Appendix A: Aquatic Invasive Species of Concern in Dowling Lake

Curly-leaf Pondweed

Curly-leaf pondweed (*Potamogeton crispus*, CLP) is an invasive aquatic plant that is native to Eurasia, Africa, and Australia (Figure 1). It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant. The leaves are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. CLP spreads through burr-like winter buds called turions (Figure 1). New plants form under the ice in winter, making CLP one of the first nuisance aquatic plants to emerge in the spring. It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start and out-compete native plants in the spring. In mid-summer, when most aquatic plants are growing, CLP plants are dying back. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. CLP forms surface mats that can interfere with aquatic recreation.

WDNR records show that CLP has been identified in the lake; however, no CLP was documented in the 2012 or 2016 plant surveys.

Figure 1: CLP Plants and Turions

Purple Loosestrife

Purple loosestrife *(Lythrum salicaria*) (Figure 2) is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. Showy flowers that vary from purple to magenta bloom from Late July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Purple loosestrife spreads mainly by seed. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Mature plants with up to 50 shoots grow over 2 meters high and produce more than two million seeds a year. Germination is restricted to open, wet soils and requires high temperatures, but seeds remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. Invasion usually begins with a few pioneering plants that build up a large seed bank in the soil for several years. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland. Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Figure 2: Purple loosestrife

Yellow Iris

Yellow flag iris (*Iris pseudacorus)* (Figure 3) is a showy perennial plant that can grow in a range of conditions from drier upland sites, to wetlands, to floating aquatic mats. A native plant of Eurasia, it can be an invasive garden escapee in Wisconsin's natural environments.

It has broad, sword-shaped leaves that grow upright, tall and stiff. They are green with a slight blue-grey tint and are very difficult to distinguish from other ornamental or native iris species. Flowers are produced on a stem that can grow 3-4 feet tall among leaves that are usually as tall or taller. The flowers are showy and variable in color from almost white to a vibrant dark yellow. Theyare between 3-4 inches wide and bloom from April to June. Three upright petals are less showy than the larger three downward pointing sepals, which may have brown to purple colored streaks.

Seeds are produced in fruits that are 6-angled capsules, 2-4 inches long. Each fruit may have over 100 seeds that start pale before turning dark brown. Each seed has a hard outer casing with a small air space underneath, which allows the seeds to float. The plants roots are thick, fleshy pink-colored rhizomes that spread extensively in good conditions, forming thick mats that can float on the surface of the water.

When not flowering, yellow flag iris could be easily confused with the native blue flag iris (*Iris versicolor*) as well as other ornamental irises that are not invasive. Blue flag iris is usually smaller and does not tend to form as dense clumps or floating mats. When not flowering or showing fruiting bodies, yellow flag iris may be confused with other wetland plants such as cattails (*Typha spp.)* or sweet flag (*Acorus spp.)* species.

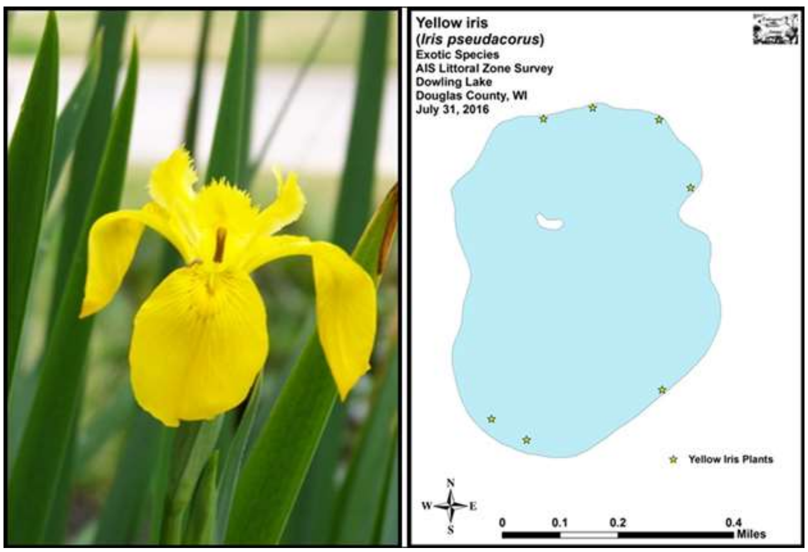

Figure 2: Yellow Flag Iris

Eurasian Watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*, EWM) is a submersed aquatic plant native to Europe, Asia, and northern Africa (Figure 2). Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. EWM is difficult to distinguish from Northern watermilfoil (NWM). EWM has 9-21 pairs of leaflets per leaf, while NWM typically has 7-11 pairs of leaflets.

EWM grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Unlike many other plants, EWM does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces by fragmentation (Figure 55), allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, and bait buckets; and can stay alive for weeks if kept moist.

Once established in an aquatic community, EWM reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, EWM is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by EWM may lead to deteriorating water quality and algae blooms in infested lakes.

The conditions that currently exist in Dowling Lake make it a ready system for invasion by EWM.

Figure 3: EWM in a bed and an EWM fragment with adventitious roots

Zebra Mussels

Zebra mussels (*Dreissena polymorpha*) are an invasive species that are displacing native mussels, disrupting ecosystems, and affecting livelihoods and quality of life (Figure 3). They hamper boating, swimming, fishing, hunting, hiking, and other recreation, and take an economic toll on commercial, agricultural, forestry, and aquacultural resources. The zebra mussel is a tiny (1/8-inch to 2-inch) bottom-dwelling mussel native to Europe and Asia. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels have a yellowish or brownish D-shaped shell, usually with alternating dark- and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals.

Zebra mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals and debris for food. This process can lead to increased water clarity, but also depletes the food supply for other aquatic organisms, including fish. The higher light penetration fosters growth of rooted aquatic plants which, although creating more habitats for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since they avoid consuming this type of algae but not others.

Once zebra mussels are established in a water body, very little can be done to control them. It is therefore crucial to take all possible measures to prevent their introduction in the first place. Some of the preventative and physical control measures include physical removal, industrial vacuums, and back flushing.

Figure 4: Zebra Mussels

New Zealand Mudsnails

New Zealand mudsnails (*Potamopyrgus antipodarum)* are very small (less than 0.25 inch) snails with 5 to 8 whorls (Figure 4). Their oval opening is on the right-side and its height is less than the height of the spire. Shell colors vary from gray and dark brown to light brown. There are three known clones within the United States. The clone from the Great Lakes exhibits a keel in the middle of each whorl.

New Zealand mudsnails occur amongst aquatic plants and prefer shallow areas in lakes or slow streams with silt and organic matter substrates, but tolerate high flow environments where it can burrow into the sediment. New Zealand mudsnails have been found in popular trout fishing destinations in the west and many tributaries to the Great Lakes. They have been documented in all of the Great Lakes, except Huron. In 2005, an established population was found in the St. Louis River estuary and the Duluth-Superior Harbor.

New Zealand mudsnails were likely introduced to the Great Lakes via ballast water discharge. In the western United States where they were likely introduced through fish stocking, they have spread via angling equipment and birds. They have been observed to pass through the gut of fish unscathed, indicating that fish themselves are capable of dispersing them. In the Great Lakes, this might be a viable means of them becoming established in tributaries as fish, such as salmon, move into interior waters. Inland sites close to population centers and blue ribbon fisheries have been vulnerable due to their heavy use by anglers. Once established in a lake, river or stream, it has been estimated that the snails can move upstream on their own over 0.5 mile per year.

New Zealand mudsnails have been observed at incredible densities of up to 800,000 per square meter. They consume large amounts of phytoplankton, which comprise the base of the aquatic food web. They also displace native snails and invertebrates that are more beneficial as food for wildlife — many birds and fish cannot digest New Zealand mudsnails. Additionally, industries drawing water from infested lakes or rivers often have problems with snails blocking their screens and clogging pipes.

The most effective method of controlling New Zealand mudsnails is through prevention of their spread to new water bodies. Thorough cleaning/scrubbing or freezing of gear for 8 hours before moving to a new waterbody is crucial.

Figure 5: New Zealand Mudsnails

Mystery Snails

Chinese mystery snails (*Bellamya chinensis*) and banded mystery snails (*Viviparus georgianus*) are non-native snails that have been found in many Wisconsin lakes (Figure 5). There is not a lot yet known about these species, however, it appears that they have a negative effect on native snail populations. Chinese mystery snails are large, often 2 or more inches in diameter. Banded mystery snails are smaller, about the size of a nickel or quarter. Both have a hard operculum (a trap door cover which protects the soft flesh inside), and a thick hard shell make them less edible by predators such as fish and raccoons.

The female mystery snail gives birth to live crawling young. This may be an important factor in their spread as it only takes one impregnated snail to start a new population. Mystery snails thrive in silt and mud areas although they can be found in lesser numbers in areas with sand or rock substrates. They are found in lakes, ponds, irrigation ditches, and slower portions of streams and rivers. They are tolerant of pollution and often thrive in stagnant water areas. Mystery snails can be found in water depths of 0.5 to 5 meters (1.5 to 15 feet). They tend to reach their maximum population densities around 1-2 meters (3-6 feet) of water depth. Mystery snails do not eat plants. Instead, they feed on detritus and, in lesser amounts, algae and phytoplankton.

Lakes with high densities of mystery snails often see large die-offs of the snails. These die-offs are related to the lake's warming coupled with low oxygen (related to algal blooms). Mystery snails cannot tolerate low oxygen levels and will die in mass when the right conditions persist.

A common fear for many lake residents is mystery snails being carriers of the swimmer's itch parasite. In theory, they are potential carriers; however, because they are an introduced species and did not evolve as part of the lake ecosystem, they are less likely to harbor the swimmer's itch parasites.

Figure 6: Chinese (left) and Banded (right) mystery snails

Rusty Crayfish

Rusty crayfish (*Orconectes rusticus*) live in lakes, ponds and streams, preferring areas with rocks, logs and other debris in water bodies with clay, silt, sand or rocky bottoms (Figure 6). They typically inhabit permanent pools and fast-moving streams of fresh, nutrient-rich water. Adults reach a maximum length of 4 inches. Males are larger than females upon maturity and both sexes have larger, claws than most native crayfish. Dark "rusty" spots are usually apparent on either side of the carapace, but are not always present in all populations. Claws are generally smooth, with grayish-green to reddish-brown coloration. Adults are opportunistic feeders, feeding upon aquatic plants, benthic invertebrates, detritus, juvenile fish and fish eggs.

The native range of the rusty crayfish includes Ohio, Tennessee, Kentucky, Indiana, Illinois and the entire Ohio River basin. However, this species may now be found in Michigan, Massachusetts, Missouri, Iowa, Minnesota, New York, New Jersey, Pennsylvania, Wisconsin, New Mexico and the entire New England state area (except Rhode Island).

Rusty crayfish reduce the amount and types of aquatic plants, invertebrate populations, and some fish populations--especially bluegill, smallmouth and largemouth bass, lake trout and walleye. They deprive native fish of their prey and cover and out-compete native crayfish. Rusty crayfish will also attack the feet of swimmers. On the positive side, rusty crayfish can be a food source for larger game fish and are commercially harvested for human consumption.

Rusty crayfish may be controlled by restoring predators like bass and sunfish populations. Preventing further introduction is important and may be accomplished by educating anglers, trappers, bait dealers and science teachers of their hazards.

It is illegal to possess both live crayfish and angling equipment simultaneously on any inland Wisconsin water (except the Mississippi River). It is also illegal to release crayfish into a water of the state without a permit.

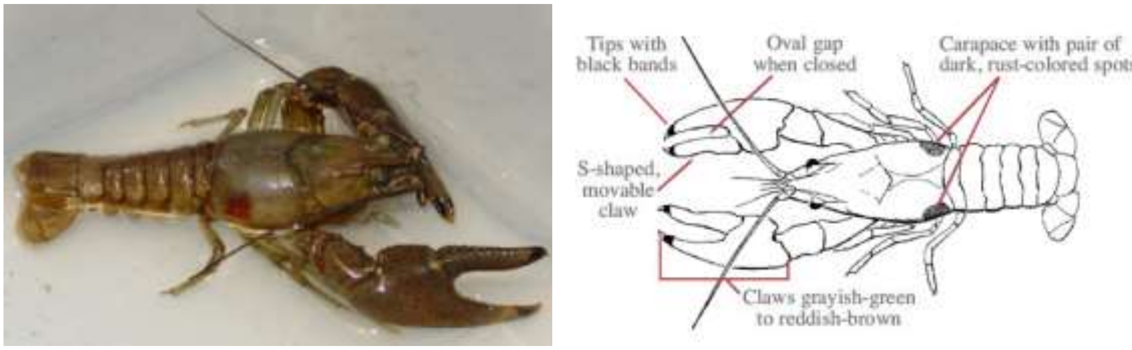

Figure 7: Rusty Crayfish and identifying characteristics

AIS Prevention Strategy

While none of these non-native, animal species have been identified in Dowling Lake, they are all nearby and could be introduced if concerted efforts to prevent this from happening are not implemented.

The ADLMD should implement an AIS education and monitoring program for Dowling Lake. Watercraft inspection (Clean Boats, Clean Waters) could be implemented at the Dowling Lake public access, but the amount of outside boater use is likely limited. However, if paired with a program that is also implemented at the Amnicon Lake public access, some inspection time would be beneficial. In addition, the ADLMD should implement a regular AIS monitoring program in and around Dowling Lake. The ADLMD should host and/or sponsor lake community events including AIS identification and management workshops; distribute education and information materials to lake property owners and lake users through the newsletter, webpage, and general mailings. All of these activities are supported by the WDNR and UW-Extension Lakes and there is grant funding available to help implement them.