Chapter II

AQUATIC INVASIVE SPECIES AND WATER RESOURCES IN WASHINGTON COUNTY

PART I – INTRODUCTION

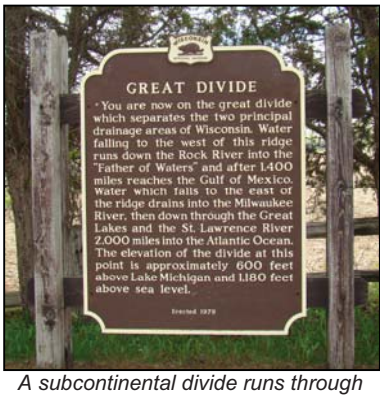
The contribution of our surface water resources to economic development, recreational activity, and scenic beauty is immeasurable. As stated in Chapter I, Aquatic Invasive Species (AIS) already have a strong hold in many Washington County lakes and are putting the future of all of our local waterbodies in jeopardy. This chapter provides a detailed explanation of AIS commonly found in Washington County and how they can be detrimental to ecosystems, native species, and to the well-being of residents and property values as they impact tourism and recreational opportunities. Water resources and watersheds within Washington County are described in this chapter with tables and maps displaying the current status of AIS and where they have been identified.

PART II – WATER RESOURCES AND WATERSHEDS

Surface water resources, consisting of lakes and streams and their associated wetlands, floodplains, and shorelands, form important elements of the natural resource base of Washington County. Both surface water and groundwater are interrelated components of a single hydrologic system. The groundwater resources are hydraulically connected to the surface water resources inasmuch as the former provide the base flow of streams and contribute to inland lake levels. The groundwater resources constitute the major source of supply for domestic, municipal, and industrial water users in Washington County.

Watersheds and Subwatersheds[9]

A subcontinental divide that separates the Mississippi River and the Great Lakes – St. Lawrence River drainage basins crosses Washington County from the Town of Wayne on the north to the Village of Richfield on the south. About 164,684 acres, or 59 percent of the County, are located east of the divide and drain to the Great Lakes – St. Lawrence River system; the remaining 114,072 acres, or 41 percent of the County, drain west to the Mississippi River.



A subcontinental divide runs through Washington County from which water either drains west to the Mississippi River or east to Lake Michigan.

The Great Lakes – St. Lawrence River drainage basin includes the Milwaukee River watershed, which encompasses about 52 percent of the County, and the Menomonee River watershed, which encompasses about seven percent of the County. The Mississippi River drainage basin includes the Rock River watershed, which encompasses about 41 percent of the County, and the Fox River watershed, which encompasses less than one-tenth of 1 percent of the County.

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[9] *Watersheds and subwatersheds within the County are shown on Map 20 in A Multi-jurisdictional Comprehensive Plan for Washington County: 2035.*

Lakes and Streams

Major streams are defined as those which maintain, at a minimum, a small continuous flow throughout the year except under unusual drought conditions. There are approximately 220 miles of such streams in Washington County. As noted above, the County includes portions of the Menomonee River, the Milwaukee River, and the Rock River watersheds, along with a very small portion of the Fox River Watershed. The major stream in the Menomonee River watershed, which is located in the southeast portion of the County, is the Menomonee River. Major streams in the Milwaukee River watershed, which generally includes the area in the eastern half of the County, include the Milwaukee River, East Branch Milwaukee River, North Branch Milwaukee River, Kewaskum Creek, Cedar Creek, Little Cedar Creek, North Branch Cedar Creek, Evergreen Creek, Quaas Creek, Silver Creek, Stony Creek, and Wallace Creek. Major streams in the Rock River watershed, which generally includes the area in the western half of the County, are the East Branch Rock River, Ashippun River, Coney River, Kohlsville River, Limestone Creek, Mason Creek, Oconomowoc River, Little Oconomowoc River, Bark River, and Rubicon River. Major streams are shown on Map 1.

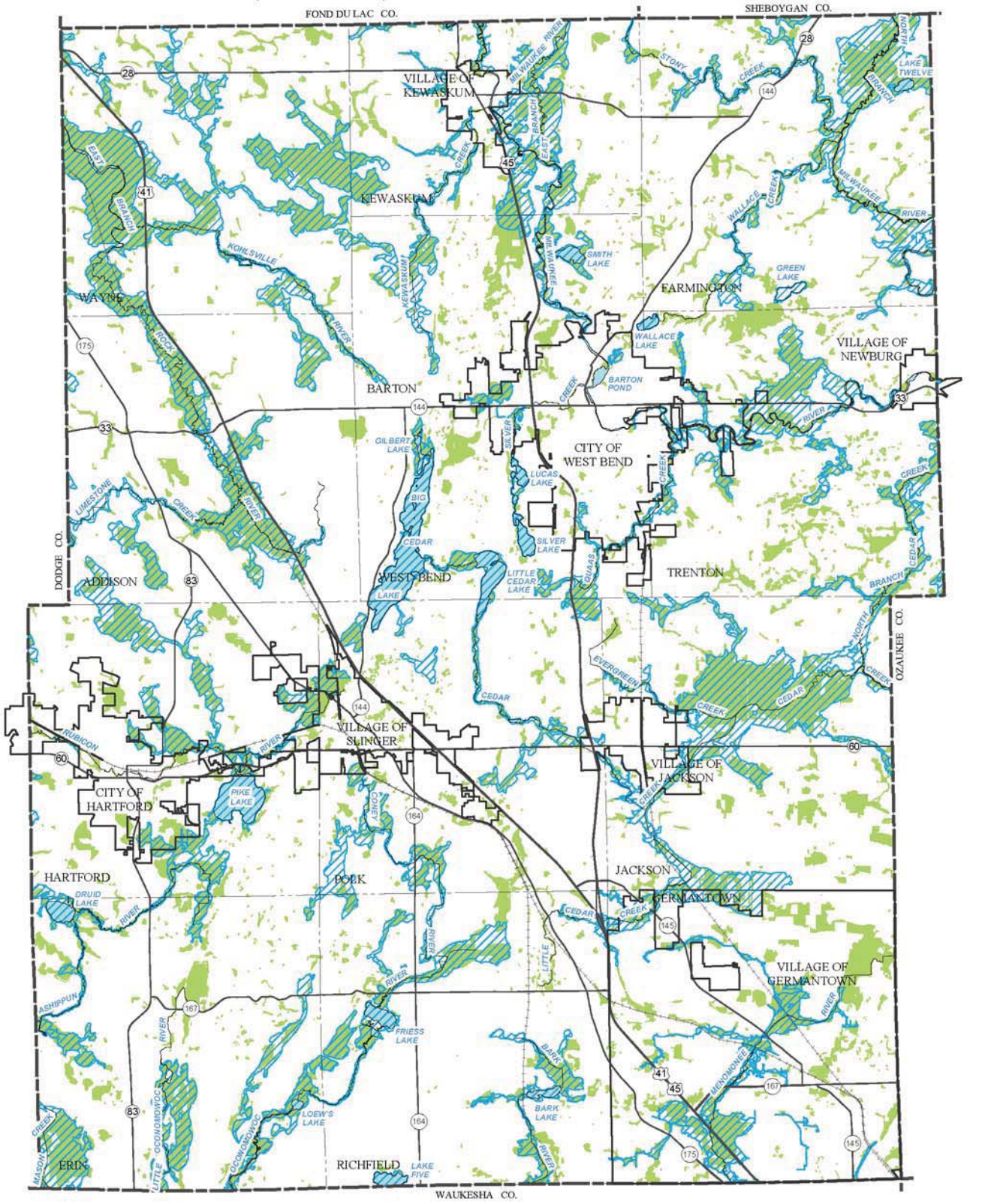
There are 13 major lakes—that is, lakes of 50 or more acres—located entirely within Washington County, which are also shown on Map 1. Major lakes in the Milwaukee River watershed are Barton Pond, Big Cedar Lake, Little Cedar Lake, Green Lake, Lucas Lake, Silver Lake, Smith Lake, Lake Twelve, and Wallace Lake. Major lakes in the Rock River watershed are Bark Lake, Druid Lake, Friess Lake, and Pike Lake. One other major lake in the Rock River watershed, Lake Five, is located partially in Washington and partially in Waukesha County. There are no major lakes within that portion of the Menomonee River watershed or the Fox River Watershed lying in Washington County. Together, these major lakes have a combined surface area of about 2,578 acres in Washington County. The three largest lakes are Big Cedar Lake, with a surface area of about 937 acres; Pike Lake, with a surface area of about 461 acres; and Little Cedar Lake, with a surface area of about 260 acres.

The Kohlsville River (shown above) is part of the Rock River watershed, which generally includes the area in the western half of the County.

Big Cedar Lake has a surface area of 937 acres and is the largest lake in Washington County.

Lakes and streams are readily susceptible to degradation through improper land use development and management. Water quality can be degraded by excessive pollutant loads, including nutrient loads, which enter from malfunctioning and improperly located onsite waste treatment systems, from sanitary sewer overflows, from construction and other urban runoff, and from careless agricultural practices. The water quality of lakes and streams may also be adversely affected by the excessive development of riparian areas and by the filling of peripheral wetlands, which remove valuable nutrient and sediment traps while adding nutrient and sediment sources. It is important that existing and future development in riparian areas be managed carefully to avoid further water quality degradation and to enhance the recreational and aesthetic values of surface water resources.

SURFACE WATERS, WETLANDS, AND FLOODPLAINS IN WASHINGTON COUNTY: 2000



Source: Federal Emergency Management Agency and SEWRPC.

Lake Protection and Rehabilitation Districts have been formed under Chapter 33 of the *Wisconsin Statutes* for Big Cedar, Druid, Friess, Little Cedar, Pike, and Silver Lakes. The location of the lake districts is shown on Map 22 in *A Multi-jurisdictional Comprehensive Plan for Washington County: 2035*. Lake districts are a special-purpose unit of government formed to maintain, protect, and improve the quality of a lake and its watershed which includes combating AIS. With the exception of the Druid Lake district, each of the lake management districts in Washington County has completed a lake management plan, or a component of such a plan. Additional information regarding lake districts and adopted lake management plans is provided in Chapter VI of *A Multi-jurisdictional Comprehensive Plan for Washington County: 2035*.

This facility is operated by the Big Cedar Lake Protection and Rehabilitation District.
Source: Big Cedar Lake PRD

Wetlands

Wetlands generally occur in depressions and near the bottom of slopes, particularly along lakeshores and stream banks, and on large land areas that are poorly drained.[10] Wetlands may, however, under certain conditions, occur on slopes and even on hilltops. Wetlands perform an important set of natural functions which include support of a wide variety of desirable, and sometimes unique, forms of plant and animal life; water quality protection; stabilization of lake levels and streamflows; reduction in stormwater runoff by providing areas for floodwater impoundment and storage; and protection of shorelines from erosion.

Wetlands identified in the Southeastern Wisconsin Regional Planning Commission's (SEWRPC) regional land use inventory encompassed about 42,770 acres, or 15 percent of the County, in 2000.

Wetlands identified in the Southeastern Wisconsin Regional Planning Commission's (SEWRPC) regional land use inventory encompassed about 42,770 acres, or 15 percent of the County, in 2000. Wetlands, which are shown on Map 1, are based on the Wisconsin Wetlands Inventory completed in 1982, updated to the year 2000 as part of the regional land use inventory. It should be noted that, in addition to the wetlands shown on Map 1, certain other areas have been identified by the USDA Natural Resources Conservation Service (NRCS) as farmed wetlands, which are subject to Federal wetland regulations. Wetlands and their boundaries are continuously changing in response to changes in drainage patterns and climatic conditions.

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[10] *The definition of "wetlands" used by SEWRPC is the same as that of the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. Under this definition, wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency, and with a duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. This definition differs somewhat from the definition used by the WDNR. Under the WDNR definition, wetlands are areas where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions. As a practical matter, application of either the WDNR definition or the EPA-Army Corps of Engineers-SEWRPC definition has been found to produce relatively consistent wetland identification and delineations in the majority of the situations in southeastern Wisconsin.*

Wetland Gems

In May 2009, the Wisconsin Wetlands Association (WWA) launched its Wetland Gems program. The program aims to increase public awareness of and appreciation for all of the State's wetlands and to generate community pride in and commitment to stewardship of local wetland treasures that have statewide, national, and even international importance. Wetland Gems are high quality habitats that represent the wetland riches - marshes, swamps, bogs, fens and more - that historically made up nearly a quarter of Wisconsin's landscape. Critically important to Wisconsin's biodiversity, these natural treasures also provide communities with valuable functions and services as well as recreational and educational opportunities. They are landscapes that both preserve the past and inspire for the future. The WWA has designated two Wetland Gems within Washington County, the Germantown Swamp and the Milwaukee River Floodplain Forest, and the spread of invasive species due to urbanization and/or intense recreation threaten the ecological integrity of both. For more information regarding Wisconsin's Wetland Gems can be found on-line at: *www.wisconsinwetlands.org/gems.htm*.

Floodplains

The floodplains of a river are the wide, gently sloping areas usually lying on both sides of a river or stream channel. In the absence of a flood control system, the flow of a river onto its floodplain is a normal phenomenon and can be expected to occur periodically. For planning and regulatory purposes, floodplains are defined as those areas subject to inundation by the 100-year recurrence interval flood event. This event has a one percent chance of being equaled or exceeded in any given year. Floodplains are generally not well suited for urban development because of the flood hazard, the presence of high water tables, and/or the presence of wet soils.

Floodplains in Washington County for which floodplain elevations have been determined through detailed engineering studies were delineated by SEWRPC on large scale topographic maps as part of an update to the Washington County shoreland and floodplain zoning maps completed in 2002. Detailed studies and 100-year flood profiles are available for the rivers and streams listed in Table 41 of *A Multi-jurisdictional Comprehensive Plan for Washington County: 2035*. Where flood elevations were not available, approximate floodplain delineations from the FEMA Flood Insurance Rate Maps were mapped on the orthophotos as part of the update to the shoreland and floodplain zoning maps. "Approximate" floodplains are those mapped by FEMA without the support of detailed engineering studies. The floodplains identified as part of the shoreland and floodplain zoning map update for Washington County in 2002 are shown on Map 1 and encompass an area of approximately 43,800 acres, or 16 percent of the County. Project-specific floodplain delineations and adjustments since 2002 are discussed in *A Multi-jurisdictional Comprehensive Plan for Washington County: 2035*.

Floodplains are generally not well suited for urban development because of the flood hazard, the presence of high water tables, and/or the presence of wet soils.

Shorelands

Shorelands are defined by the *Wisconsin Statutes* as lands within the following distances from the ordinary high water mark of navigable waters: 1,000 feet from a lake, pond, or flowage; and 300 feet from a river or stream, or to the landward side of the floodplain, whichever distance is greater. In accordance with the requirements set forth in Chapters NR 115 (shoreland regulations) and NR 116 (floodplain regulations) of the *Wisconsin Administrative Code*, the Washington County shoreland and

floodplain zoning ordinance restricts uses in wetlands located in the shorelands, and limits the uses allowed in the 100-year floodplain to prevent damage to structures and property and to protect floodwater conveyance areas and the storage capacity of floodplains. The ordinance also limits the removal of vegetation and other activities in shoreland areas and requires most structures to be set back a minimum of 75 feet from navigable waters. Additional setbacks may be required based on the lake and stream classification study conducted by the County. State law requires that counties administer shoreland and floodplain regulations in unincorporated areas. Chapter VI of *A Multi-jurisdictional Comprehensive Plan for Washington County: 2035* provides additional information about the County shoreland and floodplain zoning ordinance and lake and stream classification study, including a map of shoreland areas in unincorporated portions of the County.

Under Chapter NR 117 of the *Administrative Code*, cities and villages are required to restrict uses in wetlands located in the shoreland area. The provisions of NR 115, which regulate uses in unincorporated portions of the shoreland, apply in cities and villages only in shoreland areas annexed to a city or village after May 7, 1982. The same floodplain regulations set forth in NR 116 for unincorporated areas also apply within cities and villages. Each city and village administers the floodplain regulations within its corporate limits.

Natural Areas, Critical Species Habitat, and Aquatic Sites

Natural areas are tracts of land or water so little modified by human activity, or sufficiently recovered from the effects of such activity, that they contain intact native plant and animal communities believed to be representative of the landscape before European settlement. Natural areas are classified into one of three categories: natural areas of statewide or greater significance (NA-1), natural areas of countywide or regional significance (NA-2), and natural areas of local significance (NA-3). Classification of an area into one of these three categories is based on consideration of the diversity of plant and animal species and community type present, the structure and integrity of the native plant or animal community, the uniqueness of the natural features, the size of the site, and the educational value. As of 2009, a total of 94 natural areas, encompassing about 16,852 acres, or about six percent of the County, have been identified. Of the 94 identified sites, eight are classified as NA-1 sites (statewide or greater significance) and encompass about 3,267 acres, 29 are classified as NA-2 sites (countywide or regional significance) and encompass about 5,715 acres, and 57 are classified as NA-3 sites (local significance) and encompass about 7,870 acres.

Critical species habitat sites consist of areas outside natural areas that are important for their ability to support rare, threatened, or endangered plant or animal species. Such areas constitute "critical" habitat considered to be important to the survival of a particular species or group of species of special concern. Twenty-one critical species habitat sites have been identified in Washington County. These sites encompass an area of 615 acres, or less than one percent of the County.

As of 2009, a total of 94 natural areas, encompassing about 16,852 acres, or about 6 percent of the County, have been identified.

There are also 60 aquatic habitat sites supporting threatened or rare fish, herptile, or mussel species in the County, including 188 miles of rivers and streams and 2,749 acres of lake waters. Aquatic habitat sites are shown on Map 26 and described in Table 45 of *A Multi-jurisdictional Comprehensive Plan for Washington County: 2035*.

To ensure that natural areas and critical species habitat areas, primary environmental corridors, and the network of plant and animal communities contained within them are maintained for the future, proper management is essential. Simply designating an area as one of the above entities, although essential, is not sufficient. Equally important is ensuring an appropriate management regime. Natural areas and critical species habitat areas need proper management to ensure that the critical species and natural communities concerned can flourish. Without proper management, such as invasive species control, such areas may be significantly altered over time and their natural values diminished or lost. Management techniques appropriate for one type of natural area or critical species habitat area may not be appropriate for others and management measures must be developed and applied on a site-by-site basis.[11]

PART III – AQUATIC INVASIVE SPECIES AND WASHINGTON COUNTY

Aquatic Invasive Species and Washington County

Most Washington County residents appreciate the abundance of lakes, rivers, scenic landscapes and variety of wildlife the county exhibits, however, many residents are unaware of what aquatic invasive species are or that they are present. These invasive plants, animals and microscopic organisms are transforming local ecosystems and reducing species diversity throughout Washington County. Invasive species can create serious and often irreversible damage to lakes. Eradication of some established infestations may be nearly impossible and control measures can become controversial and expensive. Although each species has unique characteristics, they all portray common harmful impacts. They are successful because they have few natural predators, and are aggressive, prolific and mature early. AIS are spread mainly through boaters launching and transporting trailers and equipment, and also through anglers, water garden and aquarium owners, sea planes and natural dispersal. Educating the public and addressing AIS concerns on a state and local level is essential, considering the potential for them to transfer from one waterbody to the next is centered around people and their activities.

AIS Found in Washington County Waters and of Concern throughout Wisconsin

Numerous AIS can currently be found in various Washington County waterbodies and are becoming increasingly common throughout Wisconsin. The following section provides detailed descriptions of such species.[12]

Eurasian Watermilfoil *(Myriophyllum spicatum)*

- ***History:*** Eurasian watermilfoil is a submersed aquatic plant originating in Europe, Asia, and North Africa. It was introduced to Wisconsin in the 1960's, and is the only non-native milfoil found in the state.
- ***Identifying Characteristics:*** Eurasian watermilfoil has feather-like leaves that lay flat along its stem when pulled out of the water. There are usually 12-21 leaflets per leaf, which are arranged in whorls (circles) of three to five around the stem. Native milfoils typically have 7-11 leaflets. It can grow in depths of 1-20 feet. The stems of Eurasian watermilfoil tend to be limp, and the upper part of the plant usually resembles a red or pinkish color, although some native species of water milfoils also have pink stems.

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[11] *More information regarding identification and management of natural areas and critical species habitat sites can be found in SEWRPC's Amendment to the Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin (December 2010).*

[12] *Detailed descriptions of AIS listed in Part III were provided by the Wisconsin Department of Natural Resources.*

- ***Life Cycle:*** Eurasian watermilfoil starts growing when the temperature reaches 50 degrees Fahrenheit, and begins growing earlier than the native water milfoils. It produces seeds and runners, although the main method of reproduction is through vegetative fragmentation from boats and wave action. The floating fragments sprout roots, and eventually sink to the lake bed where they will root and start a new colony.
- ***Impacts:*** Eurasian watermilfoil poses a serious threat to a lake's native aquatic plant community, and poses a threat to animals that depend on native vegetation. It forms thick vegetative mats that spread horizontally across a lake's surface, and intertwines with native vegetation. It shades out native vegetation used by fish, waterfowl and other animals. It also inhibits recreational uses like fishing, boating, and swimming, and can lead to degraded water quality and algae blooms.

Eurasian Watermilfoil (Myriophyllum spicatum) Source: WDNR

Eurasian watermilfoil is perhaps the AIS most-commonly associated with diminishing property values. The U.S. Fish & Wildlife Service sites studies done in Vermont and Wisconsin in which Eurasian watermilfoil reduced lakefront property values up to 16 percent and 13 percent respectively.[13,14]

Curly-leaf Pondweed *(Potamogeton crispus)*

- ***History:*** Curly-leaf pondweed is a submersed aquatic plant originating in Eurasia, Australia and Africa. It was accidentally introduced into the United States when the common carp was brought in during the 1800's, and eventually into Wisconsin in 1905. Before Eurasian watermilfoil, Curly-leaf pondweed was considered the largest nuisance aquatic plant in the Midwest.

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[13] *http://www.fws.gov/verobeach/PythonPDF/CostofInvasivesFactSheet.pdf*

[14] *The Vermont study used a hedonic (pleasure-related) property-value method to estimate the effect of Eurasian watermilfoil on lakefront property values at selected Vermont lakes. Results indicated that as the primary component of total aquatic macrophyte growth in a lake Eurasian watermilfoil significantly and substantially affects lakefront property values. As Eurasian watermilfoil infests a lake, adding to the total macrophyte growth, property values can diminish by <1% to 16% for incremental increases in the infestation level. Hence, policies that successfully prevent infestations have significant economic benefits to owners of lakefront properties and local communities. Source: Zhang, C., Boyle, K.J., The effect of an aquatic invasive species (Eurasian watermilfoil) on lakefront property values, Ecol. Econ. (2010), doi:10.1016/j.ecolecon.2010.09.011.http://www.eaglelake1.org/envirnonmental_issues/invasive_species/aquatic/milfoil/Zhang%20and%20Boyle%20EE%202010.pdf.*

The Wisconsin study used hedonic analysis to estimate the effects of Eurasian Watermilfoil on property values across an extensive system of over 170 lakes in the northern forest region of Wisconsin. Since milfoil is inadvertently spread by recreational boaters, and since boaters are more likely to visit attractive lakes, variables indicating the presence of milfoil are endogenous in a hedonic model. Using an identification strategy based on a spatial difference-in-differences specification, results indicated that lakes invaded with milfoil experienced an average 13% decrease in land values after invasion. Source: Horsch, E., Lewis, D., The Effects of Aquatic Invasive Species on Property Values: Evidence from a Quasi-Random Experiment, University of Wisconsin-Madison Department of Agricultural & Applied Economics, Staff Paper No. 530, November 2008. http://www.aae.wisc.edu/pubs/sps/pdf/stpap530.pdf.

- ***Identifying Characteristics:*** Curly-leaf pondweed can be recognized by its stiff reddish-green "lasagna-like" looking leaves. They are about three inches long, finely toothed along the edge, and alternate along the stem. The stem of the plant is flat and reddish-brown. Like Eurasian watermilfoil, Curly-leaf pondweed can grow in a variety of water depths, usually up to 15 feet.
- ***Life Cycle:*** Curly-leaf pondweed does reproduce and spread by seed, although vegetative buds called *turions* are the primary role. Turions are hard, compacted, vegetated buds that resemble small pine cones and are produced along the stem of the plant. Curly-leaf pondweed is unique because it can start growing under the ice before any other plant, making it one of the first plants to emerge in the spring. A few days after the ice melts, it begins to grow more rapidly. In mid-summer, when most aquatic plants are still growing, curly-leaf pondweed begins to die off, dropping its turions on the lake bed to begin new plant growth. It completes its life cycle by late June or early July. It is tolerant of disturbance and can grow in most any type of water condition.

Curly-leaf Pondweed (Potamogeton crispus) Source: WDNR

- ***Impacts:*** Because Curly-leaf pondweed can grow so early, it can outcompete native plants in the spring. It forms thick mats across the surface, interfering with aquatic recreation. In the summer when Curly-leaf pondweed dies off, the decaying plants release nutrients, such as phosphorus, which cause severe algae blooms and unpleasant smells along shorelines. Plant die-offs also result in a loss of dissolved oxygen, an essential component for all aquatic life forms.

Purple Loosestrife *(Lythrum salicaria)*

- ***History:*** Purple loosestrife is a wetland plant originating from Europe. The plant was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties.
- ***Identifying Characteristics:*** Purple loosestrife is a three to nine foot semi-woody plant that has a square stem with smooth, opposite leaves. It has showy purple to pink flowers with five to six petals that are formed into numerous long spikes that bloom from July to September. It also has a large woody taproot with fibrous rhizomes that form a dense underground mat. Its optimal habitat includes marshes, stream and lake edges, and wet prairies.

Purple Loosestrife (Lythrum salicaria) Source: WDNR

- ***Life Cycle:*** Purple loosestrife can germinate in a variety of soil types, although optimum sites for growth include moist soil with neutral to slightly acidic pH. It spreads mainly by seeds, but also by its large underground taproot. Mature plants can release more than two million seeds in a single year. Plants may be quite large and several years old before they begin flowering. It is difficult to look for non-flowering plants, so the best time to spot purple loosestrife is mid-summer when they are flowering.

- ***Impacts:*** Purple loosestrife grows faster and taller than most native wetland plants. Once established on a lakeshore or adjacent wetland, it displaces native plants and reduces wildlife habitat. As native vegetation is displaced, rare plants are often the first to disappear. Thick stands of purple loosestrife can choke out recreational waterways, and eventually overrun large acres of wetlands. This can result in a loss of open water habitat.[15]

Zebra Mussel *(Dreissena polymorpha)*

- ***History:*** Zebra mussels were accidentally introduced to North America as larvae through ballast water from boats that traveled across fresh water Eurasian ports. In 1990, they were discovered in a Lake Michigan harbor.
- ***Identifying Characteristics:*** Zebra mussels look like a small D-shaped clam, only reaching a maximum of two inches in length (although most are smaller than an inch). They have yellowish-brown alternating light and dark stripes, hence their name. They are usually found growing in large clusters of individuals in shallow, algae-rich water.

Zebra Mussel
(Dreissena polymorpha)
Source: USGS

- ***Life Cycle:*** Zebra mussels reproduce sexually from spring to late fall, and form microscopic larvae called veligers. A female Zebra mussel can produce 30,000 to 1,000,000 eggs in one year. Veligers stay suspended in water for one to five weeks, where then, they begin to sink and attach to hard surfaces using their adhesive byssal threads.
- ***Impacts:*** Zebra mussels are filter feeders and can filter up to one liter of water per day. They remove plankton from the water, which is an essential food source for young fish, native mussels, and other aquatic organisms. Filtered water also leads to clearer water. This can affect light penetration which can lead to more aquatic plant growth in deeper water. Thicker plant growth can cause a problem for anglers and boaters. Zebra mussels also clog water intake pipes for industrial facilities and boat engines, making it very expensive to keep their pipes cleared out. They attach to piers, boat lifts and boats, causing damage and costly repair. They also attach to the shells of native mussels in great masses, eventually smothering them. Their sharp shells wash up on shore, and can cut the feet of beach walkers and swimmers.

Rusty Crayfish *(Orconectes rusticus)*

- ***History:*** Rusty crayfish are native to streams in the Ohio River Basin states of Ohio, Kentucky, Illinois, Indiana and Tennessee. They were likely introduced to Wisconsin waters by anglers using them as fishing bait. 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.
- ***Identifying Characteristics:*** Adult Rusty crayfish are generally three to five inches long (excluding claws). They are identified by their rust-colored spot on each side of their body. Their claws are typically larger and smoother than many other native crayfish, and have black bands on the tips.

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[15] *More educational information regarding purple loosestrife and control methods is available through the Wisconsin DNR and UW-Extension. More information can be obtained by visiting: http://dnr.wi.gov/topic/invasives/loosestrife.html or by contacting Purple Loosestrife Project, DNR Science Operations Center, 2801 Progress Road, Madison, WI 53716.*

- ***Life Cycle:*** Rusty crayfish inhabit lakes, streams and ponds. They prefer areas that have logs, rocks or other debris for cover, and bottom substrates of silt, clay, sand or rocks. They need fairly clean water, and inhabit both pool and riffle-like areas, and can be prolific, lying from 80-575 eggs.
- ***Impacts:*** Adult Rusty crayfish eat about four times the amount of food a native crayfish eats. It feeds on small fish, insects, fish eggs, and native crayfish eggs. They also feed on aquatic vegetation, damaging habitat for fish spawning, cover and food. If the Rusty crayfish are eating Eurasian watermilfoil, they are making the problem worse by spreading fragments in the water. They are also more aggressive than native crayfish, eventually displacing them from an area.

Rusty Crayfish (Orconectes rusticus) Source: USGS

Red Swamp Crayfish *(Procambarus clarkia)*

- ***History:*** Red swamp crayfish are native to the gulf coastal plain from the Florida Panhandle to Mexico, and from the southern Mississippi River drainage to Illinois. They are used primarily in aquaculture or culinary purposes and are introduced mainly through human release.
- ***Identifying Characteristics:*** Red swamp crayfish are typically dark red in color with raised bright red spots covering the body and claws. The claws and body may also be blue in color. They also have a dark wedge shaped strip on the top of the abdomen.
- ***Life Cycle:*** Red swamp crayfish are very adaptive to many environments including highly fluctuating water levels. They are highly prolific and typically mate in the fall, lay their eggs in the spring to early summer, and can also brood twice a year. A large crayfish can lay as many as 650 eggs.

Red Swamp Crayfish (Procambarus clarkia) Source: Gary Engberg Outdoors

- ***Impacts:*** Red swamp crayfish out-compete native crayfish for food and habitat. They also carry a fungus plaque which is a disease that damages the muscles of native crayfish. They are extensive burrowers and can penetrate over six feet into shorelines leading to extensive erosion. Red swamp crayfish can live for over a year in their burrows without water and have been known to travel several miles over land at night or during wet weather.

Chinese and Banded Mystery Snail *(Cipangopaludina chenesis)*

- ***History:*** Chinese and Banded Mystery Snails are native to China and other Asian countries. They were introduced to the United States as a food source, and later were distributed through the aquarium industry.
- ***Identifying Characteristics:*** The easiest way to identify a Chinese Mystery Snail is by its shell. It is a smooth, cone-shaped, spiral-shaped shell with uniform light to dark olive-green coloration and five to seven whorls. It grows upward about two inches in length. Banded Mystery Snails will achieve a length of 1-1.5 inches and have reddish-brown bands circling the shell. Only Mystery Snails have an operculum (trap door) present.

Chinese (top) and Banded (bottom) Mystery Snail (Cipangopaludina chenesis)

Sources: llsgcp.org (top) and lwipa.blogspot.com (bottom)

- ***Life Cycle:*** Chinese Mystery Snails are found in shallow, slow moving, or stagnant waters, staying partially buried in the mud. Sexual reproduction occurs, and females give birth to crawling live young twice a year. Snails mature after one year and can live three to five years.
- ***Impacts:*** Chinese Mystery Snails eat native zooplankton, filter feed on suspended matter, and compete for space with native species. They also serve as vectors for the transmission of various parasites and diseases such as flukes, which can infect humans. Unlike native snails, the Chinese Mystery Snail *will not* serve as a host for swimmers itch. Additionally, their shells clog water intake pipes, inhibiting the flow of water. They have a "trap door" called an operculum which allows them to close the opening of their shell when water conditions are unfavorable.

Rainbow Smelt *(Osmerus mordax)*

- ***History:*** Rainbow smelt entered the Great Lakes from an inland lake in Michigan, were discovered in 1928, and began to spread to Wisconsin's inland waters in the 1980's. They have become an important component of recreational and commercial fishing.
- ***Identifying Characteristics:*** Rainbow smelt mature to seven to nine inches, weighing about three ounces. They have a pale green back with a silvery iridescent purple, blue, or pink on their sides. They also have a conspicuous silvery length wise streak along each side. When removed from the water they give off the smell of cucumbers.
- ***Life Cycle:*** A female smelt may produce 33,000 to 75,000 eggs during their early spring spawn. Both males and females mature in two years and will live beyond five years of age. They are very prolific and will spawn in mass numbers along shorelines and inlets.

Rainbow Smelt (Osmerus mordax)
Source: Department of Game, Fish, and Parks, South Dakota

- ***Impacts:*** Adult smelt compete directly with juvenile walleye and will also eat young-of-the-year trout, whitefish, and cisco, directly impacting the base fishery of many cold water/deep basin lakes. Rainbow smelt are also rich in thiaminase, an enzyme that destroys thiamin. This inhibits the development of fish embryos from female fish that consume smelt.

Potential AIS Threatening Washington County

There are AIS not yet known to exist in Washington County waterbodies that have been identified in nearby counties or other states in the Midwest region. These AIS are considered threats to Washington County and are described in the following section.

Yellow Floating Heart *(Nymphoides peltata)*

- ***History:*** Yellow Floating Heart (YFH) is a very aggressive exotic plant from Asia and has been documented in six private ponds in Wisconsin. YFH was introduced to Wisconsin primarily as a water garden plant. YFH was discovered in two stormwater detention ponds in Walworth County in 2007. Once introduced and established, YFH is extremely difficult to eradicate.

- ***Identifying Characteristics:*** It is identified by its round heart shaped leaves that are up to six inches in diameter and have sculpted edges. Many of the floating leaves are purple underneath. The flower sits on a stalk about two inches above the water and is yellow with five fringed pedals.
- ***Life Cycle:*** YFH spreads through fragmentation and seed movement from high water as well as bird and animal movement.
- ***Impacts:*** It develops very thick mats that cover complete water surfaces limiting sunlight and oxygen to the water below. YFH is very difficult to control; mechanical removal with heavy equipment and lining with heavy duty, thick plastic liners is most effective. Chemical treatment has shown to be ineffective and also drastically effects other aquatic vegetation in the area.

Yellow Floating Heart (Nymphoides peltata) Source: WDNR

Viral Hemorrhagic Septicemia Virus *(VHS)*

- ***History:*** VHS is a deadly fish virus that is threatening Wisconsin's fish. It has mutated from the original virus that was discovered in the 1930's that infected European trout farms. More recently, it has caused large fish kills in several eastern Great Lakes in 2005 and 2006. In 2007, VHS was confirmed in Lake Michigan, after first being found in the Lake Winnebago system. The virus infects the internal organs and cells that line the blood vessels of fish, causing severe hemorrhaging (bleeding) and death. Fish can also be infected when they eat an infected fish.
- ***Identifying Characteristics:*** Fish infected with VHS may have clinical signs of bulging eyes, external and internal hemorrhaging, swollen or pale organs, or bloated abdomens. Infected fish shed the virus through their reproductive fluids and urine. The blood vessels become weak causing hemorrhaging in the internal organs, muscles and skin. The virus grows best when the water temperature is between 37-54 degrees Fahrenheit. Most infected fish die at 37 to 41 degrees but rarely die above 59 degrees. The virus can survive in water for at least 14 days. Although some infected fish may not show any signs, transporting these fish to new locations could spread the disease to unaffected waters.
- ***Impacts:*** Presently, there are about 45 species of fish that are known to be susceptible to VHS. Fortunately, studies have shown VHS is not a threat to people who handle or eat infected fish. The virus can potentially cause massive fish population die offs and can severely impact the billion dollar fisheries industry.
- ***Symptoms Include:*** External hemorrhaging, internal hemorrhaging, swollen or pale organs, and bulging. Lakes closest to Washington County where VHS has been documented to exist include Lake Michigan and Lake Winnebago.

Viral Hemorrhagic Septicemia (VHS) Source: WDNR

Spiny Waterflea *(Bythotrephes longimanus) and*
Fishhook Waterflea *(Cercopagis pengoi)*

- ***History:*** Both species of waterfleas entered the Great Lakes through ballast ship water from Europe. The spiny waterflea arrived in the 1980's, followed by the fishhook during the 1990's.
- ***Identifying Characteristics:*** Both species are about ¼ to ½ inch long. Spiny waterfleas are distinguished by their long tail spines, which usually have one to three barbs. Fishhook waterfleas have smaller barbs on their tails and the end of the tail has a "fishhook" appearance. Both species will appear as a white slimy glob on fishing line.
- ***Life Cycle:*** Both species reproduce sexually and asexually in the summer. This means that no males are required; therefore a single female can start a new population herself. Eggs can be transferred to new waterbodies through boating, fishing and other water recreational equipment. Resting eggs can survive long after the adults are dead, even under extreme environmental conditions.

Spiny Waterflea (Bythotrephes longimanus) and Fishhook Waterflea (Cercopagis pengoi)
Source: WDNR

- ***Impacts:*** Spiny and fishhook waterfleas reproduce very rapidly, leading to large increased populations. They eat smaller zooplankton, including the native daphnia (native waterfleas) which are an important food source for young fish. Additionally, young fish have trouble eating these waterfleas due to their long spiny tails. Waterfleas also gather in thick globby masses on fishing line and downrigger cables, clog eyelids of fishing rods and damage a reel's drag system, all of which can prevent fish from being landed.

Quagga Mussel *(Dreissena bugensis)*

- ***History:*** Much like Zebra mussels, Quagga mussels were transported here through ballast water most likely in the late 1990's but were not confirmed in Lake Superior and Lake Michigan until 2005.
- ***Identifying Characteristics:*** The adult Quagga mussels are larger than Zebra Mussels and can be up to two inches in length. The shell is more rounded than the Zebra mussel and will roll over if placed on its hinge side. The shell is a light cream color with dark concentric rings. Quagga mussels will survive in a much broader range of water temperature and depth.

Quagga Mussel (Dreissena bugensis)
Source: Sea Grant Michigan

- ***Life Cycle:*** Quagga mussels reproduce sexually from spring to late fall, and form microscopic larvae called veligers, much like Zebra mussels. Veligers stay suspended in water for one to five weeks, where then, they begin to sink and attach to hard as well as soft surfaces using their adhesive byssal threads.
- ***Impacts:*** Quagga mussels have much the same impacts that Zebra mussels do but to a greater extent due to their ability to survive in deeper colder water. This has caused matting of filamentous algae reducing fish habitat and environmental concerns when mats of algae drift ashore.

Round Goby *(Neogobius melanostomus)*

- ***History:*** Round goby are originally from the Caspian Sea and were introduced via ballast water. They were first discovered in the Great Lakes in 1990. Once established, the population rapidly spread.
- ***Identifying Characteristics:*** The Round goby is bottom dwelling, has a large head, and can grow to ten inches, more commonly four to six inches. They have a fused suction cup like pelvic fin, and the front dorsal fin has a large dark spot.

Round Goby (Neogobius melanostomus)
Source: North American Native Fishes Association

- ***Life Cycle:*** Gobies spread easily through swimming and currents and can reproduce up to six times a summer. They are fierce competitors and can feed in total darkness. They are known as voracious egg predators.
- ***Impacts:*** Round gobies take over the prime spawning sites and habitat of native sculpins and log perch. Gobies will consume the eggs of any species, raiding nests temporarily vacated by bass or other panfish and they will also consume the eggs of broadcast spawners.

Asian Carp, Bighead *(Hypophthalmichthys nobilis)*
and ***Silver*** *(H. molitrix)*

- ***History:*** Bighead and Silver carp were brought to North America from China in the early 1970's to improve water quality in aquaculture ponds and were marketed as fish food. They entered the Mississippi River through a high water event and started moving upstream at a rate of 50 miles per year.
- ***Identifying Characteristics:*** Both species have low set eyes with large upturned mouths and no barbells. Their heads have no scales, while the scales on their bodies are very small. Silver carp are primarily silver in color, while the Bighead carp have dark blotches along the top of its body.
- ***Life Cycle:*** Both Asian carp species are very prolific and fast growing to a length of more than four feet. Female Bighead carp can produce between 200,000 and one million eggs in their lifetime, while Silver carp produce between 300 and 5,000 eggs. They are both filter feeders and can consume their weight in plankton daily.

Bighead Carp (Hypophthalmichthys nobilis)
Source: D. Riecks

Silver Carp (Hypophthalmichthys molitrix)
Source: L. Lovshin

- ***Impacts:*** Because they are such efficient feeders, they drastically diminish the base food for native fish, thus disrupting the entire food chain. Asian carp are also renowned for leaping out of the water when disturbed by watercraft, potentially injuring boaters.

PART IV – AQUATIC INVASIVE SPECIES WITHIN WASHINGTON COUNTY WATER RESOURCES AND WATERSHEDS

As previously mentioned, AIS are already commonly found in many Washington County waterbodies and watersheds. The following summarizes where specific AIS are already established in Washington County and where AIS are considered to be threatening or of concern.

AIS in Washington County's Lakes

Numerous major lakes of 50 acres or more in Washington County contain populations of various aquatic invasive species.[16] Table 5 summarizes known AIS populations that have been identified in the County's major lakes. It is also very important to document and manage existing AIS populations on small waterbodies such as lakes smaller than 50 acres, private ponds and small wetland areas. Even a minor AIS infestation could spread to other uninfected waterbodies. Table 6 is an inventory of waterbodies less than 50 acres in size in Washington County and summarizes if certain AIS populations have been identified within it. All waterbodies in Washington County with identified AIS are displayed on Map 2. Maps 3 through 15 document where AIS populations are located in various Washington County major lakes and provide physical characteristics of each lake. Lake maps are not available for all lakes in Washington County under 50 acres. "Other" waterbodies with reported AIS that have been mapped are displayed as Maps 16 through 18. As new reports of AIS are documented and maps are created, they will be added as this plan is updated in the future. It is also important to note that seasonal occurrences of AIS may occur throughout the County's lakes.

Licensed Fisherman and Registered Boats in Washington County

Washington County acquired data from the WDNR to determine where licensed fishermen and registered boat owners reside within the County. This information is valuable because fishermen and boat owners possess significant potential to spread AIS. Since AIS commonly spread via fishing and boating equipment, it is important to communicate and educate people within these two demographic categories about AIS and how to prevent their spread.

Through analysis of this information and as shown on Map 19, it is evident that the majority of licensed fisherman and registered boat owners live in large clusters within the County's most populous communities and around major lakes.[17] Map 19 can aid in pinpointing areas in the County in which to focus educational and boat launch monitoring efforts.

Significant amounts of fishermen and boat owners also reside in a scattered pattern throughout the rest of Washington County. The scattered pattern may indicate that many County residents travel significant distances, often to waterbodies outside of Washington County, and possess a higher potential of bringing AIS into the County.

Project Riverine Early Detection (Project RED)

Wisconsin's rivers are vulnerable to invasion by a number of invasive species. The key to successfully protecting rivers is detecting invasives early when it is still possible to isolate or eradicate the infestation. Project RED (Riverine Early Detectors) is a collaboration between the WDNR, the National Institute for Invasive Species Science and the River Alliance of Wisconsin that provides local resident volunteers with the necessary tools to be a Riverine Early Detector.

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[16] *There are 13 major lakes located entirely within Washington County. Lake Five is located partially in Washington and partially in Waukesha County.*

[17] *Data on Map 19 does not include customers who have opted off of the WDNR's mailing list.*

The program includes free training that teaches volunteers to monitor rivers by canoe, kayak, or on foot for 15 species of concern. The WDNR helps volunteers choose locations and a monitoring schedule that are convenient to them and provides online data management tools available through *http://www.citsci.org/* that help participants report and map their findings. If an invasive is identified in a riparian corridor, the River Alliance of Wisconsin and the WDNR can also help with eradication or containment by providing funding and technical resources. More information on Project RED is available on the WDNR website: *dnr.wi.gov*.

Project RED provides local resident volunteers with the necessary tools to detect invasives in their early stages. Source: River Alliance of Wisconsin

Table 5

MAJOR LAKES (50 ACRES OR LARGER) IN WASHINGTON COUNTY AND IDENTIFIED AIS

Number on Map 2	Water-body Name	Surface Area (acres)	Volume (acre-feet)	Length of Shoreline (miles)	Max. Depth (feet)	Mean Depth (feet)	Under 3 Ft. (%)	Over 20 Ft. (%)	Subwater-shed Area (acres)	Surface Elevation (feet)	Waterbody Inventoried No AIS Found	Aquatic Invasive Species						
												Curly-Leaf Pondweed	Eurasian Water-milfoil	Rainbow Smelt	Zebra Mussel	Rusty Crayfish	Red Swamp Crayfish	Chinese & Banded Mystery Snail
1	Bark Lake	65	868	1.8	34	14	15.9	31.1	3,043	973.7			X					
2	Barton Pond	63	189	1.2	5	3	51.7	-	44,120	890.8						X		
3	Big Cedar Lake	937	31,983	11	105	34	7	47	6,641	1,304.4		X	X	X	X			
4	Druid Lake	122	3,000	1.7	53	25	21.6	62.2	6,870	969.6		X						
5	Friess Lake	121	3,102	2.3	48	26	13	68	12,374	955.5		X	X			X		
6	Green Lake	70	1,207	1.8	37	17	11.4	37.8	550	868.7		X	X					X
7	Lake Five[a]	104	1,100	1.9	23	11	-	-	930	972.3			X					
8	Lake Twelve	53	318	1.3	20	6	34	-	320	801.2			X					
9	Little Cedar Lake	260	3,198	4	56	13	16.9	37.3	7,565	1,013.0		X	X		X			
10	Lucas Lake	69	468	2.8	15	7	20	-	560	994.3		X	X					
11	Pike Lake	461	2,349	3.8	45	5	-	-	8,100	992.9		X	X		X			
12	Silver Lake	122	2,306	2.7	47	20	12	56	305	998.7		X	X		X			X
13	Smith Lake	85	630	1.7	5	3	45	-	86	923.3	X							
14	Wallace Lake	54	558	1.2	35	11	15.6	18.6	370	899.1		X	X		X			

[a]*Lake Five is located in both Washington and Waukesha Counties.*

Source: Wisconsin Department of Natural Resources and Washington County.

Table 6

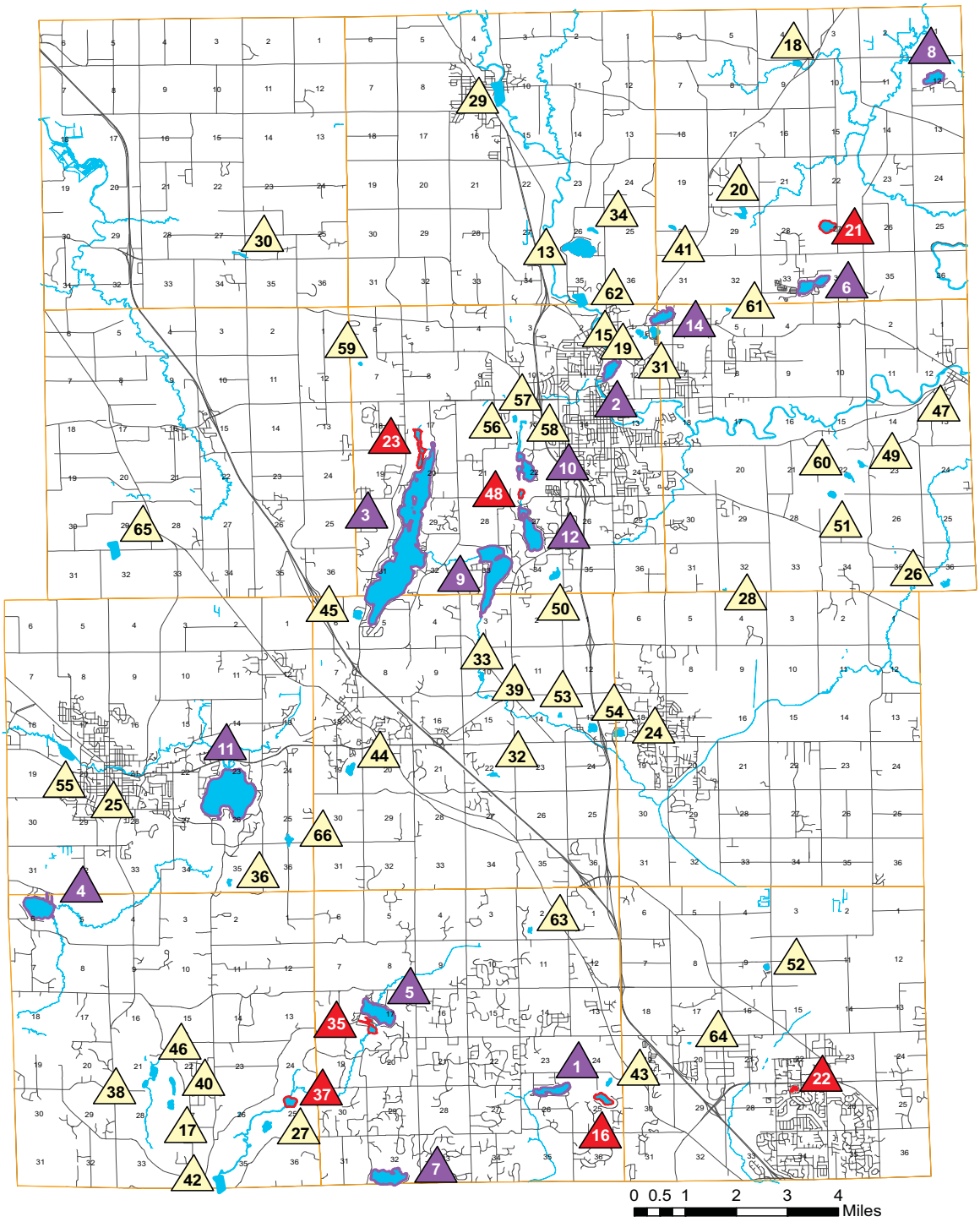
OTHER WASHINGTON COUNTY WATERBODIES (LESS THAN 50 ACRES) AND IDENTIFIED AIS

Number on Map 2	Waterbody Name	Surface Area (acres)	Maximum Depth (feet)	Waterbody Inventoried No AIS Found	Aquatic Invasive Species						
					Curly-Leaf Pondweed	Eurasian Water-milfoil	Rainbow Smelt	Zebra Mussel	Rusty Crayfish	Red Swamp Crayfish	Chinese & Banded Mystery Snail
15	Allis Lake	7	34								
16	Amy Belle Lake	30	37								X
17	Beck Lake	15	8								
18	Boltonville Millpond	9	10								
19	Brickyard Lake	4	4								
20	Ehne Lake	16	15								
21	Erler Lake	35	34			X					
22	Esquire Estates Pond (T.9N. R.20E., Sec.27)	5	12							X	
23	Gilbert Lake	43	30		X	X					
24	Hasmer Lake	13	34								
25	Hartford Millpond	10	8								
26	Hawthorn Lake	8	12								
27	Hickey Lake	12	14								
28	Keowns Pond	1	15								
29	Kewaskum Millpond	5	8								
30	Kohlsville Millpond	3	7								
31	Lake Lenwood	15	38								
32	Lehner Lake	4	22								
33	Lent Lake	4	7								
34	Little Drickens Lake	8	20								
35	Little Friess Lake	16	34			X					
36	Lohr Pond	9	8								
37	Loew's Lake	24	23		X	X					
38	Malloy Lake	6	24								
39	Mayfield Pond	8	4								
40	McConville Lake	14	37								
41	Miller Lake	5	16								
42	Monches Millpond	14	4								
43	Mud Lake (T.9N. R.19E., Sec. 25)	7	10								
44	Mud Lake (T.10N. R.19E., Sec 19)	25	5								
45	Mueller Lake	12	33								
46	Murphy Lake	17	37								
47	Newburg Pond	10	8								
48	Paradise Valley Lake	9	35			X					
49	Proschinger Lake	6	23								
50	Quaas Lake	7	12								
51	Radtke Lake	9	14								
52	Rockfield Quarry Pond	4	27								
53	Schwietzer Pond	3	-								
54	Tilly Lake	12	48								
55	Unnamed (T.10N R.18E., Sec. 20)	8	-								
56	Unnamed (T.11N R.19E., Sec. 15)	2	-								
57	Unnamed (T.11N R.19E., Sec. 15)	2	-								
58	Unnamed (T.11N R.19E., Sec. 15)	6	-								
59	Unnamed (T.11N R.19E., Sec. 7)	0	-								
60	Unnamed (T.11N R.20E., Sec. 22)	7	-								
61	Unnamed (T.11N R.20E., Sec. 5)	3	-								
62	Unnamed (T.12N R.19E., Sec. 35)	8	-								
63	Unnamed (T.9N R.19E., Sec. 2)	3	-								
64	Unnamed (T.9N R.20E., Sec. 20)	1	-								
65	Unnamed (T.11N R.18E., Sec. 32)	0	-								
66	Werner Pond	4	8								

Note: Not all waterbodies listed in this table have been inventoried by Washington County. Not all information in this table has been confirmed by Washington County and information listed may not be all-inclusive.
Source: Wisconsin Department of Natural Resources and Washington County.

Map 2

Washington County Waterbodies Identified with AIS



Prepared by:
Washington County
Planning & Parks Department
Land & Water Conservation Division
Dated 11/19/12

This information is issued subject to errors and omissions and is not certified by Washington County.

Legend

Surface Water

Major Waterbodies (greater than 50 Ac.) with AIS

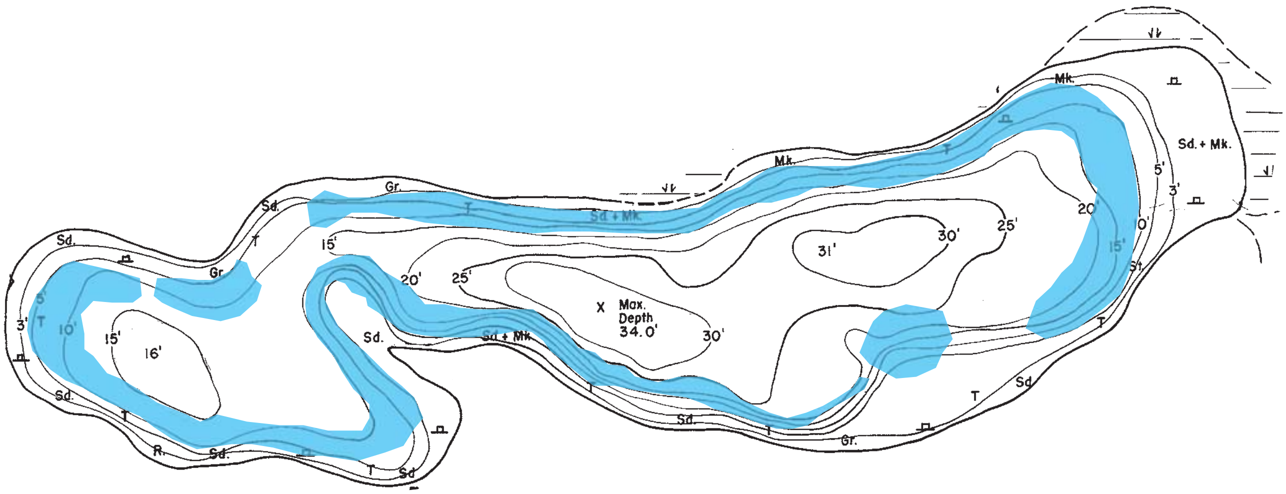
Other Waterbodies (less than 50 Ac.) with AIS

Corresponding Waterbody as Listed in Table 5 or 6

Note: Rusty Crayfish found throughout various streams.

Map 3
Aquatic Invasive Species Identified in

Bark Lake



Bark Lake
Known AIS Species

- [ ] Curly-Leaf Pondweed (green)
- [x] √ Eurasian Watermilfoil (blue)
- [ ] Rainbow Smelt
- [ ] Zebra Mussel
- [ ] Rusty Crayfish
- [ ] Banded Mystery Snail

Not to Scale

Physical Characteristics

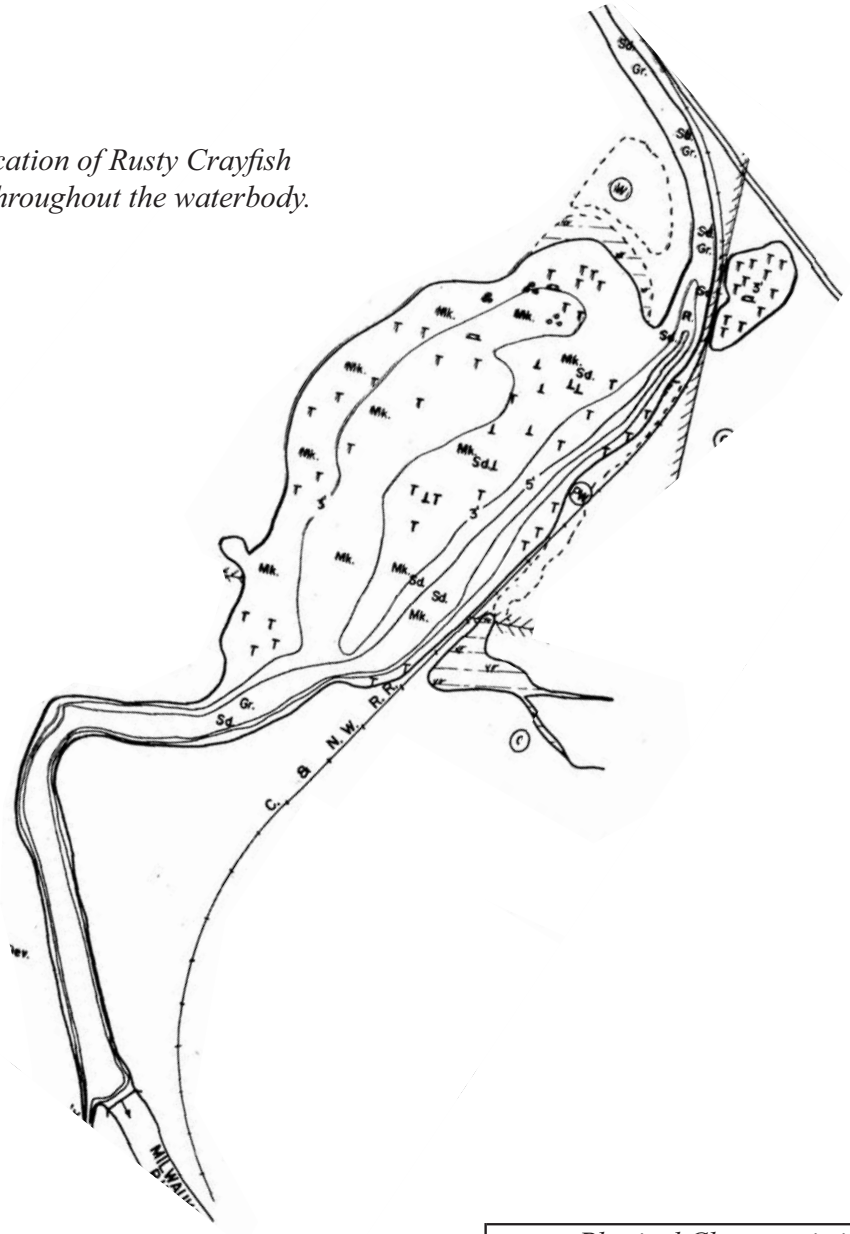
65	Surface Area (acres)
868	Volume (acre-feet)
1.8	Length of Shoreline (miles)
34	Maximum Depth (feet)
14	Mean Depth (feet)
15.9 %	Under 3 ft. deep
31.1 %	Over 20 ft. deep
3,043	Subwatershed Area (acres)
973.7	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, June 1970 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 4
Aquatic Invasive Species Identified in

Barton Pond

Note: Positive identification of Rusty Crayfish have occurred throughout the waterbody.



Barton Pond
Known AIS Species

	Curly-Leaf Pondweed	
	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
√	Rusty Crayfish	
	Banded Mystery Snail	

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Not to Scale

Physical Characteristics	
63	Surface Area (acres)
189	Volume (acre-feet)
1.2	Length of Shoreline (miles)
5	Maximum Depth (feet)
3	Mean Depth (feet)
51.7 %	Under 3 ft. deep
- %	Over 20 ft. deep
44,120	Subwatershed Area (acres)
890.8	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, June 1968 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 5
Aquatic Invasive Species Identified in

Big Cedar Lake

Note: Positive identification of Rainbow Smelt have occurred mainly in the southern basin of the lake; and also positive identification of Zebra Mussels have occurred throughout the lake.

Not to Scale

Big Cedar Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
√	Rainbow Smelt	
√	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

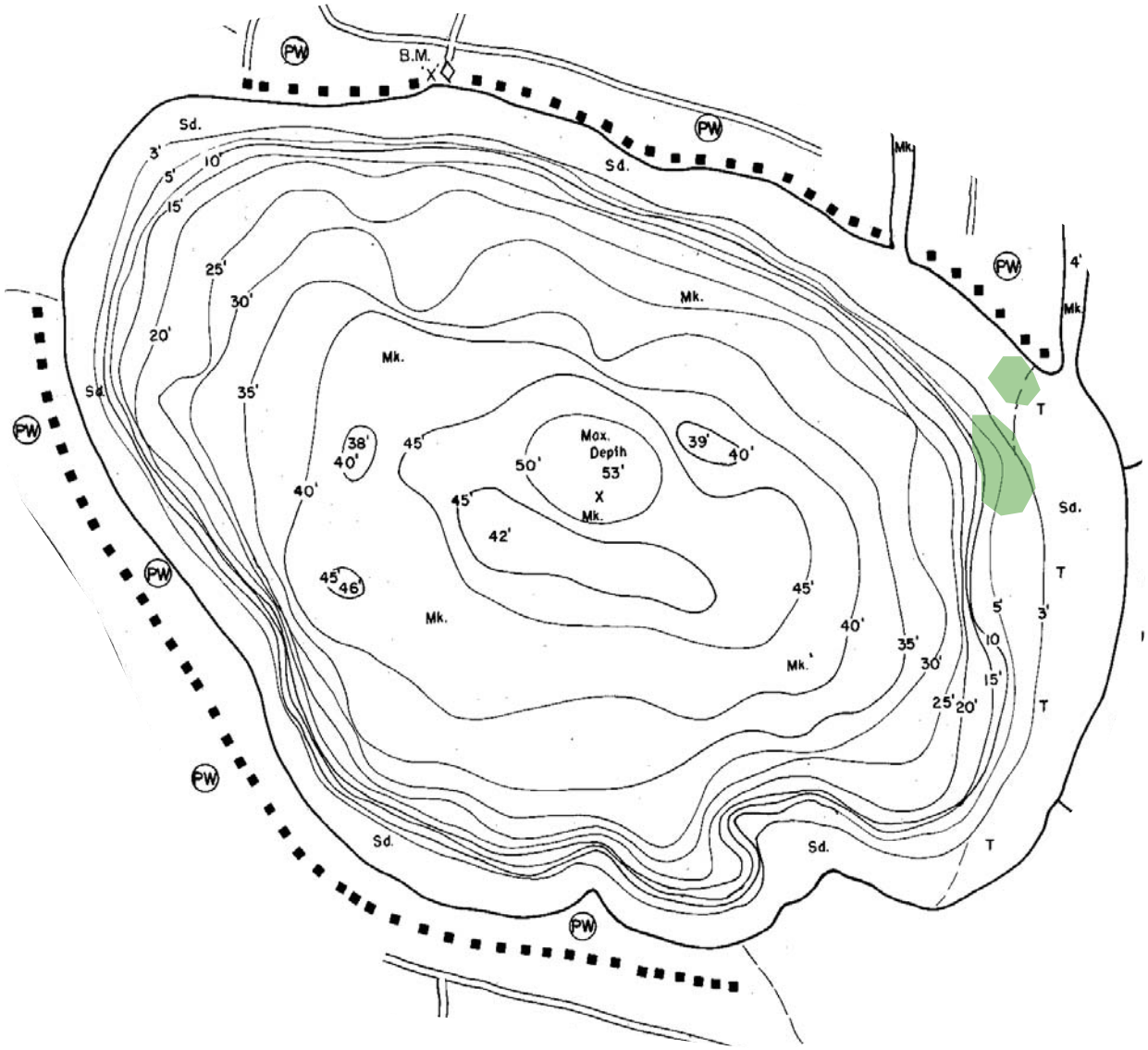
Physical Characteristics

937	Surface Area (acres)
31,983	Volume (acre-feet)
11	Length of Shoreline (miles)
105	Maximum Depth (feet)
34	Mean Depth (feet)
7 %	Under 3 ft. deep
47 %	Over 20 ft. deep
6,641	Subwatershed Area (acres)
1,030.4	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, April, 1969 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 6
Aquatic Invasive Species Identified in

Druid Lake



Druid Lake
Known AIS Species

√	Curly-Leaf Pondweed	
	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

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Not to Scale

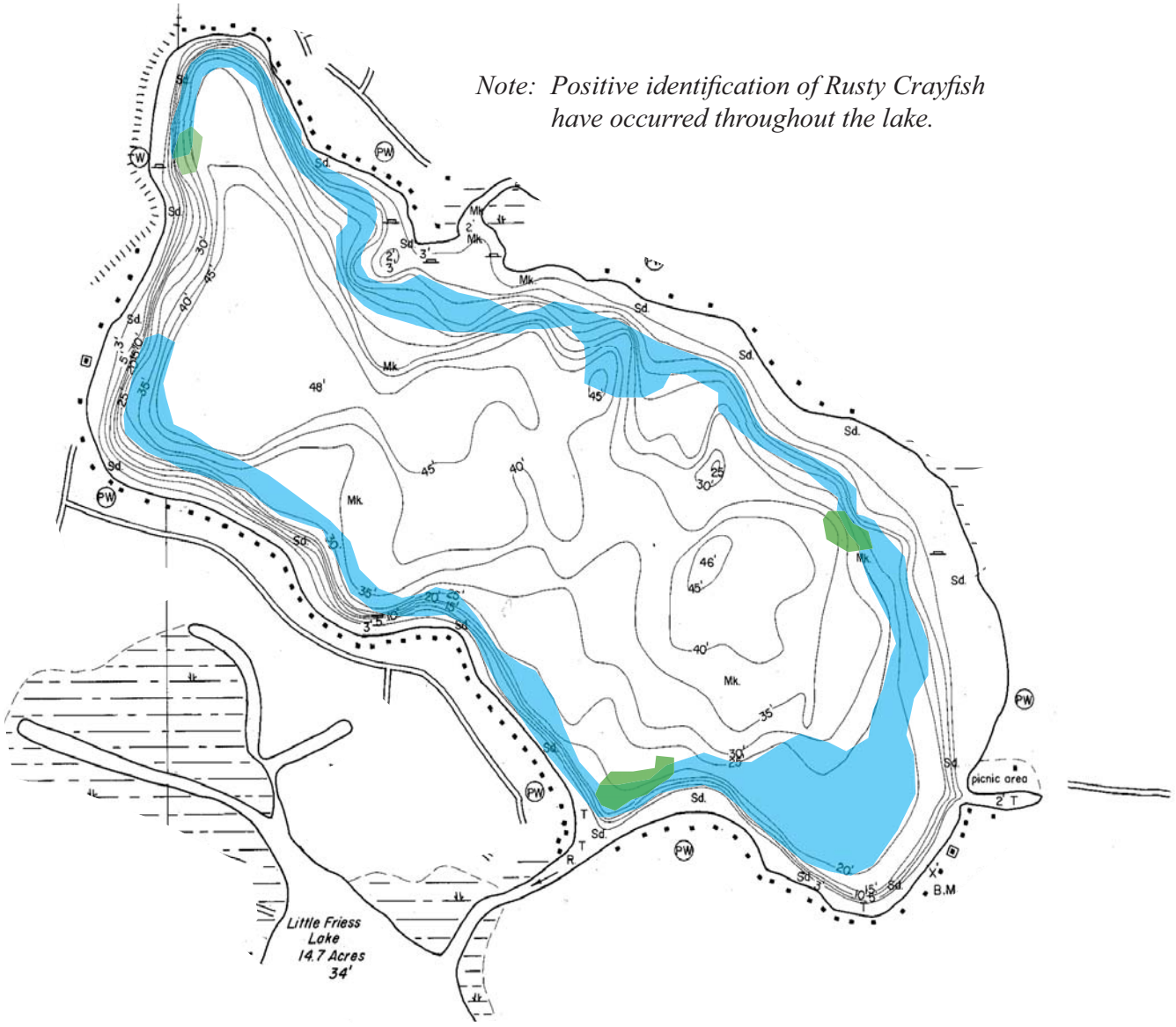
Physical Characteristics

122	Surface Area (acres)
3,000	Volume (acre-feet)
1.7	Length of Shoreline (miles)
53	Maximum Depth (feet)
25	Mean Depth (feet)
21.6 %	Under 3 ft. deep
62.2 %	Over 20 ft. deep
6,870	Subwatershed Area (acres)
969.6	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, June 1970 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 7
Aquatic Invasive Species Identified in

Friess Lake



Note: Positive identification of Rusty Crayfish have occurred throughout the lake.

Friess Lake Known AIS Species	
√	Curly-Leaf Pondweed
√	Eurasian Watermilfoil
	Rainbow Smelt
	Zebra Mussel
√	Rusty Crayfish
	Banded Mystery Snail

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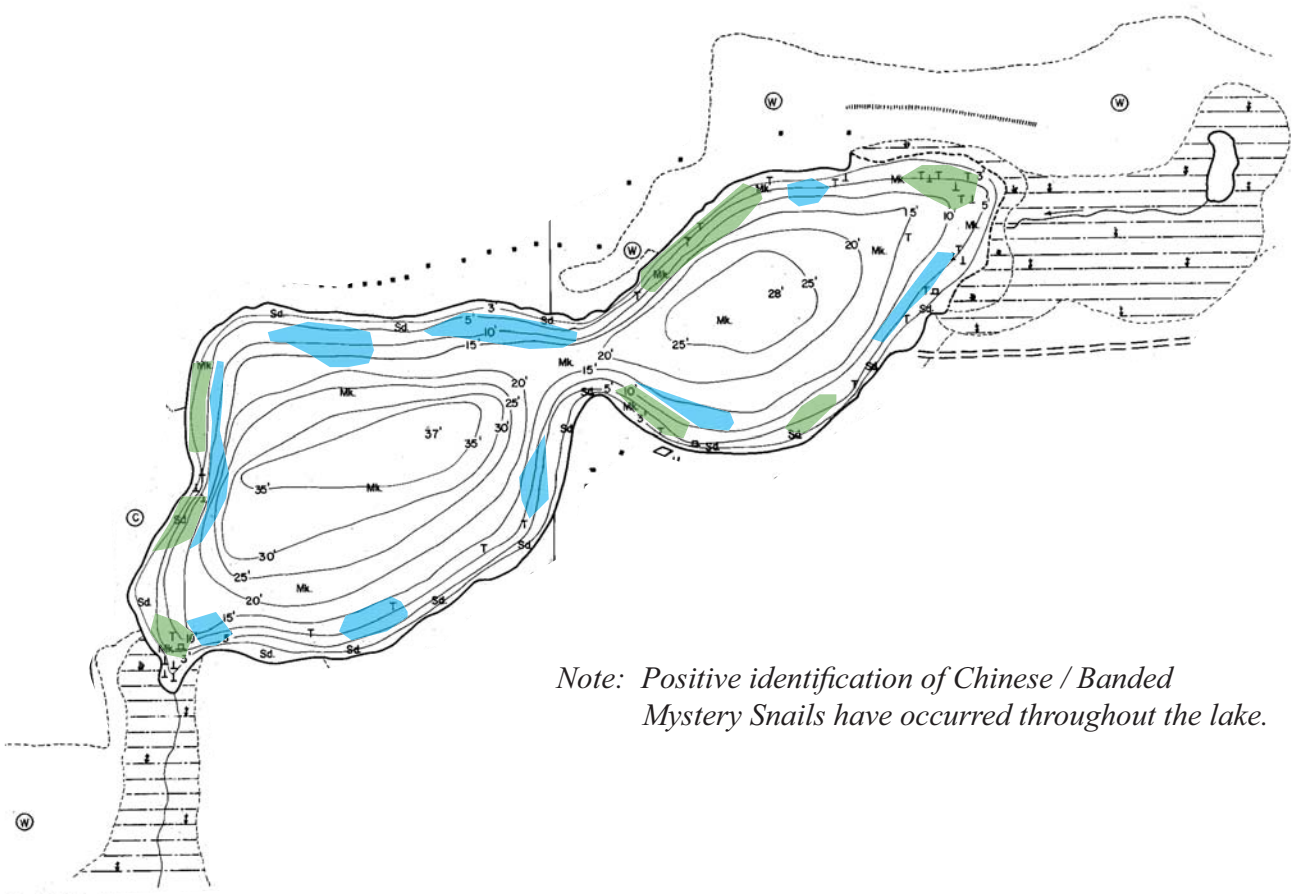
Not to Scale

Physical Characteristics	
121	Surface Area (acres)
3,102	Volume (acre-feet)
2.3	Length of Shoreline (miles)
48	Maximum Depth (feet)
26	Mean Depth (feet)
13 %	Under 3 ft. deep
68 %	Over 20 ft. deep
12,374	Subwatershed Area (acres)
955.5	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, June 1970 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 8
Aquatic Invasive Speces Identified in

Green Lake



Note: Positive identification of Chinese / Banded Mystery Snails have occurred throughout the lake.

Green Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
√	Banded Mystery Snail	

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Not to Scale

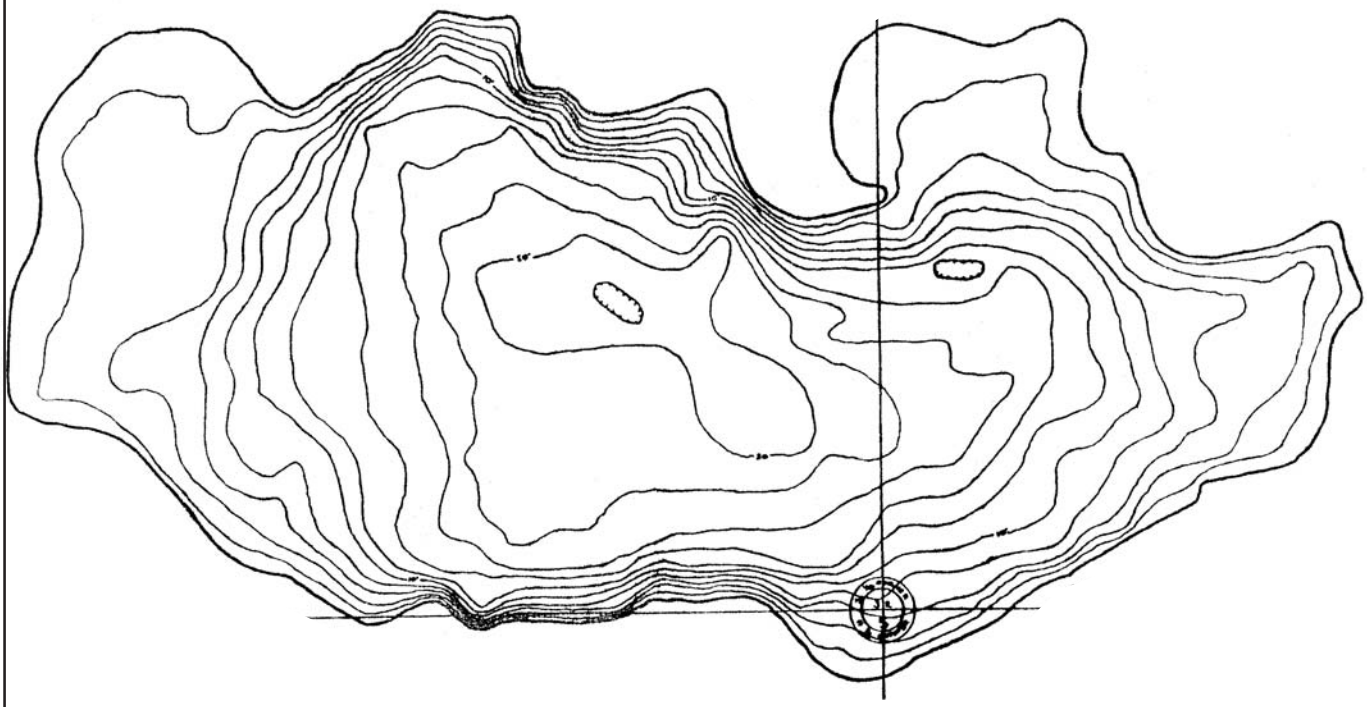
Physical Characteristics	
70	Surface Area (acres)
1,207	Volume (acre-feet)
1.8	Length of Shoreline (miles)
37	Maximum Depth (feet)
17	Mean Depth (feet)
11.4 %	Under 3 ft. deep
37.8 %	Over 20 ft. deep
550	Subwatershed Area (acres)
868.7	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, May 1969 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Aquatic Biologists, Inc., WI, April 2012.

Map 9
Aquatic Invasive Species Identified in

Lake Five

Note: Eurasian Watermilfoil has been previously documented in Lake Five by the Department of Natural Resources, but Washington County was unable to confirm its existence in the summer of 2012.



Lake Five
Known AIS Species

	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

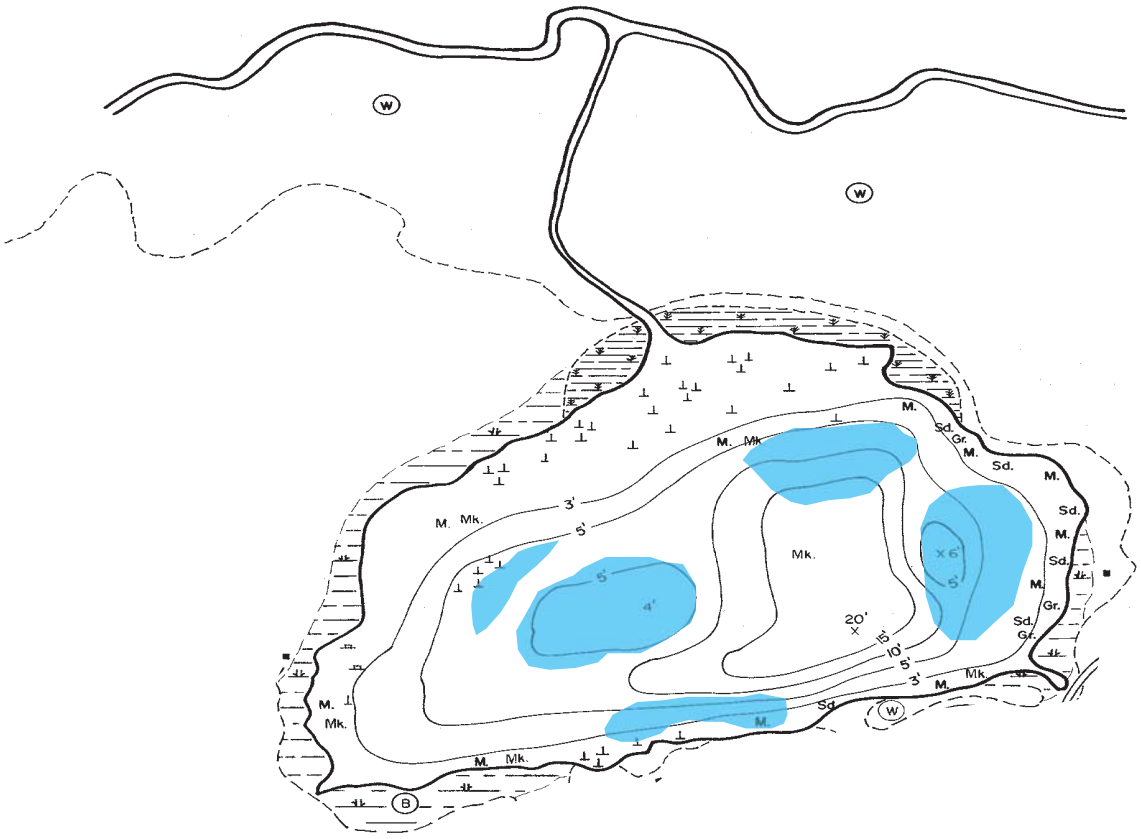
Not to Scale

Physical Characteristics	
104	Surface Area (acres)
1,100	Volume (acre-feet)
1.9	Length of Shoreline (miles)
23	Maximum Depth (feet)
11	Mean Depth (feet)
- %	Under 3 ft. deep
- %	Over 20 ft. deep
930	Subwatershed Area (acres)
972.3	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, Date Unknown - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 10
Aquatic Invasive Species Identified in

Lake Twelve



Lake Twelve
Known AIS Species

	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

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Not to Scale

Physical Characteristics

45	Surface Area (acres)
318	Volume (acre-feet)
1.3	Length of Shoreline (miles)
20	Maximum Depth (feet)
6	Mean Depth (feet)
34 %	Under 3 ft. deep
- %	Over 20 ft. deep
320	Subwatershed Area (acres)
801.2	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, May 1969 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 11
Aquatic Invasive Species Identified in

Little Cedar Lake

Note: Positive identification of Zebra Mussels have occurred throughout the lake.

Little Cedar Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
√	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

Not to Scale

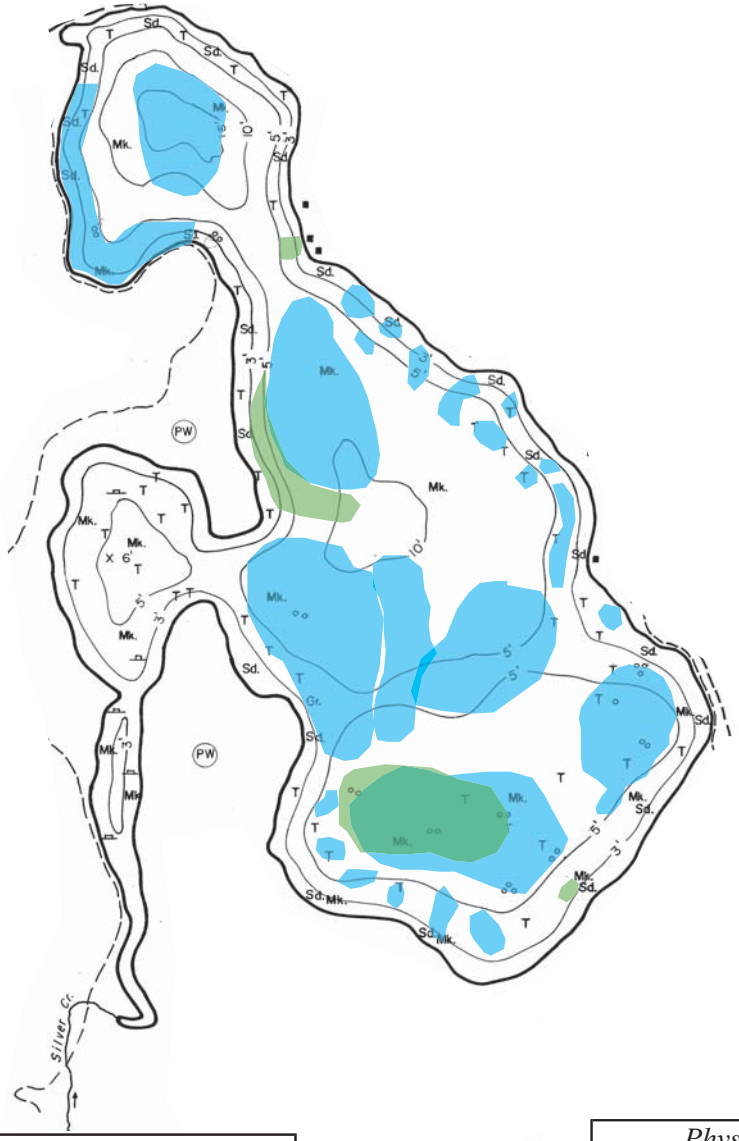
Physical Characteristics

260	Surface Area (acres)
3,198	Volume (acre-feet)
4	Length of Shoreline (miles)
56	Maximum Depth (feet)
13	Mean Depth (feet)
16.9 %	Under 3 ft. deep
37.3 %	Over 20 ft. deep
7,565	Subwatershed Area (acres)
1,013	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, April 1968 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 12
Aquatic Invasive Species Identified in

Lucas Lake



Lucas Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

N
W E
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Not to Scale

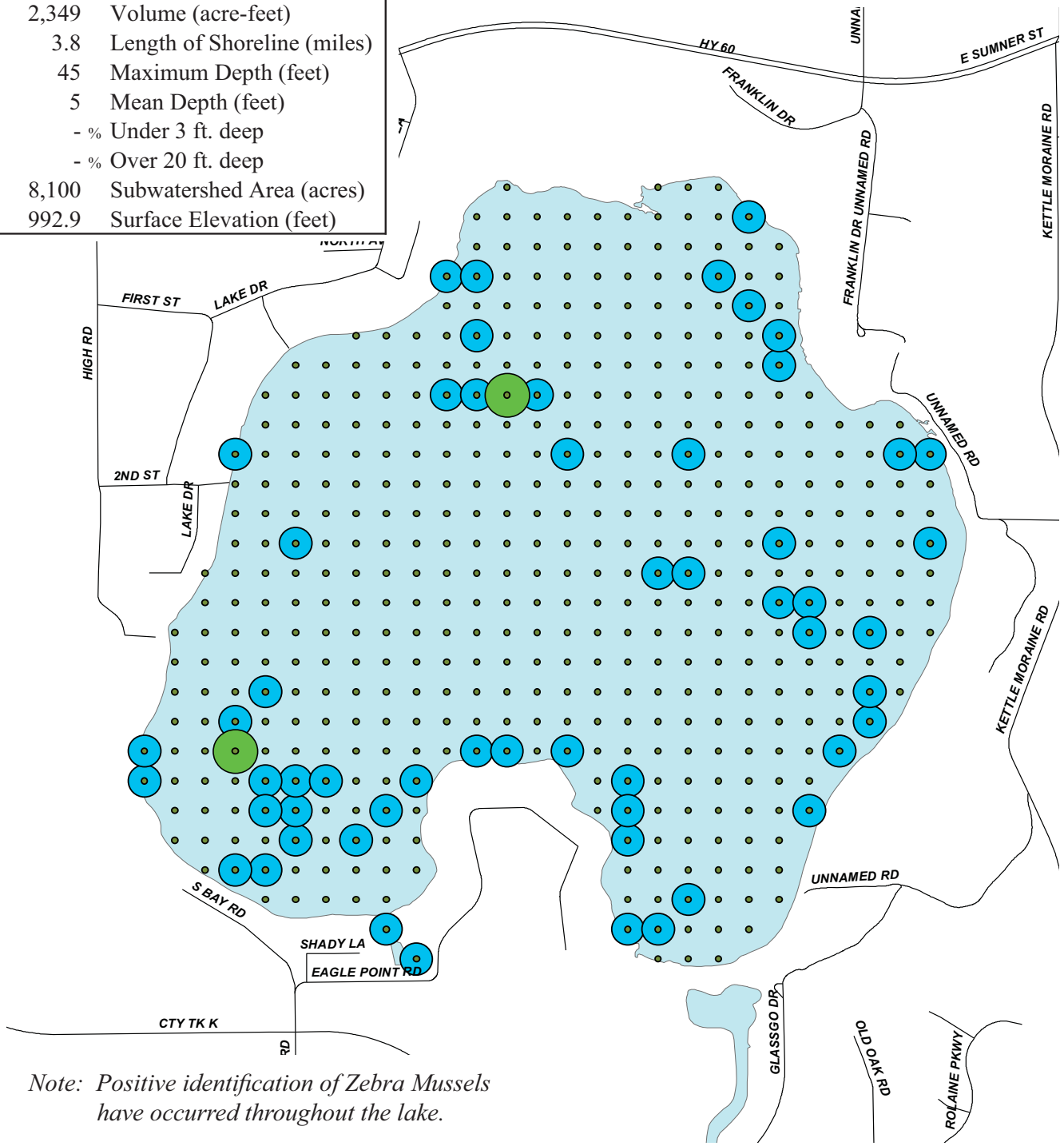
Physical Characteristics	
69	Surface Area (acres)
468	Volume (acre-feet)
2.8	Length of Shoreline (miles)
15	Maximum Depth (feet)
7	Mean Depth (feet)
20 %	Under 3 ft. deep
- %	Over 20 ft. deep
560	Subwatershed Area (acres)
994.3	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, May 1969 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 13
Aquatic Invasive Species Identified in

Pike Lake

Physical Characteristics	
461	Surface Area (acres)
2,349	Volume (acre-feet)
3.8	Length of Shoreline (miles)
45	Maximum Depth (feet)
5	Mean Depth (feet)
- %	Under 3 ft. deep
- %	Over 20 ft. deep
8,100	Subwatershed Area (acres)
992.9	Surface Elevation (feet)



Note: Positive identification of Zebra Mussels have occurred throughout the lake.

Prepared by:
Washington County
Planning & Parks Department
Land & Water Conservation Division
dated 12/07/12

0 500 1,000 Feet

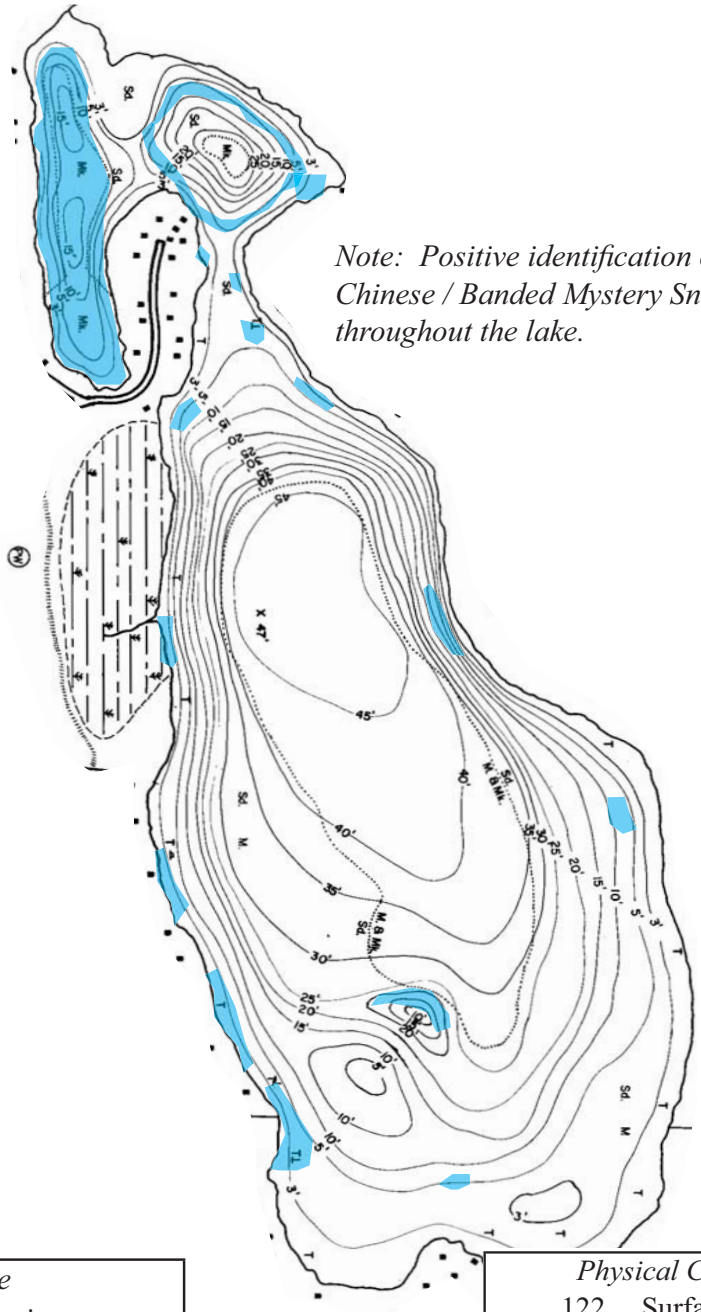
N W E S

Legend
- Curly-Leaf Pondweed
- Eurasian Watermilfoil
- Control Points

Source: SEWRPC Data Collected on 07/12/12
Subject to errors and ommissions and not certified by Washington County

Map 14
Aquatic Invasive Species Identified in

Silver Lake



Note: Positive identification of Zebra Mussels and Chinese / Banded Mystery Snails have occurred throughout the lake.

Silver Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
√	Zebra Mussel	
	Rusty Crayfish	
√	Banded Mystery Snail	

N
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Not to Scale

Physical Characteristics

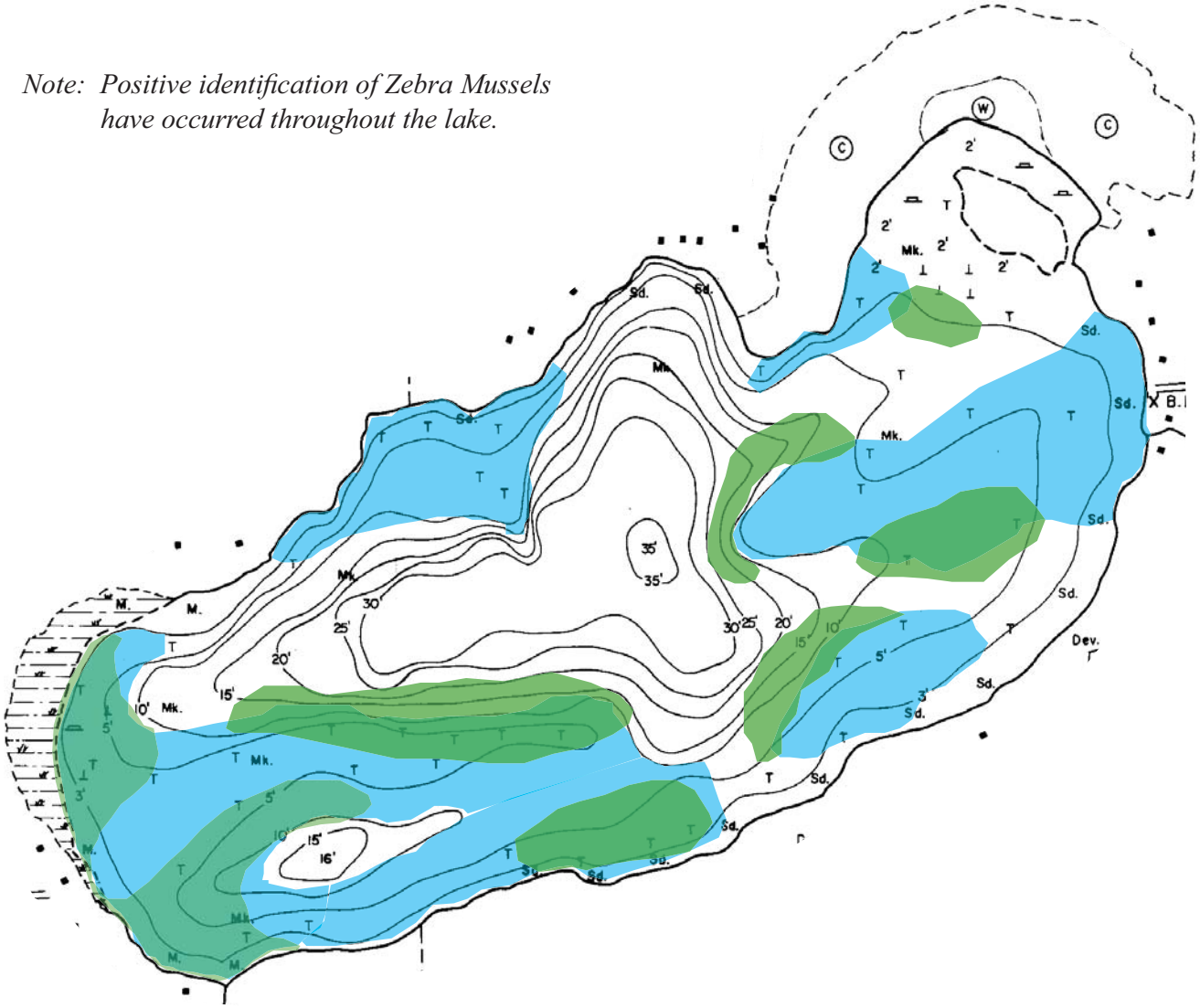
122	Surface Area (acres)
2,306	Volume (acre-feet)
2.7	Length of Shoreline (miles)
47	Maximum Depth (feet)
20	Mean Depth (feet)
12 %	Under 3 ft. deep
56 %	Over 20 ft. deep
305	Subwatershed Area (acres)
998.7	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, June 1969 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Marine Biochemists, WI, April 2011.

Map 15
Aquatic Invasive Species Identified in

Wallace Lake

Note: Positive identification of Zebra Mussels have occurred throughout the lake.



Wallace Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
√	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

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Not to Scale

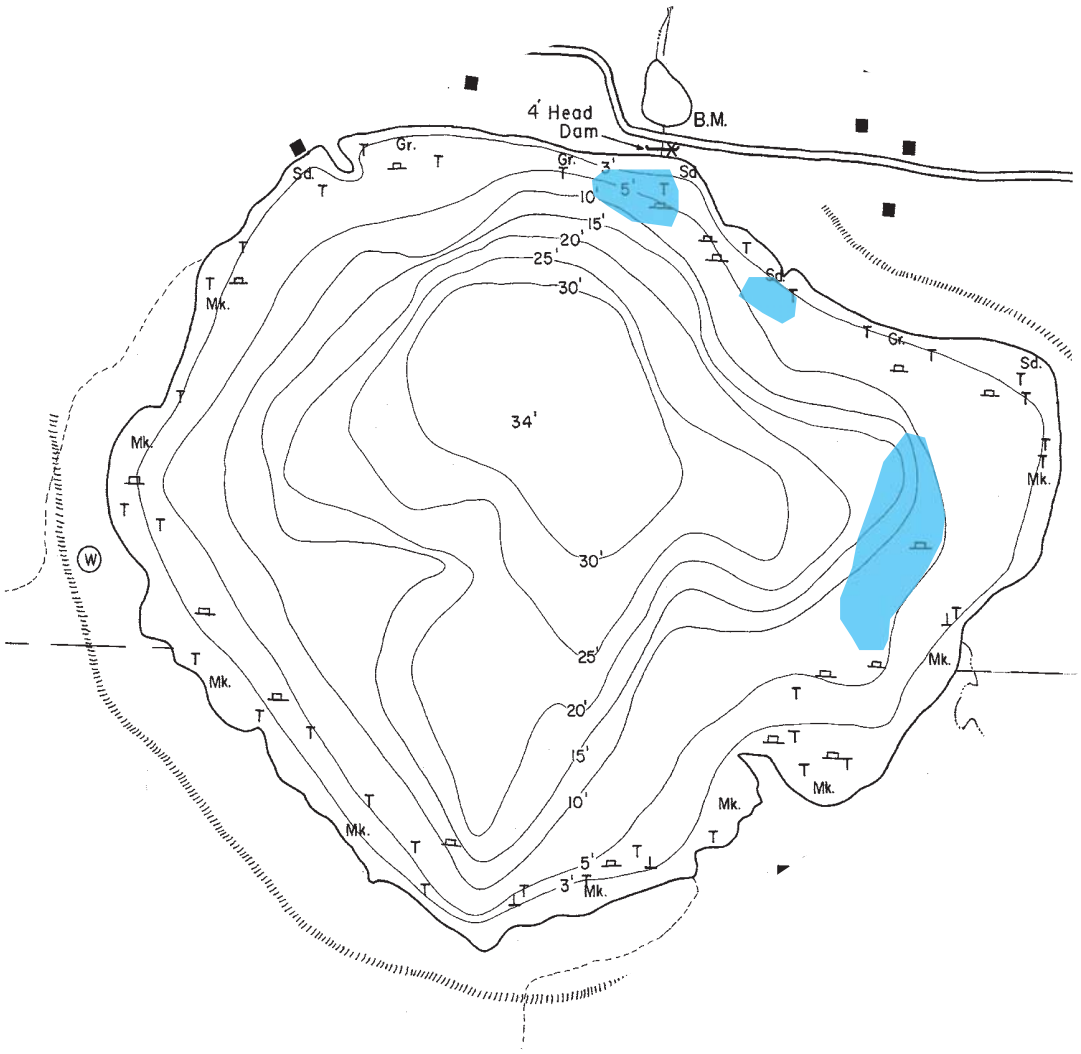
Physical Characteristics

54	Surface Area (acres)
558	Volume (acre-feet)
1.2	Length of Shoreline (miles)
35	Maximum Depth (feet)
11	Mean Depth (feet)
15.6 %	Under 3 ft. deep
18.6 %	Over 20 ft. deep
370	Subwatershed Area (acres)
899.1	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, April 1968 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 16
Aquatic Invasive Species Identified in

Erler Lake



Erler Lake
Known AIS Species

	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

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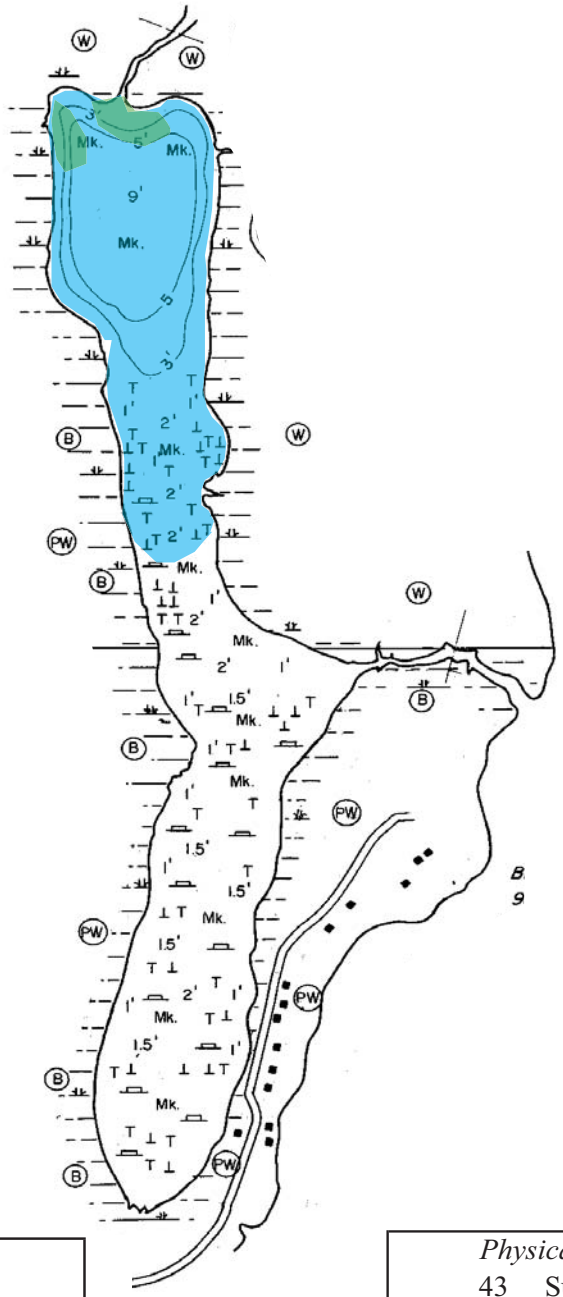
Not to Scale

Physical Characteristics	
35	Surface Area (acres)
518	Volume (acre-feet)
0.9	Length of Shoreline (miles)
34	Maximum Depth (feet)
14	Mean Depth (feet)
11.4 %	Under 3 ft. deep
30.7 %	Over 20 ft. deep
1,080	Subwatershed Area (acres)
830.6	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, July 1968 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 17
Aquatic Invasive Species Identified in

Gilbert Lake



Gilbert Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

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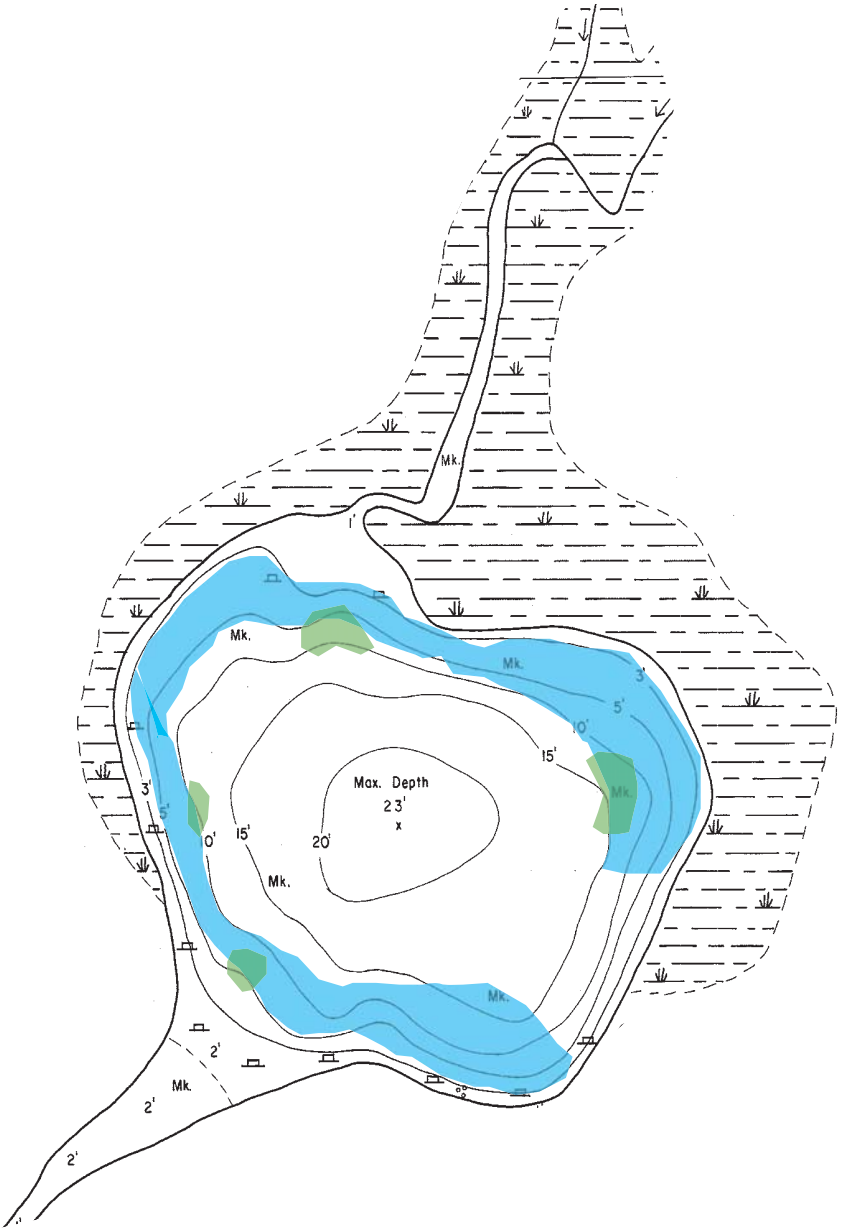
Not to Scale

Physical Characteristics	
43	Surface Area (acres)
132	Volume (acre-feet)
1.8	Length of Shoreline (miles)
30	Maximum Depth (feet)
3	Mean Depth (feet)
80 %	Under 3 ft. deep
- %	Over 20 ft. deep
420	Subwatershed Area (acres)
1,030.2	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, April 1968 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 18
Aquatic Invasive Species Identified in

Loew's Lake



Loew's Lake
Known AIS Species

√	Curly-Leaf Pondweed	
√	Eurasian Watermilfoil	
	Rainbow Smelt	
	Zebra Mussel	
	Rusty Crayfish	
	Banded Mystery Snail	

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Not to Scale

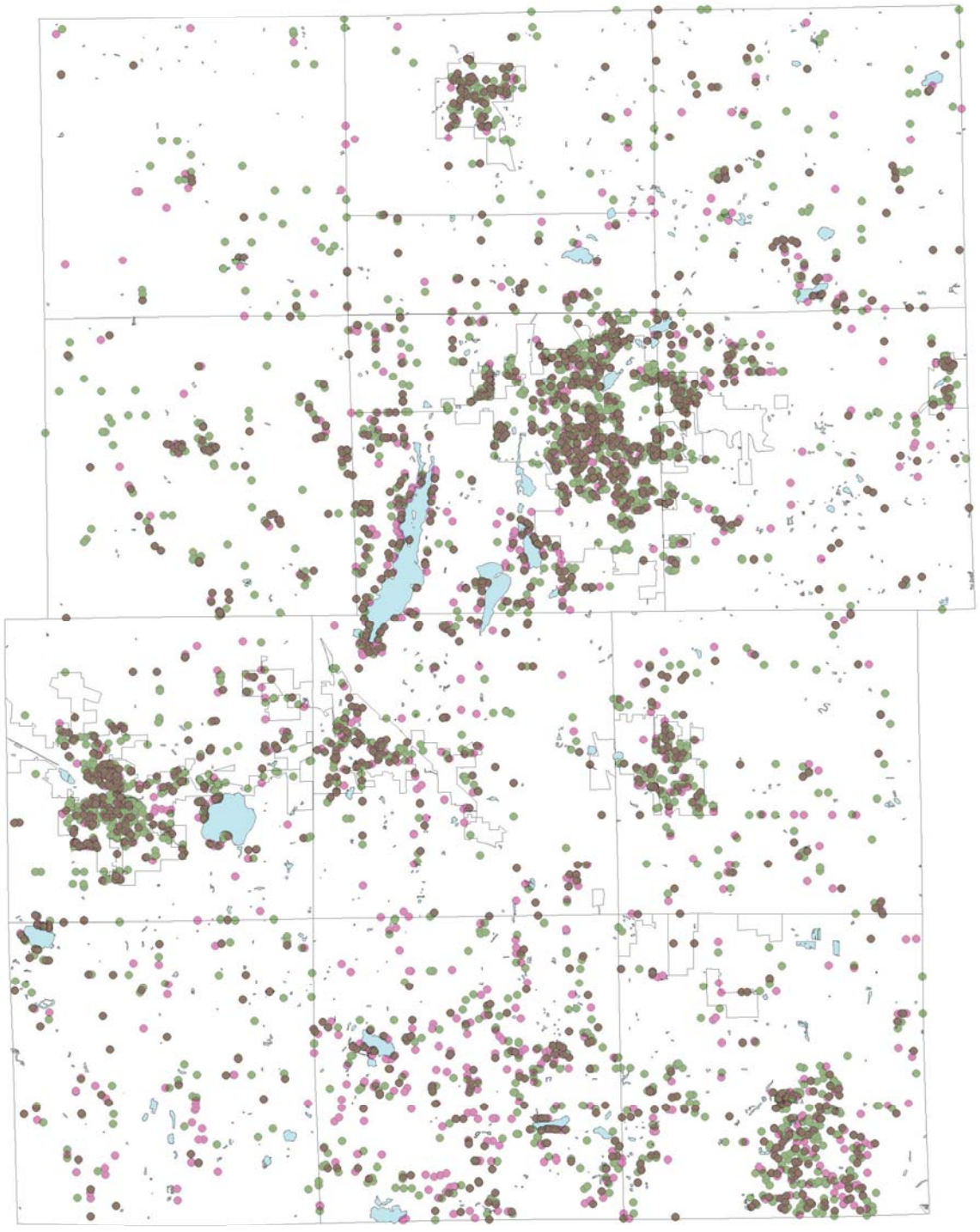
Physical Characteristics

24	Surface Area (acres)
253	Volume (acre-feet)
0.9	Length of Shoreline (miles)
23	Maximum Depth (feet)
11	Mean Depth (feet)
14 %	Under 3 ft. deep
7 %	Over 20 ft. deep
14,150	Subwatershed Area (acres)
931.6	Surface Elevation (feet)

Source: Wisconsin Department of Natural Resources, June 1970 - Historical Lake Map - Not for Navigation, Aquatic Invasive Species determined by Washington County, May 2012.

Map 19

WASHINGTON COUNTY - LICENSED FISHERMEN & BOATS



Prepared by:
Washington County
Planning & Parks Department
Land & Water Conservation Division
dated 11/19/12

Source: WDNR - Data includes 25% of customers who have not opted off of WDNR's mailing lists.
Subject to errors and ommissions and not certified by Washington County

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0 0.5 1 2 3 Miles

Legend

- Boats Registered as of 06/06/12 ~3077
- Fishing Licenses as of 12/31/11 ~4036
- Overlap of Registered Boats and Fishing Licenses ~1445