	N 44° 17' 03.7" W 88° 14' 21.4"	<p>Station 1: 0-0.5m: <i>Vallisneria americana</i> (eelgrass) 5 percent, <i>Nymphaea odorata</i> (white water lily) 5 percent, <i>Myriophyllum spicatum</i> (Eurasian water-milfoil [ewm]) 15 percent, <i>Ceratophyllum demersum</i> (coontail) 15 percent (percent of surface area covered) 0.5-1.5m: eelgrass (low density) 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 2: 0-0.5m: ewm 40 percent of surface, <i>Potamogeton crispus</i> (curly pondweed) 5 percent of surface 0.5-1.5m: ewm 20 percent of depth 1.5-3m: no findings 3+m: water too shallow</p> <p>Station 3: 0-0.5m: no findings 0.5-1.5m: no findings 1.5-3m: no findings 3+m: no findings</p> <p>Station 4: 0-0.5m: no findings 0.5-1.5m: no findings 1.5-3m: no findings 3+m: no findings</p>
Aquatic transect 2	N 44° 18' 53.3" W 88° 12' 34.2"	<p>Station 1: 0-0.5m: ewm 70 percent of surface (large patch ~ 100 feet by 40 feet) 0.5-1.5m: ewm, 20 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 2: 0-0.5m: no findings 0.5-1.5m: curly pondweed 5 percent 1.5-3m: no findings 3+m: water too shallow</p> <p>Station 3: 0-0.5m: no findings 0.5-1.5m: no findings 1.5-3m: no findings 3+m: no findings</p> <p>Station 4: 0-0.5m: no findings</p>

Table 2 Rapide-Croche Flowage Survey Findings		
Rapide-Croche Flowage	GPS coordinates	Findings
		<p>0.5-1.5m: no findings 1.5-3m: no findings 3+m: no findings</p>
Aquatic transect 3	N 44° 17' 19.2" W 88° 14' 33.9"	<p>Station 1: 0-0.5m: emw 40 percent, coontail 5 percent of surface 0.5-1.5m: emw 20 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 2: 0-0.5m: emw 60 percent of surface 0.5-1.5m: emw 20 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 3: 0-0.5m: emw 70 percent of surface, eelgrass 5 percent 0.5-1.5m: emw 20 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 4: 0-0.5m: emw 50 percent 0.5-1.5m: emw 20 percent 1.5-3m: water too shallow 3+m: water too shallow</p>
Aquatic transect 4	N 44° 16' 34" W 88° 14' 57.7"	<p>Station 1: 0-0.5m: emw 45 percent of surface 0.5-1.5m: emw 10 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 2: 0-0.5m: emw 50 percent, coontail 5 percent of surface 0.5-1.5m: emw 15 percent, curly pondweed 5 percent 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 3: 0-0.5m: emw 50 percent of surface 0.5-1.5m: emw 10 percent of depth 1.5-3m: water too shallow 3+m: water too shallow</p> <p>Station 4: 0-0.5m: emw 45 percent of surface 0.5-1.5m: emw 10 percent of depth</p>

Table 2 Rapide-Croche Flowage Survey Findings		
Rapide-Croche Flowage	GPS coordinates	Findings
		1.5-3m: water too shallow 3+m: water too shallow
Purple loosestrife	N 44° 17' 05.7" W 88° 14' 42.1"	One plant with about 15 stems. Plant was uprooted and removed from the site.
Other area of Eurasian water-milfoil infestation	N 44° 17' 36.1" W 88° 13' 45.2"	Shallow water area near the confluence of a creek with the Fox River. Infestation is approximately 100 feet x 60 feet and covers between 30 to 60 percent of the water's surface.

Appendix A. Project Exhibits



Outagamie County, Wisconsin

Badger - Rapide Croche Invasive Species Survey

Exhibit 1. Project Location Map



Badger-Rapide Croche Invasive Species Survey

Exhibit 2. Badger Flowage Transect and Sample Locations

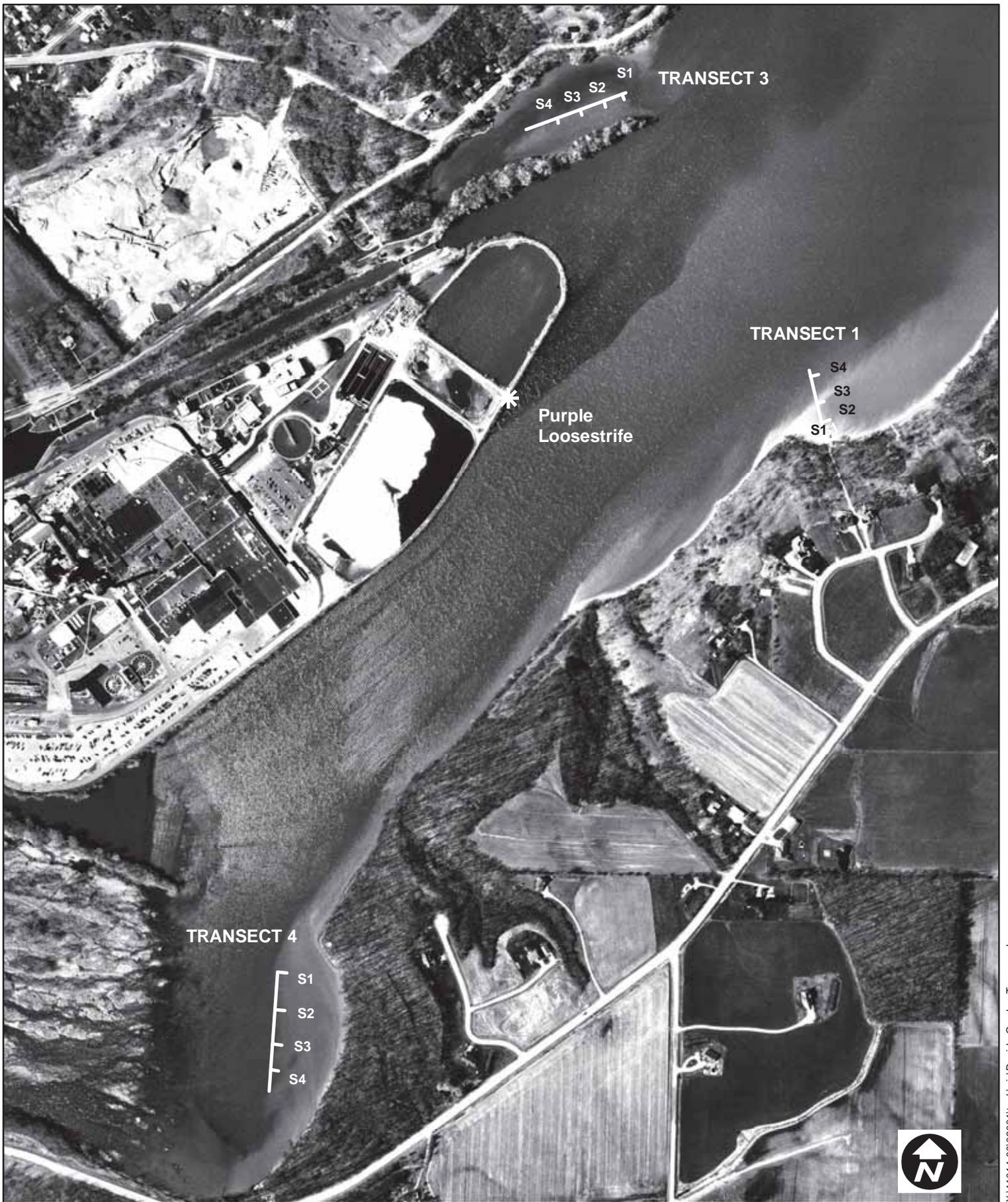


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Badger-Rapide Croche Invasive Species Survey



Exhibit 3. Rapide-Croche Flowage Transect and Sample Locations



Badger-Rapide Croche Invasive Species Survey

Exhibit 4. Rapide-Croche Flowage Transect and Sample Locations





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Badger-Rapide Croche Invasive Species Survey



Exhibit 5. Rapide-Croche Flowage Transect and Sample Locations



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Badger-Rapide Croche Invasive Species Survey



Exhibit 6. Rapide-Croche Flowage Transect and Sample Locations

Appendix B. License Article 401 (401 Certification Condition 8)

Badger-Rapide Croche Hydroelectric Project
FERC Project No. 2677

License Article 401 (401 Certification Condition 8)

Kaukauna Utilities shall develop an Invasive species monitoring and control plan subject to the approval of FERC and WDNR review and approval within one year of issuance of a FERC license. The invasive species monitoring and control plan should include Japanese knotweed, garlic mustard, buckthorn, Eurasian water milfoil, purple loosestrife, phalaris, phragmites, and dreissenid mussels. In addition, Kaukauna Utilities must monitor for any “prohibited” species as required under NR 40, Wisconsin Administrative Code. “Prohibited invasive species” or “prohibited species” means an invasive species that the department, at the time of listing under s. NR 40.04 (2), has determined is likely to survive and spread if introduced into the state, potentially causing economic or environmental harm or harm to human health, but which is not found in the state or in that region of the state where the species is listed as prohibited in s. NR 40.04 (2), with the exception of isolated individuals, small populations or small pioneer stands of terrestrial species, or in the case of aquatic species, that are isolated to a specific watershed in the state or the Great Lakes, and for which statewide or regional eradication or containment may be feasible.

Appendix C. Wisconsin NR 40

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01	Purpose.
NR 40.02	Definitions.
NR 40.03	Classifications.
NR 40.04	Prohibited category.
NR 40.045	Emergency additions to prohibited category.

NR 40.05	Restricted category.
NR 40.06	Invasive species permits.
NR 40.07	Preventive measures.
NR 40.08	Enforcement.
NR 40.09	Interagency coordination.

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free-floating or floating-leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water.

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sinkholes, but does not include a rock shelter.

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary.

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground, and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

(10) "Cultivate" means, for plants, intentionally maintaining an individual or population of a plant.

(11) "Cyanobacteria" means a predominately photosynthetic prokaryotic organism occurring singly or in colonies.

(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease-causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self-sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (*Alosa pseudoharengus*), common carp (*Cyprinus carpio*), rainbow smelt (*Osmerus mordax*), round goby (*Neogobius melanostomus*), ruffe (*Gymnocephalus cernuus*), sea lamprey (*Petromyzon marinus*), three-spine stickleback (*Gasterosteus aculeatus*), tubenose goby (*Proterorhinus marmoratus*), white perch (*Morone americana*), and rusty crayfish (*Orconectes rusticus*).

(18) "Feral" means existing in an untamed or wild, unconfined state, having returned to such a state from domestication.

(19) "Genetically modified" refers to an organism whose genome, chromosomal or extrachromosomal, is modified permanently and heritably, using recombinant nucleic acid techniques, and includes the progeny of any genetically modified organism.

(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

(21) "Import" means to bring into Wisconsin or to arrange for another person to bring into Wisconsin.

(22) "Incidental" means something is done inadvertently when performing an otherwise legal activity.

(23) "Introduce" means to stock, plant, release or otherwise put an invasive species into the outdoor environment or use an invasive species in this state anywhere except within an indoor facility which is designed to physically contain the organism, including but not limited to a laboratory, greenhouse, growth chamber or fermenter.

(24) "Invasive species" has the meaning given it in s. 23.22 (1) (c), Stats. In addition, "invasive species" means nonnative species including hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life-stages of such species. For fish, "invasive species" includes all nonnative species.

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Note: Section 23.22 (1) (c), Stats., states that “invasive species” means nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

(25) “Management action” means limiting the spread of established populations or abating harmful ecological, economic, social and public health impacts associated with invasive species introductions.

(25m) “Mine” means any artificial excavation, shaft, underground passageway, slope, tunnel or working from which ore or mineral is or was extracted, but does not include an open pit mine. However, caves or mines may be located adjacent to open pit mines.

(26) “Native duckweed” means any of the following: *Lemna aequinoctialis* (lesser duckweed, three-nerved duckweed), *Lemna minor* (common duckweed), *Lemna obscura* (little duckweed, purple duckweed), *Lemna perpusilla* (least duckweed, minute duckweed), *Lemna trisulca* (forked duckweed, star duckweed), *Lemna turionifera* (perennial duckweed, turion duckweed), *Spirodela polyrrhiza* (giant duckweed), *Wolffia borealis* (northern watermeal), *Wolffia brasiliensis* (Brazilian watermeal), and *Wolffia columbiana* (Columbian watermeal).

(27) “Native species” means a species indigenous to Wisconsin, and includes an individual specimen. For fish, “native species” means those fish species identified as native fish species in *Wisconsin Fishes 2000: Status and Distribution*, by Lyons, J., P. A. Cochran, and D. Fago, published by University of Wisconsin Sea Grant Institute, and includes an individual specimen, regardless of the specimen’s origin.

(28) “Natural areas” means undeveloped or wild lands and those lands preserved or restored and managed for their natural features, including but not limited to parks, forests, refuges, grasslands, wetlands and shorelines on public and private lands.

(29) “Nonnative” or “nonnative species” means a species not indigenous to Wisconsin, and includes an individual specimen.

(30) “Nonnative fish species in the aquaculture industry” means arctic char (*Salvelinus alpinus*), Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), rainbow trout (*Oncorhynchus mykiss*), pink salmon (*Oncorhynchus gorbuscha*), redear sunfish (*Lepomis microlophus*), tiger trout (a hybrid of *Salvelinus fontinalis* and *Salmo trutta*) and tilapia (*Tilapia* spp).

(31) “Nonnative viable fish species in the aquarium trade” means goldfish (*Carassius auratus*), koi carp (*Cyprinus carpio*), sterlet (*Acipenser ruthenus*), Chinese hi-fin banded shark (*Myxocyprinus asiaticus*), bitterling (*Rhodeus* spp.), ide (*Leuciscus idus*) and weather loach (*Misgurnus anguillicaudatus*).

(32) “Non-reproductive” means, for plants, not capable of reproduction sexually or asexually.

(33) “Nonviable” means, with respect to aquatic vertebrates including fish species, species for which eggs, fry, or adults are not capable of surviving water temperature below 38 degrees Fahrenheit or not capable of surviving in fresh water. “Nonviable” means, with respect to terrestrial vertebrates, species that are not capable of living, growing, developing, and functioning successfully in Wisconsin’s outdoor environment.

(34) “Open pond” means an outdoor pond that is not entirely covered to prevent the escape of fish.

(35) “Order” means an element of the Linnean taxonomic classification system, unless the context indicates otherwise.

(36) “Person” means an individual, partnership, corporation, society, association, firm, unit of government, public agency or public institution, and includes an agent of one of these entities.

(37) “Pet” means an animal raised or kept for companionship and generally kept indoors, in an enclosure or otherwise confined or restrained, and not allowed to roam freely out-of-doors.

(38) “Plant” means, as a verb, to place entire live plants, plant parts or seeds into the water, the ground or a planter out of doors for the purpose of growing them. “Plant”, as a noun, means any member of the Kingdom Plantae, lichens, algae and cyanobacteria, and any varieties, cultivars, hybrids or genetically modified variants thereof, and includes any plant parts capable of vegetative or sexual reproduction.

(39) “Plant taxa” mean taxonomic categories or units of plant classification, such as family, genus, species, variety and cultivar.

(40) “Possess” means to own, maintain control over, restrain, hold, grow, raise or keep.

(41) “Prohibited invasive species” or “prohibited species” means an invasive species that the department, at the time of listing under s. NR 40.04 (2), has determined is likely to survive and spread if introduced into the state, potentially causing economic or environmental harm or harm to human health, but which is not found in the state or in that region of the state where the species is listed as prohibited in s. NR 40.04 (2), with the exception of isolated individuals, small populations or small pioneer stands of terrestrial species, or in the case of aquatic species, that are isolated to a specific watershed in the state or the Great Lakes, and for which statewide or regional eradication or containment may be feasible.

(42) “Propagules” means specimens or parts of a species that are capable of producing additional specimens through either sexual or asexual reproduction, including but not limited to seeds, roots, stems, rhizomes, tubers and spores.

(43) “Public highway” means every public street, alley, road, highway or thoroughfare of any kind, except waterways, in this state while open to public travel and use, but does not include public boat access sites and associated parking areas.

(44) “Reasonable precautions” means intentional actions that prevent or minimize the transport, introduction, possession or transfer of invasive species. Reasonable precautions include but are not limited to best management practices (BMPs) for invasive species approved by the department, practices recommended by the “Wisconsin Clean Boats, Clean Waters” program and “Stop Aquatic Hitchhikers” campaign, and compliance with DATCP quarantine regulations imposed under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declared under 7 USC section 7714 or 7715. For the transfer of aquatic plants, reasonable precautions include verifying that the species transferred is identified correctly and is not listed in s. NR 40.04 or 40.05 as prohibited or restricted, and that there are no other listed invasive species commingled with the species being transferred.

(45) “Recombinant nucleic acid techniques” means laboratory techniques through which genetic material is isolated and manipulated in vitro and then inserted into an organism, resulting in a transgenic organism.

(46) “Restricted invasive species” or “restricted species” means an invasive species that the department, at the time of listing under s. NR 40.05 (2), has determined is already established in the state or in that region of the state where the species is listed as restricted in s. NR 40.05 (2) and that causes or has the potential to cause economic or environmental harm or harm to human health, and for which statewide or regional eradication or containment may not be feasible.

(46m) “Rock shelter” means an overhang or cave-like opening in a bluff, cliff or ledge that is shallow and does not provide an area of substantial daytime darkness.

(47) “Safe facility” means, for fish, an aquarium or container that does not directly drain into a water of the state, is not subject to intermittent or periodic flooding, is not connected to any water of the state, and is not an open pond. For crayfish and other aquatic invertebrates, “safe facility” means an aquarium or container that

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prevents the escape of the aquatic invertebrates and that does not directly drain into a water of the state.

(48) “Species” means monera, protista, fungi, plantae, animalia, viruses, phytoplasmata, mycoplasma-like organisms and prions and includes seeds, propagules and individual living specimens, eggs, larvae, and any other viable life-stages of such species. “Species” includes genetically modified species, cultivars, hybrids and sub-specific taxa.

(49) “Transfer” means to buy, sell, trade, barter, exchange, give or receive or to offer to buy, sell, trade, barter, exchange, give or receive.

(50) “Transport” means to cause, or attempt to cause, an invasive species to be imported or carried or moved within the state, and includes accepting or receiving a specimen for the purpose of transportation or shipment.

(51) “Unknowing” means unaware of the presence of a prohibited or restricted invasive species.

(52) “Waters of the state” has the meaning given it in s. 281.01 (18), Stats.

Note: Section 281.01 (18), Stats., provides as follows: “Waters of the state” includes those portions of Lake Michigan and Lake Superior within the boundaries of this state, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other surface water or groundwater, natural or artificial, public or private, within this state or its jurisdiction.

(53) “Wild animal” means any mammal, bird, or other creature of a wild nature endowed with sensation and the power of voluntary motion, except fish and crayfish.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09; CR 10-016: cr. (3m), am. (16), (42) and (53) Register August 2010 No. 656, eff. 9-1-10; **EmR1039:** emerg. cr. (7g), (7r), (25m), (46m), eff. 11-3-10; **CR 10-123:** cr. (7g), (7r), (25m), (46m) Register May 2011 No. 665, eff. 6-1-11.

NR 40.03 Classifications. (1) CLASSIFICATION CATEGORIES. For purposes of this chapter, invasive species are classified into the following categories: prohibited and restricted.

Note: For informational and educational purposes, the department informally maintains and updates as needed a caution list of invasive species and a list of non-restricted invasive species. Caution list invasive species are either not found in the state, or if they are, the extent of their presence or impact is not sufficiently documented. Caution list species may have shown evidence of invasiveness in similar environments in other states and could potentially spread in Wisconsin. Unlike the prohibited and restricted categories, caution list category invasive species are not regulated under this chapter. Additional information is needed to determine if caution list species belong in another category. Any person finding a caution list species or knowing of its spread or lack thereof is encouraged to report the location, spread and impact (if known) to the department and to contain the spread of the species. Any person selling or distributing a caution list plant species is encouraged to distribute educational materials asking that the plants not be planted near wild, natural or environmentally sensitive areas. Non-restricted invasive species may have beneficial uses, but they also may have adverse environmental, recreational or economic impacts or cause harm to human health. Most of the non-restricted species are already integrated into Wisconsin’s ecosystems, and state-wide control or eradication is not practical or feasible. Non-restricted category invasive species are not regulated under this chapter. All other non-native species recommended for listing as invasive but not yet assessed for this rule are put on an informal pending list. Future rule revisions will involve assessing some species from this list.

Note: A copy of the latest caution list and non-restricted list may be obtained at no cost at <http://dnr.wi.gov/invasives> or by writing to the department at the following address:

Invasive Plant Coordinator — ER/6
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

(2) **CRITERIA.** The department shall consider the following criteria in classifying a nonnative species as an invasive species for the purpose of this chapter:

(a) The species’ potential to directly or indirectly cause economic or environmental harm or harm to human health, including harm to native species, biodiversity, natural scenic beauty and natural ecosystem structure, function or sustainability; harm to the long-term genetic integrity of native species; harm to recreational, commercial, industrial and other uses of natural resources in the state; and harm to the safety or well being of humans, including vulnerable or sensitive individuals.

(b) The extent to which the species is already present in the state, or in portions of the state, including whether there are isolated pioneer stands.

(c) The likelihood that the species, upon introduction, will become established and spread within the state.

(d) The potential for eradicating the species or controlling the species’ spread within the state, including the technological and economic feasibility of eradication or control.

(e) The socio-economic value afforded by the species, including any beneficial uses or values the species may provide for recreation, commerce, agriculture or industry within the state.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09.

NR 40.04 Prohibited category. (1) PROHIBITED INVASIVE SPECIES. Prohibited invasive species are identified in this section by scientific and common names and by specific categories of species.

(2) **IDENTIFICATION OF PROHIBITED SPECIES.** (a) *Algae and cyanobacteria.* The following algae and cyanobacteria invasive species are prohibited:

1. *Cylindrospermopsis raciborskii* (Cylindro)
2. *Didymosphenia geminata* (Didymo or rock snot), except in Lake Superior
3. *Nitellopsis obtusa* (Starry stonewort)
4. Novel cyanobacterial epiphyte of the order Stigonematales linked with avian vacuolar myelinopathy
5. *Prymnesium parvum* (Golden alga)
6. *Ulva* species, including species previously known as *Enteromorpha* species

(b) *Plants.* The following plant invasive species are prohibited:

1. *Ampelopsis brevipedunculata* (Porcelain berry) including the variegated cultivar
2. *Anthriscus sylvestris* (Wild chervil) except in Barron, Columbia, Dane, Milwaukee, Polk and Walworth counties
3. *Bunias orientalis* (Hill mustard) except in Green and Lafayette counties
4. *Cabomba caroliniana* (Fanwort)
5. *Centaurea solstitialis* (Yellow star thistle)
6. *Chelidonium majus* (Celandine) in Ashland, Barron, Bayfield, Burnett, Chippewa, Douglas, Dunn, Florence, Forest, Iron, Langlade, Lincoln, Marinette, Oconto, Oneida, Polk, Price, Rusk, St. Croix, Sawyer, Taylor, Vilas and Washburn counties
7. *Cirsium palustre* (European marsh thistle) except in Ashland, Bayfield, Chippewa, Door, Florence, Forest, Iron, Langlade, Lincoln, Marathon, Marinette, Menominee, Oconto, Oneida, Price, Rusk, Sawyer, Shawano, Taylor and Vilas counties
8. *Conium maculatum* (Poison hemlock) except in Crawford, Dane, Grant, Green, Iowa, Lafayette, Richland, Rock, and Sauk counties
9. *Crassula helmsii* (Australian swamp crop or New Zealand pygmyweed)
10. *Cytisus scoparius* (Scotch broom)
11. *Dioscorea oppositifolia* (Chinese yam)
12. *Egeria densa* (Brazilian waterweed)
13. *Epilobium hirsutum* (Hairy willow herb) except in Kenosha county
14. *Glyceria maxima* (Tall or reed mannagrass) except in Brown, Calumet, Dodge, Door, Fond du Lac, Jefferson, Kenosha, Kewaunee, Manitowoc, Milwaukee, Outagamie, Ozaukee, Racine, Sheboygan, Walworth, Washington, Waukesha and Winnebago counties
15. *Heracleum mantegazzianum* (Giant hogweed)

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16. *Humulus japonicus* (Japanese hops) except in Grant and Crawford counties

17. *Hydrilla verticillata* (Hydrilla)

18. *Hydrocharis morsus-ranae* (European frogbit)

19. *Lagarosiphon major* (Oxygen-weed, African elodea or African waterweed)

20. *Lepidium latifolium* (Perennial or broadleaved pepperweed)

21. *Lespedeza cuneata* or *Lespedeza sericea* (Sericea or Chinese lespedeza)

22. *Leymus arenarius* or *Elymus arenarius* (Lyme grass or sand ryegrass) except in Door, Kewaunee, Manitowoc, Sheboygan and Racine counties

23. *Lonicera japonica* (Japanese honeysuckle)

24. *Lonicera maackii* (Amur honeysuckle) except in Adams, Brown, Calumet, Columbia, Crawford, Dane, Dodge, Fond du Lac, Grant, Green, Green Lake, Iowa, Jefferson, Juneau, Kenosha, Kewaunee, La Crosse, Lafayette, Manitowoc, Marquette, Milwaukee, Monroe, Outagamie, Ozaukee, Racine, Richland, Rock, Sauk, Sheboygan, Vernon, Walworth, Washington, Waushara, Waupaca, Waushara and Winnebago counties

25. *Microstegium vimineum* (Japanese stilt grass)

26. *Myriophyllum aquaticum* (Parrot feather)

27. *Najas minor* (Brittle naiad, or Lesser, Bushy, Slender, Spiny or Minor naiad or waternymph)

28. *Nymphoides peltata* (Yellow floating heart)

29. *Paulownia tomentosa* (Princess tree)

30. *Polygonum perfoliatum* (Mile-a-minute vine)

31. *Polygonum sachalinense* (Giant knotweed)

32. *Pueraria montana* (Kudzu)

33. *Quercus acutissima* (Sawtooth oak)

34. *Rubus phoenicolasius* (Wineberry or wine raspberry)

35. *Torilis arvensis* (Spreading hedgeparsley)

36. *Torilis japonica* (Japanese hedgeparsley or erect hedgeparsley) in Ashland, Barron, Bayfield, Buffalo, Burnett, Chippewa, Clark, Douglas, Dunn, Eau Claire, Florence, Forest, Iron, Jackson, Lincoln, Oneida, Pepin, Pierce, Polk, Price, Rusk, St. Croix, Sawyer, Trempealeau, Taylor, Washburn, Vilas and Wood counties

37. *Trapa natans* (Water chestnut)

38. *Vincetoxicum nigrum* or *Cynanchum louiseae* (Black or Louise's swallow-wort) except in Columbia, Crawford, Dane, Grant, Green, Iowa, Jefferson, Juneau, Kenosha, La Crosse, Lafayette, Milwaukee, Monroe, Racine, Richland, Rock, Sauk, Vernon, Walworth and Waukesha counties

39. *Vincetoxicum rossicum* or *Cynanchum rossicum* (Pale or European swallow-wort)

(c) *Fish and crayfish*. The following fish invasive species and crayfish invasive species are prohibited:

1. *Channidae* (snakehead), including *Channa argus* (Northern snakehead), *Channa bleheri* (Rainbow snakehead), *Channa gachua* (Dwarf snakehead), *Channa maculata* (Blotched snakehead), *Channa marulius* (Bullseye snakehead), *Channa punctata* (Spotted snakehead), and *Channa striata* (Chevron snakehead)

2. *Ctenopharyngodon idella* (Grass carp)

3. *Cyprinella lutrensis* (Red shiner)

4. *Gambusia affinis* (Western mosquitofish)

5. *Gambusia holbrooki* (Eastern mosquitofish)

6. *Hypophthalmichthys molitrix* (Silver carp)

7. *Hypophthalmichthys nobilis* (Bighead carp)

8. *Mylopharyngodon piceus* (Black carp)

9. *Sander lucioperca* (Zander)

10. *Scardinius erythrophthalmus* (Rudd)

11. *Tinca tinca* (Tench)

12. All other nonnative fish and nonnative crayfish except:

a. Established nonnative fish species and established nonnative crayfish species

b. Nonnative viable fish species in the aquarium trade

c. Nonnative fish species in the aquaculture industry

d. Fish species that the department has determined are nonviable fish species

Note: As of Jan. 1, 2010, the department determined that the following Snakehead fish species are nonviable fish species: *Channa amphibeus* (Chel snakehead), *Channa asiatica* (Chinese snakehead), *Channa aurantimaculata* (Orangespotted snakehead), *Channa bankanensis* (Bangka snakehead), *Channa baramensis* (Baram snakehead), *Channa barca* (Barca snakehead), *Channa burmanica* (Burmese snakehead), *Channa cyanospilos* (Bluespotted snakehead), *Channa harcourtbutleri* (Inle snakehead), *Channa lucius* (Splendid snakehead), *Channa maruliodes* (Emperor snakehead), *Channa melnopterus* (Blackfinned snakehead), *Channa melasoma* (Black snakehead), *Channa micropeltes* (Giant snakehead), *Channa nox* (Night snakehead), *Channa orientalis* (Ceylon snakehead), *Channa panaw* (Panaw snakehead), *Channa pleurophthalma* (Ocellated snakehead), *Channa stewartii* (Golden snakehead), *Parachanna Africana* (Niger snakehead), *Parachanna insignis* (Congo snakehead), and *Parachanna Obscura* (African snakehead). For the latest list of nonviable fish species, contact the department at:

Attn: FH/4

Wisconsin Department of Natural Resources

PO Box 7921

Madison, WI 53707-7921

(d) *Aquatic invertebrates except crayfish*. The following aquatic invertebrate invasive species are prohibited:

1. *Bithynia tentaculata* (Faucet snail)

2. *Bythotrephes cederstroemi* (Spiny water flea)

3. *Cercopagis pengoi* (Fishhook water flea)

4. *Corbicula fluminea* (Asian clam)

5. *Daphnia lumholtzi* (Water flea)

6. *Dreissena rostriformis* (Quagga mussel)

7. *Eriocheir sinensi* (Chinese mitten crabs)

8. *Hemimysis anomala* (Bloody shrimp)

9. *Potamopyrgus antipodarum* (New Zealand mud snail)

(e) *Terrestrial invertebrates and plant disease-causing microorganisms*. The following terrestrial invertebrate invasive species and plant disease-causing microorganism invasive species are prohibited:

1. *Adelges tsugae* (Hemlock woolly adelgid)

2. *Agrilus planipennis* (Emerald ash borer)

3. *Amyntas* or *Amyntus* species (Crazy worm)

4. *Anoplophora glabripennis* (Asian longhorned beetle)

5. *Cryptococcus fagisuga* (Scale associated with beech bark disease)

6. *Lymantria dispar Asian race* (Asian Gypsy moth)

7. *Phytophthora ramorum* (Sudden oak death pathogen)

Note: These terrestrial invertebrates and plant disease-causing microorganisms are also regulated by the department under s. NR 45.04 and by DATCP under ch. ATCP 21 and ch. 94, Stats.

(f) *Terrestrial and aquatic vertebrates except fish*. The following terrestrial and aquatic vertebrate invasive species are prohibited:

1. *Myiopsitta monachus* (Monk or Quaker parakeet or parrot)

2. *Sus domestica* (Feral domestic swine)

3. *Sus scrofa* (Russian boar) and other wild swine

(g) *Fungi*. The following fungus invasive species are prohibited:

1. *Geomyces destructans* (white-nose syndrome fungal pathogen)

(3) ACTIONS PROHIBITED BY THIS CLASSIFICATION; EXEMPTIONS.
(a) Except as otherwise provided in pars. (b) to (h), no person may transport, possess, transfer or introduce a prohibited invasive species identified or listed under sub. (2).

(b) Paragraph (a) does not apply to a person who transports, possesses, transfers or introduces a prohibited invasive species identified or listed under sub. (2) if the department determines that the transportation, possession, transfer or introduction was inci-

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dental or unknowing, and was not due to the person's failure to take reasonable precautions.

Note: Paragraph (b) does not apply to preventive measures set out in s. NR 40.07.

(c) If authorized by a permit issued by the department under this chapter, a person may transport, possess, transfer or introduce a prohibited invasive species for research, public display, or, if the species is not a fish or crayfish, for other purposes specified by the department in the permit.

(d) A legally obtained nonnative wild animal that is a pet may be possessed, transported or transferred without a permit issued by the department under this chapter, but may not be introduced.

Note: "Wild animal" is defined in s. NR 40.02 (53) to mean any mammal, bird, or other creature of a wild nature endowed with sensation and the power of voluntary motion, except fish and crayfish.

(e) Paragraph (a) does not apply to a person who transports, possesses, transfers or introduces a terrestrial invertebrate or plant disease-causing microorganism that is regulated under a quarantine imposed by DATCP under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine area declared under 7 USC section 7714 or 7715 if the person is in compliance with a DATCP-USDA APHIS compliance agreement applicable to the terrestrial invertebrate or plant disease-causing microorganism.

(f) Paragraph (a) does not apply to a person who has a permit issued by DATCP under s. ATCP 21.04 for importation, movement, distribution or release of a pest or biological control agent that is a prohibited invasive species identified or listed under sub. (2).

(g) A person may transport, possess or give away a prohibited invasive species for the purpose of identification or disposal without a permit issued by the department under this chapter, if the person reports the location of origin of the prohibited invasive species to the department and no individual specimens or propagules are allowed to escape or be introduced. Reports shall be submitted within 30 days of the person taking possession and shall include contact and property owner information, type and detailed location of the species, the purpose for transporting, possessing or giving away the invasive species, and the final disposition of the invasive species. This paragraph does not apply to terrestrial and aquatic vertebrates or fish species.

Note: Paragraph (g) does not apply to transport of identified carriers of invasive species as described in s. NR 40.07 (5) (a).

Note: Reports for fish may be sent to:

Attn: FH/4
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Note: Reports for other vertebrates may be sent to:

Attn: Wildlife Regulation Policy Specialist, WM/6
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Note: Reports for terrestrial plants may be sent to:

Attn: Forestry Invasive Species Coordinator — FR/4
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Note: Reports for aquatic species except fish may be sent to:

Attn: Aquatic Invasive Species Coordinator
Wisconsin Department of Natural Resources
141 NW Barstow St., Room 180
Waukesha, WI 53188

Note: Reports for terrestrial invertebrates and plant disease-causing microorganisms may be sent to:

Forest Health Protection Program Coordinator
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd.
Fitchburg, WI 53711

Note: Reports may also be sent by email to invasive.species@wisconsin.gov

(h) Paragraph (a) does not apply to any of the following:

1. A person who holds a scientific collector permit for the invasive species under s. 29.614, Stats.

2. A person who, while lawfully fishing, inadvertently catches a fish invasive species.

Note: Section NR 20.20 (73) (c) 1. sets a bag limit of 0 for nonindigenous detrimental fish, but allows one such fish to be taken by hook and line if it is killed immediately and delivered immediately to a department service center or regional office. All nonindigenous fish species are declared under s. NR 20.38 (6) to be detrimental fish if the fish were imported without a permit in violation of s. 29.735, Stats., or are found in any water where their presence is not specifically permitted by the department.

(3m) EARLY DETECTION MONITORING. Unless entry is otherwise authorized by law, as part of an invasive species early detection program, the department or its designee may enter property where a cave or mine may be located to monitor, survey or inspect for the presence of the prohibited invasive fungus species *Geomyces destructans* (white-nose syndrome fungal pathogen) in the cave or mine, with permission of the person who owns, controls or manages the property, but if the person does not grant permission or cannot be located by the department after making reasonable effort, the department may seek an inspection warrant under s. 66.0119, Stats., from the appropriate circuit court authorizing entry. Data obtained by the department under this subsection shall be made available to the person who owns, controls or manages the property.

(4) CONTROL REQUIREMENTS. (a) Unless entry is otherwise authorized by law, if the department has reason to believe that a prohibited species is present, the department or its designee may enter property to inspect for, survey or control prohibited species with permission of the person who owns, controls or manages the property, but if the person does not grant permission or cannot be located by the department after making reasonable effort, the department may seek an inspection warrant from the appropriate circuit court authorizing entry.

(b) The department may ask any person who owns, controls or manages property where a prohibited species is present to control the prohibited species in accordance with a plan approved by the department. The department will seek funds to assist in the control of prohibited species. However, a person who owns, controls or manages property where a prohibited species is present is responsible for controlling the prohibited species that exists on the property.

Note: The department anticipates it will request control of a prohibited invasive species only if it is feasible and reasonable to control the prohibited species on the property.

(c) If voluntary cooperation is not achievable or likely, and it is feasible and reasonable to control the prohibited species on the property, the department or its designee may control the prohibited species or it may offer the person the opportunity to negotiate the terms of a consent order for control purposes.

(d) If a consent order is not achievable or likely, the department may issue a unilateral order requiring that the person who owns, controls or manages the property control the prohibited species in accordance with a plan approved by the department unless the department determines that the prohibited species is present through no fault of the person. If the department determines that the prohibited species is present through no fault of the person, the department or its designee may control the prohibited species.

(e) If the person does not control the prohibited species upon order of the department, the department or its designee may control the prohibited species and the department may recover the reasonable and necessary expenses it incurs.

(f) The department may remove, or cause to be removed any detrimental fish or other aquatic invasive species from waters of the state.

Note: All nonindigenous fish species are declared under s. NR 20.38 (6) to be detrimental fish if the fish were imported without a permit in violation of s. 29.735, Stats., or are found in any water where their presence is not specifically permitted by the department.

Note: Persons finding any prohibited species are encouraged to report the species and its location to the department.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09; CR 10-016: am. (2) (b) 6., 7., 8., 14., 24., 36., 38., r. and recr. (2) (c) Register August 2010 No. 656, eff. 9-1-10; **EmR1039: emerg. cr. (3m), eff. 11-3-10; CR 10-123: cr. (3m) Register May 2011 No. 665, eff. 6-1-11; EmR1036: emerg. cr. (2) (g), eff. 9-29-10; CR 10-115: cr. (2) (g) Register May 2011 No. 665, eff. 6-1-11.**

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NR 40.045 Emergency additions to prohibited category. (1) The department may temporarily identify an additional species as an invasive species and may classify it into the prohibited category of s. NR 40.04 (2) if the secretary determines that all of the following are met:

(a) The species meets the definition of invasive species in s. NR 40.02 (24).

(b) Based on consideration of the criteria of s. NR 40.03 (2), the species meets the definition of prohibited invasive species for inclusion under s. NR 40.04 (2).

(c) An emergency exists, making it necessary for the preservation of public peace, health, safety or welfare, or the environment, to require the immediate identification and classification of the species as a prohibited invasive species under this chapter prior to the time it would take effect if the department complied with the procedures for permanent rulemaking under ch. 227, Stats.

(2) Department action under sub. (1) shall become effective upon issuance of an emergency order by the secretary and publication of a notice of the emergency order in the official state newspaper.

(3) The department shall provide the notice of the emergency order to the Wisconsin Council on Invasive Species and shall promptly notify the public of its determination by issuing a press release, by posting the notice of the emergency order on the department's internet site, and by such other means as the department determines are reasonably likely to inform the public.

(4) During the time that an emergency order issued under sub. (2) is in effect, the actions prohibited by s. NR 40.04 (3) (a) and the exemptions of s. NR 40.04 (3) (b) through (h) apply to the additional species. In addition, the control requirements of s. NR 40.04 (4) apply to the additional species.

(5) The identification and classification under sub. (1) of an additional species as an invasive species in the prohibited category terminates 2 years after the emergency order is issued under sub. (2), when the emergency order issued under sub. (2) is withdrawn by the department, or when a permanent rule takes effect adding the species to this chapter, whichever occurs first.

Note: Under s. 23.22 (2t) (a), Stats., the department may promulgate an emergency rule to identify, classify, or control an invasive species and is not required to provide evidence that such a rule is necessary for the preservation of public peace, health, safety, or welfare or to provide a finding of emergency for such a rule. An emergency rule promulgated under s. 23.22 (2t) (a), Stats., remains in effect for 24 months or until the repeal of the emergency rule, or until the effective date of the permanent rule identifying, classifying, or controlling the invasive species, whichever occurs first.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09.

NR 40.05 Restricted category. (1) RESTRICTED INVASIVE SPECIES. Restricted species are listed or identified in this section by scientific and common names and by specific categories of species.

(2) IDENTIFICATION OF RESTRICTED SPECIES. (a) *Algae and cyanobacteria.* The following algae and cyanobacteria invasive species are restricted: None.

(b) *Plants.* The following plant invasive species are restricted:

1. *Ailanthus altissima* (Tree of heaven)
2. *Alliaria petiolata* (Garlic mustard)
3. *Anthriscus sylvestris* (Wild chervil) in Barron, Columbia, Dane, Milwaukee, Polk and Walworth counties
4. *Bunias orientalis* (Hill mustard) in Green and Lafayette counties
5. *Butomus umbellatus* (Flowering rush)
6. *Campanula rapunculoides* (Creeping bellflower)
7. *Carduus acanthoides* (Plumeless thistle)
8. *Carduus nutans* (Musk thistle or Nodding thistle)
9. *Celastrus orbiculatus* (Oriental bittersweet)
10. *Centaurea biebersteinii*, *Centaurea maculosa* or *Centaurea stoebe* (Spotted knapweed)

11. *Chelidonium majus* (Celandine) except in Ashland, Barron, Bayfield, Burnett, Chippewa, Douglas, Dunn, Florence, Forest, Iron, Langlade, Lincoln, Marinette, Oconto, Oneida, Polk, Price, Rusk, St. Croix, Sawyer, Taylor, Vilas and Washburn counties

12. *Cirsium arvense* (Canada thistle)

13. *Cirsium palustre* (European marsh thistle) in Ashland, Bayfield, Chippewa, Door, Florence, Forest, Iron, Langlade, Lincoln, Marathon, Marinette, Menominee, Oconto, Oneida, Price, Rusk, Sawyer, Shawano, Taylor and Vilas counties

14. *Conium maculatum* (Poison hemlock) in Crawford, Dane, Grant, Green, Iowa, Lafayette, Richland, Rock, and Sauk counties

15. *Cynoglossum officinale* (Hound's tongue)

16. *Dipsacus laciniatus* (Cut-leaved teasel)

17. *Dipsacus sylvestris* or *Dipsacus fullonum* (Common teasel)

18. *Elaeagnus angustifolia* (Russian olive)

19. *Elaeagnus umbellata* (Autumn olive)

20. *Epilobium hirsutum* (Hairy willow herb) in Kenosha county

21. *Epipactis helleborine* (Helleborine orchid)

22. *Euphorbia cyparissias* (Cypress spurge)

23. *Euphorbia esula* (Leafy spurge)

24. *Galeopsis tetrahit* (Hemp nettle)

25. *Glyceria maxima* (Tall or reed mannagrass) in Brown, Calumet, Dodge, Door, Fond du Lac, Jefferson, Kenosha, Kewaunee, Manitowoc, Milwaukee, Outagamie, Ozaukee, Racine, Sheboygan, Walworth, Washington, Waukesha and Winnebago counties

26. *Hesperis matronalis* (Dame's rocket)

27. *Humulus japonicus* (Japanese hops) in Grant and Crawford counties

28. *Leymus arenarius* or *Elymus arenarius* (Lyme grass or sand ryegrass) in Door, Kewaunee, Manitowoc, Sheboygan and Racine counties

29. *Lonicera maaackii* (Amur honeysuckle) in Adams, Brown, Calumet, Columbia, Crawford, Dane, Dodge, Fond du Lac, Grant, Green, Green Lake, Iowa, Jefferson, Juneau, Kenosha, Kewaunee, La Crosse, Lafayette, Manitowoc, Marquette, Milwaukee, Monroe, Outagamie, Ozaukee, Racine, Richland, Rock, Sauk, Sheboygan, Vernon, Walworth, Washington, Waukesha, Waupaca, Waushara and Winnebago counties

30. *Lonicera morrowii* (Morrow's honeysuckle)

31. *Lonicera tatarica* (Tartarian honeysuckle)

32. *Lonicera x bella* (Bell's or showy bush honeysuckle)

33. *Lythrum salicaria* (Purple loosestrife)

Note: Purple loosestrife is also designated as an invasive aquatic plant statewide under s. NR 109.07 (2).

34. *Myriophyllum spicatum* (Eurasian watermilfoil)

Note: Eurasian watermilfoil is also designated as an invasive aquatic plant statewide under s. NR 109.07 (2).

35. *Pastinaca sativa* (Wild parsnip), except for the garden vegetable form

36. *Phragmites australis* (Phragmites or Common reed) non-native ecotype

37. *Polygonum cuspidatum* (Japanese knotweed)

38. *Potamogeton crispus* (Curly-leaf pondweed)

Note: Curly-leaf pondweed is also designated as an invasive aquatic plant statewide under s. NR 109.07 (2).

39. *Rhamnus cathartica* (Common buckthorn)

40. *Rhamnus frangula* or *Frangula alnus* (Glossy buckthorn) including the Columnaris (tall hedge) cultivar but excluding the cultivars Asplenifolia and Finesline (Ron Williams)

41. *Rosa multiflora* (Multiflora rose)

42. *Tanacetum vulgare* (Tansy), except the cultivars Aureum and Compactum

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43. *Torilis japonica* (Japanese hedge parsley or erect hedge-parsley) except in Ashland, Barron, Bayfield, Buffalo, Burnett, Chippewa, Clark, Douglas, Dunn, Eau Claire, Florence, Forest, Iron, Jackson, Lincoln, Oneida, Pepin, Pierce, Polk, Price, Rusk, St. Croix, Sawyer, Trempeleau, Taylor, Washburn, Vilas and Wood counties

44. *Typha angustifolia* (Narrow-leaf cattail)

45. *Typha x glauca* (Hybrid cattail)

46. *Vincetoxicum nigrum* or *Cynanchum louiseae* (Black or Louise's swallow-wort) in Columbia, Crawford, Dane, Grant, Green, Iowa, Jefferson, Juneau, Kenosha, La Crosse, Lafayette, Milwaukee, Monroe, Racine, Richland, Rock, Sauk, Vernon, Walworth and Waukesha counties

(c) *Fish and crayfish*. The following fish invasive species and crayfish invasive species are restricted:

1. Established nonnative fish species and established nonnative crayfish species
2. Nonnative viable fish species in the aquarium trade
3. Nonnative fish species in the aquaculture industry
4. Nonviable fish species

(d) *Aquatic invertebrates except crayfish*. The following aquatic invertebrate invasive species are restricted:

1. *Cipangopaludina chinensis* (Chinese mystery snail)
2. *Dreissena polymorpha* (Zebra mussel)

(e) *Terrestrial invertebrates and plant disease-causing microorganisms*. The following terrestrial invertebrate invasive species and plant disease-causing microorganism invasive species are restricted:

1. *Lymantria dispar* (European Gypsy moth) European race in all counties except those included in a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715.

Note: This terrestrial invertebrate is also regulated by DATCP under ch. ATCP 21 and ch. 94, Stats.

Note: Gypsy moth quarantined areas may be viewed at: <http://www.gypsy-moth.wisconsin.gov/>.

(f) *Terrestrial and aquatic vertebrates except fish*. The following terrestrial vertebrate invasive species are restricted:

1. *Trachemys scripta elegans* (Red-eared slider) with a carapace (top shell) length less than 4 inches.

(3) ACTIONS RESTRICTED BY THIS CLASSIFICATION; EXEMPTIONS.

(a) Except as otherwise provided in pars. (b) to (e), no person may do any of the following:

1. Transport, possess, transfer or introduce a restricted invasive fish or crayfish species identified or listed under sub. (2).
2. Transport, transfer or introduce any other restricted invasive species identified or listed under sub. (2).

(b) Paragraph (a) does not apply to a person who transports, possesses, transfers or introduces a restricted invasive species identified or listed under sub. (2) if the department determines that the transportation, possession, transfer or introduction was incidental or unknowing, and was not due to the person's failure to take reasonable precautions.

Note: Paragraph (b) does not apply to preventive measures set out in s. NR 40.07.

(c) If authorized by a permit issued by the department under this chapter, a person may transport, possess, transfer or introduce a restricted invasive species for research, public display, or for other purposes specified by the department in the permit.

(d) A legally obtained nonnative wild animal that is a pet may be possessed, transported or transferred without a permit issued by the department under this chapter.

Note: "Wild animal" is defined in s. NR 40.02 (53) to mean any mammal, bird, or other creature of a wild nature endowed with sensation and the power of voluntary motion, except fish and crayfish.

(e) Paragraph (a) does not apply to a person who transports, possesses, transfers or introduces a terrestrial invertebrate or plant

disease-causing microorganism that is regulated under a quarantine imposed by DATCP under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine area declared under 7 USC section 7714 or 7715 if the person is in compliance with a DATCP-USDA APHIS compliance agreement applicable to the terrestrial invertebrate or plant disease-causing microorganism.

(f) A person may transport or give away a restricted invasive species for the purpose of identification, education, control or disposal without a permit issued by the department under this chapter, if no viable individual specimens or propagules are allowed to escape or be introduced. This paragraph does not apply to aquatic plants, algae and cyanobacteria, terrestrial and aquatic vertebrates or fish species.

(g) For aquatic plants, algae and cyanobacteria, a person may transport or give away a restricted invasive species for the purpose of identification, control or disposal without a permit issued by the department under this chapter if the restricted invasive species is listed on the department's website as present in the waterbody from which the aquatic plant, algae or cyanobacteria came or, if the restricted invasive species is not listed, the person reports the restricted invasive species to the department within 30 days.

Note: Reports required by par. (g) shall be sent to:
Aquatic Invasive Species Coordinator
Wisconsin Department of Natural Resources
141 NW Barstow St., Room 180
Waukesha, WI 53188

Note: New populations of restricted aquatic plant species may be reported to the appropriate department regional aquatic invasive species coordinator. For a list of known waterbodies with restricted aquatic plant, algae and cyanobacteria species, see <http://dnr.wi.gov/invasives/aquatic>. To contact the appropriate aquatic invasive species coordinator see <http://dnr.wi.gov/invasives/aquatic/contacts/>.

(h) Restricted plant species parts that are incapable of reproducing or propagating may be transported, transferred or introduced without a permit issued by the department under this chapter.

(i) Multiflora rose, when used as root stock for ornamental roses, may be transported, transferred or introduced without a permit issued by the department under this chapter.

(j) Koi carp and goldfish may be transported, possessed or transferred without a permit issued by the department under this chapter but koi carp may not be used as bait or introduced to any water of the state except waters of the state that are artificial, entirely confined and retained upon the property of a person, do not drain to other waters of the state, are not subject to intermittent or periodic flooding, and are not connected to any other water of the state.

Note: Section NR 20.08 (1) prohibits the use of goldfish as bait and the possession of goldfish in any form or manner on any water of the state.

(k) If held in a safe facility, rusty crayfish, nonviable fish species and nonnative viable fish species in the aquarium trade may be transported, possessed or transferred without a permit issued by the department under this chapter. In addition, rusty crayfish may be transported, possessed or transferred without a permit when being used as bait on the Mississippi river as authorized under s. NR 19.27 (4) (a) 1. a.

(L) Nonnative fish species in the aquaculture industry may be transported, possessed in a safe facility, possessed in a registered fish farm, or transferred without a permit issued by the department under this chapter.

Note: A department permit is required under this chapter and s. 29.735, Stats., to import nonnative fish for the purpose of introduction into any waters of the state, and under s. 29.736, Stats., to stock or introduce any fish, and DATCP regulates fish farms under ch. ATCP 10.

(m) Paragraph (a) does not apply to a person who has a permit issued by DATCP under s. ATCP 21.04 for importation, movement, distribution or release of a pest or biological control agent that is a restricted invasive species identified or listed under sub. (2).

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(n) Paragraph (a) does not apply to phragmites associated with a reed bed treatment unit used in a wastewater treatment facility authorized by a WPDES permit under ch. 283, Stats.

(o) Paragraph (a) does not apply to any of the following:

1. A person who holds a scientific collector permit for the invasive species under s. 29.614, Stats.
2. A person who, while lawfully fishing, inadvertently catches a fish invasive species.

Note: Section NR 20.20 (73) (c) 1. sets a bag limit of 0 for nonindigenous detrimental fish, but allows one such fish to be taken by hook and line if it is killed immediately and delivered immediately to a department service center or regional office. All nonindigenous fish species are declared under s. NR 20.38 (6) to be detrimental fish if the fish were imported without a permit in violation of s. 29.735, Stats., or are found in any water where their presence is not specifically permitted by the department.

(4) CONTROL REQUIREMENTS. Any person who grows a restricted plant at a nursery shall make a good faith effort to destroy it upon closure of the nursery.

Note: Any person who owns, controls or manages land where a restricted plant species is present in the pioneering stage, in an area otherwise not infested with that species or where there is a high priority resource threatened by a restricted plant species is encouraged to control the restricted plant or contain it to the already infested sites, to reduce its population, and to foster an increase in desired species.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09; CR 10-016: am. (2) (b) 11., 13., 14., 25., 29., 43., 46. Register August 2010 No. 656, eff. 9-1-10.

NR 40.06 Invasive species permits. A person may transport, possess, transfer or introduce a prohibited invasive species listed in s. NR 40.04 (2), or a restricted invasive species listed in s. NR 40.05 (2), if the person has been issued a permit by the department under this section for the activity.

(1) WRITTEN APPLICATION REQUIRED. (a) Applications for permits under this chapter shall be submitted in writing to the department on forms available from the department. The application shall include the name and quantity or number of invasive species specimens for which a permit is sought, whether the permit is sought for the transportation, possession, transfer or introduction of the invasive species, a description of other relevant permits, approvals or licenses of the applicant and the applicant's purpose or reasons for seeking a permit. The department may request additional information in order to determine whether the criteria of sub. (2) are met. This may include but is not limited to: where the invasive species is located or will be kept, how they will be kept from spreading into the wild, how they will be disseminated, and how they will be destroyed once the applicant is done using them.

Note: Applications for permits for fish and aquatic invertebrates may be sent to:
Attn: FH/4
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Note: Applications for permits for terrestrial plants may be sent to:
Attn: Forestry Invasive Species Coordinator — FR/4
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Note: Applications for permits for aquatic plants may be sent to:
Attn: Aquatic Invasive Species Coordinator
Wisconsin Department of Natural Resources
141 NW Barstow St., Room 180
Waukesha, WI 53188

Note: Applications for permits for other vertebrates may be sent to:
Attn: Wildlife Regulation Policy Specialist, WM/6
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Note: Applications for permits for terrestrial invertebrates and plant disease-causing microorganisms may be sent to:

Forest Health Protection Program Coordinator
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd.
Fitchburg, WI 53711

(b) The department shall act on complete permit applications within 45 days following receipt of the application.

(2) APPROVAL CRITERIA. The department shall review permit applications to determine whether all of the following criteria are met:

(a) The applicant is knowledgeable in the proper management or humane care of the invasive species.

(b) The applicant has an adequate site or facility for containment of the invasive species.

(c) The applicant has demonstrated to the department's satisfaction that permitted activities will not cause significant ecologic or economic harm or harm to human health.

(d) The applicant has complied with the conditions of any previous department permits issued under this chapter.

(3) ISSUANCE AND CONDITIONS. (a) If it determines that there is significant public interest, the department may hold a public informational hearing on a permit application before acting on the application.

(b) An applicant meeting the criteria described in sub. (2) may be issued a permit subject to conditions the department considers reasonable.

(4) RECORDS AND REPORTING. Each permittee shall keep a current, correct and complete record of all permit activities as required by the department, on forms available from the department. Permit records may be inspected and copied by the department at any time. Copies of records shall be provided to the department upon request.

(5) PERMIT TRANSFER; ALTERATION. Unless expressly provided by the terms of the permit or by subsequent written approval of the department, permits issued under this chapter are not transferable. No person may alter or deface a permit issued under this chapter.

(6) VIOLATIONS. No person may violate any term of any permit issued under this chapter.

(7) OTHER PERMITS OR APPROVALS. A person who holds a permit or approval issued by the department under another chapter or a statute other than s. 23.22, Stats., is not required to hold a permit under this chapter to transport, possess, transfer or introduce a prohibited invasive species listed in s. NR 40.04 (2), or a restricted invasive species listed in s. NR 40.05 (2), if the department determines that all of the following apply:

(a) The permit or approval expressly authorizes the transportation, possession, transfer or introduction of the prohibited invasive species listed in s. NR 40.04 (2), or the restricted invasive species listed in s. NR 40.05 (2).

(b) The permit or approval includes legally enforceable requirements that are at least equivalent to those that would be contained in a permit issued by the department under this chapter.

(c) The person is not in violation of the permit or approval.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09.

NR 40.07 Preventive measures. **(1) NOTIFICATION REQUIRED.** Any person who possesses a restricted invasive fish species in a safe facility shall notify the department within 24 hours of any escape of a specimen or viable part of a specimen, or of any failure of the integrity of the safe facility that could allow the escape of any specimen or viable part of a specimen. The notice shall be made in writing by mail or by e-mail and shall include the specific location of the known, suspected, or anticipated escape and the fish species involved.

Note: The notice shall be mailed to the Director, Bureau of Fisheries Management, Wisconsin Department of Natural Resources, PO Box 7921, Madison, Wisconsin 53707-7921 and e-mailed to DNRFishHabitatProtection@wisconsin.gov.

(2) IMMEDIATE REMOVAL OF AQUATIC PLANTS AND AQUATIC ANIMALS AND DRAINAGE OF WATER. (a) Except as provided in pars. (b) to (g):

1. Any person who removes a vehicle, boat, boat trailer, boating or fishing equipment, or other equipment or gear of any type from any inland or outlying water or from its bank or shore shall remove all attached aquatic plants and aquatic animals immediately after removing the vehicle, boat, boat trailer, boating or fishing equipment or other equipment or gear from the water, bank or shore and before leaving any boat launch area or associated parking area.

Note: Section 30.07 (2) (a) and (b), Stats., prohibit any person from placing or operating a vehicle, seaplane, watercraft, or other object of any kind in a navigable water if it has any aquatic plants or aquatic animals attached to the exterior and from

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taking off with a seaplane, or transporting or operating a vehicle, watercraft, or other object of any kind on a highway with aquatic plants or aquatic animals attached to the exterior.

2. Any person who removes a vehicle or equipment other than boating or fishing equipment, or gear of any type from any inland or outlying water or from its bank or shore shall drain all water from the vehicle, equipment or gear, including water in any motor, tank or other container, immediately after removing the vehicle, equipment or gear from the water, bank or shore and before leaving any boat launch area or associated parking area.

Note: Section NR 19.055 (1) requires any person who removes a boat, boat trailer, boating equipment or fishing equipment from any inland or outlying water or its bank or shore to immediately drain all water from the boat, boat trailer, boating equipment or fishing equipment, including water in any bilge, ballast tank, bait bucket, live well or other container immediately after removing the boat, boat trailer, boating equipment or fishing equipment from the water, bank or shore, with certain exceptions.

Note: Chapters NR 320, 323, 328, 329, 341, 343 and 345, relating to general navigable waters permit criteria, set out equipment decontamination requirements to stop the spread of invasive species from one waterway to another and require removal of all plants, animals, mud, debris, etc., before and after use.

Note: See ss. 30.18 (2) and 31.02 (1), Stats., regarding the diversion or withdrawal of water from lakes and streams. Withdrawals are regulated through individual permits that may consider the associated risk of spreading invasive species.

(b) The department may exempt any vehicle, equipment or gear in writing from par. (a) 1. or 2. if it determines that it will not allow invasive species to be transported to other waters.

(c) Paragraph (a) does not apply to decontaminated equipment, tanks or containers when used for the operation or maintenance of dry fire hydrants that are subject to ch. NR 329.

Note: See s. NR 329.04 (1) (c) 5. and (2) (c) 4. c. regarding the maintenance and operation of dry fire hydrants.

(d) Paragraph (a) 1. does not apply to an aquatic animal whose possession is authorized by department rule.

Note: An example of an aquatic animal whose possession is authorized by department rule is a dead game fish taken in compliance with ch. NR 20.

(e) Paragraph (a) 2. does not apply to water in closed engine cooling systems or to tanks or containers of potable drinking water or other beverages meant for human consumption.

(f) Paragraph (a) 2. does not apply to water in a container that holds live bait minnows obtained from a Wisconsin bait dealer, if the container holds no other fish, contains 2 gallons or less of water, and is used to transport only live minnows that have not been exposed to water or fish from that inland or outlying water or will be used for bait only on the same inland or outlying water, its bank or shore.

Note: The transport of live fish and fish eggs away from any inland or outlying water or its bank or shore is prohibited by s. NR 19.05 (3), with certain exceptions.

(g) Paragraph (a) does not apply to vehicles, equipment, or gear while engaged in fire suppression.

(3) TRANSPORT OF VEHICLES AND EQUIPMENT INTO WISCONSIN; REMOVAL PRIOR TO ENTRY OF AQUATIC PLANTS AND AQUATIC ANIMALS AND DRAINAGE OF WATER. (a) Except as provided in pars. (b) to (d), no person may do any of the following:

1. Transport over land from another state any vehicle, boat, boat trailer, boating or fishing equipment, or other equipment or gear of any type for use on any water of the state or its bank or shore unless the person first removes all attached aquatic plants and aquatic animals from the vehicle, boat, boat trailer, boating or fishing equipment, or other equipment or gear of any type before entering the state.

Note: Section 30.07 (2) (a) and (b), Stats., prohibit any person from placing or operating a vehicle, seaplane, watercraft, or other object of any kind in a navigable water if it has any aquatic plants or aquatic animals attached to the exterior and from taking off with a seaplane, or transporting or operating a vehicle, watercraft, or other object of any kind on a highway with aquatic plants or aquatic animals attached to the exterior.

2. Transport over land from another state any vehicle, equipment other than boating or fishing equipment, or gear of any type for use on any water of the state or its bank or shore unless the person first drains all water from the vehicle, equipment or gear, including water in any motor, tank, or other container before entering the state.

Note: Section NR 19.055 (2) prohibits any person from transporting over land from another state any boat, boat trailer, boating equipment or fishing equipment for use on any water of the state or its bank or shore unless the person drains all water from the boat, boat trailer, boating equipment or fishing equipment, including water in any bilge, ballast tank, bait bucket, live well or other container before entering the state, with certain exceptions.

(b) The department may exempt any vehicle, boat, boat trailer, equipment or gear in writing from par. (a) 1. or 2. if it determines that it will not allow invasive species to be transported to waters of the state.

(c) Paragraph (a) 1. does not apply to dead game fish lawfully taken in another state, as provided by s. 29.047, Stats.

(d) Paragraph (a) 2. does not apply to water in closed engine cooling systems or to tanks or containers of potable drinking water or other beverages meant for human consumption.

(4) ILLEGAL TO LAUNCH, TAKE OFF OR TRANSPORT. (a) Except as provided in par. (b), no person may place or operate a vehicle, watercraft or other object of any kind in any wetland or non-navigable water of the state if the vehicle, watercraft or other object has an aquatic plant or aquatic animal attached to the exterior.

(b) Paragraph (a) does not apply if the aquatic plant is native duckweed or wild rice.

(c) Paragraph (a) does not apply to vehicles, watercraft or other objects while engaged in fire suppression.

(5) QUARANTINED MATERIALS. (a) No person may transport an identified carrier of an invasive species from a department infestation control zone designated under s. 26.30 (7), Stats., a DATCP quarantine area imposed under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine area declared under 7 USC section 7714 or 7715, for the specific identified invasive species.

Note: Identified carriers of invasive terrestrial invertebrates and plant-disease causing microorganisms most commonly include but are not limited to trees that support life stages of the invasive species. Trees include all parts of a tree including limbs, branches, roots and foliage. Raw forest products such as unprocessed logs, slabs with bark, cut firewood and chips may be considered as carriers. The department does not consider certified firewood to be an identified carrier. Certified firewood is firewood that has been treated by a DATCP-certified firewood dealer using one or more DATCP-approved firewood treatment methods to prevent the spread of invasive pests.

(b) Paragraph (a) does not apply to a person who transports an identified carrier of an invasive species from a department infestation control zone designated under s. 26.30 (7), Stats., a DATCP quarantine area imposed under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine area declared under 7 USC section 7714 or 7715, if the person is in compliance with a DATCP-USDA APHIS compliance agreement applicable to the terrestrial invertebrate or plant disease-causing microorganism.

(6) USE OF PROHIBITED FISH OR CRAYFISH AS BAIT. Unless authorized by a permit issued by the department under this chapter, no person may use a prohibited fish invasive species or prohibited crayfish invasive species as bait.

Note: Prohibited fish invasive species and crayfish invasive species are identified in s. NR 40.04 (2) (c).

(7) INTRODUCTION PROHIBITED. Unless authorized by a permit issued by the department under this chapter, no person may introduce a nonnative algae or cyanobacteria species in any water of the state. This subsection does not apply to the incidental introduction of a nonnative algae or cyanobacteria species by a person operating an aircraft, vehicle, equipment or gear while engaged in fire suppression.

Note: Section 23.24 (3) (a) 1., Stats., prohibits any person from introducing nonnative aquatic plants into waters of this state unless the person has a valid aquatic plant management permit issued by the department.

(8) WHITE-NOSE SYNDROME PREVENTION. (a) *Definition.* In this subsection "near a cave or mine" means within 100 feet of a cave or mine.

(b) *Entry with imported items prohibited.* Except as provided in par. (e), no person may bring or place any equipment, gear, clothing or other object of any kind in or near a cave or mine if the

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

equipment, gear, clothing or other object has been in or near a cave or mine located outside of Wisconsin.

(c) *Requirements.* 1. Except as provided in subd. 5. and par. (e), no person may bring or place any equipment, gear, clothing or other object of any kind in or near a cave or mine if the equipment, gear, clothing or other object has been in or near a cave or mine located in this state unless the equipment, gear, clothing or other object has first been cleaned in accordance with par. (d).

2. Except as provided in subd. 5. and par. (e), any person removing any equipment, gear, clothing or other object of any kind from any cave or mine or from within 100 feet of any cave or mine or exiting any cave or mine or the area within 100 feet of any cave or mine with any equipment, gear, clothing or other object of any kind shall clean the equipment, gear, clothing and other objects in accordance with par. (d).

3. Except as provided in subd. 5. and par. (e), any person who caused or will cause contact to occur between a bat and an individual or object of any kind, including but not limited to a net, trap, weighting tube, bat bag, wing punch, ruler, clothing, glove, electronic equipment or exclusion material shall, prior to and immediately following the contact, clean the individual or object in accordance with par. (d).

4. Except as provided in subd. 5. and par. (e), any person who owns or operates an active mine or a commercial cave or mine shall ensure that each individual entering or exiting the person's active mine or commercial cave or mine complies with par. (b) and subds. 1. to 3.

5. The requirements of subds. 1. to 4. do not apply to dedicated equipment, gear, clothing and other objects of any kind that are used exclusively in or near and stored exclusively in or near a single cave or mine.

(d) *Protocols.* Individuals, equipment, gear, clothing and other objects of any kind to which the requirement of par. (c) 1., 2., or 3. applies shall be cleaned in accordance with protocols approved by the department. Unless it determines that emergency conditions require otherwise, the department shall provide notice and opportunity for public comment at least 14 days before it materially changes an approved protocol.

Note: Detailed information about department-approved cleaning protocols may be obtained at <http://dnr.wi.gov/org/land/er/bats/> or by writing to Wisconsin Department of Natural Resources, Wisconsin Bat Monitoring Program, Bureau of Endangered Resources, P.O. Box 7921, Madison, WI 53707-7921.

(e) *Written exemption.* The department may exempt any person in writing from par. (b) or (c) if it determines that the exemption will not significantly increase the risk that *Geomyces destructans* (white-nose syndrome fungal pathogen) would be introduced or transported to other locations. The department may set conditions in any written exemption granted under this paragraph. Any person who receives a conditional exemption from the department under this paragraph shall comply with the conditions of the exemption.

(f) *Site-specific prevention plan.* Except as provided in subd. 5., any person who owns or operates a cave or mine shall develop a written plan for each of the person's caves and mines to prevent the introduction and transmission of *Geomyces destructans* (white-nose syndrome fungal pathogen).

1. The prevention plan shall include a description of practices that will be installed or implemented by the owner or operator to prevent the introduction or transmission of *Geomyces destructans*

via human transmission. The plan may include practices such as screening visitors, cleaning equipment, gear, clothing and other objects before they are brought into the cave or mine or upon their removal, the use of dedicated equipment, gear, clothing and other objects, and modification of the cave or mine environment to make it unsuitable for establishment and transmission of *Geomyces destructans*.

2. The prevention plan shall be submitted by the owner or operator to the department by June 1, 2011, for its review and approval. The department may set conditions for the approval of any plan required under this paragraph and shall include any exemption granted under par. (e) to the owner or operator of a cave or mine in a plan approval issued under this paragraph. In setting conditions for the approval of any plan, the department shall consider the site-specific risk of *Geomyces destructans* introduction and transmission along with the feasibility and reasonableness of alternative practices for the prevention of *Geomyces destructans* transmission or introduction.

3. The owner or operator shall implement the plan as approved by the department and shall maintain as appropriate all practices specified in the plan.

4. The owner or operator shall maintain a copy of the approved prevention plan at the cave or mine covered by the plan or an alternate location approved by the department and shall make the copy available for inspection upon request by the department at any reasonable time.

5. This paragraph does not apply to any of the following:

a. A cave or mine that the department has determined in writing lacks the environmental conditions, including temperature and humidity, suitable for the introduction or transmission of *Geomyces destructans*.

b. A cave or mine where the owner or operator restricts human access through the use of department-supplied and maintained signage or bat-friendly barriers or gates.

c. A cave or mine where the primary reason for human presence in the cave or mine relates to the storage or processing of a food or beverage intended for human consumption.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09; CR 10-016: am. (4) and (7) Register August 2010 No. 656, eff. 9-1-10; **EmR1039: emerg. cr (8), eff. 11-3-10; CR 10-123: cr. (8) Register May 2011 No. 665, eff. 6-1-11.**

NR 40.08 Enforcement. Under s. 23.22 (9), Stats., if the department finds that any person is violating this chapter or a permit issued under this chapter, the department may do one or more of the following:

(1) Issue a citation pursuant to ss. 23.50 to 23.99, Stats.

(2) Refer the matter to the department of justice for enforcement.

(3) Revoke any permit issued under this chapter, after notice and opportunity for hearing.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09.

NR 40.09 Interagency coordination. This chapter does not affect the authority of DATCP under chs. 93, 94, 95 and 97, Stats. The action of the department under this chapter shall be coordinated with DATCP. The secretaries of the department and DATCP shall execute a memorandum of agreement to enable coordination of invasive species work of their departments.

History: CR 08-074: cr. Register August 2009 No. 644, eff. 9-1-09.

**Appendix D. Recommended Baseline Monitoring of Aquatic Plants
in Wisconsin**

Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications



**Jennifer Hauxwell, Susan Knight, Kelly Wagner, Alison Mikulyuk,
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**Recommended Baseline Monitoring of Aquatic Plants in Wisconsin:
Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis,
and Applications**

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EXECUTIVE SUMMARY

We outline a baseline monitoring protocol designed to quantitatively assess the distribution and abundance of aquatic plants in lake ecosystems. This protocol employs a point-intercept sampling design, with sites located on a geo-referenced sampling grid placed over the entire lake. At each site, the aquatic plant community is surveyed from a boat with a rake sampler to characterize species presence and rake fullness. In addition, a qualitative survey is recommended to map obvious species and augment the species list generated through quantitative sampling. Application of this methodology allows: 1) assessment of the frequencies of occurrence of different plant species, as well as estimates of species richness, abundance, and maximum depth of plant colonization; and 2) comparisons of aquatic plant variables over time and among lakes. This document contains complete instructions for conducting a baseline aquatic plant survey, including details on obtaining an electronic file of site coordinates, uploading site coordinates into a Global Positioning System (GPS) receiver, conducting field work, entering data, working with data summaries, processing voucher specimens, and provides example applications of the collected data. Final products from each baseline survey will include: 1) raw data from the quantitative survey which provides individual site-by-site species distribution and rake fullness data, 2) summary statistics useful in characterizing and comparing populations, 3) additional species observations from the general qualitative survey, and 4) voucher specimens cataloguing species presence. All electronic data should be sent for long-term record-keeping to the WDNR (DNRBaselineAquaticPlants@wisconsin.gov).

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INTRODUCTION

In lake ecosystems, the aquatic plant community serves as critical habitat and nursery for fish and other animals, a source of oxygen for all organisms, a refuge for prey as well as a foraging area for predators, a buffer against erosion and sediment resuspension from both waves and shoreline inputs, and can significantly contribute to overall lake primary productivity. Over the past several decades, losses of or changes in assemblages of native submersed aquatic vegetation has been a reoccurring phenomenon due to a relatively limited number of factors. Repeatedly, changes in landscapes and atmospheric conditions as a result of human activities have increasingly affected the ecology of adjacent aquatic systems, including aquatic plant communities. In addition, in-lake aquatic plant management activities have increased due to the increasing spread of invasive exotic plants¹.

The Wisconsin Department of Natural Resources (WDNR) is charged with protecting and enhancing the state's natural resources, including lake ecosystems. Given the many ecosystem services associated with aquatic plant communities as well as the recent threats to native species, it has become increasingly important to develop monitoring techniques to support science-based decision-making for effectively managing lake ecosystems. In this document, we present a quantitative, replicable monitoring protocol. Standardized, quantitative and replicable data are an essential part of strategic lake management for three reasons. First, good data allows us to better understand each individual lake; we can use survey data to produce detailed lake maps that show the locations of native, rare, or exotic plant species. Data can then be used as a baseline against which any changes in a lake associated with water clarity, exotic species introduction, water level, or lake management activity can be compared. Second, good data helps direct management by taking the conflict and guesswork out of planning. Aquatic plant management requires weighing a number of potential management options, some of which can be very costly or extensive. Baseline data allows lake groups to identify the most appropriate management options and design the best possible management plan. Additionally, by conducting quantitative comparisons between the aquatic plant communities before and after management actions, lake groups and managers may evaluate whether or not management goals were achieved. Third, by compiling and comparing survey information on lakes statewide, we are able to identify regional trends and refine our understanding of aquatic plant populations on a broader scale in both space and time.

SURVEY OBJECTIVE

In this document, we outline a baseline monitoring protocol designed to assess aquatic plant communities on a whole-lake scale. We recommend a formal quantitative survey conducted at pre-determined sampling locations distributed evenly throughout the lake, accompanied by a general qualitative survey to map obvious species and augment the species list generated through the quantitative survey. Our primary goals in adopting this methodology are to:

¹ Knight, S., and J. Hauxwell. 2009. Distribution and abundance of aquatic plants- human impacts. *In*: G. Likens (editor-in-chief), *Encyclopedia of Inland Waters*. Elsevier, Oxford, United Kingdom.

1) Collect quantitative data describing the frequencies of occurrence of different plant species, as well as estimates of species richness, abundance, and maximum depth of plant colonization for use in developing various management plans; and

2) Use the data to statistically compare aquatic plant variables over time and among lakes.

The importance of a statewide standardized protocol is that observed differences in a lake's plant community can be attributed to actual changes in the community over time, without the confounding variation that results from different field workers employing different sampling techniques.

The quantitative survey employs a point-intercept sampling design, adapted from terrestrial methods, with sites located on a geo-referenced sampling grid placed over the entire lake. At each site, the aquatic plant community is surveyed from a boat with a rake sampler to characterize species presence and rake fullness ratings. Although the presence/absence data cannot be used to estimate biomass or percent cover, it is less sensitive to interannual or seasonal variations in plant abundance². The method is also relatively rapid and cost-effective and can be used on the large scale to collect baseline data and statistically compare communities over time^{2,3}. In summary, it has the following attributes for estimation of aquatic plant distribution and abundance:

- Systematic, quantitative, and replicable
- Appropriate for lakes that vary in depth, size, region, shoreline complexity, and vegetation distribution
- Evenly spaced distribution of sites results in a good coverage of the entire lake, precluding the random exclusion of niche habitats
- Procedural simplicity
- Inexpensive implementation
- Results are easily analyzed with scientifically rigorous statistical methods
- Spatial data preserved and can be mapped for both the managers' use and for clearly communicating distributional data with the public

These guidelines are intended to work on most lakes. However, modifications may be required if a lake is uniquely shaped so that a uniform distribution of points isn't representative (long, skinny lake shape), or if obtaining rake samples is difficult due to substrate (rocky/cobble bottom).

Please note that these are "baseline" recommendations. Additional monitoring activities may be warranted if the goal is to assess a specific management activity. For example, to gauge the ability of chemical spot-treatments to control relatively small stands of an exotic species in a

² Madsen, J.D. 1999. Point intercept and line intercept methods for aquatic plant management. Aquatic plant control technical note MI-02. Army Engineer Waterways Experiment Station, Vicksburg, MS.

³ Dodd-Williams, L., G.O. Dick, R.M. Smart and C.S. Owens. 2008. Point Intercept and Surface Observation GPS (SOG): A Comparison of Survey Methods – Lake Gaston, NC/VA. ERDC/TN APCRP-EA-19. Vicksburg, MS: U.S. Army Engineer Research and Development Center

relatively large lake, we recommend additional mapping of the beds following the pre- and post-treatment protocol available in Appendix D of the Aquatic Plant Management guide⁴.

Unlike the procedures used by the Citizen-Based Lake Monitoring Network, this protocol is not designed for most volunteers. The protocol requires at least one of the field workers be an experienced plant taxonomist and able to identify most plant species in the field. Less experienced volunteers may be able to help with data recording and navigation, but without the help of a professional aquatic ecologist, volunteers may not be able to conduct an entire plant survey without a significant degree of training or study.

SURVEY OVERVIEW

Sampling Sites

This method employs a point-intercept design in which a grid of sampling sites is distributed evenly over the entire lake surface (Figure 1). Lake organizations or individuals can request an electronic file of survey sites by contacting the WDNR Lake Coordinator from their region (see Appendix 1) with the lake name and county, as well as the town, range and section (TRS) or water body identification code (WBIC). Please make requests well in advance of planned field work to allow WDNR staff sufficient time for map creation (recommend at least 1 month). WDNR staff will determine the number of sites and grid resolution based on the estimated size of the littoral zone (the area in which plants grow) and shape of the lake. Grids will be scaled to produce a greater number of sites on lakes that are larger and have more complex shorelines. Lakes with a narrow littoral zone may be assigned a comparatively high number of sampling sites to achieve sufficient survey coverage. Once created, the sampling map (Figure 1) and an associated GPS text file containing the latitude and longitude information associated with each sample site will be provided electronically by the WDNR.

Timing of Sampling

Surveys should be conducted between early July and mid August. Although certain plant community parameters (such as rake fullness and biomass) can change over the course of the

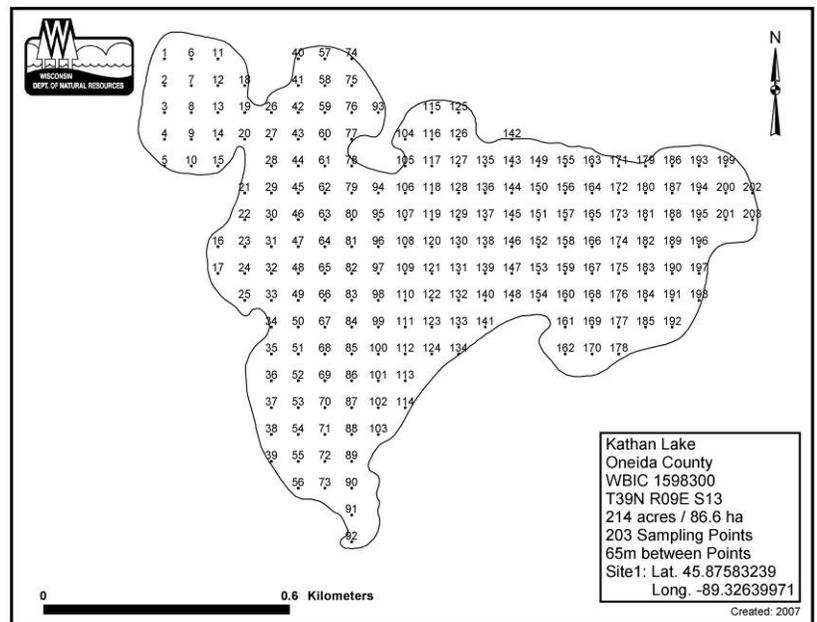


Figure 1: The point-intercept grid for Kathan Lake, Oneida County, WI, with 203 sampling sites.

⁴ Aquatic Plant Treatment Evaluation. <http://www.uwsp.edu/cnr/uwexlakes/ecology/APM/Appendix-D.pdf>

growing season, presence/absence data is less sensitive to seasonal variation²; presence can often be detected throughout the season. For many species, including Eurasian water milfoil (EWM), plant biomass and density may increase as the season progresses, whereas some species like curly-leaf pondweed (CLP), senesce much earlier in the sampling season. Rake fullness data for these species must be interpreted carefully with the sampling date in mind. If early-senescing species such as CLP are targets of management actions, please contact the WDNR Lake Coordinator in your region to coordinate the best possible sampling time.

Time Spent Sampling

Depending on the size of the lake, a survey may be completed in a few hours, or it may take several days. Ideally, a crew spends one-half to three minutes per sample site; however, this may vary depending on the following factors:

- Distance between sample sites
- Weather (i.e. wind, rain, etc.)
- Rake fullness
- Ease of navigation
- Experience; less experienced field workers may take longer to identify unfamiliar plants. However, most field workers have found that the time spent per site drops dramatically with experience. Others have reported their speed increasing greatly with a few hours of training.



PREPARING FOR FIELD WORK

Field Gear

Necessary equipment:

- Appropriate watercraft and all equipment required by state law
- Double-sided sampling rake attached to a 15-ft (4.6m) pole
- Weighted sampling rake attached to a 40-ft (12m) rope
- Handheld GPS receiver with WDNR sample sites loaded
- Print-out of lake map with WDNR sample sites
- Print-out of WDNR field datasheets on waterproof paper
- Pencils
- Sealable storage bags for voucher specimens
- Waterproof voucher sample labels
- Cooler(s) with ice for storing voucher specimens
- Depth finder

Helpful, but not required:

- Trolling motor for reaching shallow sites
- Bathymetric map
- Plant ID references or guides to aid in plant identification
- Hand lens to aid in plant identification
- Digital camera for plant specimens or field pictures
- Underwater video camera for viewing the maximum depth of plant colonization

Loading Sample Site Locations onto the GPS Receiver

Detailed instructions on loading sample site locations onto the GPS receiver depend greatly on the type of GPS receiver as well as the software used to translate site location from the text file to “waypoints” in the receiver. The WDNR commonly utilizes Garmin 76 model GPS receivers and the WDNR Garmin GPS Standalone Tool software. The WDNR Standalone Tool is only available to WDNR employees, and only works with Garmin GPS receivers. The Minnesota Garmin GPS Tool and appropriate guidance documents are available to the public and can be found online at the Minnesota DNR internet site⁵. The two programs are similar; their chief difference is that the Minnesota tool requires the GPS text file to be comma-delimited instead of tab-delimited. Procedures for other GPS models with a Wide Area Augmentation System (WAAS-capability) may be used; please refer to the manufacturer’s instructions for details on uploading site locations.

Please note that storage capability varies by GPS model. Some GPS receivers are unable to store the large numbers of data sites required in some surveys. In the event that the number of sampling sites exceeds your receiver's storage capacity, the text file containing the survey site information can be split into smaller text files. You will then be able to upload successive files of sites as needed or work from multiple receivers in the field.

The instructions below describe how WDNR employees can use the WDNR Garmin Standalone Tool software to load sample site locations, or “waypoints,” onto a Garmin 76 model GPS receiver.

To upload waypoints from a GPS text file to the GPS receiver, you will need:

- **PC/laptop with WDNR Garmin GPS Tool.** Your IT administrator can help you obtain and install the software.
- **GPS text file (.txt extension).** A tab-delimited text file containing the sample sites and their geographical information.
- **A Garmin 76 model GPS receiver with external data port.**



⁵ Available online at: <http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html> (accessed September, 2009)

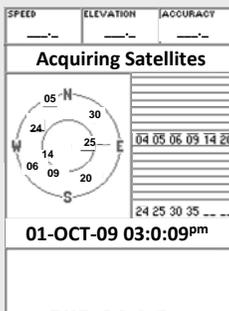


- **PC interface cable (with USB or 9-pin serial connector).** Can be purchased online at <http://www.garmin.com>

Step 1: Set GPS to the “Simulating GPS” Mode

Operating the receiver in “Simulating GPS” mode prevents the GPS receiver from trying to acquire a satellite signal indoors.

1. Press and hold the red [ON/OFF] button for two seconds to turn the GPS receiver on.
2. Press [PAGE] to navigate through the welcome screens until the “Acquiring Satellites” page is visible.



3. Press the [MENU] button, select “Start Simulator”, and press [ENTER]; the screen heading should now read “Simulating GPS.”

Step 2: Set Serial Data Format (this setting will **not** have to be re-set upon each use)

Set the serial data format on the Garmin 76 receiver to GARMIN prior to transferring data. Failure to set the serial data format to GARMIN will cause a communication error.

1. Press the [MENU] button twice to reach the main menu, use the rocker key to select “Setup”, and then press [ENTER].
2. Use the rocker key to scroll left or right until the “Interface” tab is highlighted. Use the rocker key to scroll down to highlight the drop-down box and press [ENTER].
3. A menu will appear; select “GARMIN” and press [ENTER]. Press [QUIT] twice to exit the menu.

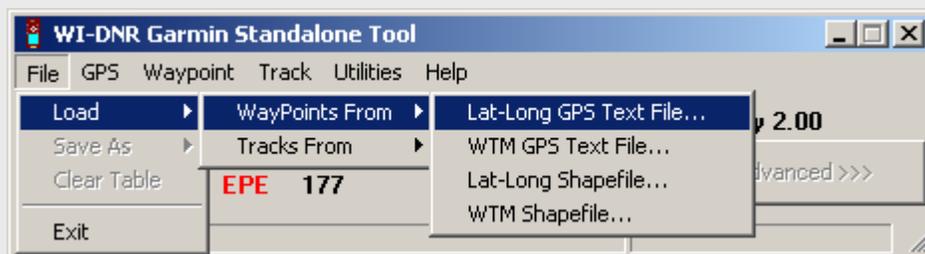
Step 3: Plug in the PC Interface Cable

1. The GPS receiver should be on and in simulation mode.

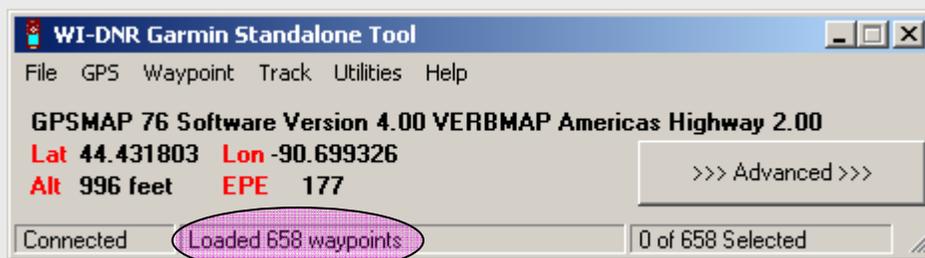
2. Plug the 9-pin serial connector cable into COM port #1 on your PC. If port #1 is in use, plug into the next available port and note the port number. The newest version of the WDNR Garmin GPS Tool (ver. 8.2.8) supports USB connectivity as an alternate to COM port connection.
3. Plug the round end of the PC interface cable into the external data/auxiliary power port under the rubber panel on the back of the GPS receiver.

Step 4: Load the GPS text file into the WDNR Garmin Standalone Tool

1. Open the WDNR Garmin GPS Tool file on your computer. Select:
File > Load > Waypoints From > Lat-Long GPS Text File.



2. Navigate to and select the appropriate GPS text file and select OK. The waypoints will be visible in the Tool's status bar.

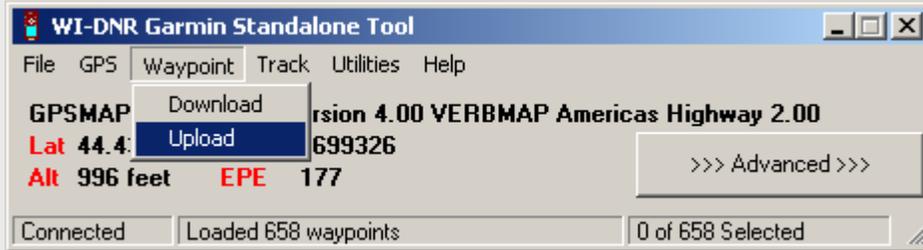


3. If necessary, you can view and edit waypoints by clicking the [Advanced] button on the WDNR Garmin GPS Tool.
4. Troubleshooting COM-enabled setups
 - a. Check that the correct COM port is selected in the WDNR Garmin GPS tool.
 - i. GPS > Assign Port > select correct port #
 - b. Check that the baud rate matches that of the GPS receiver.
 - i. GPS > Assign Port > Baud Rate > 9600
 - ii. A Garmin 76 receiver will transfer at 9600 bits per second

- c. Check that the serial data format is set to “GARMIN” (see Step 2).
- d. If your problem persists, please consult your GPS unit’s user’s manual.

Step 5: Upload Waypoint Data from the WDNR Garmin GPS Tool to the GPS receiver

1. In the menu bar, select: Waypoint > Upload



2. A pop-up window will indicate the completion of a successful upload. Click OK.



3. Check that the uploaded waypoints are visible on the GPS receiver: press [MENU] twice to get to the main menu, select “Points”, press [ENTER], select “Waypoints”, and press [ENTER].
4. Troubleshooting
 - a. Storage capability varies by GPS model. In the event that the number of sampling sites exceeds your receiver's storage capacity, the text file containing the survey site information can be split into smaller text files. You will then be able to upload successive files as needed or work from multiple receivers in the field.
 - b. For more help, please refer to the appropriate online documentation or user’s manuals.

Printing Datasheets

The form used for recording data can be found on the tab labeled "FIELD SHEET" in the Aquatic Plant Survey Data Workbook, downloadable from the University of Wisconsin Extension website (<http://www.uwsp.edu/cnr/uwexplakes/ecology/APM/Appendix-C.xls>). Print the field sheet (waterproof paper recommended), using the "Print Area > Set Print Area" function under the "File" menu to set the appropriate number of rows to print. Under Header (View > Header and Footer > Custom Header) record lake name, Waterbody Identification Code (WBIC), county and survey date.

The screenshot shows a Microsoft Excel spreadsheet titled "Appendix-C" with the following structure:

- Row 1:** Observer 1: name and hours: (A-H), Observer 2: name and hours: (I-R), Observer 3: name and hours: (S-V), Total hours worked: (W-X)
- Row 2:** Site # (A), Depth (ft) (B), Dominant sediment type (M, S, R) (C), Rake pole (P) or rake rope (R)? (D), Total Rake Fullness (E), EWM 1,2,3 (F), CLP 1,2,3 (G), and 21 numbered columns (H-AC).
- Rows 3-30:** A grid for data entry with site numbers 1-28 in the first column and rake pass numbers 1-21 in the top row.

The spreadsheet interface includes the standard Excel menu bar (File, Edit, View, Insert, Format, Tools, Data, Window, Help), a toolbar with various icons, and a status bar at the bottom showing "Ready" and "NUM".

Constructing the Rake Samplers

The rake samplers are each constructed of two rake heads welded together, bar-to-bar, to form a double-sided rake head. The rake head is 13.8 inches (35 centimeters) long, with approximately 14 tines on each side. For use in shallow waters, mount a double-sided rake head to a pole that has the capability to extend to 15 feet (4.6 meters). For use in deeper waters, attach a second double-sided rake head to a rope; this rake head should also be weighted (Figure 2).

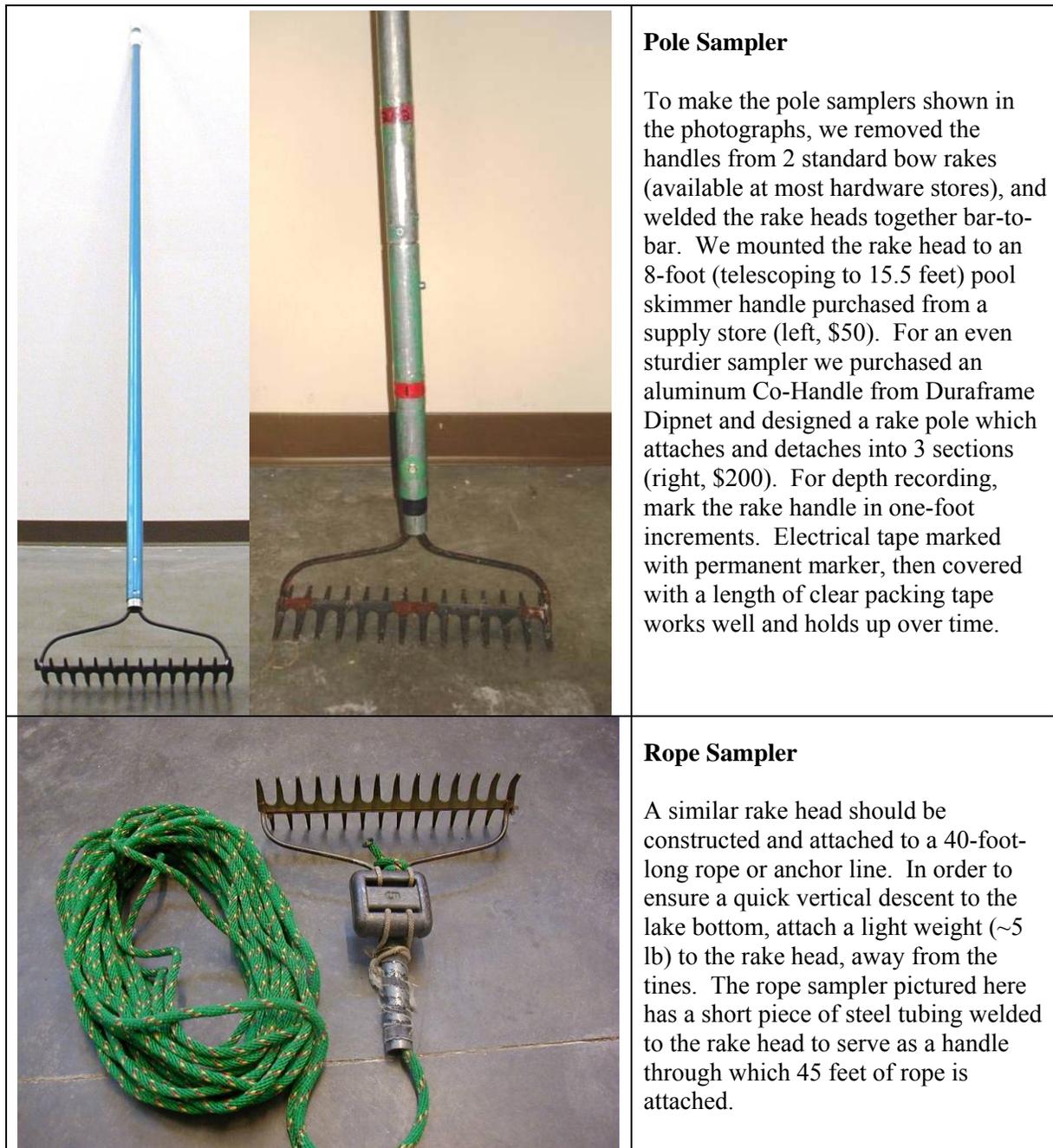


Figure 2: Examples of sampling rakes used during surveys.

COLLECTING AND RECORDING FIELD DATA

Using the Rake Samplers

Collect one rake sample per sample site.

In water shallower than 15 feet deep, use the pole sampler. At each sample site, lower the rake straight through the water column to rest lightly on the bottom, twist the rake around twice, and then pull the rake straight out of the water.

In water deeper than 15 feet, drop the rope sampler straight into the water alongside the boat, drag the rake along the sediment surface for approximately one foot (0.3 m), and then pull the rake to the surface.

A large tray or bin may be used to aid in processing the entire sample.

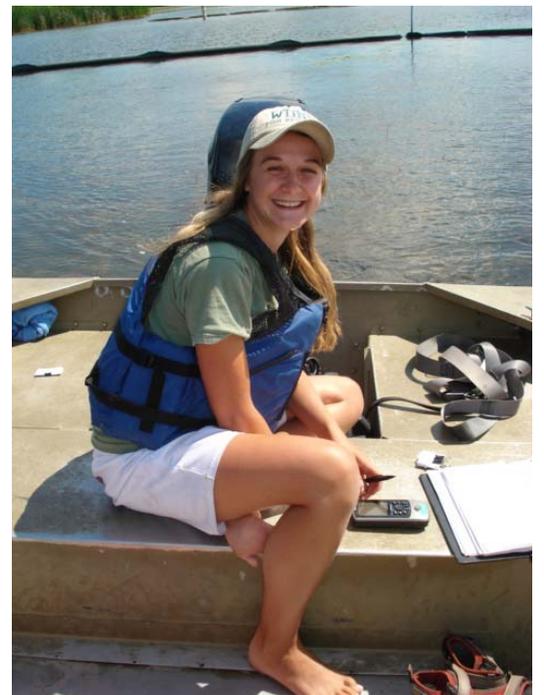
Navigating to Sites

Accuracy

The location reported by the GPS receiver has an element of error that varies under different conditions. The total error from the GPS and your navigational error *combined* should not exceed half of the sampling resolution. Therefore, when sampling with a Garmin 76 receiver, navigate at no greater than an 80-foot zoom level and aim to completely cover the sampling site with the arrow. At 80-foot zoom, the locator arrow shown on the screen represents approximately 25 feet in length. In order to sample with acceptable accuracy, the arrow must completely cover the sample site on screen. At coarser zoom levels, because the size of the arrow remains constant, the boat may be more distant from the site even though the arrow completely covers the site. You can use a lower zoom level (120-foot is appropriate) in order to travel from site to site, but as you approach the target site, you must confirm your location at using at least the 80-ft zoom resolution to ensure you are sampling with acceptable accuracy.

Determining Maximum Depth of Plant Colonization

When sampling, you will have to determine the maximum depth at which the plants are rooted. The maximum depth of colonization (MDC) can vary greatly among lakes, from just a few feet to as deep as the physiological requirements of a species will allow. When sampling a line of sites heading from shore out to deep water, take samples until plants are no longer found on the



rake. Continue sampling at least two sites deeper to ensure you sampled well over the maximum depth of colonization. If no plants are found at these sites, simply record the depth, sampling tool used, and dominant sediment type. Leave the rake fullness and species information blank. Depending on the lake bathymetry, you may choose to continue down the same row to the other side of the lake. Use a depth finder and begin sampling again when the depth reaches that of the last (no plant) site sampled. Alternatively, if the rows are very long, you may choose to move over to the next row and sample sites back into shore, working back and forth along the shoreline and around the lake. However, if the second row is shallower than the first, be sure to start sampling sufficiently far from shore so that the depth is similar to that at which you stopped sampling in the first row. By sampling in this way, over time you will begin to hone in on the maximum depth of plant colonization.



After working several rows crossing the edge of the littoral zone, estimate the maximum depth of colonization (e.g. 20 feet) and only continue to sample deeper sites within 6 feet of this estimation (all sites ≤ 26 feet). As you complete more rows and gain confidence in your estimation, you can then begin to gradually omit sampling depths that are too deep for plants to grow. Once you have sampled the deep end of your estimated maximum depth of colonization (i.e. 26 feet) at least three times and have not found any plants, then you can discontinue sampling at anything deeper, but continue to sample any sites shallower (≤ 25 feet). If you then sample a shallower depth three times (i.e. 25 feet) and find no plants at any of those sites, you may now discontinue sampling at these deeper sites and only sample sites shallower than this new sampling depth (≤ 24 feet). Continue to successively eliminate shallower depths in sequence until you establish the maximum depth of colonization. To account for patchiness and other sources of variation, never narrow the sampling window to less than 1.5 feet of the estimated maximum depth of colonization. Use your best judgment when eliminating depths, and remember that plant distribution may be uneven and that different areas of a single lake may have plants growing relatively deeper or shallower. It is good practice to err on the side of oversampling.

Recording Data

Completing the Field Sheet

1. General site information
Complete the top portion of the “Field Sheet” with the lake name, county, WBIC, date, names of observers, and how many hours each person worked during the survey.



2. Site number
Each site location is numbered sequentially. Each site number will have one row of data on the “Field Sheet.”
3. Depth
Measure and record the depth to the nearest half-foot increment at each site sampled, regardless of whether vegetation is present. The pole mounted rake and rope sampler should be marked to measure the depth of water at a sample site. However, a variety of options exist for taking depth measurements, including sonar handheld depth finders (trigger models) and boat-mounted depth finders. If you are using a depth finder, it is useful to know that the accuracy may decrease greatly in densely vegetated areas. Depth finders sometimes report the depth to the top of the vegetation instead of to the sediment surface. In most cases, it is best to use depth markings on a pole-mounted rake for shallow sites.
4. Dominant sediment type
At each sample site, record the dominant sediment type based on how the rake feels when in contact with the sediment surface as: mucky (M), sandy (S), or rocky (R).
5. Pole vs. Rope
Record whether the pole (P) mounted rake or the rake-on-a-rope (R) was used to take the sample.
6. Rake fullness
At each site, after pulling the rake from the water record the overall rake fullness rating that best estimates the total coverage of plants on the rake (1 - few, 2 - moderate, 3 - abundant; see Figure 3). Also identify the different species present on the rake and record a separate rake fullness rating for each. Account for plant parts that dangle or trail from the rake tines as if they were fully wrapped around the rake head. The rake may dislodge plants that will float to the surface, especially short rosette species not easily caught in the tines. Include the rake fullness rating for plants dislodged and floating but not collected on the rake. Record rake fullness ratings for filamentous algae, aquatic moss, freshwater sponges, and liverworts, but do not include these ratings when determining the overall rake fullness rating. While at a site, perform a brief visual scan. If you observe any species within 6 feet (2m) of the sample site, but not collected with the rake, record these species as observed visually (“V”) on the field sheet. These species will be included in total number of species observed.

Fullness Rating	Coverage	Description
1		Only few plants. There are not enough plants to entirely cover the length of the rake head in a single layer.
2		There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines.
3		The rake is completely covered and tines are not visible.

Figure 3: Illustration of rake fullness ratings used during the survey.

7. Species names

Note that the field datasheet does not include any species names, except for EWM (Eurasian water milfoil) and CLP (Curly-leaf pondweed). The sampling crew must write the species name in subsequent columns the first time that species is encountered. Names must be re-written on successive field sheets as they are encountered. You may use common or Latin names, but be sure there is no ambiguity in the name that will present problems during data entry. The use of standard abbreviations can greatly shorten this process. It is generally safe to shorten the names to include the first three letters of the genus name followed by the first three letters of the species name (i.e. *Ceratophyllum demersum* = CerDem).

8. Inaccessible sites

It may be impossible or unsafe to reach some sample sites. Where the water is very shallow, rocks are present, or dense plant growth prevents navigation, field workers should attempt to access the site as long as doing so is safe and relatively practical. It is often possible to reach difficult sites by using oars or poling; however, keep safety in mind and practice good judgment. Do not get out and drag the boat through mucky sediment to reach a site. If the sampling site is shallow but the substrate is firm, you may be able to walk to the site from shore or from the boat. If you cannot access a site, leave the depth blank and record the appropriate comment on the field datasheet from the list below. Remember to also transfer these to the “Comments” column of the ENTRY sheet (see data entry section):

a. NONNAVIGABLE (PLANTS)

1. Sample site cannot be accessed due to thick plant growth.
2. Aquatic plants that are visible within 6 feet of a non-navigable sample site (e.g. water lilies, cattails, bulrushes, etc.) should be recorded as visuals (V) on the datasheet.

b. TERRESTRIAL

1. Sample site occurs on land (including islands).
2. Aquatic plants visible within 6 feet of a terrestrial sample site (e.g. water lilies, cattails, bulrushes, etc.) may be included in the general boat survey list, but should not be marked as visuals (V) on the datasheet.
3. Only species rooted in water should be recorded as present or as part of the boat survey.

c. SHALLOW

1. Sample site is in water that is too shallow to allow access.
2. Aquatic plants that are visible within 6 feet of a shallow sample site should be recorded as visuals (V) on the datasheet.

d. ROCKS

1. Sample site is inaccessible due to the presence of rocks.

e. DOCK

1. Sample site is inaccessible due to the presence of a dock or pier.

f. SWIM AREA

1. Sample site is inaccessible due to the presence of a designated swimming area.

g. TEMPORARY OBSTACLE

1. Sample site is inaccessible due to the presence of a temporary obstacle such as a boater, swimmer, raft, loon, etc.
2. If possible, try to revisit this site later on during the survey once the temporary obstacle has moved.

h. NO INFORMATION

1. No information is available about the sample site because it was not traveled to (inaccessible channel, accidentally omitted during survey, skipped due to time constraints, etc.).

i. OTHER

1. Site was not sampled for another reason; please provide a brief description.

9. Filling Out the Boat Survey Datasheet

Often there will be localized occurrences of certain species (e.g., floating-leaf or emergent species) that are missed by the point-intercept grid. For areas that are outside the grid or in between sampling sites, record the name of the plant and the closest site to the plant. This information will be entered into the “BOAT SURVEY” section of the data entry file. Emergent near-shore vegetation should only be recorded if it’s rooted in water.

Collecting and Identifying Voucher Samples

Voucher each plant species for verification and identification. You can often use plants collected on the rake as vouchers. However, if the sample is of poor quality or lacks reproductive structures, attempt to collect a better specimen. If a better specimen is unavailable, voucher and press what you are able to collect. Remember that the more material collected, the easier identification will be. Whenever possible, collect at least two specimens, and include reproductive material such as seeds, flowers, fruit, roots, etc. Place the voucher plant into a re-sealable plastic bag with a waterproof voucher label. The voucher label should include the species name, or in the case of unknown species, a unique identifier, the lake name, county, sample site, sediment type, collector's name, and the date. Additional information about habitat or co-occurring species may also be included on the tag. Place all specimens in a cooler for transport to the lab. See below, "Pressing Plants" for instructions once back at the laboratory.

Plant Identification and Troublesome Taxa

1. Plants should be identified to species whenever possible. Certain genera, including *Carex*, *Sparganium*, and *Sagittaria* must be flowering and/or fruiting to confirm identification and may not be identifiable to species without these parts.
2. Non-angiosperms such as *Chara* or *Nitella* are identified to genus only. Often, *Isoetes* can be identified to species by looking at spores, if present. Filamentous algae, aquatic moss, and freshwater sponge can be referred to simply as algae, moss, and sponge.
3. If a plant cannot be identified in the field, place the two voucher specimens in a re-sealable bag with a separate voucher label. Take these specimens back to the lab to verify the identity. The label should include a unique identifier, lake, county, the sample site number, and sediment type. The presence and fullness of the species should be recorded on the field datasheet under the same unique identifier name listed on the voucher label.
4. In the lab, try to identify the plant using plant identification keys and a stereo microscope. If you are still uncertain of the identity of the plant, contact a DNR biologist in your region to help with identification. Do not send specimens to an expert until you notify them of your intended shipment and they have instructed you to do so. Once the plant is identified, record this information so that the correct identification is used during data entry.



ENTERING DATA ELECTRONICALLY

Worksheet Descriptions and Instructions

The Aquatic Plant Survey Data Workbook (<http://www.uwsp.edu/cnr/uwexlakes/ecology/APM/Appendix-C.xls>) contains eight worksheets:



1. READ ME

Provide a brief description of the six other worksheets included in the workbook.

2. FIELD SHEET

The FIELD SHEET should be printed on waterproof paper for recording the field data.

3. ENTRY

- a. There are many formulas embedded in the ENTRY sheet that allow for the statistical calculations on the STATS sheet. Thus, **DO NOT add or delete columns or rows on the ENTRY or STATS sheets.**
- b. Data collected in the field is recorded on the FIELD SHEET and afterwards transferred to the electronic ENTRY sheet.
- c. Copy latitude and longitude information for the sample sites from the GPS text file and paste into the appropriate columns of the ENTRY sheet.
- d. Record the lake and county name, WBIC, survey date, and the names of the field workers.
- e. There is a column for comments on the ENTRY sheet. Please use the standardized comments discussed on page 18 of this protocol.
- f. Species' Latin names appear alphabetically in the first row of the spreadsheet. Species such as aquatic moss, freshwater sponge, filamentous algae, and liverworts are listed separately at the end of the alphabetical list.
- g. Additional species not already listed should be added in the columns at the end of the alphabetical list (sp1, sp2, etc.). Any vouchered specimens that are awaiting ID confirmation should be entered here as well. You should use the same unique voucher identifier established in the field to for ease of updating the information.

- h. We strongly recommend double-checking the electronically entered data against the original field datasheets to ensure that no errors or omissions occurred during the entry process.

4. BOAT SURVEY

- a. Enter information on plants observed during the survey that were observed more than 6 feet away from a sample site.
- b. Additional comments about field conditions, known management activities, or other observations can also be recorded in this worksheet.

5. STATS

The STATS worksheet automatically calculates summary statistics using the data entered into the ENTRY worksheet (see Appendix 2, Table 1). There are several summary calculations including:

a. Individual Species Statistics:

- i. **Frequency of occurrence within vegetated areas (%)**: Number of sites at which a species was observed divided by the total number of vegetated sites. Frequency of occurrence is sensitive to the number of sample sites included. Including non-vegetated sites will lower the frequency of occurrence.
- ii. **Frequency of occurrence at sites shallower than maximum depth of plants**: Number of sites a species was observed at divided by the total number of sites shallower than maximum depth of plants.
- iii. **Relative frequency (%)**: This is a proportional value that reflects the degree to which an individual species contributes to the sum total of all species observations. The sum of the relative frequencies of all species is 100%. Relative frequency is not sensitive to whether all sampled sites, including non-vegetated sites, are included. Relative frequency does not take into account aquatic moss, freshwater sponges, filamentous algae, or liverworts.
- iv. **Relative frequency (squared)**: This value is only part of a calculation and is not used directly.
- v. **Number of sites where a species was found**: This is the sum of the number of sites at which a species was recorded on the rake.
- vi. **Average rake fullness**: Mean rake fullness rating, ranges from 1-3.
- vii. **Number of visual sightings**: This is the total number of times a plant was seen within 6 feet of the boat, but not collected on the rake.
- viii. **Present (visual or collected)**: Automatically fills in “present” if the species was observed at a sample site.

b. Summary Statistics:

- i. Total number of sites visited:** Total number of sites where depth was recorded, even if a rake sample was not taken.
- ii. Total number of sites with vegetation:** Total number of sites where at least one plant was found on the rake.
- iii. Total number of sites shallower than maximum depth of plants:** Total number of sites where the depth was less than or equal to the maximum depth at which plants were found. This value is used for frequency of occurrence at sites shallower than maximum depth of plants.
- iv. Frequency of occurrence at sites shallower than maximum depth of plants:** Number of times plants were recorded at a site divided by the total number of sites sampled that were shallower than the maximum depth of plants.
- v. Simpson's Diversity Index:** A nonparametric estimator of community heterogeneity. It is based on relative frequency and thus is not sensitive to whether all sampled sites (including non-vegetated sites) are included. The closer the Simpson Diversity Index is to 1, the more diverse the community.
- vi. The maximum depth of plants:** This is the depth of the deepest site sampled at which vegetation was present. Please note that this value does not take into account aquatic moss, freshwater sponges, filamentous algae, or liverworts. See "MAX DEPTH GRAPH" below for more information.
- vii. Number of sites sampled using rake on rope (R)**
- viii. Number of sites sampled using rake on pole (P)**
- ix. Average number of all species per site (shallower than max depth):** Mean number of species found at sample sites which were less than or equal to the maximum depth of plant colonization.
- x. Average number of species per site (vegetated sites only):** Mean number of species found at sample sites where vegetation was present.
- xi. Average number of native species per site (shallower than maximum depth):** This does not include Eurasian water milfoil, Curly-leaf pondweed, Purple loosestrife, Spiny naiad, or Reed canary grass.
- xii. Average number of native species per site (vegetated sites only)**
- xiii. Species richness:** Total number of species observed not including visual sightings. Please note that this value does not include aquatic moss, freshwater sponges, filamentous algae, or liverworts.
- xiv. Species richness (including visuals):** Total number of species observed including visual sightings recorded within 6 feet of the sample site (but does not include additional species found during the boat survey).

6. MAX DEPTH GRAPH

The maximum depth of colonization is an important metric to characterize accurately, as it can indicate changes in water clarity and water quality over time. This worksheet automatically displays a histogram of plant occurrences by water depth. Occasionally, unrooted plants floating in the water column are snagged by the rake, which can sometimes result in an inaccurate estimation of the maximum depth of colonization. It is

important to examine the reported maximum depth of plant colonization in order to detect potential outliers. As a general rule, a single plant occurrence reported at a site which is 2 or more feet deeper than the next shallowest site with plants is considered an outlier, and should be excluded when determining the maximum depth of plant colonization (see Figure 4).

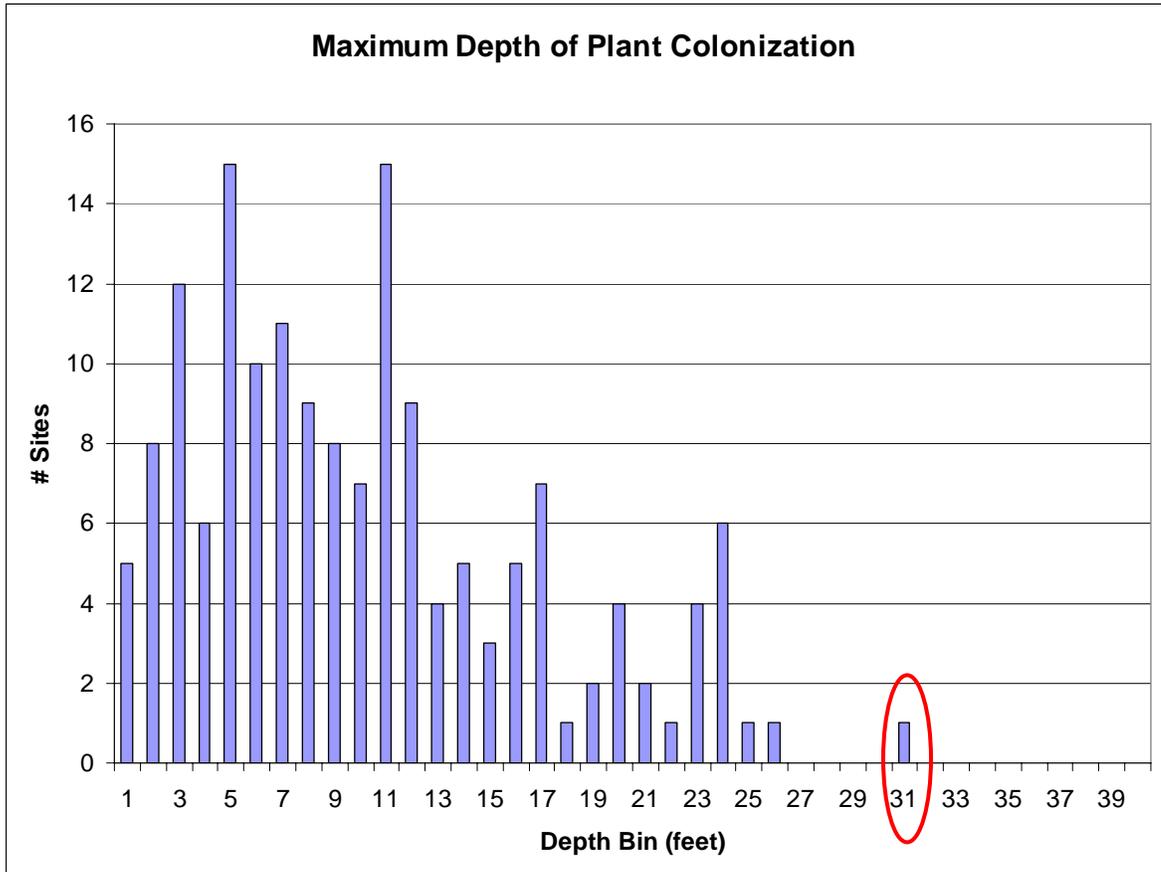


Figure 4: Distribution of plant occurrences versus water column depth. The value circled in red is more than 2 feet deeper than all other plants found during the survey, and is considered an outlier. Outliers should be omitted when determining the maximum depth of plant colonization.

It is necessary to delete the occurrence of this outlier from the ENTRY spreadsheet so that the automatically-calculated statistics will reflect the revised maximum depth of colonization. To do this, locate the sampling point number on the ENTRY worksheet where the outlier was found. Scroll across the row until you find the outlier to omit. Once you've located the cell with the outlier, press delete to clear the cell. Right click on the cell and select "Insert Comment". Briefly describe the occurrence of the outlier and the reason for omitting it. Follow the same steps with the overall rake fullness column, deleting out the contents of the cell and including a brief comment. Please also include information regarding any omissions of outliers and revised MDC directly on the STATS spreadsheet, typing all comments in the space below "See Max Depth Graph Worksheet to Confirm".

Saving the File

Once the data is electronically entered into the Aquatic Plant Survey Data Workbook (<http://www.uwsp.edu/cnr/uwexplakes/ecology/APM/Appendix-C.xls>), please save the file with a name indicating the lake, county, WBIC, and year sampled. The format we recommend is: Lake_County_WBIC_(year).xls. For example, Lake Mendota sampled in 2009 would be named: Mendota_Dane_805400_(2009).xls

Double-Checking the Data

We strongly recommend double-checking the electronic data against the field sheet to catch any errors made during the entry process.

Sending the Data

Send the final electronic file to the WDNR via email (DNRBaselineAquaticPlants@wisconsin.gov). There should be one file for each completed lake survey.

Creation of Plant Distribution Maps

Aquatic plant distribution maps can be easily created using the point-intercept data collected during the survey. Instructions on how to create these maps can be found in Appendix 3 and 4.

Statistical Analysis of Data

Statistical comparisons of datasets can easily be analyzed between pre- and post-management activities or between two survey years by using a simple chi-square analysis. The chi-square analysis is commonly used to examine whether or not there was a statistically significant change in the occurrence of a plant species between the survey years or after management activities have occurred. The “Compute Pre-Post Data” worksheet (available at: <http://www.uwsp.edu/cnr/uwexplakes/ecology/APM/Apendix-D1.xls>), allows users to enter in the number of sites at which a species was recorded during each survey, and provides an output indicating whether or not differences reflect a statistically significant change in the plant community.

PRESSING PLANTS – PREPARATION OF VOUCHER SPECIMENS

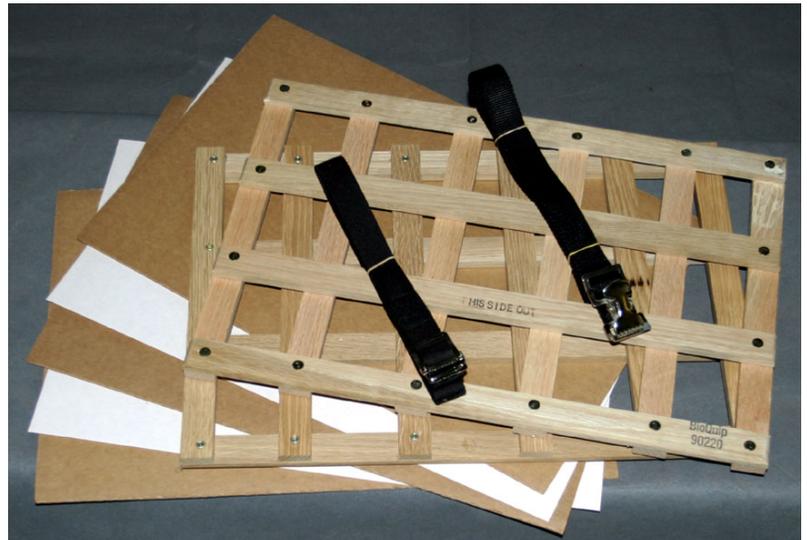
“Floating” Specimens

Because most aquatic plants, especially finely dissected specimens, tend to stick to paper as they dry, it is usually better to “float” the plant directly onto herbarium paper. However, if the plant is large and robust, or not entirely aquatic (such as bulrushes, emergent sedges or pickerelweed) you can press the plant in newsprint.

1. Use a pencil to label the mounting paper with the plant name, geographic location, date collected, and serial code (a unique identifier in a series that identifies all specimens you have pressed; we use the initials of the presser followed by the year and a sequential number; i.e. AM2009-01). Mount only one species per sheet, and do not cut herbarium sheets in half.
2. Carefully rinse the plant so it is free of epiphyton, silt, and other debris.
3. Fill a sink or tray with about one inch of water. Slip the labeled mounting paper into the water.
4. Float the plant in the water and arrange it onto the sheet.
5. If the plant has fine leaflets, such as water milfoil or bladderwort, cut off one leaf and display it floated out onto the paper so that leaflet characteristics can be readily observed.
6. The plant may be bent into a “V” or “W” or curled shape to fit on the sheet.
7. Slowly lift the paper out of the water by one end. Keeping the plant in place, let the water slowly drain off.
8. Use a toothpick or probe to spread out plant parts for better display, making sure to expose identifiable characteristics such as stipules, sheaths or seeds.

Pressing Specimens

- Cover the plant with a sheet of waxed paper or plastic wrap if it is especially delicate (we recommend this technique especially for bladderworts and other fine, delicate species).
- Place the specimen sheet inside folds of newspaper.
- Place the newspaper between two sheets of blotting paper, and the blotting paper between two sheets of corrugated cardboard.
- Place multiple specimens in a plant press. Use rope or straps to compress plants to keep specimens flat as they dry.
- Place the press somewhere warm and dry. Placing the press on its long edge on top of a ventilated aluminum or aluminum-lined box containing incandescent light bulbs allows for quick drying. Remove plants after several days when they are thoroughly dry.



Suggested Herbarium Materials

Herbarium and science supply businesses such as the Herbarium Supply Company (www.herbariumsupply.com; 800-348-2338) sell many herbarium products including mounting paper, plant presses, blotting paper, and cardboard spacers. When ordering herbarium mounting paper, look for acid-free, non-glossy, 100% rag, and heavy or standard weights.

Preparing Dried Specimens for Shipment to an Herbarium

1. **Package specimens.** Place each dried specimen with unique identifier clearly marked on the newsprint or mounting paper in the fold of a single sheet of newspaper and place all of the newspaper/specimens between two pieces of cardboard. Tie or rubber band the cardboard bundle together, and put it into a padded envelope or a box. As long as the package is going to or from an educational institution, a special 4th class mailing rate called “Library Rate” can be used.
2. **Label information.** Both of the herbaria utilized by the WDNR label the dried plant specimens themselves. Prepare an electronic spreadsheet with the relevant information for each specimen. Send the file to Mark Wetter (mawetter@wisc.edu) for the Madison herbarium or to Robert Freckmann (rfreckma@uwsp.edu) for the Stevens Point herbarium. Each row (i.e. each specimen) in the file will need a unique identifier such as the collector’s initials followed by a specimen number. Use the same identifier on the specimen so the herbaria can match the label to the specimen. Each row of the spreadsheet should include columns for the following (column heading in **bold**, example in plain text):
 - a. **Specimen Identifier** CD2009-01
 - b. **Collector Name** Isabel Velez
 - c. **Preparer's Name** (If different from collector) Chad Douwe
 - d. **Lake Name** Little John Jr.
 - e. **County** Vilas
 - f. **Date collected** 7 July 2009
 - g. **Specimen ID** *Potamogeton spirillus*, Spiral-fruited pondweed
 - h. **Habitat** muck over sand
 - i. **Associated species (if known)** *Najas gracillima*, *Potamogeton friesii*
 - j. **TRS** T41N R07E S29
 - k. **WBIC** 1861700
 - l. **More detailed location** (if known) SW edge of lake, 1 m depth
 - m. **GPS lat/long coordinates** (if known) N 46°15.037' W090°01.804'
 - n. **Herbarium of deposition** UWSP
3. **Send pressed plants** to Mark Wetter or Ted Cochrane (UW- Madison), or to Dr. Robert Freckmann (UW-Stevens Point). **Please notify the herbarium of your intention and wait for confirmation before sending plants:**

Mark Wetter or Ted Cochrane
University of Wisconsin-Madison Herbarium
Department of Botany, Birge Hall
430 Lincoln Drive
Madison, WI 53706-1381
tel.: (608) 262-2792
FAX: (608) 262-7509
www.botany.wisc.edu/herbarium/

Dr. Robert Freckmann
Robert Freckmann Herbarium
0310 CNR Addition
1900 Franklin Street
Stevens Point, WI 54481
rfreckma@uwsp.edu

- 4. Send electronic record to the WDNR.** Please send a copy of the electronic herbarium file along with the plant data to DNRBaselineAquaticPlants@wisconsin.gov.

CONCLUSIONS

There will be four products from each plant survey. First, there will be the raw data from the quantitative survey which provides a lakewide plant species list and distribution and rake fullness data for each species observed. Second, there will be summary statistics useful in characterizing and comparing populations. Third, there will be observations from the general boat survey. Fourth, voucher specimens will provide a catalog of plant species present in the lake and will bolster the state collections. All electronic data should be sent by email to the WDNR (DNRBaselineAquaticPlants@wisconsin.gov).

ACKNOWLEDGEMENTS

We would like to extend our sincere thanks to the WDNR Lake Coordinators and Aquatic Plant Management staff for recommendations and comments in the design, implementation, and applications of the data and the survey methodology. The many hours the field staff put into testing this methodology was integral to its successful development, and we are very grateful for all of their hard work.

Appendix 1

Current (02/2010) contact information for regional WDNR aquatic plant management (APM) and lake coordinators

Northern Region (NOR)

(Ashland, Barron, Bayfield, Burnett, Douglas, Florence, Forest, Iron, Langlade, Lincoln, Oneida, Polk, Price, Rusk, Sawyer, Taylor, Vilas, & Washburn Co.)



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APM Coordinator
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Pamela Toshner

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pamela.toshner@wisconsin.gov

Jim Kreitlow

Ashland, Iron, Price, Rusk, Sawyer, & Taylor Co.
715-365-8947

james.kreitlow@wisconsin.gov

Southeast Region (SER)

(Kenosha, Milwaukee, Ozaukee, Racine, Sheboygan, Walworth, Washington, & Waukesha Co.)



Heidi Bunk

: Ozaukee, Sheboygan, Walworth, Washington, & Waukesha Co.
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heidi.bunk@wisconsin.gov

Craig Helker

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craig.helker@wisconsin.gov

South Central Region (SCR)

(Columbia, Dane, Dodge, Green, Grant, Iowa, Jefferson, Lafayette, Richland, Rock, & Sauk Co.)



Susan Graham

Lake & APM Coordinator
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Northeast Region (NER)

(Brown, Calumet, Door, Fond du Lac, Green Lake, Kewaunee, Manitowoc, Marinette, Marquette, Menominee, Oconto, Outagamie, Shawano, Waupaca, Waushara, & Winnebago Co.)



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Greg Sevener

Marinette Co.
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West Central Region (WCR)

(Adams, Buffalo, Chippewa, Clark, Crawford, Dunn, Eau Claire, Jackson, Juneau, La Crosse, Marathon, Monroe, Pepin, Pierce, Polk, Portage, St. Croix, Trempealeau, Vernon, & Wood Co.)



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Appendix 2

This appendix contains examples of statistical outputs created through the point-intercept sampling method for Kathan Lake, Oneida County. The data was collected during a survey conducted August 21-22, 2007.

Table 1. Summary Statistics

Total number of sites set-up	203
Total number of sites visited	171
Total number of sites with vegetation	149
Total number of sites shallower than maximum depth of plants	165
Frequency of occurrence at sites shallower than maximum depth of plants	90.30
Simpson Diversity Index	0.94
Maximum depth of plants (ft)	9.50
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	171
Average number of all species per site (shallower than max depth)	3.96
Average number of all species per site (veg. sites only)	4.39
Average number of native species per site (shallower than max depth)	3.56
Average number of native species per site (veg. sites only)	3.95
Species Richness	37
Species Richness (including visuals)	38
Species Richness (including visuals & boat survey)	40

Table 2. Individual species frequency of occurrences

Common Name	Scientific Name	% Frequency (Littoral)	% Frequency (Whole lake)	% Frequency (in vegetated areas)	Relative Frequency (%)
Bushy pondweed	<i>Najas flexilis</i>	41.2	39.8	45.6	10.4
Common waterweed	<i>Elodea canadensis</i>	40.6	39.2	45.0	10.2
Eurasian water milfoil*	<i>Myriophyllum spicatum*</i>	40.0	38.6	44.3	10.1
Filamentous algae	<i>Algae spp.</i>	26.1	25.1	28.9	6.6
Coontail	<i>Ceratophyllum demersum</i>	23.0	22.2	25.5	5.8
Stoneworts	<i>Nitella spp.</i>	21.8	21.1	24.2	5.5
Watershield	<i>Brasenia schreberi</i>	20.6	19.9	22.8	5.2
Small bladderwort	<i>Utricularia minor</i>	17.6	17.0	19.5	4.4
Small pondweed	<i>Potamogeton pusillus</i>	17.0	16.4	18.8	4.3
Common bladderwort	<i>Utricularia vulgaris</i>	16.4	15.8	18.1	4.1
Wild celery	<i>Vallisneria americana</i>	15.2	14.6	16.8	3.8
Flat stem pondweed	<i>Potamogeton zosteriformis</i>	13.9	13.5	15.4	3.5
Stiff pondweed	<i>Potamogeton strictifolius</i>	11.5	11.1	12.8	2.9
Ribbon leaf pondweed	<i>Potamogeton epihydrus</i>	9.1	8.8	10.1	2.3
White water lily	<i>Nymphaea odorata</i>	7.9	7.6	8.7	2.0
Muskgrasses	<i>Chara spp.</i>	7.3	7.0	8.1	1.8
Freshwater sponge	<i>Sponge spp.</i>	6.1	5.8	6.7	1.5
Moss	<i>Moss spp.</i>	6.1	5.8	6.7	1.5
Large-leaf pondweed	<i>Potamogeton amplifolius</i>	5.5	5.3	6.0	1.4
Spiny-spored quillwort	<i>Isoetes echinospora</i>	4.9	4.7	5.4	1.2
Waterwort	<i>Elatine minima</i>	4.2	4.1	4.7	1.1
Creeping spikerush	<i>Eleocharis palustris</i>	4.2	4.1	4.7	1.1
Water horsetail	<i>Equisetum fluviatile</i>	4.2	4.1	4.7	1.1
Northern water milfoil	<i>Myriophyllum sibiricum</i>	4.2	4.1	4.7	1.1
Thin floating-leaf bur-reed	<i>Sparganium sp.</i>	4.2	4.1	4.7	1.1
Spatterdock	<i>Nuphar variegata</i>	3.6	3.5	4.0	0.9
Spiral-fruited pondweed	<i>Potamogeton spirillus</i>	3.6	3.5	4.0	0.9
American bur-reed	<i>Sparganium americanum</i>	3.6	3.5	4.0	0.9
Shoreweed	<i>Littorella uniflora</i>	3.0	2.9	3.4	0.8
Brown-fruited rush	<i>Juncus pelocarpus f. submersus</i>	2.4	2.3	2.7	0.6
Variable pondweed	<i>Potamogeton gramineus</i>	2.4	2.3	2.7	0.6
Twin-stemmed bladderwort	<i>Utricularia geminiscapa</i>	1.8	1.8	2.0	0.5
Pipewort	<i>Eriocaulon aquaticum</i>	0.6	0.6	0.7	0.2
Clasping leaf pondweed	<i>Potamogeton richardsonii</i>	0.6	0.6	0.7	0.2
Broad-leaved arrowhead	<i>Sagittaria latifolia</i>	0.6	0.6	0.7	0.2
Thin-leaved pondweed	<i>Potamogeton sp.</i>	0.6	0.6	0.7	0.2
Flat-leaved bladderwort	<i>Utricularia intermedia</i>	0.6	0.6	0.7	0.2
Cattail	<i>Typha sp.</i>	Visual	Visual	Visual	Visual
Needle spikerush	<i>Eleocharis acicularis</i>	Boat Survey	Boat Survey	Boat Survey	Boat Survey
Three-way sedge	<i>Dulichium arundinaceum</i>	Boat Survey	Boat Survey	Boat Survey	Boat Survey

Table 3. Number of sites where species was found and average rake fullness rating

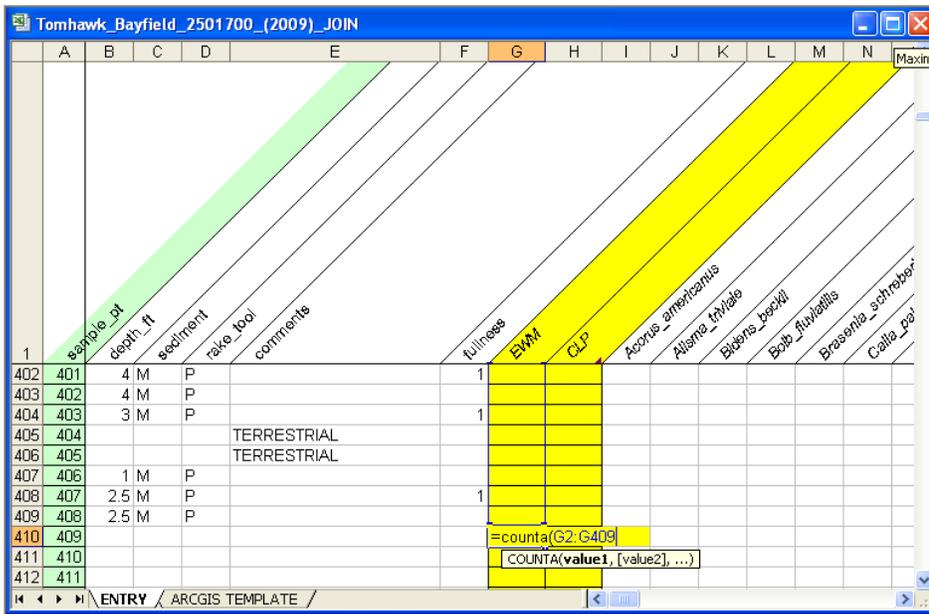
Common Name	Scientific Name	# sites where species was found	# sites where species was found (including visuals)	Average rake fullness rating
Bushy pondweed	<i>Najas flexilis</i>	68	68	1.28
Common waterweed	<i>Elodea canadensis</i>	67	67	1.28
Eurasian water milfoil*	<i>Myriophyllum spicatum</i> *	66	71	1.47
Filamentous algae	<i>Algae</i> spp.	43	43	1.00
Coontail	<i>Ceratophyllum demersum</i>	38	38	1.37
Stoneworts	<i>Nitella</i> spp.	36	36	1.00
Watershield	<i>Brasenia schreberi</i>	34	58	1.68
Small bladderwort	<i>Utricularia minor</i>	29	29	1.10
Small pondweed	<i>Potamogeton pusillus</i>	28	28	1.14
Common bladderwort	<i>Utricularia vulgaris</i>	27	27	1.30
Wild celery	<i>Vallisneria americana</i>	25	26	1.36
Flat stem pondweed	<i>Potamogeton zosteriformis</i>	23	25	1.22
Stiff pondweed	<i>Potamogeton strictifolius</i>	19	19	1.16
Ribbon leaf pondweed	<i>Potamogeton epihydrus</i>	15	18	1.27
White water lily	<i>Nymphaea odorata</i>	13	42	1.69
Muskgrasses	<i>Chara</i> spp.	12	12	1.25
Freshwater sponge	Sponge spp.	10	11	1.00
Moss	Moss spp.	10	10	1.20
Large-leaf pondweed	<i>Potamogeton amplifolius</i>	9	10	1.33
Spiny-spored quillwort	<i>Isoetes echinospora</i>	8	11	1.00
Waterwort	<i>Elatine minima</i>	7	8	1.00
Creeping spikerush	<i>Eleocharis palustris</i>	7	9	1.14
Water horsetail	<i>Equisetum fluviatile</i>	7	15	1.43
Northern water milfoil	<i>Myriophyllum sibiricum</i>	7	7	1.00
Thin floating-leaf bur-reed	<i>Sparganium</i> sp.	7	7	1.00
Spatterdock	<i>Nuphar variegata</i>	6	22	1.17
Spiral-fruited pondweed	<i>Potamogeton spirillus</i>	6	6	1.00
American bur-reed	<i>Sparganium americanum</i>	6	11	1.50
Shoreweed	<i>Littorella uniflora</i>	5	5	1.00
Brown-fruited rush	<i>Juncus pelocarpus</i> f. <i>submersus</i>	4	5	1.25
Variable pondweed	<i>Potamogeton gramineus</i>	4	5	1.00
Twin-stemmed bladderwort	<i>Utricularia geminiscapa</i>	3	3	1.00
Pipewort	<i>Eriocaulon aquaticum</i>	1	2	1.00
Clasping leaf pondweed	<i>Potamogeton richardsonii</i>	1	1	2.00
Broad-leaved arrowhead	<i>Sagittaria latifolia</i>	1	1	1.00
Thin-leaved pondweed	<i>Potamogeton</i> sp.	1	1	1.00
Flat-leaved bladderwort	<i>Utricularia intermedia</i>	1	1	1.00
Cattail	<i>Typha</i> sp.	Visual	3	n/a
Needle spikerush	<i>Eleocharis acicularis</i>	Boat Survey	Boat Survey	n/a
Three-way sedge	<i>Dulichium arundinaceum</i>	Boat Survey	Boat Survey	n/a

Appendix 3

Creating a Plant Distribution Map Using Point Intercept Data in ArcGIS 9.3

This is a protocol for making a plant distribution map using ArcGIS 9.3 and the Excel (2003 version) file of data from the point intercept (PI) survey. This protocol can be changed in a number of different ways and still produce a similar product. The best way to make PI-based maps depends on the particular dataset; however, this procedure works well in most cases. Similar images may be created in PowerPoint or in photo editing software if the dataset is not large or complex.

1. After entering the PI survey data into the Aquatic Plant Survey Data Workbook (Appendix-C.xls), save the file using a unique name. We recommend the convention: Lake_County_WBIC_(YYYY).xls
2. Prepare <Lake_County_WBIC_(YYYY).xls> For Join
 - a. Open file in Excel
 - b. **File → Save As → Lake_County_WBIC_(YYYY)_JOIN.xls (DO NOT MODIFY ORIGINAL FILE)**
 - c. Delete all worksheets except for ENTRY and ARCGIS TEMPLATE (make sure to scroll left and delete the README sheet)
 - i. Click on worksheet tab; Edit → Delete Sheet → Delete
 - d. Delete the following columns
 - i. Entry columns (A & I) and calculated columns (B-H)
 1. Columns B-H are normally hidden. To “unhide” them, cursor over the column heading (A) at the top of the sheet and click/drag to highlight it and the adjacent column (I). Right click the highlighted region, then select unhide. Columns B-H are colored blue. Now delete all columns A-I.
 - ii. Latitude, Longitude columns (possibly hidden, located between sampling point and depth columns)
 - iii. Replace first row of ENTRY with ARCGIS TEMPLATE
 1. Copy the entire first row of truncated species names from the ARCGIS TEMPLATE worksheet
 2. Highlight the first row on the ENTRY worksheet and replace with the template (Edit → Paste)
 - iv. Species columns with no data
 1. Add a count row to identify empty columns to delete
 - a. Select all cells and remove any validation
 - i. Select All (Ctrl-A)
 - ii. Data → Validation → OK → Allow Any Value → OK
 - b. In the row below the last sampled point, and in the first column under a plant species, enter the formula =counta(
 - c. Then highlight the column up to the first sampling point. The beginning of this procedure is depicted below.



- d. Finally, add a closing) and hit enter. The final formula will be similar to this: =counta(G2:G500)
- e. Point the cursor over the bottom right corner of the cell until cursor turns into a “+”. Click/Drag this formula all the way across to the end of the species list.
- f. Delete any columns where the sum row is equal to 0
- g. Then delete the sum row
- e. Delete any rows after the last applicable sample point
 - i. The “sample_pt” column is usually populated up to 4000 points; delete any rows where the sampling point column is numbered, but these sample points are greater than the number of points set-up in the lakewide grid, and therefore the row doesn’t contain any information.
- f. Add a “dummy” row so all data imports into ArcGIS as “text”
 - i. Add a row directly above the first sampled point
 - ii. In this newly created row, under the Sampling Point column, enter the number equal to the total number of sample points plus 1 (i.e. total sampling points in example image is 187. The number 188 would be entered into the “dummy” row under the sampling point)
- g. Enter “Z” in all other cells in all columns that contain any information

	sample_pt	depth_ft	sediment	rake_foot	comments	fullness	EWM	CLP	Acorus_americanus	Alisma_trifide	Bibano_bocid	Boala_flavellis	Brassica_schneider	Crotia_pa
1														
2	188	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	1	0.25 M	P											
4	2		SHALLOW											

- h. Save the file and close Excel
3. Save the lake specific polygon and point shapefiles to a folder on a local drive
 - a. We’ll refer to this folder as “MapFolder”
4. Open ArcMap
 - a. Select to Start using ArcMap with “a new empty map” and click “OK”

5. Add Data (either method “a” or “b”)

a. Using Add Data Button

- i. Select the “Add Data” button; or File → Add Data 
- ii. Navigate to MapFolder
- iii. Highlight both the lake polygon (lake_county_WBIC_poly.shp) and point (lake_county_WBIC_XXmpts.shp) shapefiles
- iv. Click on ‘Add’

b. Directly from ArcCatalog

- i. Situate ArcMap and ArcCatalog windows so that you can see both
- ii. Navigate to MapFolder in ArcCatalog
- iii. Highlight both the lake polygon (lake_county_WBIC_poly) and point (lake_county_WBIC_XXmpts) shapefiles
- iv. Drag and drop these shapefiles into ArcMap
- v. Note: Shapefiles should only be saved, deleted, moved, etc. in ArcCatalog. Using Windows Explorer with shapefiles can result in accidental deletion of individual shapefile files (i.e. *.shp, *.dbf, *.sbn, *.shx, *.sbx, and *.sbn files must all be stored together. ArcCatalog packages these files together so nothing gets lost)

6. Defining Shapefile Projections

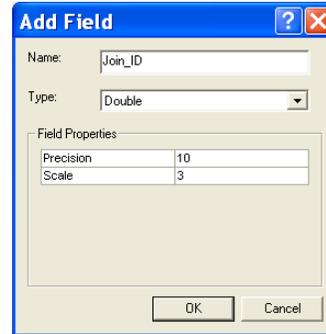
a. If after adding in your shapefiles a warning message regarding “Unknown Spatial Reference” appears, the shapefiles coordinate system is not defined

- i. To define and verify projection, please contact DNRBaselineAquaticPlants@wisconsin.gov
- ii. Alternatively, the shapefile projection can be defined manually by using the Define Projection Tool located in ArcToolbox
 1. ArcToolbox → Data Management Tools → Projections and Transformations → Define Projection
 2. Input Dataset or Feature Class
 - a. Select the shapefile that needs a defined projection
 3. Click on the browse button (right side of dialog box)
 4. In the Spatial Reference Properties dialog box, click on the “Select” button
 5. Browse for the correct coordinate system
 - a. Projected Coordinate System → State Systems → NAD 1983 HARN Wisconsin TM.prj; Click Add.
 - i. Do not use the US Feet system
 - ii. The coordinate system name may also be displayed as NAD 1983 HARN Transverse Mercator
 - iii. Coordinate system parameters:
 1. Projection → Transverse Mercator
 - False Easting → 520000.00000000
 - False Northing → -4480000.000000
 - Central Meridian → -90.00000000
 - Linear Unit → Meter

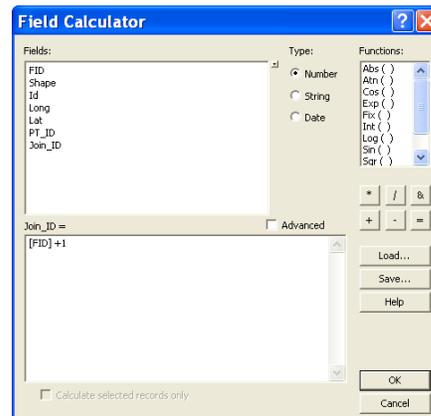
6. Select “OK” on Spatial Reference Properties dialog box, and “OK” on define projection tool

7. Edit Attribute Table for point shapefile

- a. Open Attribute Table
 - i. Right click on point shapefile in ArcMap table of contents
 - ii. Select “Open Attribute Table”
- b. Add a Field
 - i. Select the “Options” button → “Add Field”
 - ii. Name: Join_ID
 - iii. Type: Double
 - iv. Precision: 10
 - v. Scale: 3



- c. Populate Join_ID Column
 - i. Right click on “Join_ID” column heading
 - ii. Select “Field Calculator”
 - iii. If Field Calculator warning message pops up, click “Yes”
 - iv. Set expression by double-clicking FID in the “Fields:” box and typing +1. The white box under “Join_ID =” should now read [FID] +1
 - v. Click “OK”

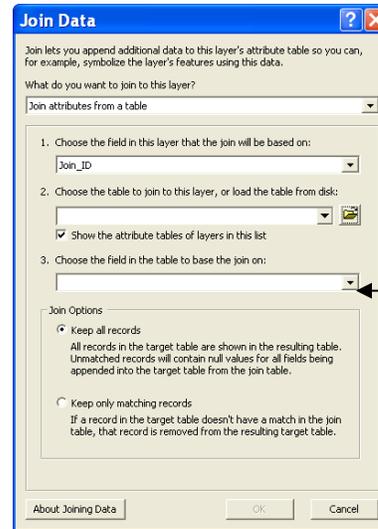


- vi. Your Join_ID column should now be populated in sequential order, starting with point #1 at the top
- vii. Close the attribute table
- viii. Note: This expression is assuming that each unique ID was based off of the calculation [FID] +1 when creating the initial point file. If the unique ID’s were not created in sequential order based on the FID field, then calculate Join_ID field accordingly (example: Truncate a unique ID such as ‘Como001’ so that it just reads ‘001’ in the Join_ID field.)

8. Join shapefile to <Lake_County_WBIC_(YYYY)_JOIN.xls>

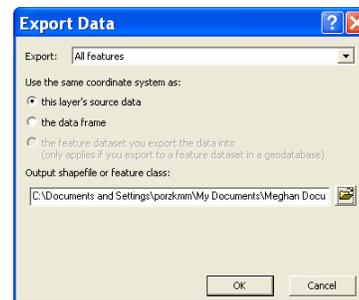
- a. Right click on point shapefile in ArcMap table of contents
- b. Select Joins and Relates → Join...
- c. Set the following options:
 - i. Join Attributes from a table
 - ii. Join will be based on “Join_ID”
 - iii. Choose the table to join to this layer
 1. Click on Window Folder (See arrow)

2. Navigate to and double-click on the Excel file saved in step 2
3. Double-click on the 'ENTRY \$' sheet
4. Click "Add"
- iv. Base the join on "sample_pt"
- v. Join Options: Keep All Records (If using ArcGIS 9.2, these options can be viewed by clicking the "Advanced" button)
- vi. Click "OK"
- vii. If prompted to create index, select "Yes"



9. Export joined shapefile to make it permanent

- a. Right click on joined point shapefile in ArcMap table of contents
- b. Select Data → Export Data
- c. Set the following options:
 - i. Export: All Features
 - ii. Use the same coordinate system as: this layer's source data
 - iii. Output shapefile or feature class:



Save in MapFolder as **Lake_County_WBIC_XXpts_YEAR_JOIN.shp**

- d. Click "OK"
- e. When asked if you want to add the exported data to the map as a layer, select "Yes"
 - i. This final joined shapefile will now be referred to as "Joined Point Shapefile"
- f. Remove the Join from the original point shapefile
 - i. Right click on point shapefile in ArcMap table of contents
 - ii. Select Joins and Relates → Remove Join(s) → Remove All Joins
- g. In the table of contents, uncheck or remove the original point shapefile that was used to create the Joined Point Shapefile.

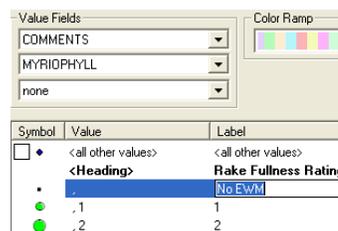
10. Check Join Results

- a. Right click on the Joined Point Shapefile in the table of contents
- b. Select "Open Attribute Table"
- c. Verify that Join was successful
 - i. All data present in Excel file should now be located in the Joined Point Shapefile attribute table, and the Join_ID and Sample_Pt columns will be identical

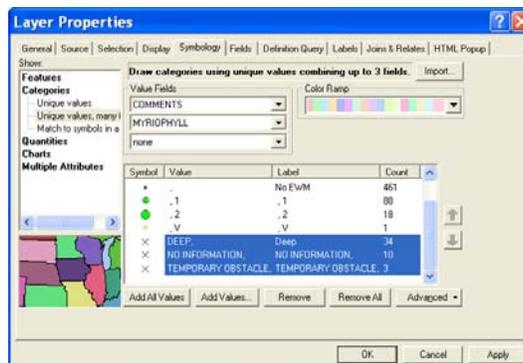
11. Display Plant Distribution Data

- a. Right click on the Joined Point Shapefile in the table of contents
- b. Select “Properties”
- c. Select “Symbology” tab
- d. On left side of dialog box under “Show:”, select “Categories – Unique Values, Many Fields”
- e. Value Fields should be “Comments”. Be sure to select the appropriate Comments field, as there may be two that appear similar.
- f. You will then choose additional Value Fields to display species information (i.e. If you want to display both EWM and CLP species information, then both EWM and CLP need to be chosen as Value Fields)
- g. Select “Add All Values”
 - i. All possible values are now displayed, separated by a comma. Each position indicates the unique values for each Value Field you designated in steps e & f, in the order entered. That is, if you selected ‘comments’, ‘EWM’, and ‘CLP’ as your value fields, the first value might read: ‘ , , ‘ indicating points that were sampled, but had neither a comment, EWM, nor CLP present. The next value might read ‘ , ,1’, which includes points with no comments, no EWM, and fullness rating of 1 for CLP.
 - ii. Points with information for the ‘comments’ value field were likely not sampled; the comment listed should clarify how to work with these points.
- h. Un-check <all other values> box
- i. Double-click on symbol next to each value to set symbology
 - i. You must now choose appropriate symbols and colors for the different variables being expressed.
 - ii. Typically we use increasing sizes of a green circle for EWM density ratings (values: 1, 2, 3), a small light green circle for visuals (V), a small black dot for sites sampled that had no relevant plant data, and a small “x” symbol for all sites not sampled

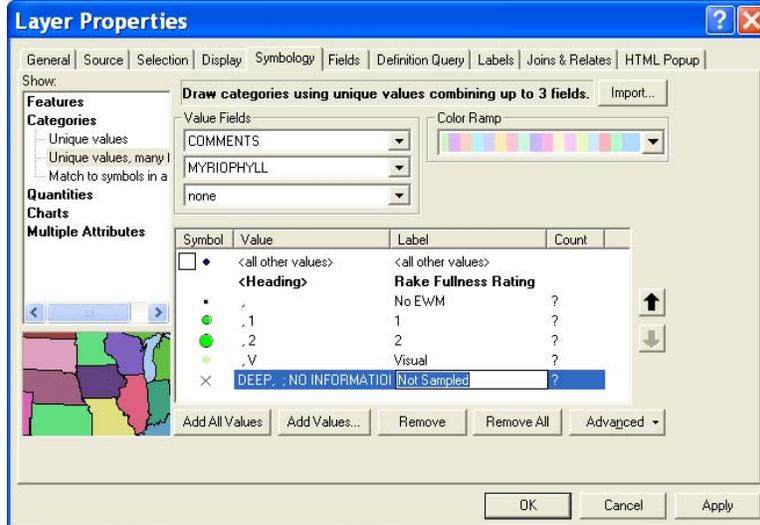
- j. You can change the label name of the symbol being represented by clicking on the respective space under “Label” (e.g. change “ , , ” to “No EWM”; “ , ,1” to “1”; “ , ,V” to “Visual”; “Deep, ” to “Not Sampled”)



- k. You can also group values together (e.g. No Information, Deep, Shallow, etc)
 - i. Hold down the Shift key and highlight all rows that should be grouped



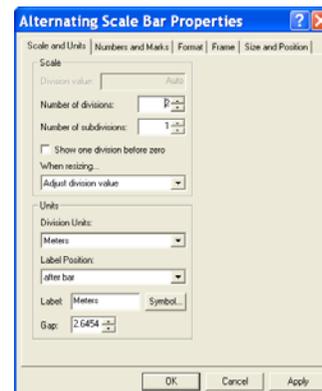
- ii. Right click on highlighted rows and select “Group Values”
- iii. The final Layer Properties dialog box should look similar to this: Note: If you want to change the order that these will appear in the legend, highlight a row and use the arrows on the right side to move.
- iv. Click “Apply” then “OK” to update symbols on map



- v. The polygon shapefile fill color and outline may also be modified similarly under the “Symbology” tab

12. Map Page Layout

- a. Verify that the coordinate system is defined correctly for the Data Frame
 - i. Select View → Data Frame Properties → Coordinate System Tab
 - ii. If the coordinate system is incorrectly defined, browse for the correct coordinate system
 - 1. Predefined → Projected Coordinate System → State Systems → NAD 1983 HARN Wisconsin TM.prj
- b. View → Layout View
- c. File → Page and Print Setup → Select Landscape or Portrait
- d. Modify size/shape of data frame to fit on entire page and serve as map border
 - i. Right click data frame, select Properties, under the ‘Frame’ tab, change border to a thickness of 2 and select OK.
- e. Insert → North Arrow
 - i. Size and position appropriately
- f. Insert → Scale Bar
 - i. Select “Alternating Scale Bar 1” and click “OK”
 - ii. Double-click on Scale Bar in Layout view to edit properties
 - iii. Set the following properties:
 - 1. Number of divisions: 2
 - 2. Number of subdivisions: 1
 - 3. Set units to kilometers

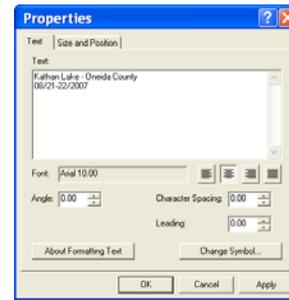


4. Click “OK”

g. Insert → Text

i. Double-click on Text Box to edit information

1. Create text box with the following information:
 - a. Lake Name, County, Date Sampled, etc.
2. Format text as appropriate using “Change Symbol...” button



h. Insert → Picture → Navigate to WDNR Logo (Black & White)

i. Size and position appropriately

i. Legend

i. In the table of contents, modify the displayed name of your shapefile as you would like it to appear in your legend by single clicking on the text

ii. Insert → Legend

iii. Choose which layers you want to include in your legend

1. Include the layer that has the plant distribution symbology information

2. You may have to remove the polygon layer by highlighting it under “Legend Items” and clicking the single left angle bracket (<), then select “Next”

iv. Remove the word “Legend” from the Legend Title and select “Next”

v. Continue selecting “Next” and then “Finish”

vi. Format legend text

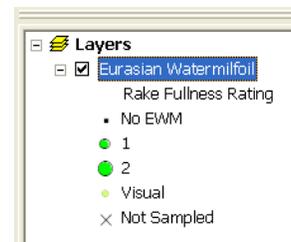
1. Right click on Legend and select “Properties”

vii. Size and position legend as appropriate

j. If you’re going to be switching between maps quickly to look at comparisons between years or species, we suggest making and refining the layout first, then saving it as an ArcMap Template so you can use the same one each time

i. File → Save As → Save As Type: ArcMap Template

k. Check printed map for color accuracy before you export (Step 13). Sometimes the colors may look different on screen, but may print with the same hue and value, making interpretation impossible. You can set a custom color if necessary.



13. Saving Map as JPEG

a. File → Export Map

i. Save as type: JPEG

ii. Set Resolution: 300 dpi

iii. Navigate to appropriate folder and Save

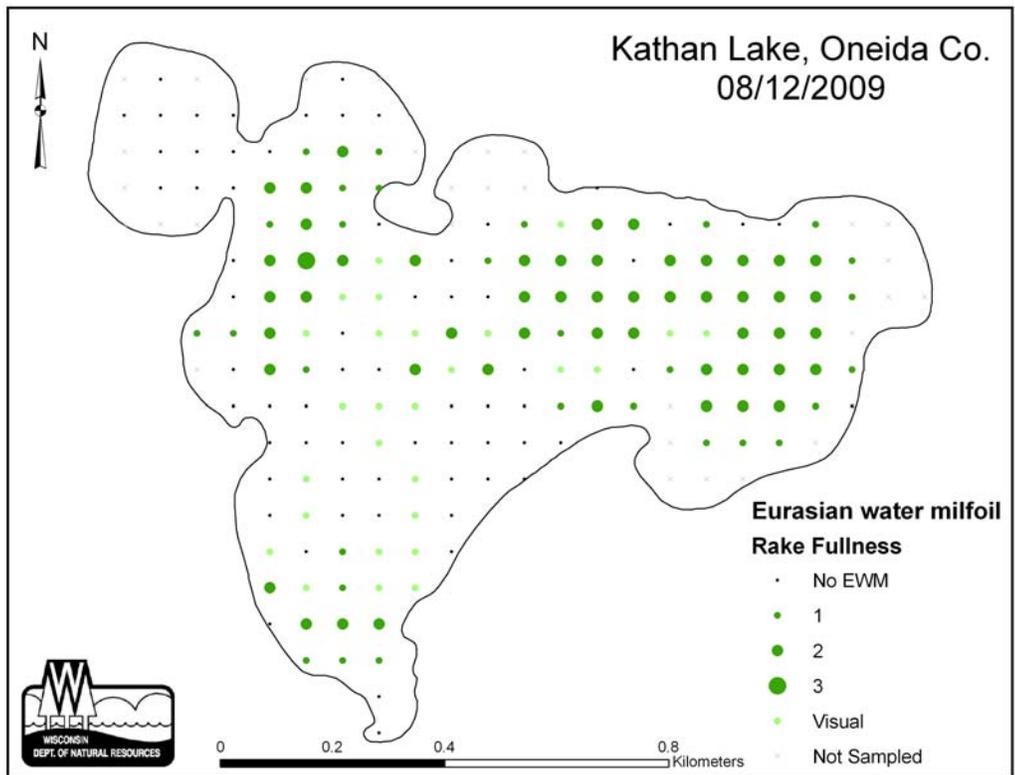


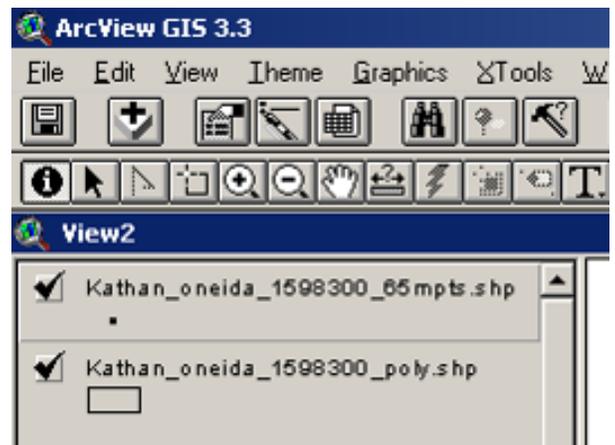
Figure 6: Example plant distribution map created using point-intercept data and ArcGIS 9.3 software for Kathan Lake, Oneida County.

Appendix 4

Creating a Plant Distribution Map Using Point Intercept Data in ArcGIS 3.3

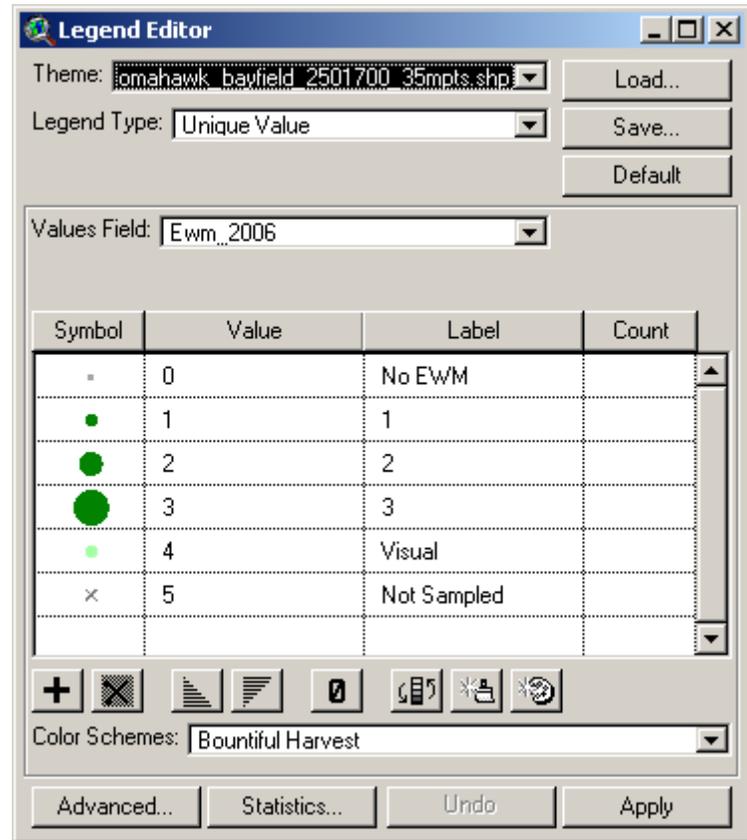
This is a protocol for making plant maps using ArcView GIS 3.3 and the Aquatic Plant Survey Data Workbook Excel file <Appendix-C.xls.>. This protocol can be changed in a number of different ways and still produce a similar product. The best way to make PI-based maps depends on the particular dataset; however, this procedure works well in most cases. Similar images may be created in PowerPoint or in photo editing software if the dataset is not large or complex.

1. Save the ArcView shapefiles (*.shp, *.dbf, *.sbn, *.shx, *.sbx, *.sbn) to a folder on a local drive.
 - a. We'll refer to this folder as "MapFolder"
2. Open ArcView and create a new project with a new view.
 - a. Click "yes" to add data
3. Add shapefiles from MapFolder
 - a. You can add multiple files at once by holding down "shift" while you click the individual files
4. View window: select the point file
 - a. Make sure both themes have the box checked in order to view them
 - b. Click once on the point layer to activate that theme (raised box around that item)
 - c. If necessary, drag the activated point layer above the polygon layer in order to see the sample points
5. Open theme table
 - a. Theme > Table or
 - b. The open theme table shortcut button
6. Start editing, add variable column
 - a. Table > Start Editing
 - b. Edit > Add Field
 - i. Enter the name of the field (e.g. EWM_2009)
 - ii. Specifications 'type', 'width', and 'decimal places' do not need to be changed
 - iii. Click "OK"
7. Stop editing, save edits
 - a. Table > Stop Editing, 'Yes' to save edits
8. Export point file



- a. File > Export
 - b. Select 'dBASE'
 - c. Select MapFolder to save file
 - d. Default will be named <table1.dbf>
 - e. Close table
9. Set-working directory
- i. File > Set Working Directory
 - ii. Change working directory to MapFolder
10. Save project, exit ArcView
- a. File > Save Project As > save in MapFolder (for ease of reference, lets call the file EWM_Map.apr)
 - b. Exit ArcView
11. Open file saved in step 8 with Excel
- a. Open excel; Open a file, when prompted to find the file, navigate to MapFolder
 - b. In "Files of type" option bar select "All files"
 - c. Open <table1.dbf>
12. List information under data field created (EWM_2009)
- a. Open PI data entry excel file (WiAPMS.xls)
 - b. Copy columns "Sample point, Depth, Comments, & EWM"
 - c. Paste special "values" into new excel workbook
 - i. Edit > Paste Special > Values
 - d. Highlight all data, sort by comments
 - i. Data > Sort > Comments
 - e. Enter the number 5 into EWM column for all unsampled sites (deep, terrestrial, non-navigable, etc) (this is so the legend can code these sites)
 - f. Highlight EWM data column and replace all blanks with 0 (zero), and V (visuals) with 4
 - i. Edit > Replace, replace all
 - g. Highlight all data, re-sort by sampling site
 - i. Data > Sort > Sampling Point
 - h. Copy EWM column, excluding header, paste into the .dbf file (already open, originally created in step 8)
 - i. "Save as" this file as the **original dbf** file's name (the copy you placed in MapFolder, not the original file, obviously)
 - i. i.e. overwrite the ISS original (e.g. Kathan_Oneida_1598300_65mpts.dbf) with the new file you just modified in excel. The name must be EXACTLY the same!!
 - ii. Close excel
13. Reopen project in ArcView
- a. Open existing project

- b. Open MapFolder and click on EWM_Map.apr (or whatever you chose to name it in step 9)
14. Create legend
- a. Double-click point symbol in the View frame to open the legend window
 - b. In “Legend Type” option bar, choose “Unique Value”
 - c. In “Values Field” option bar select “EWM_2009” column (or whatever column you want this map to show)
 - d. Apply
 - e. You must now choose appropriate symbols and colors for the different variables being expressed by the legend. You can change the symbol by double clicking on it
 - f. Typically we use increasing sizes of a green circle for EWM density ratings (values: 1, 2 , 3), a small light green circle for visuals (value: 4), a small black dot for sites sampled, but without EWM, (value: 0), and a small “x” symbol for sites not sampled (value: 5).
 - g. You can change the label name of the symbol being represented by clicking on the respective cell under “Label”. (e.g. change “5” to “Not Sampled”, change “4” to Visual)
 - h. The color or shading of the polygon can also be changed by double clicking on the theme



15. Set units
- a. View > Properties
 - b. Change map units to “meters” and distance units to “kilometers”

16. Layout
- a. View > Layout
 - b. Select Landscape or Portrait
 - c. Double-click ‘View1’ to change map title
 - d. Double-click scale bar to adjust range or units
 - e. If you’re going to be switching between maps quickly to look at comparisons between years or species, we suggest making and refining the layout first, then saving it as a Template (Layout > Store as Template) so you can use the same one each time.

- f. Check printed map for color accuracy before you export (step 17). Sometimes the colors may look different on screen, but may print with the same hue and value, making interpretation impossible. You can set a custom color if necessary.

17. Save as JPEG

- a. Have the final layout window active
- b. Select File > Export
- c. In “List Files of Type” option bar, select JPEG
- d. Click ‘Options’ button
 - i. Set resolution to highest number
 - ii. Likely 144 DPI and Quality = 100
- e. Type file name, choose location in which to save the JPEG
- f. Click OK

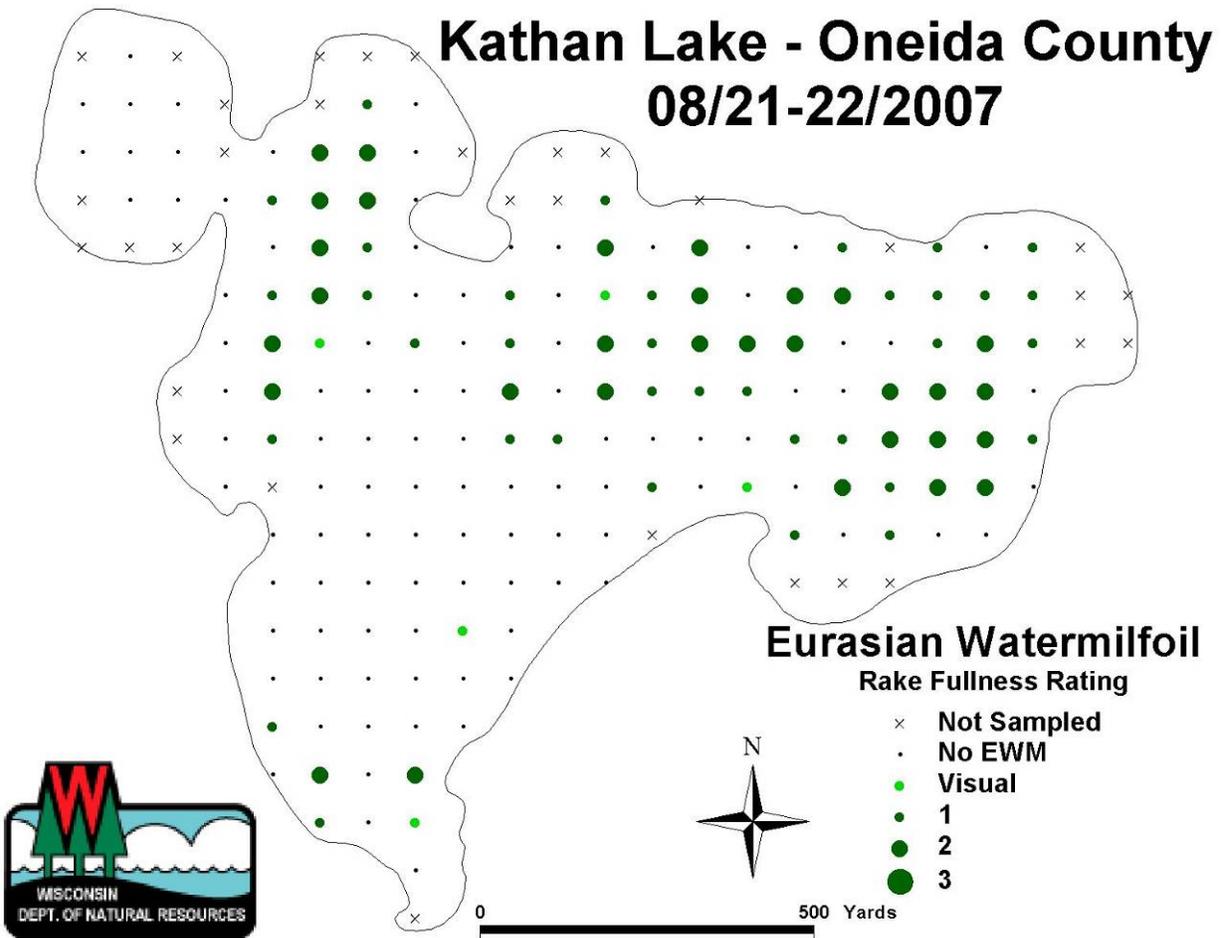


Figure 7: Example plant distribution map created using point-intercept data and ArcGIS 3.3 software for Kathan Lake, Oneida County.

Document citation:

Hauxwell, J., S. Knight, K. Wagner, A. Mikulyuk, M. Nault, M. Porzky and S. Chase. 2010. Recommended baseline monitoring of aquatic plants in Wisconsin: sampling design, field and laboratory procedures, data entry and analysis, and applications. Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010. Madison, Wisconsin, USA.



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- conducting research and acquiring original knowledge.
 - analyzing new information and emerging technologies.
 - synthesizing information for policy and management decisions.
 - applying the scientific method to the solution of environmental and natural resources problems.
 - providing science-based support services for department initiatives.
 - collaborating with local, state, regional, and federal agencies and academic institutions in Wisconsin and around the world.
-



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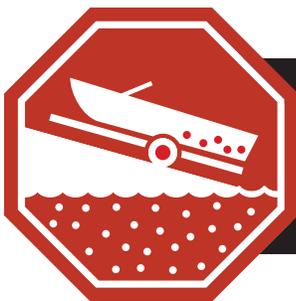
Appendix E. Information Sign and Brochures

PREVENT THE SPREAD OF **INVASIVE SPECIES** IT'S THE LAW

PENALTIES MAY EXCEED \$2000

Before *launching* and before *leaving* **YOU MUST:**

- ✓ **INSPECT** boats, trailers, and equipment.
- ✓ **REMOVE** all attached aquatic plants and animals.
- ✓ **DRAIN** all water from boats, vehicles, and equipment.
- ✓ **NEVER MOVE** plants or live fish away from a waterbody.*



STOP AQUATIC HITCHHIKERS!

Prevent the spread of invasive species, it's the law



*Limited exceptions apply. Visit WWW.DNR.WI.GOV and search for "BAIT LAWS."

FOR MORE INFORMATION

If you would like more information about aquatic invasive species, the problems they cause, regulations to prevent their spread, or methods and permits for their control, contact one of the following offices:

Wisconsin Department Of Natural Resources
888-WDNRINFO
DNR.WI.GOV search "Aquatic Invasives"

University of Wisconsin- Extension
(715) 346-2116
WWW.UWSP.EDU/CNR/UWEXLAKES

Wisconsin Sea Grant
(608) 262-0905
WWW.SEAGRANT.WISC.EDU
WWW.PROTECTYOURWATERS.NET

Thanks to the following for supporting educational efforts on aquatic invasive species:

- U.S. Fish and Wildlife Service
- Great Lakes Indian Fish and Wildlife Commission
- National Park Service

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Environmental Resources Center, UW-Extension

Photo Credits:
Sea Grant, UW-Extension, DNR



STOP Aquatic HITCHHIKERS



ENJOYING THE GREAT OUTDOORS

Enjoying the great outdoors is important to many of us. Boating, fishing, hunting, and wildlife watching are traditions that we want to preserve for our children and their children. Today, these traditions are at risk. Aquatic invaders such as zebra mussels, purple loosestrife, Eurasian water-milfoil, bighead and silver carp, threaten our valuable waters and recreation. These and other non-native, or exotic, plants and animals do not naturally occur in our waters and are called invasive species because they cause ecological or economic harm.

These invasive species can get into lakes, rivers, and wetlands by "hitching" rides with anglers, boaters, and other outdoor recreationists, who transport them from one waterbody to another.

Once established, these "aquatic hitchhikers," can harm native fisheries, degrade water quality, disrupt food webs and reduce the quality of our recreational experiences.



The good news is that the majority of waters are not yet infested with invasive species and by taking the necessary steps you can help protect our valuable waters.

If you think you have found
an **INVASIVE SPECIES:**

REPORT NEW SIGHTINGS

If you suspect a new infestation of an invasive plant or animal, save a specimen and report it to a local Department of Natural Resources or Sea Grant office. Wisconsin has "ID" cards, websites, and volunteer monitoring networks to help you identify and report invasive species.



Eurasian Watermilfoil

Eurasian Ruffe

New Zealand
Mudsnail

CONSULT YOUR NATURAL RESOURCE AGENCY

Do-it-yourself control treatments may be illegal and can make matters worse by harming native fish, wildlife, and plants. Before attempting to control an invasive species or add new plants along your shoreline, contact your local Department of Natural Resources office. DNR staff can provide recommendations and notify you what permits are required.



Spiny Water Fleas

Zebra Mussels

Curly Leaf Pondweed

DNR.WI.GOV search "Aquatic Invasives"



STOP AQUATIC HITCHHIKERS

IS A NATIONAL CAMPAIGN THAT HELPS RECREATIONAL USERS TO BECOME PART OF THE SOLUTION TO STOP THE TRANSPORT AND SPREAD OF AQUATIC INVASIVE SPECIES.

IN WISCONSIN IT IS THE LAW...

Aquatic hitchhikers can spread in many ways such as on recreational equipment, and in water. Fortunately, there are a few simple actions you can take to prevent them from spreading.



INSPECT boats, trailers, and equipment

REMOVE all attached aquatic plants, animals, and mud before launching and before leaving the water access.

Many invasive species spread by attaching themselves to boats, trailers, and equipment and "hitching a ride" to another waterbody. Therefore, Wisconsin law requires that you remove these aquatic hitchhikers before you launch your boat or leave the access area.

DRAIN all water from your boat, motor, bilge, live wells, bait containers and all equipment before leaving the water access.

Many types of invasive species are very small and easily overlooked. In fact, some aquatic hitchhikers, like zebra mussel larvae, are invisible to the naked eye. To prevent the transport of these aquatic hitchhikers drain water from all equipment before you leave the access area.



For more information visit: **DNR.WI.GOV** and search "bait laws"

Draining ballast water and lake or river water can prevent the spread of aquatic invasive species and fish diseases, like VHS.

NEVER MOVE

plants or live fish away from a waterbody.

In Wisconsin, it is illegal to transport any aquatic plants, mud, live fish or live fish eggs away from any state waterbody. This includes live gamefish and roughfish, like gizzard shad. There are exceptions for minnows obtained from a Wisconsin licensed bait dealer or registered fish farm, which may be transported away live and used again:

- *On the same waterbody, or*
- *On any other waterbody if no lake or river water, or other fish were added to their container*



BUY minnows from a Wisconsin licensed bait dealer.

For more information on collecting your own minnows visit:

DNR.WI.GOV and search "VHS Prevention"



DISPOSE of unwanted bait and other animals or aquatic plants in the trash.

If possible, dispose of ALL unwanted bait (including earthworms) in a trash can at the boat landing or access point. Otherwise, take them home and dispose of them by placing them in the trash, composting them, or using them in a garden as fertilizer. Likewise, other aquatic plants or animals that you collect, or buy in a pet store, should NEVER be released into the wild.



When possible, dispose of unwanted bait in the trash at access points. Never release them into the environment.

WISCONSIN REGULATION

Wisconsin has several laws to prevent the spread of aquatic invasive species and the fish disease Viral Hemorrhagic Septicemia (VHS). Failure to follow Wisconsin law can result in fines up to or exceeding \$2000. Don't be caught unaware!

ADDITIONAL STEPS:

Although not required by WI law, additional steps are highly recommended, particularly if you are transporting a boat and/or equipment from one waterbody to another. Additional steps include:

SPRAY, RINSE, or DRY boats and recreational equipment to remove or kill species that were not visible when leaving a waterbody. Before transporting to another water: *Spray/rinse with high pressure, and/or hot tap water (above 104° F or 40° C), especially if moored for more than a day. OR Dry for at least five days.*

DISINFECT boats and recreational equipment to kill species and fish diseases that were not visible when leaving a waterbody. Many aquatic hitchhikers can survive out of water for some period of time. *To prevent their spread, you can sanitize your boat, trailer or equipment by washing it with a mixture of 2 Tbs of household bleach per 1 gallon of water.*

OTHER WATER USES:



Don't get caught spreading aquatic invasive plants or animals! Wisconsin laws, as highlighted above, can apply to many types of water activities, not just boating and fishing. Although these activities might not seem dangerous, they CAN establish and spread invasive species. It is important you follow the steps above for all water activities in order to prevent the spread of aquatic invasive species. These activities include:

- *Using personal watercraft*
- *Shore and fly-fishing*
- *Sailing*
- *Scuba Diving*
- *Waterfowl hunting*



FAILURE TO FOLLOW WISCONSIN LAWS CAN LEAD TO FINES.

For additional information contact your local DNR staff or visit: **DNR.WI.GOV**

Protect Your Boat

Zebra mussels attach to a variety of materials, including fiberglass, aluminum, wood, and steel and may damage a boat's finish. Veligers are extremely small and can be drawn into engine passages. Once they settle out in the engine cooling system, they can grow into adults and may block intake screens, internal passages, hoses, seacocks, and strainers. The best ways for boat owners to avoid these types of damage are:

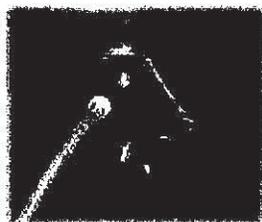
- Use a boatlift to completely remove the watercraft from the water when not in use.
- Run your boat regularly if it is moored in zebra mussel infested waters. Run the engine at least twice a week at slow speeds (about 4-½ mph) for 10 to 15 minutes. Monitor engine temperatures – if you notice an increase, it may mean that zebra mussels are clogging your cooling system. Immediately inspect the system and remove any zebra mussels. The end of boating season is also a good time to inspect and clean the cooling system.
- Lift the motor out of the water between uses if mooring. Fully discharge any water that may still remain in the lower portion of the cooling system.
- Tip down the motor and discharge the water when leaving a waterbody to reduce the likelihood of transporting veligers (in water) to another waterbody.



- Clean your boat and equipment. Physically remove (scrape) adult mussels from your boat, trailer, and equipment by hand. Young zebra mussels and veligers may be too small to see. Wash your boat with high-pressure hot water (use water >104°F if possible). Use high-pressure cold water if hot water is not available. (Avoid pressure washing classic wooden boats or others not made of metal.)

- Apply anti-fouling paints or coatings to the hull and the engine's cooling system to prevent zebra mussel attachment. It is best to purchase these from an area boat dealer or your local marina. Anti-fouling paints that are copper based can be used in Wisconsin, and typically need to be reapplied every one to two years. In-line strainers can also be installed in the engine's cooling system.

- Use motor "muffs", also known as motor flushers, to remove zebra mussels and other materials from your boat engine or personal watercraft. Clamp the motor



Amy Bellows, WI DNR

flusher onto the lower unit over the cooling inlets on either side of the motor, and screw the nozzle of your garden hose into it. Run the boat engine for approximately 10 minutes or as suggested by the manufacturer.

Special note of caution for anglers

Dispose of unwanted bait in the trash - do not transfer bait or water from one waterbody to another. Larval zebra mussels or other invasive species could be present in the water with the bait.



Help prevent aquatic hitchhikers from catching a ride on your boat or equipment:

- Inspect and remove aquatic plants and animals,
- Drain water,
- Dispose of unwanted bait in the trash,
- Rinse with hot and/or high-pressure water, OR
- Dry for 5 days.

Clean Boats . . . Clean Waters

For a list of known zebra mussel infested waters, visit:

www.dnr.wi.gov/org/water/wm/GLWSP/exotics/zebra.html

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Sea Grant

STOP AQUATIC HITCHHIKERS
Prevent the transport of aquatic species.
Clean all recreational equipment.

Cover photo: L. Pohlod. Inset: Great Lakes Sea Grant Network
Designed by L. Pohlod, Blue Sky Design, LLC PUB-WT-383 2004

Zebra Mussel Boater's Guide

Looking to the future . . . protect your boat and our waters!

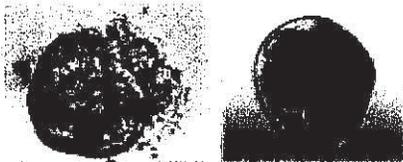
Zebra mussel identification and life cycle

Mature zebra mussels look like small D-shaped clams. Their yellowish-brown shells have alternating light and dark stripes.

Zebra mussels can reach a maximum of 2 inches in length, though most are smaller than an inch. They are typically found attached to solid objects, often growing in large clusters.



Ohio Sea Grant



Ontario Ministry of Natural Resources Amy Bellows, WI DNR

Zebra mussels begin as eggs, then develop into free-swimming larvae (called veligers), which are microscopic. The veliger photos shown above were taken with the aid of a microscope. Veligers are spread by currents; after about three weeks, they settle out and firmly attach themselves to hard surfaces, where they grow into adults. Their lifespan is typically three to five

years. They begin to reproduce after a year or two - females can release up to one million eggs per year!



James Lubner, University of Wisconsin Sea Grant

What do zebra mussels do?

Zebra mussels are filter feeders that can filter large volumes of water (up to 1 Liter/day). In some cases they can filter the whole volume of a lake in a few months. They remove plankton - tiny plants and animals - from the water. What they eat (and what they don't eat) ultimately ends up on the lake or river bottom. Plankton is an important food source for young fish, native mussels, and other aquatic organisms. Zebra mussels may concentrate this food at the bottom, leaving open water species with less to eat!

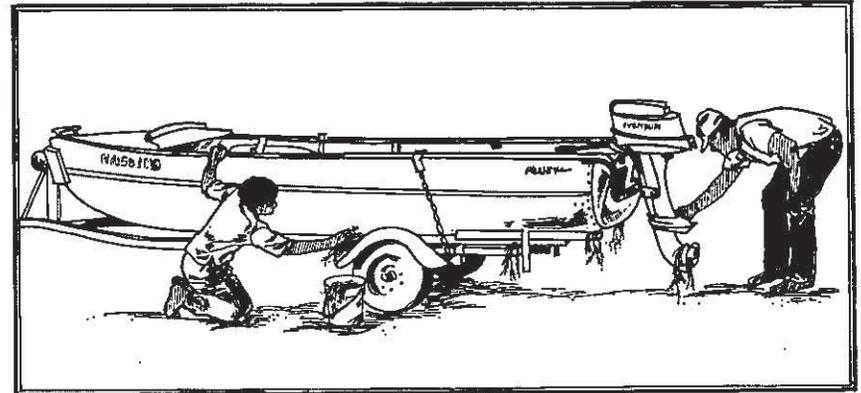
Because they are so good at filtering, zebra mussels often **make water clearer**. This may force light-sensitive fish, like salmon and walleye, into deeper water to seek shelter from the sun. Increased light penetration allows aquatic plants to grow in deeper water and spread to a larger area. This may help smaller fish to survive by giving them places to hide, but makes it harder for large, predatory fish to find food. **Thicker plant growth** may also cause problems for boaters and anglers.



Don Schloesser, Great Lakes Science Center, National Biological Services

Zebra mussels cause people additional problems. They clog water intakes and pipes - large water users on the Great Lakes spent \$120 million from 1989 to 1994 to combat zebra mussels. They also attach to piers, boatlifts, boats, and motors, which can cause damage requiring costly repair and maintenance. Even when they die, their sharp shells wash up on beaches, creating foul odors and cutting the feet of swimmers.

How can I help prevent the spread of zebra mussels?



Microscopic veligers may be carried in livewells, bait buckets, bilge water - any water that's transported to another waterbody. They can also travel in currents to downstream waters. Adults can attach to boats or boating equipment that are moored in the water. They frequently attach to aquatic plants, which themselves may hitch a ride on boats and equipment. For these reasons, it is important to take the following steps to prevent the spread of zebra mussels and other aquatic invasive species while boating:

Before moving your boat from one water body to another:

- ✓ **Inspect and remove** aquatic plants, animals, and mud from your boat, trailer, and equipment,
- ✓ **Drain** all water from your equipment (boat, motor, bilges, transom wells, live wells, etc.),
- ✓ **Dispose** of unwanted bait in the trash, not in the water,

- ✓ **Rinse** your boat and equipment with hot (> 104°F) and/or high pressure water, particularly if moored for more than one day, OR
- ✓ **Dry** your boat and equipment thoroughly (in the sun) for five days.

Pressure washing note:

- ✗ Avoid pressure washing classic and wooden boats, along with canoes and kayaks that are not made of metal. These types of boats should be drained, cleared of all plant and animal materials, and left in the sun to dry completely.

Effective May 2002, Section 30.715, WI Act 16 prohibits launching a boat or placing a boat or trailer in navigable waters if it has aquatic plants or zebra mussels attached.

Regulated Aquatic Invasive Plants in WI

Please report any **prohibited** species (as indicated by the red frame box) to the WDNR.

Report by email to: Invasive.Species@wi.gov or by phone at: (608) 266-6437

OR to find out more information, for information on reporting restricted species and whom to contact go to:

<http://dnr.wi.gov/invasives/aquatic/whattodo/>



Flowering rush
(*Butomus umbellatus*)



Purple loosestrife
(*Lythrum salicaria*)



Curly-leaf pondweed
(*Potamogeton crispus*)



Eurasian water milfoil
(*Myriophyllum spicatum*)



Australian swamp stonecrop
(*Crassula helmsii*)



Brazilian waterweed
(*Egeria densa*)



Hydrilla
(*Hydrilla verticillata*)



European frog-bit
(*Hydrocharis morsus-ranae*)



African elodea
(*Lagarosiphon major*)



Parrot feather
(*Myriophyllum aquaticum*)



Brittle water nymph
(*Najas minor*)



Yellow floating heart
(*Nymphoides peltata*)



Water chestnut
(*Trapa natans*)



Fanwort
(*Cabomba caroliniana*)



Didymo or rock snot (alga)
(*Didymosphenia geminata*)



Starry stonewort (alga)
(*Nitellopsis obtusa*)

 Restricted Species

 Prohibited Species

For more information about NR 40 (WI's Invasive Species Rule), Restricted, or Prohibited species please visit: www.dnr.wi.gov/invasives/classification

Bureau of Watershed Management
Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707-7921



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Design and Layout by Bonnie Reichert

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-  **INSPECT** boats, trailers, and equipment.
-  **REMOVE** all attached aquatic plants and animals.
-  **DRAIN** all water from boats, vehicles, and equipment.
-  **NEVER MOVE** plants or live fish away from a waterbody.*



STOP AQUATIC HITCHHIKERS!

Prevent the spread of invasive species, it's the law



*Limited exceptions apply. Visit WWW.DNR.WI.GOV and search for "BAIT LAWS."

Chapter NR 40:

Invasive Species Identification Classification and Control Boater & Angler Summary

The Invasive Species Rule (Chapter NR 40) went into effect on September 1, 2009. The rule establishes a comprehensive, science-based way to classify and regulate invasive species in Wisconsin. The rule divides species into 2 categories, "Prohibited" and "Restricted," with different regulations and control requirements. The rule also establishes "Preventative Measures" to show what actions we can take to slow the spread of invasive species. The preventative measures of NR 40, along with the measures required by Act 55, the "No Transport Law" may require changes in boater and angler actions.

Following the *Prevent the Spread* guidelines on the left is a great start to following these laws. Additional information and requirements for the Invasive Species Rule are listed below.

Prohibited Invasive Species

- These species are not yet in the state or only in a few places
- These species are likely to cause environmental and/or economic harm
- It is still possible to eradicate these species and prevent their spread statewide

Regulations: **Cannot transport, possess, transfer, or introduce without a permit***
Control Authority: Control is required. DNR may order or conduct a control effort

Restricted Invasive Species

- These species are already widely established in the state
- High environmental and/or economic impacts are evident with these species
- Complete eradication of these species is unlikely

Regulations: **Cannot transport, transfer, or introduce without a permit***
Possession is allowed except for fish or crayfish

Control Authority: Control is encouraged but not required
*Any viable part of the species is covered by these regulations.

Preventative Measures

- Drainage of water from boats and removal of aquatic plants and animals from equipment is required before entering onto a road or coming into the state
- The introduction of non-native aquatic plants prohibited
- The transport of live fish and eggs are prohibited
- You may not use prohibited fish or crayfish as bait

For more information, please visit: www.dnr.wi.gov/invasives/classification

Or contact the WDNR Invasive Species Project Coordinator at:

Email: Invasive.Species@wi.gov or **Phone:** (608) 266-6437

Why Should Purple Loosestrife Concern You?

- Plant diversity in wetlands declines dramatically and many rare and endangered plants found in our remaining wetlands are threatened.
- Most wetland animals that depend on native plants for food and shelter decline significantly. Some species, such as Baltimore butterflies, marsh wrens, and least bitterns may disappear entirely.
- Recreational uses of wetlands for hunting, trapping, fishing, bird watching and nature study decrease. Thick growth of purple loosestrife may impede boat travel.
- Wetlands may store and filter less water.
- Millions of dollars spent to preserve wetlands would be wasted.

Photo credits: Dennis Woodland, Asa Thorenson, Clifford Orstead, Mary Melgard, Kitty Kohout, Paul Berry, Merel Black, Dan Woodland, Robert Beirman and Emmet Judziewicz.

Pickeral Weed:
Pontederia cordata
Flowers 2-lipped, spikes 3"-4"; leaves heart shaped, single; water, 1' to 3'



False Dragonhead:
Physostegia virginiana
Tubular flowers, dissimilar petals; toothed leaves; 1' to 5' (Other large mint family plants: Hedge Nettle, Giant Hyssop)



Fireweed:
Epilobium angustifolium
Fatter spikes of 4-petaled, stalked flowers; alternate, toothed leaves; northern plant of drier areas; 2' to 6'



Swamp Loosestrife:
Decodon verticillatus
Flowers bunched at well-separated leaf bases; leaves whorled in 3s or 4s; stems usually arching, 1' to 8'



Look-a-likes



PURPLE LOOSESTRIFE
DO NOT CONFUSE THESE NATIVE SPECIES WITH PURPLE LOOSESTRIFE!

Smartweed:
Polygonum sp. (many native species) - Tiny flowers, skinny spikes 1' to 4"; alternate leaves clasp stem at base; stems jointed, 1' to 6'



Blue Vervain:
Verbena hastata (+ other *Verbena* sp.)
Flowers tiny, pencil thin spikes; toothed, oval, stalked leaves; moist to dry places; 2' to 6'



Steeplebush:
Spiraea tomentosa
Tiny flowers, conical set of flower spikes; alternate, oval leaves; woody stem 1' to 4'



Gayfeather, Blazing Star:
Liatris pycnostachya (+ other *Liatris* sp.) - Shorter flower spike of tufted flower heads, many skinny petals; grasslike leaves; 2' to 4'



Lupine:
Lupinus perennis
Pea-like flowers; alternate, palm-like leaves; dry, sandy places; 2' to 4'



Winged Loosestrife:
Lythrum alatum
Smaller, single flowers at well-separated leaf bases; upper leaves single; southern prairies, 2' to 3'



Joe-Pye Weed:
Eupatorium maculatum
Flowers heads in flat-topped clusters; whorls of 3 to 6 toothed leaves; 3' to 9' (Other flat-topped, native flowers: Ironweed, Marsh Milkweed)



Smooth Phlox:
Phlox glaberrima (+ other *Phlox* sp.) - Flowers tubular, flat topped, petals alike, in loose round arrangement; often wooded settings; 1' to 4' (Other tubular, flat petalled flowers may not be native, e.g. Dame's Rocket)



IDENTIFICATION

Growth: Upright, semi-woody perennial with a dense bushy growth of 1 to 50 stems. The square to many sided, green to red stems grow 3' to 9' feet tall and die back each fall. Old stems may persist for several years. Often found in clumps of several plants.

Flowers: Purple to pink and on numerous long spikes. Individual flowers are 1/2" to 3/4" across, with 5 or 6 petals.

Seeds: Tiny, smaller than a pin head. 2 to 3 million produced annually on each healthy, mature plant.

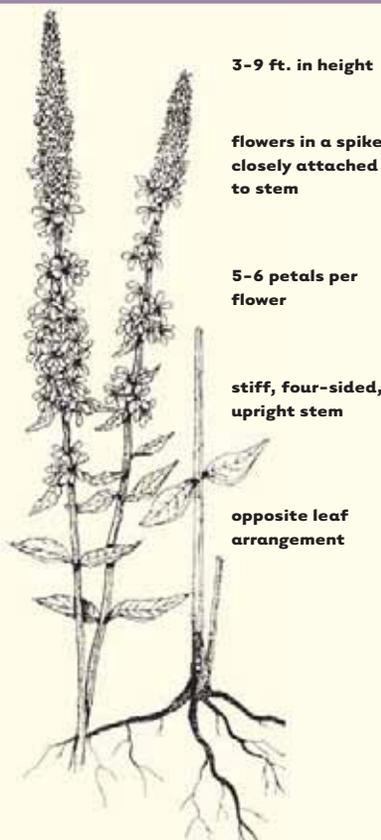
Leaves: Variable, usually opposite, but sometimes alternate or bunched in whorls. Linear shaped; smooth edged; sometimes hairy; attached directly (no stalks) to stems with each pair at 90 degrees to those above and below. No noticeable odor.

Root: Woody with many fibrous side roots forming a dense mat. Root masses may be several feet across in old clumps.

Blooming period: Late June through early September. Spike blooms from bottom up. Lower pods may drop seeds while upper blooms are still present.

Habitat: Moist-soil to shallow-water sites, such as wet meadows and pastures, marshes, stream and river banks, lake shores and ditches. Established plants tolerate dry conditions, such as gravel roadsides and abandoned fields. Still planted (illegally) in some gardens.

Distinguishing it from similar species: Few other wetland plants grow as tall with numerous square or multisided stems and brilliant purple spikes that turn into candelabras covered with many small, oval pods.



3-9 ft. in height

flowers in a spike; closely attached to stem

5-6 petals per flower

stiff, four-sided, upright stem

opposite leaf arrangement

THE ECOLOGICAL PROBLEM

Purple loosestrife is an attractive wetland perennial plant from Europe and Asia that was introduced to North America without the specialized insects and diseases that keep it in check in its native lands. Freed from its natural controls, purple loosestrife grows taller and faster than our native wetland plants. These advantages and prolific seed production have allowed it to invade many Wisconsin wetlands to the near total exclusion of most other vegetation. Once established, it literally shades everything else out. Loosestrife has spread rapidly in Wisconsin over the last 20 to 30 years.

FOR MORE INFORMATION :

On invasive species, including purple loosestrife, access the Department of Natural Resources web site (search for purple loosestrife) at:

www.dnr.wi.gov/org/caer/ce/invasives

Contact your region's WDNR Aquatic Plant Management Coordinator for herbicide permits. For purple loosestrife biocontrol information contact the Wisconsin Purple Loosestrife Biocontrol Program at: 1350 Femrite Dr., Monona WI 53716, (608) 221-6349, or email: brock.woods@dnr.state.wi.us

PURPLE Loosestrife

(*Lythrum salicaria* & *Lythrum virgatum*)



A MAJOR THREAT TO WISCONSIN'S WETLANDS AND WATERWAYS



gate that WDNR and UWEX have created a program in which hundreds of citizens have raised and released millions of beetles. Though purple loosestrife will never be eliminated from Wisconsin, the release of sufficient numbers of these biocontrol insects, in combination with continued use of traditional control methods, may restore a more natural balance between purple loosestrife and other wetland species.

You Can Help!

1 LEARN TO IDENTIFY PURPLE LOOSESTRIFE. Distinguish it from native look-a-likes by using the photos, or get a good plant book. (Note that several valuable native yellow-flowered plants in the genus *Lysimachia* are also known as "loosestrifes")

2 REPORT PURPLE LOOSESTRIFE INFESTATIONS. Check the web site map to see if your sites were previously reported. If not, or if they have changed substantially, send the new site information to the WDNR using their Watch Form found online or send information to brock.woods@dnr.state.wi.us, the Wisconsin Purple Loosestrife Biocontrol Program.

3 HELP PREVENT THE SPREAD OF PURPLE LOOSESTRIFE:

- ✓ Clean off equipment, boats and trailers, clothing and footwear used in infested areas before moving into uninfested areas.
- ✓ Encourage your local highway department to stop mowing the plant. Cut-up stem pieces will root when spread to new moist ground, and mowing can spread its seeds along the roadway.

✓ Help curb local use of the plant. State law bans the sale, distribution or cultivation of purple loosestrife in Wisconsin: §100 fine per violation [sec.23.235, p.3]. The law includes all cultivars, hybrids and varieties of *Lythrum salicaria* and *L. virgatum*. Report sales of the plant to the Wis. Dept. of Agriculture, Trade and Consumer Protection at (608) 224-4571. Work with local government to curb local cultivation or distribution. Help educate local gardeners about invasive plants and encourage them to use native plants (see photos).

✓ Watch for pioneering loosestrife plants and remove them immediately, especially from areas otherwise free of loosestrife.

4 HELP ELIMINATE ESTABLISHED LOOSESTRIFE IN YOUR AREA Citizen action is critical, as many infestations are on private property. Choose traditional or biological control methods or use them in combination.

5 TEACH ABOUT INVASIVE SPECIES AND CITIZEN ACTION

Use See Cella Chow: *A Purple Loosestrife Biocontrol Manual for Educators*, found at www.dnr.wi.gov/org/es/science/publications/ss981_2003.htm

HOW DOES PURPLE LOOSESTRIFE SPREAD?

Purple loosestrife spreads primarily by seed, but it can also establish from bits of root or broken stem fragments that readily root in moist soil. A mature loosestrife plant annually produces over 2 million tiny seeds that may remain viable in the soil for many years. Water, animals (especially birds), boats, construction equipment and people can transport the seeds long distances. Also, some uninformed gardeners still plant purple loosestrife.

All sunny wetlands, including temporarily moist fields and roadside ditches, are susceptible to purple loosestrife invasion. A new infestation usually starts with a few transported seeds that grow into pioneering plants. These quickly build up a large seed bank in the soil. Disturbances such as water drawdowns accelerate the invasion by providing open substrate and sun for seed germination, and can quickly help fill the wetland with loosestrife.

BIOLOGICAL CONTROL: A LONG-TERM SOLUTION

Traditional control methods can provide up to 95% control of loosestrife on a site, but these methods are often labor intensive, expensive and disruptive. Biological control (biocontrol) is necessary for statewide control.

Biocontrol uses one organism to control another. A search of Europe in the late 1980s found insects that feed exclusively on and control the purple loosestrife there. After careful research to identify the best and safest species to use, four insect species were imported to help control the plant here. Purple loosestrife biocontrol in Wisconsin began in 1994 with the release of two beetle species that eat its leaves. Root and flower feeding weevils came a year later. Monitoring for almost 10 years has ensured that these insects pose no threat to either our crop plants or native flora. Field research has also shown that the insects reduce both the height and seed output of our purple loosestrife, often enabling other plants to regain control of a wetland in a few years. As a wetland's loosestrife diminishes, the control insects fly to find new loosestrife sites elsewhere.

The two foliage beetles give the best control effect and are so easy to propa-



As shown in the photos biological control can be highly effective in controlling purple loosestrife.

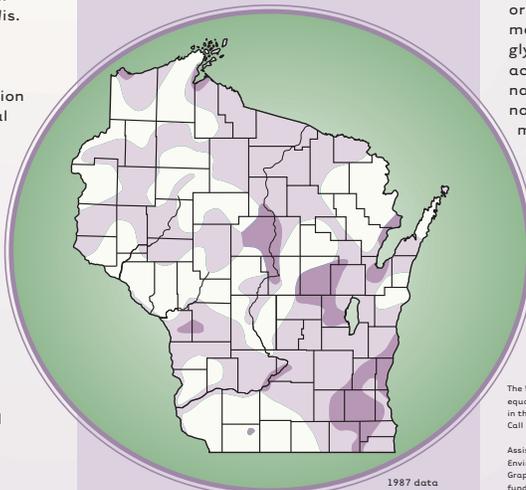
DISTRIBUTION OF PURPLE LOOSESTRIFE IN WISCONSIN

Purple loosestrife is most common in the Eastern U.S. where it first appeared in North America in the early 1800s. It is now found in all 50 states and most Canadian provinces.

It moved into Wisconsin after 1900, and is now in all 72 counties (see map). However, most infestations here are still small and it probably still occupies less than 10 percent of our total wetland acreage. Thus, there is still time to control purple loosestrife here.

A web site map with up-to-date information on purple loosestrife in Wisconsin is found at:

www.glifwc-maps.org



1987 data

- Mild infestation
- Moderate infestation
- Heavy infestation

CONTROL METHODS:

BIOLOGICAL CONTROL is useful on any site, especially large ones, except where ill-suited to insect success (e.g., with summer flooding) or where loosestrife seeds can easily infest new areas. Combining it with traditional methods may give the best long-term control.

Acquire and distribute enough bio control beetles to control your local purple loosestrife infestation. Propagate beetles at home or school. It's easy and inexpensive. If you can't propagate, collect them from an established beetle site near you, or buy them. A free WDNR permit is required to cultivate loosestrife to raise control beetles.

TRADITIONAL METHODS offer quick control, but require follow-up to catch missed plants and new seedlings, and may be impractical or too expensive on large sites. Avoid site disturbances that expose the loosestrife seed bank. Follow all label instructions when using herbicides. Destroy any removed loosestrife by drying and burning it or placing it in a landfill. Do not compost it. Acquire a free WDNR permit for any herbicide work over water.

1 On small sites, gently pull or dig small, young plants, especially in loose, sandy or gravelly soil.

2 On small sites, cut loosestrife stems during active growth and immediately apply a glyphosate herbicide (20-40% active ingredient) to the stumps. Use Roundup® or equivalent product on drier sites. Use Rodeo® or equivalent product on plants over water. Cut and treat all stems in a clump if it might have more than one plant.

3 On large sites, carefully spray loosestrife foliage with glyphosate or triclopyr herbicides. For sites with mainly broad-leaved plants use glyphosate in a foliar solution (1% active ingredient). Avoid spraying native plants, since glyphosate is non-selective. On sites with many monocots, such as cattails, sedges or grasses, spray with triclopyr, such as Renovate®, in a foliar solution. Triclopyr kills only broad-leaved plants.

The Wisconsin Department of Natural Resources (WDNR) provides equal opportunities in employment and programs. The information in this publication can be made available in alternative formats. Call 608/267-7694.

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YOU CAN HELP CONTROL JAPANESE KNOTWEED!

- ❖ **Learn to identify it** (and other invasive plants):
 - Carry this brochure or a Japanese knotweed Wildcard (WDNR # PUB ER-106V-2003) when you travel.
 - Take a native plant class to discover your area's rich diversity, how to distinguish Japanese knotweed from natives, and what to use to replace it after clone elimination.
 - Get and learn to use a good plant identification guide — it'll be fun...!
- ❖ **Report infestations** in wild areas, especially along watercourses:
 - Use WDNR's Invasive Plant Report Form found at <http://dnr.wi.gov/invasives/futureplants> (under "How you can help") or
 - Email or call Kelly Kearns at kelly.kearns@wisconsin.gov or 608-267-5066.
- ❖ **Help prevent** the spread of Japanese knotweed:
 - Clean footwear when leaving an infested site to slow seed dispersal.
 - Be sure your local highway mowers do not disperse plant fragments.
 - Help curb local use of the plant for landscaping. Avoid moving contaminated fill.
 - Work to get Japanese knotweed on your local noxious weed list, with incentives for prevention of the plant (early removal), and reasonable elimination requirements.
- Work with landowners to remove pioneering plants.
- Dispose of all plant parts properly, especially near moving water.
- ❖ **Teach others** about Japanese knotweed (and other invasive plants):
 - Learn about the many invasive plant species already in Wisconsin and how to help control them at <http://dnr.wi.gov/invasives/plants.htm>
 - Learn about future invasive plants at <http://dnr.wi.gov/invasives/futureplants>
 - Get educational materials from WDNR and UW-Extension to use with other people and groups in your area.
- ❖ **Urge elected officials** to provide adequate funding for biological control research for all invasive plants:
 - Help Wisconsin become part of international efforts to find effective, long-term control insects or plant diseases specific to Japanese knotweed and other invasive plants. These biological controls can help us control invasive plants efficiently, with minimal herbicide use.
- ❖ **Help control** Japanese knotweed in your area by eliminating established clones and working with others to develop your watershed's control plan
 - Be responsible and know and control the plant on your own land first.
 - Always get landowner permission for work on private property.



Regrowth after early-season cutting.

COVER PHOTO: Japanese Knotweed leaves and flowers (Tom Heutte photo, www.invasive.org).

Websites for more information

dnr.wi.gov/invasives/plants.htm

tncweeds.ucdavis.edu/esadocs/polycusp.html

www.invasiveplants.net/InvasivePlants/Knotweed/Knotweed.asp

www.nps.gov/plants/alien/fact/pocu1.htm

www.invasiveplants.net/InvasivePlants/Knotweed/Knotweed.asp

NOTE: References to pesticide and other products in this publication are for your convenience and are not an endorsement or criticism of one product over similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.

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Invasive species publications are available at most DNR service centers and can be ordered by DNR publication number. Many are also on WDNR and UWEX web sites.

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Japanese KNOTWEED

Polygonum cuspidatum (Fallopia japonica)



**A NEW THREAT
TO WISCONSIN'S
WATERWAYS,
LAKESHORES, AND
WETLANDS**

DNR PUB - ER - 657 2007

Picture your favorite trout stream or canoeing river lined for miles with a tangle of rigid, bamboo-like stems ten feet tall. These canes confront you like prison bars, and to get through them you have to use a machete to hack your way to the water's edge. Once there, you find that the fish have disappeared and that you can't move up or down the shoreline. You can enter the waterway only where you chopped your way in.

This is the unfortunate scene on some rivers in the Eastern United States now, and could be along many of Wisconsin's streams and shorelines in the future if Japanese knotweed is allowed to begin colonizing them. Fortunately, we can take action now to ensure that our wild waterways, lakeshores, and wetlands remain open and accessible for future generations.

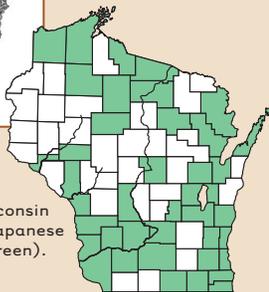
WHERE DID IT COME FROM?

The plant is a large, aggressive perennial from Asia that was exported without the insects and diseases that control it at home. Introduced to Europe by 1800, it has alarmed country after country there with its rapid spread and difficult control.

Japanese Knotweed appeared in the US in the late 1800s and has since spread across the continent from Northeast Canada to South Carolina, and west to the Pacific (see map.) It is now a plant of great concern in most states.



Left — Current North American status of Japanese Knotweed. (L. Seigert map)



Counties in Wisconsin with reported Japanese Knotweed (in green).

SPREAD THROUGH PLANTING

The experiences of other countries and states are being duplicated here and are cause for alarm. Brought to Wisconsin in the mid-1900s, the species is planted in urban areas around the state. However, many landowners now regret having it on their land, as it usurps garden space and encroaches on the rest of their property. One unhappy man in Green Bay has been mowing this plant for forty years, unable to eliminate it from his lawn!

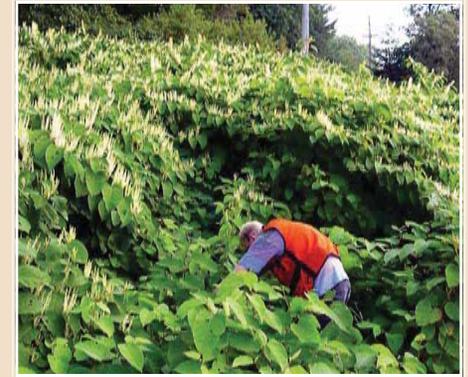
It is now reported from most counties in the state (see state map) Once established,

this plant defies control, with roots that grow as deep as 9 feet and rhizomes (horizontal roots that send up shoots) that grow out to 60 feet. Though it dies to the ground with the first frost, every spring it sends up numerous early shoots along the whole length of these rhizomes.

The rhizomes can also push their way under streets and up through pavement. In Bayfield, rhizomes have grown under streets to infest neighboring properties. A business in the United Kingdom spent over \$600,000 to replace its parking lot after extensive damage from rhizomes, and one Welsh family even found the plant invading its living room as it pushed up from beneath the floor!

Wisconsin is now poised to suffer an explosion of Japanese knotweed in wetlands, along stream banks, and lake shores unless we act to prevent the spread.

Giant knotweed, *Polygonum sachalinense* (*Fallopia sachalinense*), is another similar exotic knotweed now found in several northern Wisconsin counties. This plant grows to 15 feet tall and has larger leaves than Japanese knotweed. Less important than vegetative spread, seed production and fertility in both species is uncertain. Unfortunately, these species hybridize and their offspring can produce viable seeds. Both plants and all hybrids must be eliminated or controlled, especially due to the possibility of increased dispersal from viable seed which could vastly complicate exotic knotweed control. The seeds need open habitat and moist soil to germinate.



Dense stand of 10-foot-tall Japanese Knotweed.



Large roadside stand is also typical along streams.

Tom Heuter photo, www.invasive.org

Tom Heuter photo, www.invasive.org

JAPANESE KNOTWEED IS NOW APPEARING IN WISCONSIN WILD PLACES

- ✓ Appears in such places as shady woods and dry uplands, but of main concern are patches found in valuable open wetland habitats and riparian areas.
- ✓ Grows faster and taller than most native herbs; its long rhizomes quickly form dense thickets up to several acres in size that shade out native plants, reducing site biodiversity.
- ✓ Is food for few native insects or other animals, which contributes to its vigorous growth, but makes its sites of little value to wildlife.
- ✓ Creates bare ground under its clones, which results in faster erosion and more flooding, and makes stream banks more vulnerable to flood damage.
- ✓ Spreads quickly, both filling up its sites and spreading to new ones, especially when stream banks are undercut and fragments of stems and roots fall into the water and are carried downstream.



Dispersion of streamside Japanese Knotweed, caused by high water.

- ✓ Begins new clones in many open streamside and shoreline sites because root and stem fragments as small as ½ inch can sprout new roots.

The widespread planting of Japanese knotweed, its ability to spread easily to new sites, and its increasing frequency in wild places suggest it is starting to follow a trajectory similar to other serious invasive plant species. It is likely to begin expanding at an alarming rate if nothing is done to prevent it from doing so.

Manual, mechanical, and chemical control methods described below can slow the spread of the plant, but have proven inadequate to stop its spread in Europe, as is likely here as well.

European workers are now banking on biological control as the critical long-term control method.

IDENTIFICATION

How to identify Japanese knotweed:

- ✿ Upright, semi-woody, shrub-like herb that can grow 10 feet tall
- ✿ Stems: resemble bamboo, smooth and hollow between swollen joints that have a membranous sheath, often tinged with red, with few branches
- ✿ Winter stems: usually stout, persistent, rust-colored and appear very numerous
- ✿ Leaves: variable, normally about 6 inches long by 3 to 4 inches broad, heart shaped to somewhat triangular with a pointed tip
- ✿ Flowers: very small, greenish-white, arranged in attractive, branched sprays in late summer
- ✿ Fruits: small and winged, with tiny, triangular, shiny seeds
- ✿ Grows in dense stands that often line high light areas such as stream banks and moist roadsides, and may be up to several acres in size
- ✿ Sprouts very early in spring and grows fast, quickly towering over other plants



Japanese knotweed leaves and flowers.



Winter is a good time to look for Japanese Knotweed.



Stems resemble bamboo.

CONTROL METHODS

At this time eradication of Japanese knotweed from the landscape is unlikely since it grows in so many locations and its clones are so difficult to eliminate. Thus, control on a watershed scale should be considered. Highest priority should be given to sites where it has established along water courses, starting at the top of the watershed. High priority should also go to eliminating any plants producing seeds, regardless of location.

Control of clones Control is possible, though not easy because large clones are usually a single plant with an extensive root system. Find and destroy such plants before they become large clones! Eradication of even small patches rarely takes less than a year, even with multiple attempts. The methods you choose will depend on patch location, resources available, etc. Most control measures result in vigorous re-sprouting from rhizomes, so whatever method you use, watch the area 2 to 7 yards out from the obvious infestation edge to be sure rhizomes are not sending up new shoots outside of the controlled area. All removed plant material must be dried, removed from the site and burned, or put into a capped landfill.

Manual/Mechanical In many cases continual cutting of Japanese knotweed has failed to eliminate clones of the plant, though in some small infestations cutting

the whole clone at least twice a month in the growing season for two to three consecutive years has eliminated it. If cutting works, it may be the only method available for very sensitive areas where herbicides are unwelcome. Easy site access is necessary for frequent cutting work, and the labor involved usually relegates the cutting to small sites. Hand cutting works in sensitive sites, but mowing or other mechanical cutting is much easier. Cut as close to the ground as possible. Re-examine these sites for several years to be sure the clone does not return. Cutting plant tops as flowering begins can eliminate seed production for the season.

Digging and pulling roots may also eliminate young, small clones, especially in loose soil, though root fragment usually remain to produce new plants. Tilling the soil will not control knotweed, but does cause re-sprouting that can help drain the roots of energy. It can be combined with a number of other later control measures, including herbicides. Covering the soil surface to eliminate light to the plant has not been very successful or economically viable, though it may work for smaller, isolated patches when done carefully. Coverage through a whole growing season might be required.

Herbicides Herbicides are currently the most effective control option for Japanese knotweed. Many different chemicals have been tried with varying results; all have advantages and disadvantages. Be sure to use herbicides in accordance with their label instructions to ensure safety and efficacy. Different methods and rates of application available for each herbicide will help dictate how and when it is used. More herbicide is not always better; too much active ingredient may kill plant tissue before translocation to its roots, rendering it useless in killing the plant. Always try to use the least amount of herbicide that will do the job. Field test your chosen herbicide and rate of delivery to ensure best results. Apply them only on sites listed on the label, and take extra care using chemicals over or very near water. Herbicide use in these areas in Wisconsin always requires a permit

from your regional WDNR Aquatic Plant Manager.

• **Injecting hollow Japanese knotweed stems** with glyphosate or triclopyr herbicides is a new type of application that promises to be the most effective and environmentally sound, especially in wet sites since there is little chance of chemical water contamination. It may also be the method of choice for hard to reach places since it might kill a clone in just one or two applications if all stems are treated. A new injection tool (~\$200) is available that delivers a precise amount of herbicide; 5 ml. being the optimal amount per stem for both glyphosate and triclopyr. Label restrictions on rates must be followed that might dictate how many stems can be treated in an area. For example, a maximum of 1,420 stems per acre can be treated in this way with 5 ml. of Rodeo per stem. The minimum stem diameter for injection is ½ inch.

• **Foliar spraying** is a common way to apply herbicides, though it carries a risk of damaging other plants from overspray of non-selective chemicals, unless done carefully and in still wind conditions. Many herbicides have been effective, including glyphosate (Rodeo, Aquamaster, and Round-Up, among others), triclopyr (Garlon 3a, etc.), 2,4-D, picloram (Tordon), and Imazapyr (Arsenal). Consult with your local DNR or UW Extension agent, web sites listed below, and manufacturers for advice on choosing the best for your site and application. Be sure to use a legal adjuvant for increased effectiveness.

A variety of different rates of spray application have been used and reported on the web sites listed below. Most work has been done with glyphosate and triclopyr at rates of from ¼% (for Garlon) to 8% concentration for both glyphosate and triclopyr. Unfortunately, reported results vary, making exact recommendations difficult.

• **Timing is important** in foliar applications, with flower bud stage being the best for deep rooted perennials. The most practical time for Japanese knotweed, however, is when it is only 3 to 6 feet tall and easy to

spray, but this is too early in summer for the herbicide to be most effective. Instead, consider cutting all the stems once or twice to retard their growth in height in order to apply the herbicide at the clone's best developmental stage late in summer, but on short, conveniently sized stems.

• **Herbicides may also be applied** directly on all stems in a clone cut just above ground late in summer. Sometimes stems are cut just below the second joint above the ground and herbicide is poured into the hollow stem below. Follow label instructions. In each case, follow-up foliar spraying might be necessary.

Integrating methods Combining methods, such as early cutting and later herbicide use as suggested above, allows more options and flexibility. Digging, pulling, or tilling before spraying might also increase the effectiveness of herbicides. Stems too small to inject might have to be spot sprayed.

Biological Control Surveys in Japan of insect and fungal pests of Japanese knotweed have found many insect species and a number of fungal pathogens that are promising biocontrol organisms because they appear to feed exclusively on the plant. These reduce the plant to an innocuous member of the flora there and could do the same elsewhere. The research on the safety and efficacy of biocontrol organisms for Japanese knotweed in Europe is underway and focusing on *Lixus* weevils. More than 700 European plants have been tested so far with no crossover feeding by the insects. More than 70 plants have also been successfully tested with another insect species and more than 50 plants with a leafspot fungus.

Testing should also be started as soon as possible on North American plants to bring us badly needed control help as well. Carefully researched biocontrol insect species have helped immensely with the control of purple loosestrife, leafy spurge, and other pest plants here. Given the difficulty of controlling Japanese knotweed with conventional means, biocontrol may be our only hope for keeping the plant in check.

Appendix F. Documentation of Consultation



Mead & Hunt, Inc.
M & H Architecture, Inc.
6501 Watts Road
Madison, Wisconsin 53719
608-273-6380
meadhunt.com

January 12, 2012

Ms. Cheryl Laatsch
Water Management Specialist
Wisconsin Department of Natural Resources
Horicon Field Office
N7725 Highway 28
Horicon, WI 53022-1060

Mr. Nick Utrup
U.S. Department of the Interior
Fish and Wildlife Service
Green Bay Field Office
2661 Scott Tower Drive
New Franken, WI 54229-9565

Subject: New License Article 401 (Condition 8 of the 401 Water Quality Certification)
Draft Invasive Species Monitoring and Control Plan
May 18, 2011, Order Issuing New License
Badger-Rapide Croche Hydroelectric Project; FERC Project No. 2677-019
Lower Fox River; Outagamie County, Wisconsin

Dear Ms. Laatsch and Mr. Utrup:

As per New License Article 401 (Condition 8 of the 401 Water Quality Certification) and on behalf of the City of Kaukauna (Kaukauna Utilities), Mead & Hunt, Inc. (Mead & Hunt) is hereby submitting a copy of the Draft *Invasive Species and Control Plan* for your review and comment. We would appreciate receiving your comments within 30 days.

Thank you for your time and cooperation in this matter. Please address your comments to me. If you have any questions, please contact me at (608) 273-6380 or arie.dewaal@meadhunt.com.

Sincerely,

MEAD & HUNT, Inc.

Arie DeWaal
Senior Project Manager

Enclosure

cc: Mike Pedersen, Kaukauna Utilities

Arie DeWaal

From: Arie DeWaal
Sent: Monday, February 06, 2012 1:26 PM
To: 'Laatsch, Cheryl - DNR'
Cc: nick_utrup@fws.gov; Mike Pedersen (mpedersen@ku-wi.org)
Subject: RE: FW: Meeting to discuss draft AIS plan

Categories: Filed by Newforma

Hi,

I'm a little puzzled by the reference to "AIS". I'm assuming you mean the draft Invasive Species Monitoring and Control Plan. Both yourself and Nick were sent copies of the Draft plan on January `12th via Certified Mail.

Thanks

Arie DeWaal | Senior Project Manager
Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Mobile: 608-957-6365 arie.dewaal@meadhunt.com | www.meadhunt.com

-----Original Message-----

From: Laatsch, Cheryl - DNR [mailto:Cheryl.Laatsch@Wisconsin.gov]
Sent: Monday, February 06, 2012 12:34 PM
To: Arie DeWaal
Subject: FW: FW: Meeting to discuss draft AIS plan

See below. Not sure that FWS saw the draft AIS plan.

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

Cheryl Laatsch, Horicon DNR
N7725 HIGHWAY 28
HORICON WI 53032
(920) 387-7869
(920) 485-3028 (Fax)

e-mail: Cheryl.laatsch@wisconsin.gov
Website: dnr.wi.gov
www.facebook.com/WIDNR

-----Original Message-----

From: Nick_Utrup@fws.gov [mailto:Nick_Utrup@fws.gov]

Sent: Monday, February 06, 2012 12:33 PM
To: Laatsch, Cheryl - DNR
Subject: Re: FW: Meeting to discuss draft AIS plan

If the meeting is near GB I may want to attend (depending on schedule).
I'm not sure I have received a copy of the draft plan?

Nick

Nicholas J. Utrup
Hydropower Coordinator
U.S. Fish and Wildlife Service
Green Bay Ecological Services Field Office
2661 Scott Tower Drive
New Franken, WI 54229

Office: (920) 866-1736
Cell: (920) 530-9937
FAX: (920) 866-1710
Email: Nick_Utrup@fws.gov

"Laatsch, Cheryl
- DNR"
<Cheryl.Laatsch@Wisconsin.gov> To
"Nick_Utrup@fws.gov"
<Nick_Utrup@fws.gov>
02/06/2012 12:18 PM cc
Subject
FW: Meeting to discuss draft AIS
plan

Nick - Will you be providing any comments on the draft AIS plan? Do you want to attend a meeting where DNR folks comment on the draft AIS plan.
Meeting would be up near GB.

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

Cheryl Laatsch, Horicon DNR
N7725 HIGHWAY 28
HORICON WI 53032
(920) 387-7869
(920) 485-3028 (Fax)

e-mail: Cheryl.laatsch@wisconsin.gov

Website: dnr.wi.gov

www.facebook.com/WIDNR

From: Laatsch, Cheryl - DNR
Sent: Monday, February 06, 2012 12:18 PM
To: Arie DeWaal; 'Mike Pedersen'
Cc: 'Linda Mitchell'
Subject: Meeting to discuss draft AIS plan
Importance: High

Hi - We are wanting to set up a meeting in GB to discuss the draft plan and provide formal comments. Please have Arie or Linda email me, so I can call them with our available dates. thanks

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

Cheryl Laatsch, Horicon DNR
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(920) 485-3028 (Fax)

e-mail: Cheryl.laatsch@wisconsin.gov

Website: dnr.wi.gov

www.facebook.com/WIDNR

Arie DeWaal

From: Nick_Utrup@fws.gov
Sent: Monday, February 06, 2012 2:11 PM
To: Arie DeWaal
Cc: Laatsch, Cheryl - DNR; Mike Pedersen (mpedersen@ku-wi.org)
Subject: RE: Meeting to discuss draft AIS plan

Arie,

I would agree that a site meeting should not be necessary. And yes, I was thrown off by the AIS reference (it sounded like another plan). I have received the Invasive Species Monitoring and Control Plan you mentioned.

Thanks,

Nick

Nicholas J. Utrup
Hydropower Coordinator
U.S. Fish and Wildlife Service
Green Bay Ecological Services Field Office
2661 Scott Tower Drive
New Franken, WI 54229

Office: (920) 866-1736
Cell: (920) 530-9937
FAX: (920) 866-1710
Email: Nick_Utrup@fws.gov

Arie DeWaal
<arie.dewaal@mead
hunt.com> To
"Laatsch, Cheryl - DNR"
02/06/2012 01:33 <Cheryl.Laatsch@Wisconsin.gov>
PM cc
"nick_utrump@fws.gov"
<nick_utrump@fws.gov>, "Mike
Pedersen (mpedersen@ku-wi.org)"
<mpedersen@ku-wi.org>
Subject
RE: Meeting to discuss draft AIS
plan

Hi Cheryl,

At this point, I'm wondering if we could schedule a conference call to discuss the draft plan. It would certainly be a less costly proposition for everyone involved including Kaukauna Utilities. I would also like to have Perry Rossa (author of the draft plan) participate in the discussion

Arie DeWaal | Senior Project Manager
Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI
53719
Main: 608-273-6380 | Mobile: 608-957-6365 arie.dewaal@meadhunt.com | www.meadhunt.com

From: Laatsch, Cheryl - DNR [mailto:Cheryl.Laatsch@Wisconsin.gov]
Sent: Monday, February 06, 2012 12:18 PM
To: Arie DeWaal; Mike Pedersen
Cc: Linda Mitchell
Subject: Meeting to discuss draft AIS plan
Importance: High

Hi - We are wanting to set up a meeting in GB to discuss the draft plan and provide formal comments. Please have Arie or Linda email me, to I can call them with our available dates. thanks

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

Cheryl Laatsch, Horicon DNR
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e-mail: Cheryl.laatsch@wisconsin.gov
Website: dnr.wi.gov
www.facebook.com/WIDNR

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Arie DeWaal

From: Arie DeWaal
Sent: Monday, February 06, 2012 2:44 PM
To: Laatsch, Cheryl - DNR (Cheryl.Laatsch@Wisconsin.gov)
Cc: nick_utrup@fws.gov; Perry Rossa; Mike Pedersen (mpedersen@ku-wi.org)
Subject: FW: Meeting to discuss draft AIS plan

Categories: Filed by Newforma

Hi Cheryl,

As we discussed, the plan moving forward is to have a teleconference call rather than meeting in Green Bay. I've checked with Perry and our schedules are such that 2/17 (a.m.) and anytime 2/20 or 2/21 would work from our end. I also agree with you that it would be a good idea for you (or Andy Hidaka) to compile the WDNR comments so that we can be working from one set of comments. In the interest of having a productive call, it would be helpful if we could get a copy of the comments prior to the call. I'll be happy to host the call. Let me know what works from your end.

Thanks,
Arie

Arie DeWaal | Senior Project Manager

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Mobile: 608-957-6365
arie.dewaal@meadhunt.com | www.meadhunt.com

From: Arie DeWaal
Sent: Monday, February 06, 2012 1:34 PM
To: 'Laatsch, Cheryl - DNR'
Cc: nick_utrup@fws.gov; Mike Pedersen (mpedersen@ku-wi.org)
Subject: RE: Meeting to discuss draft AIS plan

Hi Cheryl,

At this point, I'm wondering if we could schedule a conference call to discuss the draft plan. It would certainly be a less costly proposition for everyone involved including Kaukauna Utilities. I would also like to have Perry Rossa (author of the draft plan) participate in the discussion

Arie DeWaal | Senior Project Manager

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Main: 608-273-6380 | Mobile: 608-957-6365
arie.dewaal@meadhunt.com | www.meadhunt.com

From: Laatsch, Cheryl - DNR [mailto:Cheryl.Laatsch@Wisconsin.gov]
Sent: Monday, February 06, 2012 12:18 PM
To: Arie DeWaal; Mike Pedersen
Cc: Linda Mitchell
Subject: Meeting to discuss draft AIS plan
Importance: High

Hi - We are wanting to set up a meeting in GB to discuss the draft plan and provide formal comments. Please have Arie or Linda email me, so I can call them with our available dates. thanks

Cheryl Laatsch, Water Mgt Specialist,

WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

Cheryl Laatsch, Horicon DNR
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(920) 387-7869
(920) 485-3028 (Fax)

e-mail: Cheryl.laatsch@wisconsin.gov
Website: dnr.wi.gov
www.facebook.com/WIDNR

Arie DeWaal

From: Dusty Nielsen
Sent: Tuesday, February 07, 2012 8:14 AM
To: Laatsch, Cheryl - DNR
Cc: Arie DeWaal
Subject: RE: Draft AIS plan

Good morning Cheryl,

I have placed the draft report back on our guest FTP site (which you can access at the link below). Unfortunately, files are automatically deleted 24 hours after placing them on there. If anybody else needs the file they should also be able to access it using the link below.

Thanks!

Dusty Nielsen | Technical Editor

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Direct: 608-443-0411
dusty.nielsen@meadhunt.com | www.meadhunt.com

From: Laatsch, Cheryl - DNR [<mailto:Cheryl.Laatsch@Wisconsin.gov>]
Sent: Monday, February 06, 2012 11:56 AM
To: Dusty Nielsen
Cc: Arie DeWaal
Subject: RE: Draft AIS plan

can you re-activate this link. thanks.

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

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(920) 485-3028 (Fax)

e-mail: Cheryl.laatsch@wisconsin.gov
Website: dnr.wi.gov
www.facebook.com/WIDNR

From: Dusty Nielsen [<mailto:dusty.nielsen@meadhunt.com>]
Sent: Thursday, January 19, 2012 11:42 AM

To: Laatsch, Cheryl - DNR
Cc: Arie DeWaal
Subject: RE: Draft AIS plan

Good morning Cheryl,

Arie asked that I send you the Badger-Rapide Croche Invasive Species Monitoring and Control Plan. I have placed the document on our guest FTP site. To download a file using a web browser, utilize the following link:
<ftp://ftpguest:M3adgu3st@ftp.meadhunt.com>

It looks like we only have a few folders on the site right now, so it should be easy to locate. If you have any problems at all using the site, please let me know. I believe the files will only remain on the site for 24 hours, so just let me know if somebody was unable to get the file downloaded by this time tomorrow.

Thanks!

Dusty Nielsen | Technical Editor

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Direct: 608-443-0411
dusty.nielsen@meadhunt.com | www.meadhunt.com

From: Arie DeWaal
Sent: Thursday, January 19, 2012 11:27 AM
To: Dusty Nielsen
Subject: FW: Draft AIS plan

Hi Dusty,

Can we take care of Cheryl's request? She's talking about the KU Invasive species Plan.

Thanks,
Arie

Arie DeWaal | Senior Project Manager

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Mobile: 608-957-6365
arie.dewaal@meadhunt.com | www.meadhunt.com

From: Laatsch, Cheryl - DNR [<mailto:Cheryl.Laatsch@Wisconsin.gov>]
Sent: Thursday, January 19, 2012 11:02 AM
To: Arie DeWaal
Subject: Draft AIS plan

Hi - got the draft plan.

Can you email it to me on a ftp site, so I can get to our review folks ASAP. Thanks for the help. I tried to winzip it, but was way too big to email.

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor

101 S Webster St Madison WI 53707-7921
Madison office phone:(608) 264-8943

OR

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Website: dnr.wi.gov
www.facebook.com/WIDNR

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Arie DeWaal

From: Arie DeWaal
Sent: Monday, February 20, 2012 2:10 PM
To: 'Laatsch, Cheryl - DNR'; Mike Pedersen (MPedersen@ku-wi.org)
Cc: Nick_Utrup@fws.gov; Perry Rossa; andrew.hudak@wisconsin.gov
Subject: RE: Comments for Invasive Species Monitoring P-2677 KU Badger Site

Hi Cheryl,

Glad to hear that Andy has compiled the Department's comments. As I indicated a couple of weeks ago, it would certainly be more cost effective to have a teleconference call at this time. It would also be more productive if Andy's comments were sent out prior to the call. As I mentioned previously, I'd be happy to host the call. As such, I'm asking everyone listed on this email to give me some dates (at times) that would work for the call. I'm sure we would all like to finalize the plan ASAP.

Thanks,
Arie

Arie DeWaal | Senior Project Manager

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arie.dewaal@meadhunt.com | www.meadhunt.com

From: Laatsch, Cheryl - DNR [mailto:Cheryl.Laatsch@Wisconsin.gov]
Sent: Monday, February 20, 2012 1:45 PM
To: Arie DeWaal; Mike Pedersen (MPedersen@ku-wi.org)
Cc: Nick_Utrup@fws.gov
Subject: Comments for Invasive Species Monitoring P-2677 KU Badger Site

Hi guys - I have Andy's comments. He suggested we meet to talk about it, and make sure all the questions are answered right away to save time.

Not sure if FWS wants in on this meeting. Nick - do you plan to provide comments on the draft plan?

In person meeting? Conf call?

I can email the comments, so we can discuss. Andy thought 2 hours should be plenty of time.

Please let me know your thoughts. Thanks

Cheryl Laatsch, Water Mgt Specialist,
WDNR, Office of Energy, GEF2, 7th Floor
101 S Webster St Madison WI 53707-7921
Madison office phone: (608) 264-8943

OR

Cheryl Laatsch, Horicon DNR
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(920) 485-3028 (Fax)

e-mail: Cheryl.laatsch@wisconsin.gov
Website: dnr.wi.gov
www.facebook.com/WIDNR

Arie DeWaal

From: Arie DeWaal
Sent: Tuesday, February 21, 2012 10:54 AM
To: Mike Pedersen (mpedersen@ku-wi.org); Perry Rossa; nick_utrup@fws.gov
Cc: andrew.hudak@wisconsin.gov; Laatsch, Cheryl - DNR (Cheryl.Laatsch@Wisconsin.gov)
Subject: FW: Badger AI Plan Comments.doc

Categories: Filed by Newforma

Hi All,

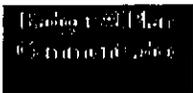
Attached are the comments received from WDNR. It is hoped that these will serve as the focal point for our teleconference call (hopefully at 9:00 a.m. on Wednesday, Feb. 29). Once I receive concurrence on the meeting date and time, I'll send out phone in information.

Thanks,
Arie

Arie DeWaal | Senior Project Manager

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Main: 608-273-6380 | Mobile: 608-957-6365
arie.dewaal@meadhunt.com | www.meadhunt.com

From: Laatsch, Cheryl - DNR [mailto:Cheryl.Laatsch@Wisconsin.gov]
Sent: Tuesday, February 21, 2012 10:39 AM
To: Arie DeWaal
Subject: Badger AI Plan Comments.doc



Here are the draft commnets.

Cheryl

Perry Rossa

From: Nault, Michelle E - DNR <Michelle.Nault@wisconsin.gov>
Sent: Wednesday, March 07, 2012 3:43 PM
To: Perry Rossa
Cc: Arie DeWaal
Subject: RE: Aquatic Plant Surveys: point-intersect field sampling method

Hi Perry-

All the documentation regarding aquatic plant management and conducting standard point-intercept (PI) plant surveys can be found here:

<http://www4.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp>

The direct link to the detailed protocol for conducting the PI aquatic plant survey is located in Appendix B:

<http://www4.uwsp.edu/cnr/uwexlakes/ecology/APM/PI-Protocol-2010.pdf>

If you're specifically looking at tracking EWM populations pre- and post-management (i.e. in a localized area instead of lake-wide), that specific guidance is located here: <http://www4.uwsp.edu/cnr/uwexlakes/ecology/APM/Appendix-D.pdf>

Please let me know if you have any additional questions. If you need a PI grid and GPS points set-up for a particular waterbody, you can contact me and I'll be sure you get the appropriate files you need.

Take care,
Michelle

 *Michelle E. Nault*

Natural Resources Research Scientist

Fisheries and Aquatic Sciences

Bureau of Science Services

Wisconsin Department of Natural Resources

(☎) phone: (608) 221-6359

(☎) cell: (608) 513-4587

(☎) fax: (608) 221-6353

(✉) e-mail: michelle.nault@wisconsin.gov

Website: dnr.wi.gov

Find us on Facebook: www.facebook.com/WIDNR

From: Perry Rossa [mailto:perry.rossa@meadhunt.com]
Sent: Wednesday, March 07, 2012 03:30 PM
To: Nault, Michelle E - DNR
Cc: Arie DeWaal
Subject: Aquatic Plant Surveys: point-intersect field sampling method

Hello Michelle,

Andy Hudak (DNR) directed us to you regarding procedures to follow for using the point-intersect field method for Eurasian Water Milfoil monitoring. I be pleased to receive anything you may have regarding this procedure – feel free to call me if you have any questions.

Perry Rossa | Project Scientist

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719

From: Perry Rossa
Sent: Friday, March 09, 2012 8:45 AM
To: 'Cheryl.Laatsch@Wisconsin.gov'
Cc: 'Andrew.Hukad@Wisconsin.gov'; Mike Pedersen (MPedersen@ku-wi.org) (MPedersen@ku-wi.org); Arie DeWaal
Subject: Badger-Rapide Croche Hydroelectric Project (FERC No. 2677): Invasive Species Monitoring & Control Plan, License Article 401

Good Morning, Cheryl,

Attached is a copy of Section 6 of the Badger-Rapide Croche invasive species plan that has been revised (see blue text) to reflect the spirit of our discussions on February 29 of this year. We have also made a number of minor additions to the document as a result of your comments, such as additional educational materials and use of the current aquatic plant survey method, but the attached text is the most important change.

Thank you for your interest and timely responses to our plans regarding this project.

Perry Rossa | Project Scientist

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Mobile: 608-577-2358 |
perry.rossa@meadhunt.com | www.meadhunt.com

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Arie DeWaal

From: Hudak, Andrew J - DNR <Andrew.Hudak@wisconsin.gov>
Sent: Monday, March 19, 2012 7:44 AM
To: Arie DeWaal
Cc: Laatsch, Cheryl - DNR; Perry Rossa
Subject: RE: Badger-Rapide Croche Hydroelectric Project (FERC No. 2677): Invasive Species Monitoring & Control Plan, License Article 401

Arie-

The revisions to Section 6 appear to meet the intent of our conversations regarding my initial comments. With this revision language, the last sentence of the original paragraph can either be removed or merged into the bullet points below.

From: Arie DeWaal [mailto:arie.dewaal@meadhunt.com]
Sent: Thursday, March 15, 2012 12:56 PM
To: Hudak, Andrew J - DNR
Cc: Laatsch, Cheryl - DNR; Perry Rossa
Subject: FW: Badger-Rapide Croche Hydroelectric Project (FERC No. 2677): Invasive Species Monitoring & Control Plan, License Article 401

Hi Andy,

Attached is the section 6 revision that we had talked about during our 2/29 conference call (please see Perry's email below). Once we get your review comments on Section 6, we'll go ahead and finalize the plan and submit it.

Thanks,
Arie

Arie DeWaal | Senior Project Manager

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Mobile: 608-957-6365
arie.dewaal@meadhunt.com | www.meadhunt.com

From: Perry Rossa
Sent: Friday, March 09, 2012 8:48 AM
To: Andrew.Hudak@Wisconsin.gov
Cc: Laatsch, Cheryl - DNR (Cheryl.Laatsch@Wisconsin.gov); Arie DeWaal; Mike Pedersen (MPedersen@ku-wi.org) (MPedersen@ku-wi.org)
Subject: FW: Badger-Rapide Croche Hydroelectric Project (FERC No. 2677): Invasive Species Monitoring & Control Plan, License Article 401

Andrew,

Apologies for the mis-directed e-mail to you below. I misspelled your e-mail address.

Perry Rossa | Project Scientist

Mead & Hunt, Inc | M & H Architecture, Inc | 6501 Watts Road | Madison, WI 53719
Main: 608-273-6380 | Mobile: 608-577-2358 |
perry.rossa@meadhunt.com | www.meadhunt.com

Arie DeWaal

From: Arie DeWaal
Sent: Monday, March 26, 2012 7:06 AM
To: 'Laatsch, Cheryl - DNR'
Cc: andrew.hudak@wisconsin.gov; Perry Rossa
Subject: RE: Badger-Rapide Croche Hydroelectric Project (FERC No. 2677): Invasive Species Monitoring & Control Plan, License Article 401

Categories: Filed by Newforma

Good Morning Cheryl,

Sorry I didn't get back to you sooner – I was out on medical leave (nothing serious). Yes, Andy's comments are sufficient and we will go ahead and make his recommended change and finalize the document. I appreciate Andy's and your input on the development of the plan.

Thanks,
Arie

Arie DeWaal | Senior Project Manager

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From: Laatsch, Cheryl - DNR [mailto:Cheryl.Laatsch@Wisconsin.gov]
Sent: Tuesday, March 20, 2012 3:56 PM
To: Arie DeWaal
Subject: FW: Badger-Rapide Croche Hydroelectric Project (FERC No. 2677): Invasive Species Monitoring & Control Plan, License Article 401

Is the email chain below sufficient for final comments?

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