# Kiel Mill Pond Aquatic Plant Management Plan: 2015-2019

## Kiel, Wisconsin

SEH No. 128562

January 20, 2015

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January 20, 2015

RE: Kiel Mill Pond Aquatic Plant Management Plan: 2015-2019
Kiel, Wisconsin
SEH No. 128562

Mr. Mike Steinhardt
City of Kiel
621 6th Street
Kiel, WI 53042

Dear Mayor:

Short Elliott Hendrickson Inc. (SEH®) and Sara Hatleli, Aquatic Plant & Habitat Services, are pleased to submit the enclosed draft copy of the Kiel Mill Pond Aquatic Plant Management Plan for your review. We would like to acknowledge the work of the local advisory committee which contributed to development of this plan, including Randy Neils, DPW; Kris August, WWTP; Mike Steinhardt, Mayor; Richard Twohig, Resident; Luanne Twohig, Resident; Jim Manz, Fish & Game Club; Julia Davis, Library. We would also like to thank Dale Katsma, DNR, Steven R Hogler, DNR, and Mary Gansberg, DNR for their review and comments on the draft Plan.

Jacob Macholl
Certified Lake Manager

Andrew Dane
Project Manager/Planner

AD
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# Kiel Mill Pond Aquatic Plant Management Plan: 2015-2019

Kiel, Wisconsin

Prepared for:
City of Kiel
Kiel, Wisconsin

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# Kiel Mill Pond Aquatic Plant Management Plan: 2015-2019

Prepared for City of Kiel

## 1.0 Introduction

The City of Kiel (sponsor of this project) is located in the extreme northern edge of the Sheboygan River Basin in parts of two counties (Calumet and Manitowoc) east of Lake Winnebago (Figure 1). The Sheboygan River originates in east-central Fond du Lac County and flows eastward into Sheboygan County, loops into Calumet and Manitowoc Counties near Kiel then flows back into Sheboygan County, ultimately entering Lake Michigan in the city of Sheboygan. There are ten dams in the Sheboygan River Watershed: Sheboygan Marsh Dam, Kiel Dam, Rockville Dam, Millhome Dam, Franklin Dam, Johnsonville Dam, Sheboygan Falls Dam, Waelderhaus Dam, lower Kohler Dam, and Mischo's Dam. The waters addressed by this project includes the millpond created by one of those dams located within the city limits of Kiel.

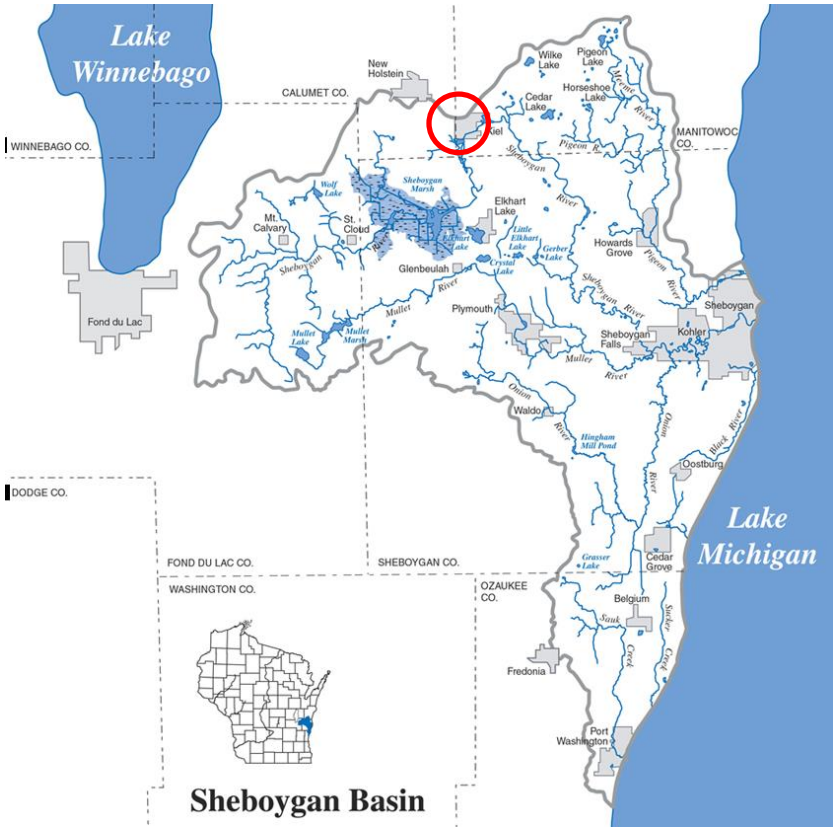



**Figure 1 – The Sheboygan River Basin and the City of Kiel (Source: Sheboygan River Basin Partnership)**

This project includes the millpond created by the Kiel MillPond Dam, and that stretch of the Sheboygan River within the Kiel city limits between the Kiel Millpond Dam and the railroad tressel on the western edge of the City (Figure 2). The entire area covers approximately 13 acres immediately downstream of the Kiel Marsh Wildlife Area (Figure 3) with approximately 7,100 ft of shoreline, of which approximatley 4,200 ft is owned by the City. Most of this area (3,600 ft) is dedicated to the City's park system. The remaining 2,900 ft is divided between twenty-one private property owners.


**Figure 2 – Project waters within the Kiel City Limits, Calumet and Manitowoc Counties (Source: WDNR Surface Water Data Viewer**

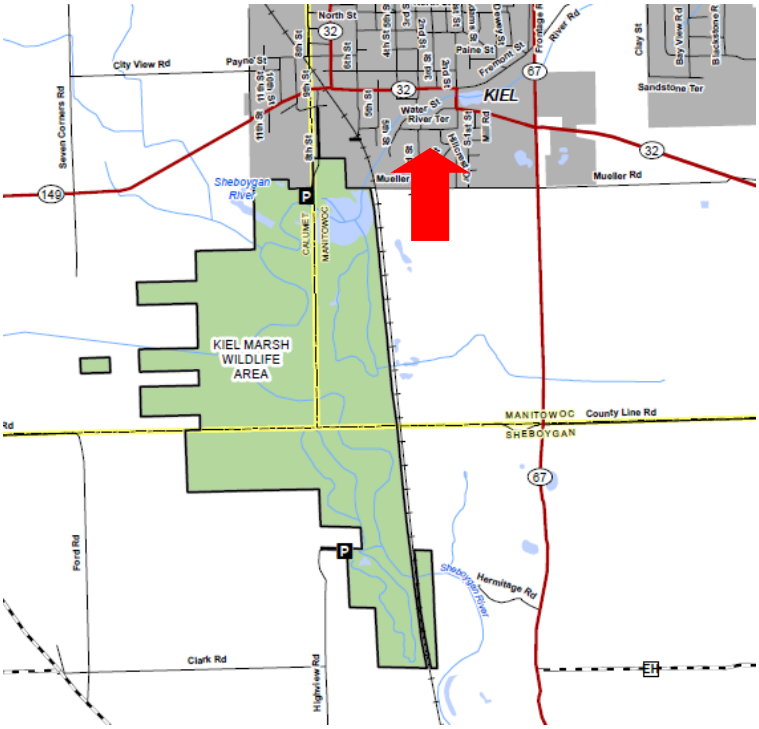



**Figure 3 – Project waters Downstream of the Kiel Marsh Wildlife Area on the Sheboygan River**

This section of the Sheboygan River is part of ***RIVER SEGMENT 4 (RM 45.0-68.3***) referenced in the Water Resources of the Sheboygan River Watershed Report, a supplement to the ***State of the Sheboygan River Basin*** published in 2001 (WDNR Publication # WR-699-01). This reach of the river extends from the Rockville Dam upstream to County Highway W. Marshlands adjacent to the channel throughout most of this reach have served as a natural filter for polluted runoff, lessening the impact from nonpoint source pollutants. Sediment collects behind all impoundments and limits in-stream habitat in this river reach. Municipal wastewater treatment plants at Kiel, Mount Calvary and St. Cloud discharge to this segment of the river.

The Kiel Millpond is maintained by a 10-ft structural dam owned by the City of Kiel. The current purpose of the dam is to provide recreational opportunities. Water quality is limited by sediment loads, nutrient excess, low dissolved oxygen, and high turbidity. Responsible factors include cropland runoff, feedlot runoff, streambank runoff, streambank pasturing, large amounts of decaying plant matter from the upstream wetland complex, and human-made impoundments. Although these pollutants and sources limit water quality, the river segment displays a wide range of water quality. Water downstream of the marshes is filtered, while water upstream of the barriers displays the characteristics of impoundments.

Survey data in the Kiel Millpond was collected in 1994. Coontail (Ceratophyllum demersum) dominated the aquatic plant community in the Kiel Impoundment. Coontail was present in dense concentrations along the shoreline in numerous places. Duckweed (Lemna sp.), Large Leaf Pondweed (Potamogeton amplifolius), Waterweed (Elodea canadensis), Flat-Stemmed Pondweed (Potamogeton zosterformis), Curly Leaf Pondweed (Potamogeton crispus) and Bushy Pondweed (Najas sp.) were observed in the impoundment.

No Eurasian watermilfoil (Myriophyllum spicatum) was observed during the 1994 survey, but it has since been identified in the Millpond and river.

The City of Kiel is concerned about how the current aquatic plant community, both native and non-native, in the Millpond and river is affecting the recreational, aesthetic, and community value of the water resource. In 2013, the City of Kiel applied for a WDNR chemical application permit to control EWM and other nuisance vegetation, but it was denied on the basis of not having enough data to determine how effective the treatment would be. At that time, the WDNR suggested that the City of Kiel apply for grant funding to complete an Aquatic Plant Management Plan (APMP) that would review plant management alternatives and determine the best approaches to incorporate that would provide the improvement desired without harming the ecosystem.

The City subsequently submitted a Lake Management Planning Grant Application to the WDNR on January 26, 2014. However, the grant application was out-competed for funding during a highly competitive grant cycle. The City decided to move forward with development of this aquatic plant management plan using its own funding. The intent is to apply for the February 1 2015 Surface Water Grant program in order to secure funding to assist with implementation of this Plan.

## 1.1 Management Units

Currently, there is no officially designated body or district established whose mission is to focus on protecting the interests of the residents and property owners of the City of Kiel as they relate to the Mill Pond. The City has consequently taken a leadership role in order to protect the ecology of the Mill Pond, enhance the natural scenic beauty, control invasive species, and promote responsible boating, fishing, and recreational opportunities that the Kiel Mill Pond offers to residents and visitors.

In planning for this project, several community volunteers, the Kiel Fish and Game Club, and the School District have worked closely with the City including the City Council, Mayor, City Administrator, and City Public Works Director.

The project waters included in this project are immediately downstream of the WDNR Kiel Marsh Wildlife Area. The Wildlife Area is currently undergoing management updates. Dale Katsma, the WDNR Area Wildlife Supervisor is in full support of this project, as what the City does with this stretch of the river and Millpond can have an effect on the Wildlife Area. The City of Kiel and its retainers intend to work closely with the WDNR wildlife managers to make sure recommendations for management in the Millpond are in line with those of the wildlife area.

There are other local lake stewardship groups within the Kiel Mill Pond watershed. In fact, Manitowoc County has several active lake associations. The Manitowoc County Lakes Association is a county-wide partnership made up of individual lake associations and individuals. It serves as an umbrella organization, helping stakeholders stay informed of and coordinate local responses to regional efforts such as county wide land use planning and zoning, building better relationships with local governments, and fostering idea and resource sharing.

Since 1996 the Manitowoc County Lakes Association (MCLA), have been working together to protect and enhance aquatic resources in the County. The Association has been involved in several projects, including a 2006 Manitowoc County Shoreland Restoration Demonstration Project funded through a WI DNR Lake Protection Grant. Its volunteers have also worked

closely with the Manitowoc County Soil Conservation Department, in an effort to work productively with upland landowners and farmers to address watershed scale solutions to water quality.

What happens in the larger watershed, impacts the aquatic plants in each of these lakes. Each of these groups are actively managing their lakes and watersheds in an effort to reduce nutrient loading which help to fuel nuisance aquatic plant growth, native or non-native invasive species. Many of these groups are either managing aquatic plants already or are considering it in the near future. The City is addressing its portion of the watershed through habitat surveys, informal citizen monitoring of Kiel Mill Pond users, and preparation of this plan. It is important that the City maintain open lines of communication with other groups in the watershed to coordinate management efforts.

## 1.2 Documentation and Need for Management

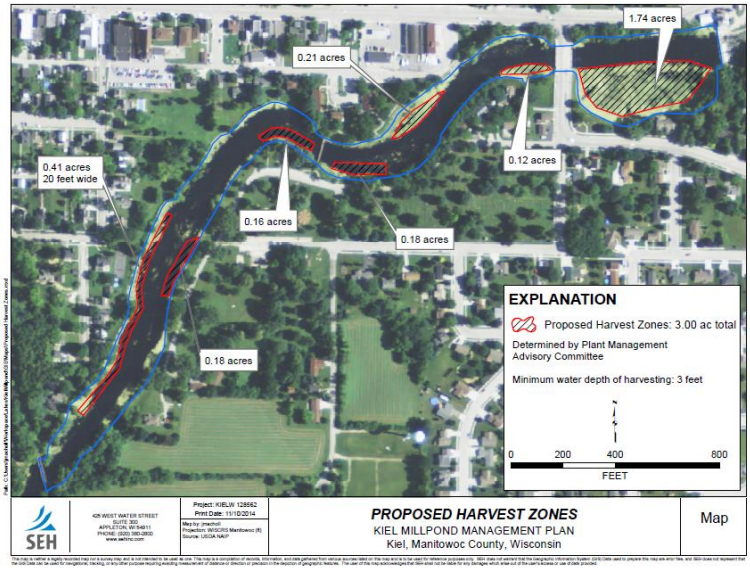
Resident complaints and concern by City officials have driven renewed interest in proactively managing the Kiel Mill Pond water resource. The City formed a Mill Pond advisory committee in spring 2014 in order to document existing conditions and develop an aquatic plant management plan. The committee includes local residents, City staff, the library director, and elected officials. The committee met four times during spring and summer 2014.

An early and late season aquatic plant survey confirmed the presence of invasive species such as Eurasian water milfoil and high concentrations of native species such as coontail (See appendices for copies of both reports).

For example in May 2014, Eurasian water-milfoil and/or curly-leaf pondweed were found at approximately one-third of the 252 survey points in the project area. The rake fullness rating for both species was 1 at most sites. There were no monotypic stands of either species observed during the survey. However, coontail (*Ceratophyllum demersum*) was observed at many sites with a rake fullness rating of 3.

The figure below shows the proposed areas for mechanical harvesting. A full size version of the map is included in the appendices of this report.

**Figure 4 – Proposed Mechanical Harvesting Zones**



# 2.0 Management History

The City of Kiel has been managing aquatic plant control on the Sheboygan River for over 30 years. Beginning in the early 1980's, aquatic plants were controlled with the use of aquatic pesticides. Treatments were applied where aquatic plants were thickest, but not a yearly basis. In the early 1990's, the city bought a mechanical aquatic plant cutter from Hockney Co. in Southern Wisconsin. The cutter cut a path 7'wide and approximately 4' deep. The cut vegetation floated towards the dam where as much could be collected as possible. Aquatic plants were cut approximately 3 times a summer, depending on the growth. This process lasted approximately 18 years until the cutter was no longer functional. At that time, the city again started contracting to have the aquatic plants chemically treated, the last treatment of approximately 3 acres being done in 2009. There has been no other type of aquatic plant control to date.

In 1988 the Kiel Millpond was dredged by the City increasing the depth and capacity substantially. Unfortunately only limited information exists about how much was dredged. No dredging has occurred since that time. According to the 2001 Water Resources report, testing of the sediment was completed in the late 1990's and at that time the concentrations of PAHs, heavy metals, and PCBs were higher in the Sheboygan River in Kiel than downstream in the Rockville Impoundment. All concentrations were consistent with values observed in urban environments. According to this report, the Sheboygan River near Kiel did not require specific sediment management activities at that time.

## 2.1 Aquatic Plant Management Strategy

The WDNR aquatic plant management guidelines and the Northern Region Aquatic Plant Management Strategy (Appendix A) formed the framework for the development of this APM plan. All existing and new APM plans and the associated management permits (chemical or harvesting) are reviewed by the WDNR.

This Aquatic Plant Management Plan supports sustainable practices to protect, maintain and improve the native aquatic plant community, the fishery, and the recreational and aesthetic values of the lake. This five-year plan is intended to be a living document to be evaluated on an annual basis and revised as needed to ensure goals and community expectations are being met.

# 3.0 Public Participation and Input

The City and the Aquatic Plant Management committee provided input, support and review of draft documents during the development of this aquatic plant management plan. The committee met four times during spring and summer of 2014.

## 3.1 Aquatic Plant Harvesting Areas

Based on discussion, observation, and public input, the City and the Aquatic Plant Management committee identified areas for mechanical harvesting of nuisance aquatic plants. These areas are shown in the Appendix "Plant Harvester Operation Plan Map" and include areas just upstream of the Kiel Mill Pond dam, areas adjacent private shoreland property, and areas adjacent the Hingiss Park. The areas were chosen to enhance recreational opportunities in the Kiel Mill Pond, improve aesthetics, and improve fish habitat.

## 3.2 Public Review and Comment Period

*The Draft Kiel Mill Pond Aquatic Plant Management Plan was released to the public on November 1 2014 for a one-month public review and comment period. The draft plan was posted on the City website for the duration of the public comment period. Individuals could also request digital copies of the draft plan by contacting the City by phone or email. A press release announcing the availability of the plan and dates of the public comment period was distributed to and published in the local newspaper. No written or verbal comments were received during the public comment period.*

# 4.0 Aquatic Plants in Kiel Mill Pond

Aquatic Plant and Habitat Services LLC completed an early season (May 2014) and late season (August 2014) aquatic plant surveys, soft sediment depth surveys, and cross sectional depth surveys of the Kiel Millpond and upstream segment of the Sheboygan River ending at the railroad bridge. See Appendix for a full copy of the Aquatic Plant Survey Report.

## 4.1 Early Season Aquatic Plant Survey

An early season plant survey was conducted on May 25, 2014 to identify aquatic invasive species in the Millpond (See Appendix). The survey was completed in late May, when curly-leaf pondweed is nearing its maximum growth stage. Eurasian water milfoil (EWM) or curly-leaf pondweed (CLP) were found at approximately one-third of the 252 survey points in the project area. (EWM at 62 points, CLP at 26 points). The rake fullness rating for both species was 1 at most sites. (Rake fullness ranges from 1-3).

CLP was visually observed at an additional 36 points, which means it was observed from the boat but the rake did not yield CLP. There were no monotypic stands of either species observed during the survey, which is positive and suggests the CLP may not be a serious nuisance to the river and millpond. The late season survey, completed during the height of the growing season and discussed below, also found EWM to be a minimal nuisance.

Eurasian water-milfoil was observed upriver of the project site. Any management efforts to control EWM would have to take this into consideration because the upstream population will provide a source of new plants.

## 4.2 Late Season Aquatic Plant Survey

Key findings from the late season survey included:

- Maximum rooting depth of plants was 7 feet
- 248 survey sites were visited, 236 of which were 7 feet deep or shallower
- 182 sites with plants / 236 sites shallower than maximum rooting depth = 77.12% sites with veg.
- Number of different species found = 17 (12 species actually at survey sites)
- Eurasian water-milfoil was found at 77 sites (compared to 62 in May 2014)
- Curly-leaf pondweed had senesced (died back) was found at 14 sites (compared to 26 in May 2014)
- Coontail was the most common plant found at 145 survey sites. Other common plants included flat-stem pondweed, common waterweed, duckweed, and watermeal (all native species)

## 4.3 Soft Sediment Depth Survey

Key observations from the soft sediment depth survey:

- Same 248 survey sites were used to assess soft sediment depth
- 126 sites were rock with no soft sediment
- 103 sites were muck with soft sediment depths ranging from 0-6 feet
- 19 sites were sand with soft sediment depths ranging from 0-2.5 feet
- Maps created by SEH illustrate soft sediment to better understand locations of sediment deposition

## 4.4 Cross Sectional Depth Survey

Key observations from the cross sectional depth survey:

- Seven (7) transects were measured starting at the east bank and working toward the west bank. Depth was measured at intervals along transects similar to methods used during the 1994 WDNR survey.
- One transect was in the millpond near the widest point and the rest were within the Sheboygan River
- Total transect width ranged from 135 feet to 170 feet in the river segments and 310 feet in the millpond
- Depth along transects ranged from 1.5 feet to 9.5 feet

## 4.5 Management Recommendations

- Protect native aquatic plants that were found at low frequencies as they provide important structural habitat and contribute to healthy lake systems.
- If necessary, shore land owners can hand pull or rake perceived nuisance vegetation in a <30-foot-wide area that is parallel to shore.
- Conduct volunteer monitoring for water quality (temperature, dissolved oxygen, Secchi, phosphorus, and chlorophyll a) to track nutrient levels. .
- Implement shoreland buffers, especially at city-owned properties, to limit surface water nutrient loading. Explore the feasibility of a watershed-scale nutrient management effort if one has not already been initiated.
- Reduce coontail abundance along the southern shore of the millpond, possibly by using mechanical harvesters. Monitor sites with reduced nuisance native plants to ensure they are not being replaced by EWM and/or CLP.

## 4.6 The Importance of Aquatic Plants in the Lake Ecosystem

A healthy lake is dependent on a healthy lake ecosystem. Native aquatic plants and animals, the wetland fringe, and fallen trees help to maintain and protect a healthy overall lake ecosystem. When management is recommended for a lake, care must be taken to protect, maintain, and if possible enhance the overall ecosystem. Aquatic plants, also known as macrophytes, are a natural part of most lake communities and provide many benefits to fish, wildlife, and people. Plants have many important functions and values in the lake ecosystem. They are the primary producers in the aquatic food chain, converting the basic chemical nutrients in the water and soil into plant matter, which becomes food for all other life.

Aquatic plants provide valuable fish and wildlife habitat. More food for fish is produced in areas of aquatic vegetation than in areas where there are no plants. Insect larvae, snails, and freshwater shrimp thrive in plant beds. Panfish eat aquatic plants in addition to aquatic insects and crustaceans. Plants also provide shelter for young fish. Northern pike spawn in marshy and flooded areas in early spring and bass, sunfish, and yellow perch usually nest in areas where vegetation is growing.

Many submerged plants produce seeds and tubers (large roots) which are eaten by waterfowl. Bulrushes, sago pondweed, wild celery, and wild rice are especially important duck foods. Submerged plants also provide habitat to a number of insect species and other invertebrates that are, in turn, important foods for brooding hens and migrating waterfowl.

The lake aesthetic valued by so many is enhanced by the aquatic plant community. The visual appeal of a lakeshore often includes aquatic plants, which are a natural, critical part of

a lake community. Plants such as water lilies, arrowhead, and pickerelweed have flowers or leaves that many people enjoy.

Aquatic plants improve water clarity and water quality. Certain plants, like bulrushes, can absorb and break down polluting chemicals. Nutrients used by aquatic plants for growth are not available to algae, thus reducing algae abundance and improving water clarity. Algae, which thrive on dissolved nutrients, can become a nuisance when too many submerged water plants are destroyed. Aquatic plants also maintain water clarity by preventing the re-suspension of bottom sediments. Aquatic plants, especially rushes and cattails, dampen the force of waves and help prevent shoreline erosion. Submerged aquatic plants also weaken wave action and help stabilize bottom sediment.

Native aquatic plant communities also offer protection from non-native aquatic invasive species. Current scientific literature generally accepts the concept that invasions of exotic plants are encouraged, and in some cases induced, by the disruption of natural plant communities. Eurasian watermilfoil and Curly-leaf pondweed, which are present in the Millpond and river, are opportunistic plants. Much like lawn and agricultural aquatic plants that germinate in newly disturbed soil, these plants are more likely to invade areas in which the native plant community has been disturbed or removed. Removing the natural competition from native plants may also open up the door to new invasive species and less desirable plant communities.

# 5.0 Water Quality

The water quality upstream and downstream of the Mill Pond Dam is regularly assessed by the City's Wastewater Department. Water samples are taken at the following 7 locations bulleted below. Samples are taken at mid-point in the water column.

- Upstream of Highway 57
- Upstream of Rockville Mill Dam
- Upstream of Kiel POTW
- Kiel Mill Pond Dam
- Road Crossing
- Cty Rd MM Bridge
- Cty Rd G at St. Cloud

Figure 4 shows the locations of two of the sampling sites located in the immediate vicinity of the Kiel Mill Pond dam.

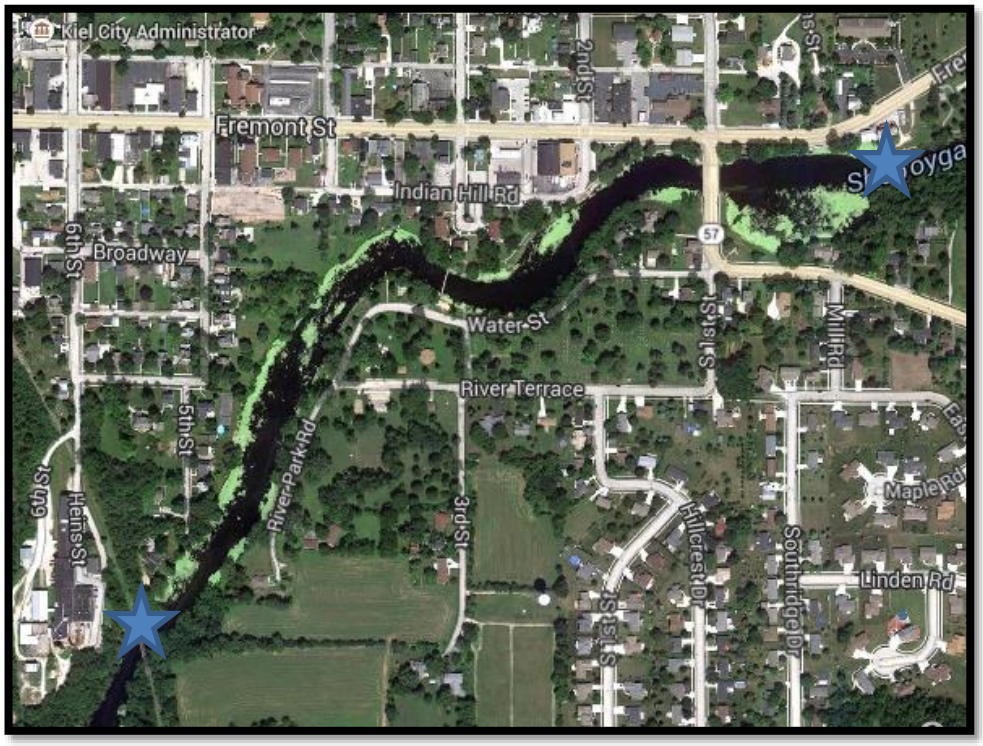



**Figure 5 – Water Quality Sampling Sites at the Kiel Millpond**

## 5.1 Temperature and Dissolved Oxygen

The figures below show temperature and dissolved oxygen levels at the Kiel Mill Pond dam and the railroad crossing, the two features which define the upstream and downstream limits of the study area. Samples were taken at mid-point in the water column. Water temperature tends to fluctuate with ambient air temperature throughout the summer months, with peak temperatures occurring in July 2014. Dissolved oxygen levels decreased over the summer 2014 period. Large quantities of decaying matter, nutrient loading, and indirect and direct factors described earlier in the report likely contribute to this trend.

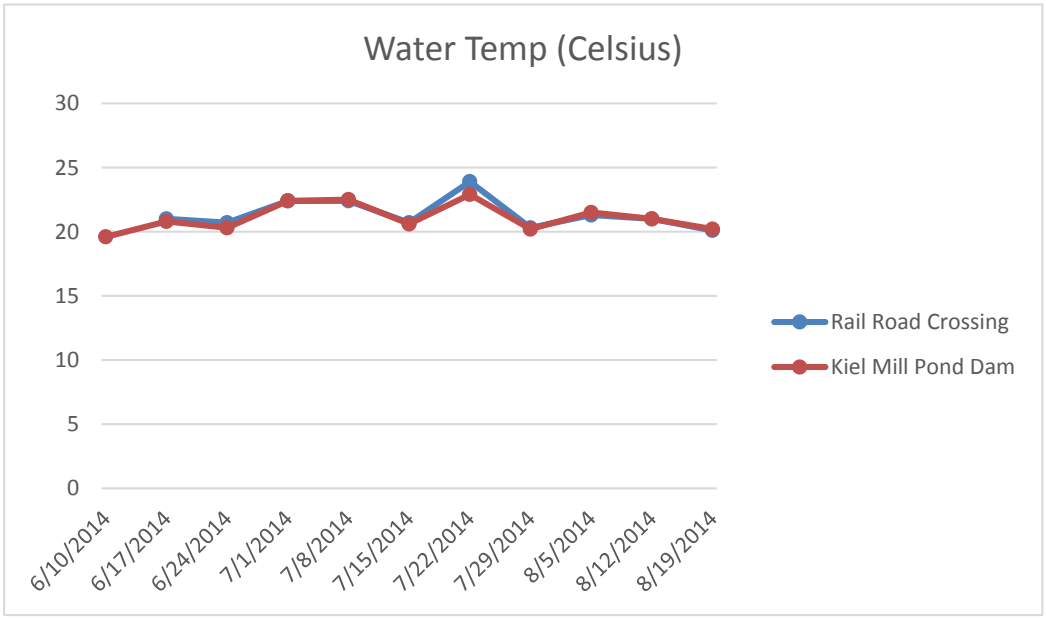



**Figure 6 – Water Temperature Sampling Sites at the Kiel Millpond**

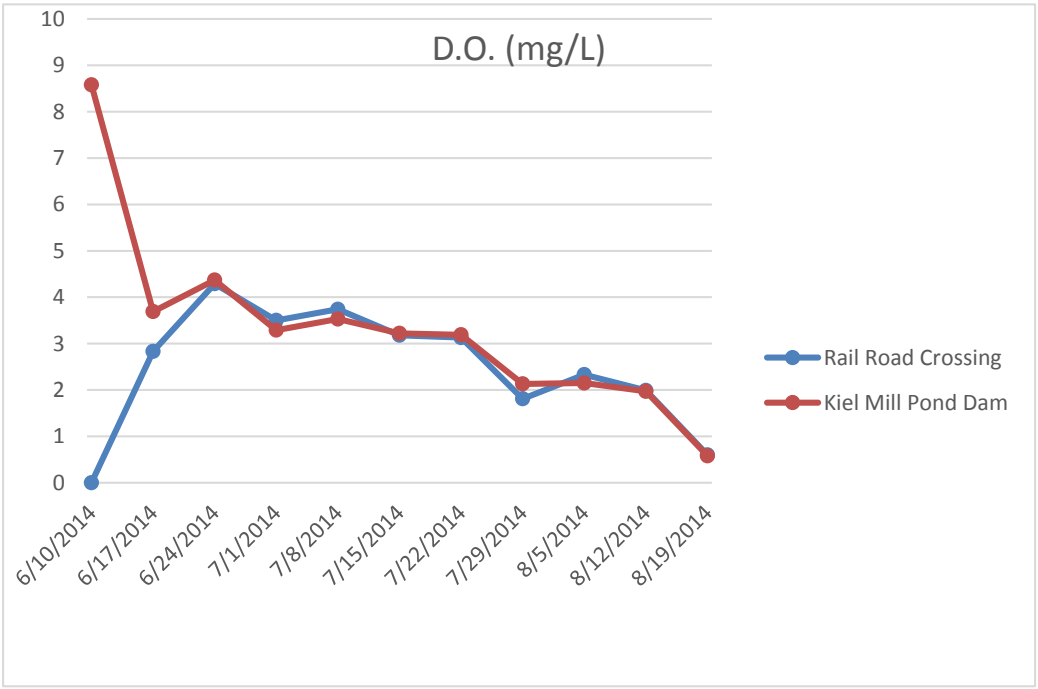



**Figure 7 – Dissolved Oxygen Sampling Sites at the Kiel Millpond**

## 5.2 Total Suspended Solids

Total Suspended Solids (TSS) is one of the most visible indicators of water quality. Water bodies with low levels of total suspended solids (TSS) are clearer and less turbid than those with high TSS concentrations. These suspended particles can come from soil erosion, runoff, discharges, stirred bottom sediments or algal blooms. Turbidity is important in aquatic systems as it can alter light intensities through the water column, thus potentially affecting rates of photosynthesis and the distribution of organisms within the water column. Lowered rates of photosynthesis may in turn affect the levels of dissolved oxygen available in a given body of water, thus affecting larger populations such as fish. High turbidity can also cause infilling of lakes and ponds if the suspended sediments settle out of the water column and are deposited. A sudden increase in turbidity in a previously clear body of water is a cause for concern. Total suspended solids (TSS) levels are shown in the figure below. Variation in TSS levels over the summer monitoring season may be the result of changes in upstream conditions resulting in an influx of TSS into the study area.

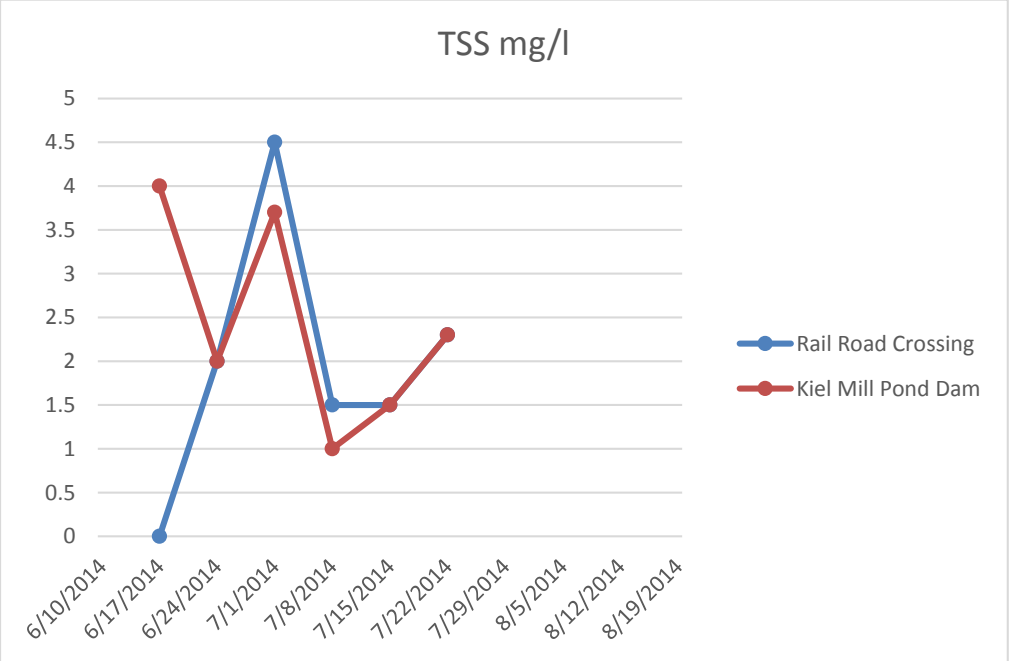



**Figure 8 – Total Suspended Solids (TSS) Sampling Sites at the Kiel Millpond**

## 5.3 Total Phosphorus

Phosphorus is an important nutrient for plant growth and is commonly the nutrient limiting plant production in Wisconsin lakes. When phosphorus is limiting production, small additions of the nutrient to a lake can cause dramatic increases in plant and algae growth. Phosphorus can become biologically available to aquatic plants and algae through external or internal means of nutrient loading. Internal loading of phosphorus is made possible when the water-sediment interface becomes anoxic (no oxygen) or when the water-sediment interface is oxic (oxygen present) and the pH is high. Research indicates that the average total phosphorous for impoundments is approximately 65 µ/l (micrograms per liter) and a concentration of total phosphorus below 30 µg/l for impoundments should be maintained to prevent nuisance algal blooms[1]. Therefore, the data in the figure below suggests that total phosphorous levels in the Kiel Millpond are quiet high. Note: the figure below uses mg/L. 1 milligram (mg) = 1,000 micrograms (µ).

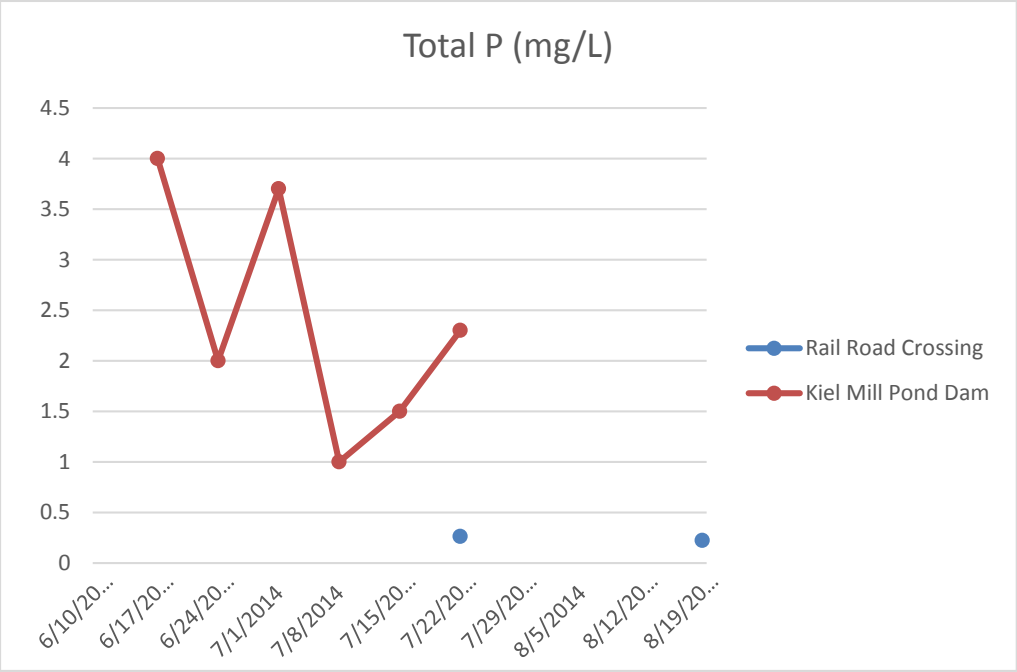



**Figure 9 – Total Phosphorous Sampling Sites at the Kiel Millpond**

[1] *Understanding Lake Data* http://www3.uwsp.edu/cnr-ap/weal/Documents/G3582.pdf

### 5.3.1 Fishery Management

Poor water quality and the resulting poor fish community is the reason for the lack of management and survival of stocked fish. This river reach is classified as supporting a warm water sport fish community, with the fishery consisting of northern pike, bullheads, crappie, largemouth bass, panfish, and yellow perch. Very tolerant species include common carp, and central mudminnow. Intolerant species such as Iowa darter, stoneroller, hornyhead chub, northern redbelly dace, and tadpole madtom were also found here (Fago, 1985; WDNR 1994). Slow moving, deep water plus poor substrate is the limiting factor to a more diverse community.

Kiel citizens feel that access to fish is a problem and better management is needed. There is currently a 26” limit on Northern Pike, and fishermen are concerned they are eating most of the pan fish that used to be present in the pond. The local fish and game club historically put fish into the mill pond but no longer does. Recent stocking in the Sheboygan River/Kiel Millpond by the Kiel Fish and Game was done at the boat landing by the foot bridge. In 2010- 2,000 yellow perch 8" long were stocked. In 2011- 4,000 black crappie 4" long were stocked. In 2012- 3500 bluegill 5" long were stocked. There was not any stocking in 2013 or 2014 due to the aquatic plant problem. The local stocking program will commence once the aquatic plant problem is brought under control.

### 5.3.2 Fishery Habitat

Coarse woody structure (CWS) is a type of structural habitat found in the littoral zone, or near-shore region, of lakes and is contributed as trees fall from shore into lakes. Natural addition of CWS to lakes can be a very slow process. For example, the mean germination date of eastern white pine (*Pinus strobus*) sampled from the littoral zone of a lake in Ontario was 600 years ago (Guyette and Cole, 1999). Therefore, most of the CWS in the littoral zone took 600 years to grow, senesce, and eventually fall into the lake. Many studies suggest that CWS is an important component of habitat in littoral zones. Wood provides a surface for insect larvae (Bowen et al. 1998) and provides shelter for small fish from predation (Werner and Hall, 1988).

Large stretches of the Kiel Mill Pond’s boundary are characterized by open, grassy areas, limiting the amount of CWS potentially available. Therefore, in pond aquatic plants provide much of the structural habitat for fish. As described earlier in the report the mill pond contains a variety of native and non-native species, which provide structural habitat for small invertebrates that are an important food source for juvenile game fish and adult panfish. The plants also provide structural habitat for juvenile and small fish to hide from predators and vice versa as larger predators may lurk in the shadows of plants in wait of forage.

Unfortunately, the density of aquatic plant growth has led to nuisance levels that hinder the aforementioned functions and benefits and also negatively impact recreation. An overabundance of vegetation causes dissolved oxygen depletion in the water as plants decompose, thereby reducing the oxygen available to fish and other aquatic organisms. This situation typically occurs in the Kiel Mill Pond in mid to late summer.

# 6.0 Critical Habitat

Every body of water has areas of aquatic vegetation or other features that offer critical or unique aquatic plant, fish and wildlife habitat. Such areas can be mapped by the WDNR and designated as Critical Habitat. Critical Habitat areas include important fish and wildlife habitat, natural shorelines, physical features important for water quality (for example, springs) and navigation thoroughfares. These areas, which can be located within or adjacent to the Mill Pond are selected because they are particularly valuable to the ecosystem or would be significantly and negatively impacted by most human induced disturbances or development. Critical Habitat areas include both Sensitive Areas and Public Rights Features. Sensitive Areas offer critical or unique fish and wildlife habitat, are important for seasonal or life-stage requirements of various animals, or offer water quality or erosion control benefits.

There are currently no officially designated critical habitat areas in the Kiel Millpond. However, Kiel Marsh Wildlife Area has been identified as a significant migratory stopover habitat area for both waterfowl and landbirds. This habitat could be enhanced by maintaining and improving riparian habitat in the City of Kiel and encouraging emergent plants along the edge of the Mill Pond.

# 7.0 Wildlife

The Northern Kettle Moraine region is rich in biological diversity including wildlife. The Wisconsin DNR's *Rapid Ecological Assessment for the Wildlife, Fishery, and State Natural Areas of the Northern Kettle Moraine Region (2010)* includes a discussion of wildlife issues and opportunities related to the Kiel Marsh Wildlife Area located directly upstream of the study area and comprising 833 acres. The report notes that "The Sheboygan River Marshes which include diverse wetland habitats for waterfowl, cranes, colonial water birds like herons, terns, and egrets, and marsh birds like rails and bitterns includes the Kiel Marsh Wildlife Area." A copy of the report is available on the web at: http://dnr.wi.gov/files/PDF/pubs/er/ER0822_ext.pdf.

The report identifies seven ecologically important sites for biodiversity conservation, including the Kiel Marsh Breeding and Migratory Bird Area, which has a "very high potential for migratory waterfowl and landbirds and supports numerous uncommon birds during the breeding season."

According to Dale Katsma, WDNR, Black terns, a threatened species, are found on the Kiel Marsh during the breeding season – just upstream of the railroad bridge. They likely use the Mill Pond for feeding. The black terns would be a significant consideration for any drawdown discussions and possibly for chemical treatment considerations. According to Wisconsin's Natural Heritage working list, the Least Bittern is also found in the vicinity of the Kiel Mill Pond (WI-NHI Portal).

Muskrats are also common place, and can be seen just about anywhere around the shore. Waterfowl are also abundant. Many species of ducks either migrate through in the spring and fall, or stay all year. In the spring and early summer broods of ducklings are commonplace.

Finally, along with an abundant duck population, there is an excess of Canada geese. Many lake residents have voiced complaints related to the excessive goose population. Geese foul the shoreline with their waste and eat huge amounts of vegetation both on shore and in the water.

# 8.0 Wetlands

In Wisconsin, a wetland is defined as an area 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 (Wisconsin Statue 23.32(1)). Wetlands contain a unique combination of terrestrial and aquatic life and physical and chemical processes. Wetlands are protected under the Clean Water Act and state law and in some places by local regulations or ordinances. Landowners and developers are required to avoid wetlands with their projects whenever possible; if the wetlands can't be avoided, they must seek the appropriate permits to allow them to impact wetlands (for example, fill, drain or disturb soils).

Wetlands are located throughout Sheboygan River watershed, with one of the largest and most prominent wetland basins being located immediately upstream of the study area, the Kiel Marsh State Wildlife Area. The marsh is noted as having continental-wide ecological significance because of its complexes of wetlands and rivers, which include shrub carr and emergent marsh. Several springs and seeps located along the marsh feed into the Sheboygan River.

Wetlands serve many functions that benefit the ecosystem surrounding Kiel. Wetlands support a great variety of native plants and are more likely to support regionally scarce plants and plant communities. Wetlands provide fish and wildlife habitat for feeding, breeding, resting, nesting, escape cover, travel corridors, spawning grounds for fish, and nurseries for mammals and waterfowl. Contrary to popular belief, healthy wetlands reduce mosquito populations; natural enemies of mosquitoes (dragonflies, damselflies, backswimmers, and predacious diving beetles) need proper habitat (that is, healthy wetlands) to survive.

Wetlands provide flood protection within the landscape by retaining stormwater from rain and melting snow and capturing floodwater from rising streams. This flood protection minimizes impacts to downstream areas. Wetlands provide groundwater recharge and discharge by allowing the surface water to move into and out of the groundwater system. The filtering capacity of wetland plants and substrates help protect groundwater quality. Wetlands can also stabilize and maintain stream flows, especially during dry months.

Wetland plants and soils provide water quality protection by storing and filtering pollutants ranging from pesticides to animal wastes. Wetlands also provide shoreline protection by acting as buffers between the land and water. Wetland plants protect against erosion by absorbing the force of waves and currents and by anchoring sediments. This is important in waterways where high boat traffic, water currents, and wave action may cause substantial damage to the shore.

Although some small (two acres or less) wetlands may not appear to provide significant functional values when assessed individually, they may be very important components of a larger natural system. Not only do small wetlands provide habitat functions, they also store phosphorus and nitrogen and trap pollutants such as heavy metals and pesticides. Draining these small wetlands, which often do not appear on maps, not only requires the proper permits, but can also release the once-stored pollutants and nutrients into lakes and streams.

# 9.0 Aquatic Plant Management Alternatives Evaluation

Nuisance aquatic plants can be managed a variety of ways in Wisconsin. The best management strategy will be different for each lake and depends on which nuisance species needs to be controlled, how widespread the problem is and the other plants and wildlife in the lake. In many cases, an integrated approach to aquatic plant management that utilizes a number of control methods is necessary.

Control methods for nuisance aquatic plants can be grouped into four broad categories:

- **manual and mechanical control**, which include harvesting, hand-pulling, and raking plants;
- **biological control**, which includes the use of organisms such as herbivorous insects, parasitic organisms, and planting aquatic plants;
- **physical habitat alteration**, which includes dredging, drawdown, lake bottom covers, and non-point source nutrient controls; and
- **chemical control**, which involves the use of herbicides.

Each of the above control categories are regulated by the WDNR and most activities require a permit from the State. Most control methods are regulated under Chapter NR 109 (Appendix C) except for chemical control which is regulated under Chapter NR 107. Installing bottom covers, which is not a commonly accepted practice, also requires a Chapter 30 permit.

Regardless of the target plant species, native or non-native, sometimes no active management of the aquatic plant community is the best option. Plant management activities can be disruptive to native plant species and their ecological functions, and may open up areas for new invasive species to colonize. Other benefits of no management include no financial cost, no system disturbance, and no unintended effects of chemicals. Not managing aquatic invasive species, however, may allow small populations of a plant to become larger and more difficult to control.

The benefits and limitations of a number of management techniques are described below. Although many of the available control methods are currently not applicable for the Kiel River Mill Pond, aquatic plant management options requires an understanding of plant management alternatives and how appropriate and acceptable each alternative is for a given lake.

## 9.1 No Manipulation

No manipulation of the aquatic plant community is often the easiest, cheapest, and in some cases most effective aquatic plant management alternative. Not actively managing aquatic plants is recommended in areas where excess aquatic plant growth does not impact lake uses, where the benefit of management is far out-weighed by the cost of management, where water quality or other lake characteristics limit nuisance growth conditions, and where highly valued native plants or habitat would be negatively impacted.

## 9.2 Manual and Mechanical Controls

Manual removal of aquatic plants by means of a hand-held rake or by pulling the plants from the lake bottom by hand is allowed within a 30-foot-wide corridor along a 100-foot length of shoreline without a permit (as shown in Figure 5) provided the plant material is removed from the lake. Plant fragments can be composted or added directly to a garden.

Even though up to 30 feet of shore can be cleared of aquatic plants, removal should only be done to the extent necessary. Clearing large swaths of aquatic plants disrupts lake habitats, disturbs lake sediment, and creates open areas for non-native species to establish. If an aquatic invasive species such as curly-leaf pondweed is the target species, then removal by this means is unrestricted as long as native plants are not damaged or eliminated.

Manual removal can be effective at controlling individual plants or small areas of plant growth. It limits disturbance to the lake bottom, is inexpensive, and can be practiced by many lake residents. Manual removal is most effective in shallow, hard bottom areas of a lake. Pulling aquatic invasive species while snorkeling or scuba diving in deeper water can be done without a permit and can be effective at slowing the spread of a new aquatic invasive species infestation within a lake when done properly. When harvesting Eurasian watermilfoil and curly-leaf pondweed it is important that all material is removed as free-floating fragments can remain viable and re-establish. Manual removal is a viable management option for the Kiel Millpond.

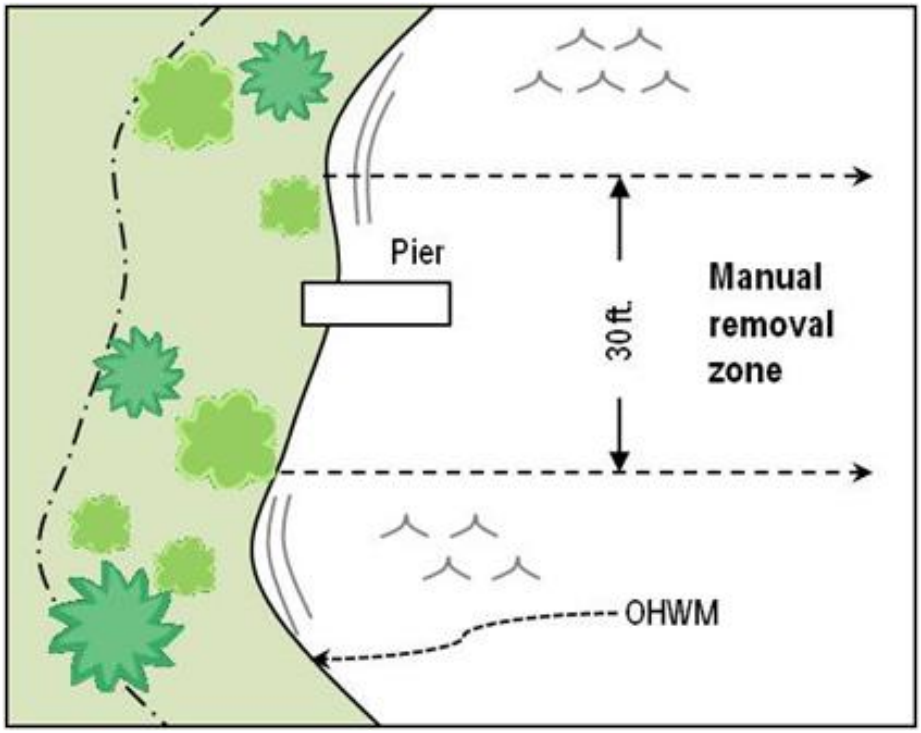



**Figure 10 – Aquatic Vegetation Manual Removal Zone**

### 9.2.1 Large-scale Manual Removal

Hand-pulling by wading or SCUBA diving is typically used when an aquatic invasive species exists as single plants or isolated beds, as in new infestations. Large-scale hand or diver removal projects have successfully reduced or controlled established aquatic invasive species populations.

A number of lakes in central Wisconsin are achieving greater success with volunteer-driven Eurasian-watermilfoil manual removal projects. This is primarily due to extensive outreach, training, and program development offered by Paul Skawinski, AIS Education Specialist, and Chris Hamerla, Regional AIS Coordinator and aggressive and prompt response to new invasions in lakes. A video is available online demonstrating the proper way to control a

Eurasian watermilfoil population by manual removal efforts at:
https://www.youtube.com/watch?v=CfsEDyAwQP4

Overall costs of contracted diver removal of Eurasian watermilfoil have been found to range from a high of $796 per hectare of Eurasian watermilfoil removed during a three-year intensive management effort followed by about $300 per hectare during the subsequent three-year maintenance period. This six-year effort successfully reduced the overall distribution of Eurasian watermilfoil in the lake from 16% of the littoral zone to 3%.

### 9.2.2 Mechanical Control

Mechanical control methods use motorized accessories to assist in vegetation removal. Mechanical control can be used for both small- and large-scale control efforts and require WDNR permits regardless of the size of the area to be managed. As with manual control, plant fragments must be removed from the water to the extent practical.

The most common form of mechanical control is the use of large-scale mechanical harvesters on the lake. The harvesters are generally driven by modified paddle wheels and include a cutter that can be raised and lowered to different depths, a conveyor system to capture and store the cuttings, and the ability to off-load the cuttings. Harvesters operate at depths ranging from skimming the surface to removing vegetation up to five feet below the surface.

Harvesters can remove thousands of pounds of vegetation in a relatively short period of time. By removing the plant biomass, harvesting also removes nutrients from a lake. Everything in the path of the harvester will be removed including the target species, other plants, macro-invertebrates, semi-aquatic vertebrates, forage fishes, young-of-the-year fishes, and even adult game fish found in the littoral zone. An advantage of mechanical aquatic plant harvesting is that the harvester typically leaves enough plant material in the lake to provide shelter for fish and other aquatic organisms, and to stabilize the lake bottom sediments (24).

Large-scale plant harvesting in a lake is similar to mowing the lawn. Plants are cut at a designated depth, but the root of the plant is often not disturbed. Plant composition can be modified by cutting away dense cover which may increase sunlight penetration enough to stimulate growth of underlying species. Cut plants will usually grow back after time, just like the lawn grass. Re-cutting during the growing season is often required to provide adequate annual control (25). Harvesting activities in shallow water can re-suspend bottom sediments into the water column releasing nutrients and other accumulated compounds (25). Some research indicates that after cutting, reduction in available plant cover causes declines in fish growth and zooplankton densities. Other research finds that creating deep lake channels by harvesting increases the growth rates of some age classes of bluegill and largemouth bass (26).

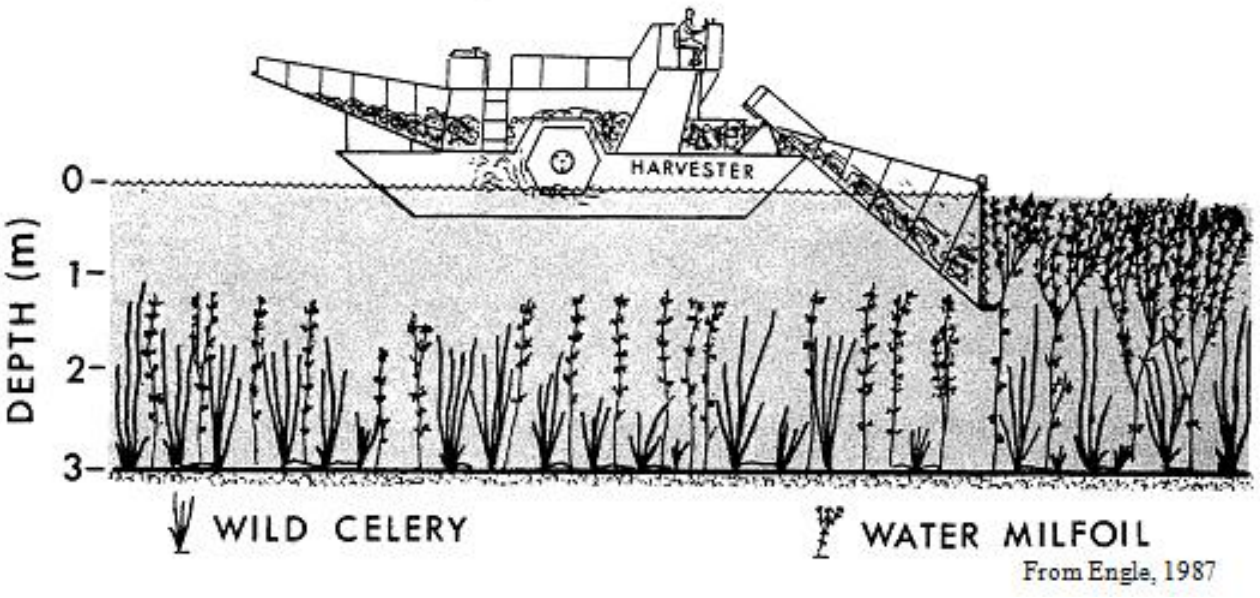



**Figure 11 – Harvesting Surface Growth to Maintain Habitat and Simulate Basal Plant Growth**

Recent cost per acre for contracting harvesting services average $410 per acre whereas costs for purchasing, operating, and maintaining a harvester average $567 per acre (27). In general, the cost of harvesting decreased with increasing total acreage harvested, from about $500 per acre at 40 acre sites to about $250 per acre at 160 acre sites (27)

There are a wide range of small-scale mechanical management techniques, most of which involve the use of boat mounted rakes, scythes, and electric cutters. As with large-scale mechanical harvesting, removing the cut plants is required and often accomplished with a rake. Commercial rakes and cutters range in prices from $100 for rakes and cutters that can be thrown from the shore or attached to a boat to around $3000 for electric cutters with a wide range of sizes and capacities.

Although not truly considered mechanical management, plant disruption by normal boat traffic is a legal method of management. Most macrophytes do not grow well in an area actively used for boating and swimming. It should be noted that purposefully navigating a boat in circles to clear large areas is not only potentially illegal, but it can also re-suspend sediments, clear paths for aquatic invasive species growth and cause ecological disruptions.

### 9.2.3 Suction Dredging

Suction dredging is a form of mechanical harvesting where diver-operated suction tubes connected to barge- or pontoon-mounted pumps and strainer devices are used to vacuum plants uprooted manually by SCUBA divers. This management technique is considered harvesting and not dredging because sediments are not removed from the system. Suction dredging is mostly used for control of isolated, new infestations of aquatic invasive species. Suction dredging requires good visibility for the SCUBA divers (i.e., high water clarity), would probably work best at sites with at least 10 feet of depth or more for divers to control buoyancy, and would also work best where sediment suspension would not cloud diver's vision as plants are uprooted. Furthermore, purchase and assembly of pumps and strainer devices on a pontoon would be required. Unless a committed volunteer base of SCUBA divers and a means to secure equipment is identified, suction dredging is not a viable option in the Kiel Millpond.

### 9.2.4 Other Mechanical Management

The mechanical aquatic plant control methods described below are not recommended for use in the Millpond because they are often extremely disruptive to aquatic ecosystems. These methods are, however, used in other states or inappropriately employed in Wisconsin and are therefore discussed.

Cutting without plant removal, grinding and returning the vegetation to the water body, and rotovating (tilling) are also methods employed to control nuisance plant growth in some lakes. Cutting is just like harvesting except the plants are left in the lake. Grinding incorporates cutting and then grinding to minimize the biomass returned to the lake. Smaller particles disperse quicker and decay more rapidly. Rotovating works up bottom sediments dislodging and destroying plant root crowns and bottom growth.

Bottom rollers and surface sweepers are devices usually attached to the end of a dock or pier and sweep through an area adjacent to the dock. Continued disruption of the bottom area causes plants to disappear and light sediments to be swept out. The use of rollers may disturb bottom dwelling organisms and spawning fish. Plant fragmentation of nuisance aquatic plants may also occur. In soft bottom areas, sediment disturbance can be significant. These devices are generally not permitted in Wisconsin. A permit under Section 30.12(3) is required which governs the placement of structures in navigable waters.

Another method for removing aquatic plants from a beach or dock area is for riparian owners to hook a bed spring, sickle mower blade, or other contraption to the back of a boat, lawn mower, or ATV and drag it back and forth across the bottom. This is a type of mechanical management that is illegal to perform in Wisconsin without a permit, and it is usually not permitted by the WDNR.

## 9.3 Biological Controls

Biological control for aquatic plant management involves using animals, fungi, insects, or pathogens as a means to control nuisance plants. The goal of bio-control is to develop a predator-prey relationship where the growth of nuisance plants is reduced, but not eliminated. A special permit is required in Wisconsin before any biological control measure can be introduced into a new area.

Specific biological controls of curly-leaf pondweed are not known at this time. Ongoing research on naturalized and native herbivores and pathogens that impact nuisance aquatic and wetland plants is increasing the number of potential biological control agents that could be incorporated into invasive plant management programs (28).

The milfoil weevil (*Euhrychiopsis lecontei*) is a native aquatic weevil that feeds on aquatic milfoils. Their host plant is typically northern watermilfoil, but they prefer Eurasian watermilfoil when it is available. Utilizing the milfoil weevil for Eurasian watermilfoil control has resulted in variable levels of control, with little control achieved on lakes with extensive motorized boat traffic. Researchers in Wisconsin have been developing a protocol for citizen rearing of the milfoil weevil

The grass carp (*Ctenopharyngodon idella*), which feeds on aquatic plants and has been used as a biological tool to control nuisance aquatic plant growth in other states, is not permitted in Wisconsin. These fish can severely disrupt the aquatic ecosystem and have been known to nearly wipe out all aquatic vegetation in the lakes they inhabit.

The *Galerucella* beetle (*G. calmariensis* and *G. pusilla*) has proven to be extremely effective for control of purple loosestrife. These beetles have been used across North America to manage purple loosestrife. Use of *Galerucella* beetles for purple loosestrife management should be continued.

Plant fungi and pathogens are currently still in the research phase. Certain species for control of hydrilla and Eurasian watermilfoil have shown promise, but only laboratory tests in aquariums and small ponds have been conducted. Methods are not available for widespread application. Whether these agents will be successful in flowing waters or large-scale applications remains to be tested (29).

Selectively planting native aquatic plants to encourage or stimulate growth of desired plant species is another form of biological control. Introducing native plants is uncommon as it is often difficult and costly and requires a fairly large source of new plants and substantial short-term labor for collecting, planting, and maintaining the stock. Maintenance of plantings may require protection from fish and birds and temporary stabilization and protection of sediment in the planting area from wind and waves. Allowing the natural re-growth of native plants in cleared areas can prevent non-native invasive plant species from establishing in those sites.

## 9.4 Physical Habitat Alteration

Reducing nutrient loading from the watershed (for example, reducing fertilizer use or controlling construction erosion) provides fewer nutrients available for plant growth. Runoff from development in the near-shore area and from other parts of the watershed can increase the amount of phosphorus available for plant and algae growth. Decreased light penetration due to increased algae in the water produces a favorable environment for plants that have adapted to low-light conditions, such as curly-leaf pondweed. Higher nutrient concentrations also favor other non-native plants such as Eurasian watermilfoil and native plants that can grow to nuisance levels, such as coontail.

Research has shown that as shoreline development increases, the amount of aquatic plant growth near that lake shore decreases. In a Minnesota study of 44 lakes with varying amounts of developed shoreline, the average loss of aquatic plants in developed areas was 66% (30). On a lake wide basis, this loss of aquatic plant growth can lead to higher levels of phosphorus and an increase in the growth of algae, including filamentous algae that may attach to structures within the littoral zone or form surface mats. Reducing nutrient loading from the watershed (for example, reducing fertilizer use, controlling construction erosion, or shoreland restoration and buffers) is a viable management option for the Millpond.

Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, have inadequate pelagic and hypolimnetic zones, need deepening for navigation, or require removal of toxic substances. A WDNR permit is required to perform any dredging in a waterbody or wetland. This method can be detrimental to desired plants, as all macrophytes would be prevented from growing for many years. This high level of disturbance may also create favorable conditions for the invasion of other invasive species. Selective dredging is appropriate for use in the Kiel Millpond.

Benthic barriers or other bottom-covering approaches are another possible physical management technique. Plants are covered with a layer of a growth-inhibiting substance such as sheets or screens of natural or synthetic materials, sediments such as dredge sediment, sand, silt or clay, fly ash, and combinations of the above. WDNR approval is required and screens must be removed each fall and reinstalled in the spring to be effective

over the long term. Benthic barriers are not recommended for aquatic plant management in the Millpond.

Lowering the lake level to allow for the desiccation, aeration, and freezing of lake sediments can be an effective aquatic plant management technique. Repeated winter drawdowns that last for 4 to 6 months and include a freezing period are sometimes effective for control of certain aquatic plants, such as Eurasian watermilfoil. Water Level management should also be considered for managing hybrid cattail problems that occasionally cause problems in the Mill Pond.

It should be noted, however, that lowered lake levels may negatively affect native plants, provides an opportunity for adventitious species such as annuals to expand, often reduces the recreational value of a waterbody (less lake area, more exposed flats), and can impact the fishery if spawning areas are affected.

The City should therefore take steps to avoid any negative unintended consequences associated with water level management, for example they should try to reduce large water level fluctuations during the spring ice out and runoff season in coordination with the managers of the Sheboygan Marsh Dam upstream and downstream dam operators. Large fluctuations in water levels tend to dislodge cattail mats that float in to the dam area and can cause blockages at the dam.

Raising water levels to flood out aquatic plants is uncommon and has a number of negative effects including the potential for shoreland flooding, shoreland erosion, and nutrient loading. Lake level alterations are not recommended for aquatic plant management at this time.

Overall, while water fluctuations can be part of an effective strategy for managing nuisance vegetation, there are a number of reasons why a drawdown may not make sense for the Kiel Mill Pond. As was mentioned above cattail mats could be a problem when the time comes to fill it back up. Second, given the mill pond's geographic proximity to the Kiel Marsh a drawdown may not be very effective in limiting coontail and EWM growth. Finally, a drawdown would be labor intensive. Given the limited potential for effectively addressing the nuisance vegetation problem and the amount of effort involved, the City may want to focus its efforts on mechanical harvesting rather than physical alteration of the mill pond at this time.

## 9.5 Chemical Control

Aquatic herbicides liquid or granular chemicals specifically formulated for use in water to kill plants or cease plant growth. Herbicides approved for aquatic use by the U.S. Environmental Protection Agency are considered compatible with the aquatic environment when used according to label directions. Some individual states, including Wisconsin, also impose additional constraints on herbicide use. There are a number of aquatic herbicides registered for use in Wisconsin. Factsheets for each can be found on the WDNR website at http://dnr.wi.gov/lakes/plants/factsheets/ (last accessed November 2013).

A WDNR permit is required to use chemical herbicides in aquatic environments and a certified pesticide applicator is required for application on most lakes. The WDNR requires aquatic plant surveys before and after chemical application when introducing new treatments to lakes where the treatment size is greater than 10 acres or greater than 10% of the lake littoral area and more than 150 feet from shore. The pre- and post-treatment survey protocol can be found at: http://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic%20Plants/Appendix-D.pdf

The advantages of using chemical herbicides for control of aquatic plant growth are the speed, ease and convenience of application, the relatively low cost, and the ability to somewhat selectively control particular plant types with certain herbicides. Disadvantages of using chemical herbicides include possible toxicity to aquatic animals or humans, oxygen depletion after plants die and decompose which can cause fishkills, a risk of increased algal blooms as nutrients are released into the water by the decaying plants, adverse effects on desirable aquatic plants, loss of fish habitat and food sources, water use restrictions, and a need to repeat treatments due to existing seed/turion banks and plant fragments. Chemical herbicide use can also create conditions favorable for non-native aquatic invasive species to outcompete native plants (for example, areas of stressed native plants or devoid of plants).

When properly applied, the possible negative impacts of chemical herbicide use can be minimized. Early spring to early summer applications are preferred because exotic species are actively growing and many native plants are dormant, thus limiting the loss of desirable plant species; plant biomass is relatively low minimizing the impacts of de-oxygenation and contribution of organic matter to the sediments; and recreational use is generally low limiting human contact. The concentration and amount of herbicides can be reduced because colder water temperatures enhance the herbicidal effects. Selectivity of herbicides can be increased with careful selection of application rates and seasonal timing (31). Lake hydrodynamics must also be considered; steep drop-offs, inflowing waters, lake currents and wind can dilute chemical herbicides or increase herbicide drift and off-target injury. This is an especially important consideration when using herbicides near environmentally sensitive areas or where there may be conflicts with various water users in the treatment vicinity.

Chemical herbicides are not recommended for aquatic plant control in the Kiel Millpond due to the high turnover rate (flushing) of water in the impoundment.

# 10.0 Strategic Plan: Management Goals Objectives and Actions

The following Goals and Objectives were identified during the plan development process. Bulleted items are actions intended to support the related goals and objectives.

## 10.1 Goal 1: Education

### 10.1.1 Obj. #1 Sponsor shoreland restoration demonstration

At least one small shoreland improvement demonstration project will be implemented as a part of this project. It is expected that the project will be a small shoreland restoration, no mow area, or rain garden on city-owned property. The project partners with the City of Kiel and community members will provide the expertise to complete the demonstration project.

- Identify educational objectives
- Identify available support resources (UW-Extension, DNR, Lakes Specialists)
- Work with local school system, library, Boy Scouts, and community center to design and implement

### 10.1.2 Obj. #2 Promote low impact development best practices such as removing downspouts, rain barrels, stormwater management planning

- Work with High School students to paint “Storm sewers drain to lake” stencils (Note: this has been done previously but it is time for a refresher)
- Send educational informational packets to private residents with property abutting or near Mill Pond
- Place Aquatic Invasive Species signage in park and at boat landing. The DNR has some signage the City could install

### 10.1.3 Obj. #3 Develop an educational booth for use at events

This could be done at the park or piggy backing on an existing event such as the annual picnic or:

- Color with Kids event
- Fishing event
- Lake Fair event
- Library
- School
- Community Center

### 10.1.4 Obj. #4 Partner with school system and other organizations to engage students in hands on educational project

Kris reached out to the school and there is a science student that could be a good candidate to take the survey and plan results and develop a presentation at the library using local photos. The committee also discussed the potential of engaging with the Boy Scouts on an educational activity.

- Finalize terms of student internship/project
- Arrange for a community presentation at the library to showcase results
- Investigate potential for a conservation merit badge project through Boy Scouts
- Investigate potential for middle/high school class to do an educational project related to the health of the Mill Pond (The middle school currently does a fish day).

### 10.1.5 Obj. #5 Continue implementing the Recreational Use Visual Survey

The purpose of this objective is to establish a baseline benchmark of recreational use on the Mill Pond. Establishing a baseline will allow the City to determine if management activities are having an impact on recreational use of the river.

Two homeowners have already begun implementing an activity log as part of the development of this Plan. This activity should continue for another year.

- At least one community volunteer who owns property along the project waters will conduct a daily visual survey of the project waters. They will be tracking the number of people using the project waters at any given time during the open water season and what they are doing. The number of boats on the water at the time of the visual survey and the number of people on the shores interacting directly with the project waters will be recorded.
- The number of people swimming, fishing, or in some other way interacting with the project waters will be recorded to the best it can be. Additional survey work may include winter use. Each volunteer will be given a form and a suggested schedule for tracking actual lake use. They will be asked to check the project waters once a day at a time that fluctuates over the course of each 24 hour day. For example, in one week a volunteer would record project water use at 7am on Day 1, 4pm on Day 2, 11am on Day 3, and so on. With one or two volunteers collecting this data at relatively random sample times a good estimation of actual project water use will be obtained.

### 10.1.6 Obj. #6 Shoreland Improvement Workshop

Together with project partners the City of Kiel will plan, sponsor, and implement a shoreland improvement workshop open to all community members. The workshop will provide information about different improvement projects that could be implemented not just on shoreland property, but also anywhere in the City of Kiel to lessen the impact on the project waters. Examples could include but are not limited to rain barrels, pervious pavers, rain gardens, rainwater diversions, and natural plantings. The workshop will also focus on what property owners can do to reduce pollutant sources to stormwater runoff that makes it way to the project waters.

- Conduct one workshop in 2015
- Consider conducting additional workshops in subsequent planning years based on response to first workshop

## 10.2 Goal 2: Aquatic Plant Management

This City seeks to actively manage nuisance vegetation in the project area in order to improve aesthetics, enhance recreational opportunities, and improve fish habitat.

### 10.2.1 Obj. #1 Evaluate purchase vs. leasing of equipment

The City has researched and seen a demonstration of the Swedish technology, Truxor weed cutter. However, as part of plan implementation the City will evaluate other technology options as well. Criteria to consider include, but are not limited to: mobility, maintenance, add-on features, cost, and effectiveness.

- Identify range of options available
- Research cost and pros/cons of each option
- In consultation with stakeholders decide on best option

### 10.2.2 Obj. #2 Implement mechanical harvesting

A Plant Harvester Operation Plan and Proposed Harvest Zone Map are provided in the appendices of this report. Please see both documents for additional details related to this objective. The specific goals of the harvesting plan are to harvest in eight (8) proposed harvest zones. The proposed harvest zones are intended to improve the aesthetic qualities of the pond, open up near shore areas to fishing, provide better fish habitat, and allow for better access to the water from land. The City of Kiel, through its Department of Public Works, will coordinate mechanical harvesting efforts. Harvesting will be done using leased or purchased equipment (see previous objective).

In order to protect habitat and minimize loss during spawning, harvesting usually starts in mid-June. This is also when plants that are problematic generally begin to be an issue. If needed, harvesting can occur earlier, but potential spawning habitat should be avoided. The number of times per year varies – it is like mowing a lawn and the plants will come back, some plants more quickly and vigorously than others.

- This Plan recommends a harvest after June 15 but before July 1 (to capture curly-leaf turions) and a mid-August harvest (if needed).
- Protect native aquatic plants that were found at low frequencies as they provide important structural habitat and contribute to healthy lake systems.
- Reduce coontail abundance along the southern shore of the millpond. Monitor sites with reduced nuisance native plants to ensure they are not being replaced by EWM and/or CLP.

## 10.3 Goal 3: Improve Water Quality

### 10.3.1 Obj. #1 Water Quality Monitoring

- Testing to determine the background condition of the project waters for this project and for future WPDES limits on the wastewater utility will be completed by the City April – October at six predetermined sample locations discussed earlier in the report.
- Lab sampling twice a month during the time frame of April-October will be done for the following criteria: Total Phosphorus, Dissolved Reactive Phosphorus, Total Suspended Solids, and Chloride. Dissolved Oxygen, Conductivity, and Water Clarity will be field gathered at the time of lab sampling. Precipitation and water level will be recorded with data loggers at the predetermined locations.
- City of Kiel Wastewater Treatment Plant employees will do the sampling. Water samples will be analyzed in the City's Waste Water Treatment laboratory. All water quality data will be provided to the City's chosen consultant for inclusion in the APMP developed as a part of this project and for use in future phases of this project.
- Water flow, volume, and quality will be compared to previous estimates and reports to determine if any significant changes have occurred.
- City of Kiel sampling will be completed at five different sites, of which only two are within the waters included in this project.

### 10.3.2 Obj. #2 Shoreland restoration

Much of the shoreline throughout the project area has no vegetative buffer. Allowing growth of a vegetative buffer along the shoreline would decrease nutrient loading from surface water run-off. Furthermore, the Kiel Marsh Wildlife Area has been identified as a significant migratory stopover habitat area for both waterfowl and landbirds. This habitat could be

enhanced by maintaining and improving shoreland buffers in the City of Kiel and encouraging emergent plants along the edge of the Mill Pond.

- Tie into educational efforts
- Focus on local areas; City has a lot of public land adjacent study area. A potential demonstration site was identified just south of the library directly east (downstream) of the pedestrian bridge on the north side of the pond.
- Identify regional resources/specialists that can help with education and restoration
- Investigate shoreland restoration options
- Conduct demonstration(s) showcasing a variety of options available to landowners
- Reduce the total shoreline that is mowed to the edge of the lake by the City
- Provide recognition for residents within the project boundaries that complete activities that will help to improve the lake.
- Partner with resource agencies to provide educational opportunities for and work with land owners design and eventually implement best management practices (for example, buffer strips, runoff diversion systems, rain gardens, rain barrels, and full-scale shoreland restorations).

### 10.3.3 Obj. #4 Educate Residents

Residents will be educated on which “sewer shed” they live in to better understand their direct connection to the Mill Pond.

This initiative can be done in conjunction with related educational objectives. The close proximity of the library to the project area makes it an excellent location to help educate residents.

### 10.3.4 Obj. #5 Continue City program of vacuuming streets with street sweeper

- Maintain records of when streets were cleaned and document as part of plan implementation

## 10.4 Goal 4: Native Species Protection & Habitat Improvement

### 10.4.1 Obj. #1 Identify potential in-stream habitat improvements

Action items include:

- During the implementation phase of the APM Plan identify potential areas where depth can be added to improve aquatic habitat

### 10.4.2 Obj. #2 Develop management plan to Improve duck habitat

There was an oil spill in early 90’s that reduced duck populations. Prior to 1978 there was good duck population; removal of brush and nesting habitat may have had a negative impact. Some modifications to the riparian habitat in the park and on private lands could provide a permanent grassland or shrub buffer and an emergent plants buffer would benefit ducks and reduce goose nuisance on the park grounds and adjacent private lawns.

- Identify opportunities to improve shoreland habitat to ehance duck habitat and discourage Canada geese
- Check with Dan Weidert, WDNR, to discuss opportunities and provide additional suggestions
- Develop a plan to improve habitat with a focus on demonstration projects
- Seek out funding and partnerships to implement

## 10.5 Goal 5: Establish a Monitoring and Evaluation Program

### 10.5.1 Obj. #1 Establish a simple management system to regularly monitor management interventions and record impacts (record keeping, monitoring, and assessment)

The City should continue to engage local property owners in monitoring efforts. Action steps include:

- Establish a citizen monitoring group
- Continue with regular comprehensive lake and tributary water quality testing completed by City staff and/or volunteers (See Table 1 for list of recommended monitoring parameters)
- Provide for employee identification of basic native and non-native plant species found in the Kiel Mill pond for the purpose of keeping records of the type and quantity of aquatic plant species removed by harvesting.
- Monitor sites with reduced nuisance native plants to ensure they are not being replaced by EWM and/or CLP.
- Complete a basic aquatic plant identification training for the purposes of recording the type and quantity of specific aquatic plants removed by the harvesters or causing navigation or nuisance conditions in the lake. The training requirement can be met by attending a Plant ID course offered by the WDNR, UW-Extension Lakes Program, a local educational institution, or qualified consultant or other person.
- Harvester operators will complete training or receive and review educational materials for the purposes of learning accepted WDNR sampling protocol for determining plant bed density. Staff/volunteers will complete an informal survey of the entire littoral zone in July, August, and September to help determine possible harvesting areas for the following year. This training will also help to determine when additional channel harvesting may be needed to provide appropriate navigation and/or nuisance relief.
- In the last year of this APM Plan (2019) the whole lake aquatic plant survey will be repeated. Results from the new plant survey will be compared to the 2014 to determine if significant changes have occurred in the aquatic plant community. Management recommendations for the next 5-year APM Plan will be based in part on these results.

**Table 1**
**Water Quality Monitoring during 2014-2019 APM Plan Implementation**

| Parameter | Mill Pond Sites | Tributary Sites |
|---|---|---|
| Secchi Disk | X | |
| Dissolved Oxygen | x | X |
| Temperature | x | X |
| Total Phosphorous | X | x |
| Total Nitrogen | x | X |
| Ortho Phosphates | X | x |
| Nitrite/Nitrate | x | X |
| Ammonia | | |
| pH | x | X |
| Conductivity | X | x |
| Total Suspended Solids | X | X |
| Water Level | X | |
| Flow | x | |

### 10.5.2 Obj. #2 Complete Annual Project Summaries and a Final Project Evaluation

In December of each year this management plan is implemented, an end-of-year summary will be provided detailing the results of activities accomplished. Pre and post plant survey results, water quality results, and plant density results will be summarized.

An end-of-project report will be provided in the last year of this project. Whole-lake plant survey results will be compared to the 2014 plant survey results. Changes in the plant community will be evaluated. The success of the overall project in accomplishing the goals set for it will be commented on and recommendations for possible changes in the revised or new plan made. Funding for the writing of the new or revised plan will be budgeted for by the City and may be supported by the WDNR Lakes Grant.

The City will archive and maintain all records of maps, GIS documents, survey results, treatment records and results, summary reports, photographic records, public participation records, etc…

## 10.6 Goal 6: Implement the Activities Associated With This APM Plan Through a Combination of Local and State of Wisconsin Grant Funding

### 10.6.1 Obj. #1 Begin implementing the activities in this APM Plan in 2015 and continue through 2019

- Use City tax levy money to fund certain “routine” activities each year, which includes shoreland and parcel improvement projects
- Apply for a surface water (river management) grant in spring 2015 in order to provide a public education plan informing the public on aquatic plant life, its benefit to the river system and how this helps the city to manage the proposed plan. The education process would include the public library, high school science class, Boy Scout projects and possible DNR presentations. Other activities may include planning, designing, constructing, and installing permanent educational stands and/or demonstration projects along the City park shoreline.
- Upon successful implementation of the APM Plan consider applying for a Lake Management Planning Grant to develop a comprehensive plan that addresses land use impacts, fishery, and wildlife concerns.
- Consider applying for a WI Lake Planning and Protection Project to fund watershed improvement activities.

### 10.6.2 Obj. #2 Involve community and other partners in making match requirements for state grants and in supporting the activities included in this plan

Foster relationships with and involve the Kiel School District, public and private institutions and organizations, other lake and river organizations, private businesses and organizations, and local and town governments in management activities associated with this APM Plan.