Credit: Map data ©2021 Google

MANAGEMENT RECOMMENDATIONS AND PLAN IMPLEMENTATION 3

3.1 INTRODUCTION

Nagawicka Lake provides a long list of valuable services to lakeshore property owners, people visiting the Lake, and nearby residents. Furthermore, the Lake provides key ecological, water quality, and floodwater detention services to the larger Bark and Rock River watersheds due to its function as a headwater lake. Because of the Lake's great value to the nearby community and overall watershed, the Lake Welfare Committee (LWC) requested, and was subsequently awarded, a grant to study issues perceived to harm or threaten the Lake, and to suggest solutions to these problems. The resultant recommendations are listed in Table 3.1 and are based upon the interests and priorities of the stakeholder group,[168] analysis of available data, practicality, and the potential for successful implementation. Implementing these recommendations helps maintain and enhance the health of the Lake and improves its ability to provide short- and long-term benefit to the overall community.

The recommendations made in this chapter cover a wide range of programs and seek to address a broad array of factors and conditions that significantly influence the health, aesthetics, and recreational use of Nagawicka Lake. Since the plan addresses a wide scope of issues, it may not be feasible to implement every recommendation in the immediate future. To promote efficient plan implementation, the relative importance and significance of each recommendation is noted to help Lake managers prioritize plan elements. Nevertheless, all recommendations should eventually be addressed, subject to possible revision based on analysis of yet-to-be collected data (e.g., future aquatic plant surveys and water quality monitoring results), project logistics, and/or changing/unforeseen conditions.

Those responsible for Lake planning and management should actively conceptualize, seek, and promote projects and partnerships that enable the recommendations of the plan to be implemented. The measures presented in this chapter focus primarily on those that can be implemented through collaboration between local organizations, watershed property owners, and others who have a vested interest in the Lake's long-term health. Examples include the LWC, Lake residents, Waukesha County, the City of Delafield, and the Village of Nashotah. Collaborative partnerships formed among other stakeholders (e.g., other agencies within the

[168] *The LWC, Waukesha County, the City of Delafield, the Village of Nashotah, other nearby communities, the Wisconsin Department of Natural Resources, members of the general public, grass-roots organizations, and other agencies.*

Table 3.1
Nagawicka Lake Recommendation Summary: 2019

Recommendation Number	Recommendation	Priority
	Hydrology/Water Quantity	
1.1	Continue to monitor Nagawicka Lake's water surface elevation and Bark River flow	High
1.2	Develop Lake outlet rating curves	Medium
1.3	Manipulate Lake water elevation to avoid ice damage	Low
1.4	Mimic natural water level fluctuations to promote Lake health	Medium
1.5	Monitor groundwater elevation and use	Medium
1.6	Implement measures promoting stormwater storage and infiltration in existing urban areas	High
1.7	Reduce the impact of existing land use and future urban development on groundwater supplies	Low-High[a]
1.8	Promote good soil health	Low-High[a]
1.9	Purchase land or land conservation easements	Medium
1.10	Continue to protect sensitive areas	High
	Water Quality	
	Nagawicka Lake Monitoring	
2.1	Continue and enhance comprehensive water quality monitoring within Nagawicka Lake	High
	Bark River Monitoring	
2.2	Re-establish water quality monitoring at the US Geological Survey gaging	High
2.3	Install continuous turbidity monitoring program on the Bark River	Medium
	Phosphorus Management	
2.4	Reduce nonpoint source external phosphorus loads	High
2.5	Manage in-Lake phosphorus sources	High
2.6	Removing nutrients through aquatic plant harvesting	High
2.7	Promoting conditions conducive to muskgrass growth	High
2.8	Implementing hypolimnetic withdrawal and on-shore treatment	Low
	Pollutant and Sediment Sources and Loads	
	Watershed Level	
3.1	Protect and enhance buffers, wetlands, and floodplains	High
3.2	Protect buffer, wetland, and floodplain function	Medium
3.3	Protect remaining woodlands	Medium
3.4	Maintain stormwater detention basins	High
3.5	Promote urban nonpoint source abatement	High
3.6	Promote native plantings in and around existing and new stormwater detention basins	Medium
3.7	Combine riparian buffers with other structures and practices	High
3.8	Retrofitting existing and enhancing planned stormwater management infrastructure to benefit water quality	High
3.9	Collect leaves in urbanized areas	High
3.10	Stringently enforce construction site erosion control and stormwater management ordinances and creative employment of these practices	High
	Sub-Basin Level	
3.11	Prioritize pollutant load reduction practices by sub-basin pollutant loading	Low-High[a]
	Shoreline Maintenance Level	
3.12	Maintain shoreline protection and prevent streambank erosion	High
3.13	Reduce refracted wave energy	Medium
3.14	Encourage pollution source reduction efforts along shorelines through BMPs	High
3.15	Enforce ordinances	High
	Aquatic Plants	
	Aquatic Plant Management	
4.1	Aquatic plant harvesting to create access lanes	High
4.2	Continue aquatic plant harvesting to enhance recreational use	Low
4.3	Harvest nearshore nuisance plant growth	High
4.4	Deep-cut harvesting may occur in the Bark River delta in designated access	Medium
4.5	Apply early spring chemical treatment in access channels only in Sensitive Areas 1 and 2 if nuisance plant growth impedes Lake access	Low
4.6	Control growth of invasive plant species	High
4.7	Manually remove nuisance plant growth in nearshore areas	Medium
4.8	Harvesting must maintain, at minimum, one foot of living rooted aquatic plant material	High

Table continued on next page.

Table 3.1 (Continued)

Recommendation Number	Recommendation	Priority
	Aquatic Plants (continued)	
	Aquatic Plant Management (continued)	
4.9	Maintain and operate harvesting equipment in conformance with manufacturer's recommendations	High
4.10	Inspect all cut plants for live animals and immediately return live animals to water	High
4.11	Avoid harvesting in the early spring as much as possible	High
4.12	All harvester operators must successfully complete training course	High
4.13	Continue plant pickup program and encourage shoreline resident participation	High
4.14	All plant debris collected from harvesting activities must be collected and properly disposed of	High
	Native Plant Community and Invasive Species	
4.15	Protect native aquatic plants to the highest degree feasible	High
4.16	Actively manage invasive species to protect native plants and wildlife	High
4.17	Avoid disrupting bottom sediment or leaving large areas of bottom sediment devoid of vegetation	High
4.18	Implement chemical control methods in early spring	High
4.19	Prevent introduction of new invasive species	High
	Cyanobacteria and Floating Algae	
5.1	Reduce Lake water phosphorus concentrations	High
5.2	Continue to monitor algal abundance	Low-High[a]
5.3	Warn residents not to enter the water in the event of an algal bloom	High
5.4	Maintain or improve overall water quality	High
5.5	Maintain a healthy aquatic plant community to compete with algal growth	High
	Fish and Wildlife	
6.1	Understand fishery information, actively participate in the WDNR's planning process, and support management recommendations	High
6.2	Protect valuable in-Lake fish habitat and avoid disturbing vulnerable fish	High
6.3	Mitigate water quality stress on aquatic life and maximize areas habitable to desirable fish	High
6.4	Continue active management actions that safeguard and/or improve long-term water quality and may promote reintroduction of cisco	Low
6.5	Identify and remove instream barriers to passage of fish and other aquatic organisms	High
6.6	Improve in-Lake aquatic habitat by maintain, encouraging, or installing large woody structure and/or vegetation buffer along shorelines	Medium
6.7	Adopt best management practices to improve wildlife habitat	Medium-High
6.8	Promote aquatic plant management plan implementation to avoid inadvertent damage to native species	High
6.9	Preserve, enhance, and expand wetland and terrestrial wildlife habitat while enhancing ecological connectivity between natural areas	High
6.10	Monitor the diversity and abundance of fish and wildlife	High
	Recreational Use and Facilities	
7.1	Encourage safe boating practices and boating pressure on navigable portions of the Lake	Medium
7.2	Maintain and enhance swimming through engaging in "swimmer-conscious" management efforts	Medium
7.3	Maintain and enhance fishing by protecting and improving aquatic habitat and ensuring the fish community remains viable	Medium
7.4	Maintain public boat launch sites	High
7.5	Existing boating regulations should be reviewed for compatibility with current conditions and expectations and ordinances should be conscientiously enforced	Low-High[a]
7.6	Consider increasing launch fees during peak use periods	Medium
	Plan Implementation	
8.1	Maintain and enhance relationships with County, municipal zoning administrators, and law enforcement officers	High
8.2	Keep abreast of activities within the watershed that can affect the Lake	High
8.3	Educate watershed residents about relevant ordinances. Update ordinances as necessary to face evolving use problems and threats	High
8.4	Apply for grants to help implement plan-recommended programs	High
8.5	Broaden Lake Welfare Committee representation	High
8.6	Encourage Lake users and residents to actively participate in future management efforts	Medium

Table continued on next page.

Table 3.1 (Continued)

Recommendation Number	Recommendation	Priority
	Plan Implementation (continued)	
8.7	Encourage key players to attend meetings, conferences, and/or training programs to build lake management knowledge and enhance institutional capacity	Medium
8.8	Continue to reinforce stakeholder inclusivity and transparency with respect to all Lake management activities	High
8.9	Foster and monitor efforts to communicate concerns, goals, actions, and achievements to future Lake managers	High
8.10	Develop an action plan	High

[a] *The priority is based on the sub recommendations.*

Source: SEWRPC

Wisconsin Department of Natural Resources (WDNR), developers, non-governmental organizations (NGOs), wastewater treatment plants, and other watershed municipalities) help promote efficient, affordable, and sustainable actions to assure the long-term ecological health of Nagawicka Lake.

As a planning document, this chapter provides concept-level descriptions of activities that may be undertaken to help protect and enhance Nagawicka Lake and its watershed. It is important to note that plan recommendations provide stakeholders and implementing entities with guidance regarding the type and nature of projects to pursue to meet plan goals. These recommendations and project suggestions do not constitute detailed technical specifications. The full logistical and design details needed to implement most recommendations must be more fully developed in the future when individual recommendations are implemented. Grants are often available to develop concepts into actionable design drawings and plans.

In summary, this chapter provides those implementing the plan the ability to:

- Better understand plan element context and what actually needs to be done
- Judge the relative importance of plan elements
- Better comprehend plan intent
- Envision what various plan elements may look like

Such concepts can be invaluable for building coalitions and partnerships, writing competitive and meaningful grant requests, and initiating project design work.

3.2 HYDROLOGY/WATER QUANTITY

General Concepts

All waterbodies gain and lose water through various means. The source of all water supplied to the Region's waterbodies is precipitation. Although some waterbodies derive most water from runoff, tributary streams, and groundwater, these sources also ultimately depend upon precipitation. Waterbodies lose water in a number of ways including evaporation, plant transpiration, outflow, infiltration into beds and banks, and human withdrawal. When water inflow and outflow are not balanced, water elevations and streamflow fluctuate. If water supply is less than water demand, lake elevations can fall, and stream flows can be reduced or eliminated. During heavier than normal precipitation, lake and river levels may rise.

Humans modify water dynamics in a drainage basin. In particular, two human activities significantly affect the hydrology of a region:

- Installing impermeable surfaces and stormwater infrastructure hastens runoff, increases runoff volume, and discourages groundwater recharge. This in turn typically increases the volume of water reaching lakes and rivers during wet weather and decreases flow to waterbodies during dry weather.

- Pumping water from wells disrupts natural groundwater flow systems. If most of the pumped water is returned as groundwater after use, overall impact may be minimal. However, when water is either consumptively used (e.g., evaporated) or exported from the local groundwater flow system (carried by sanitary sewers that discharge effluent outside of the surface-watershed and groundwatershed), groundwater elevations may fall and discharge to and flow in surface-water features can be reduced or eliminated.

Such changes are generally detrimental to waterbody health. Therefore, management actions should attempt to reduce the impact of human-induced hydrologic change on waterbodies.

The Nagawicka Lake watershed is found at the periphery of the Milwaukee metropolitan area and is home to considerable numbers of people. As such, the watershed (especially the area downstream of the Village of Merton) has significant amounts of impervious land cover and large areas drained by stormwater collection and conveyance networks. Additionally, all water supply systems depend on groundwater, and large volumes of groundwater are exported from the watershed, reducing the volume of groundwater available to feed surface water features. Reduced recharge and high human water demand stresses the watershed's surface water and groundwater resources. This situation will likely intensify as the area continues to develop.

To maintain waterbody health and provide sustainable water supplies, action should be taken to counteract human activities that compromise sustainable, high quality, water supplies. In general management actions aim to slow runoff, maintain or increase groundwater recharge, and reduce the volume of water removed from flow systems feeding Nagawicka Lake and the Bark River. Examples of such approaches are described in the following paragraphs:

- **Detain stormwater.** Urban development often manipulates landscapes in ways that increase runoff volume and speed and decrease groundwater infiltration. Action can be taken to detain and more slowly release runoff, reduce peak runoff rates, and better approximate natural rainfall/runoff patterns. When water is detained, physical and biological processes are able to reduce pollutant and sediment loads. Many features on the natural landscape detain runoff (e.g., wetlands, floodplains, closed depressions). Efforts should focus on protecting and enhancing natural stormwater detention areas. If the capacity of natural features is insufficient to achieve the desired goals, stormwater can be detained in purpose-built artificial structures (e.g., stormwater detention basins, ditch checks, swales). Artificial detention features should be installed to service new developments or retrofitted to infrastructure in developed areas. With careful and holistic planning, it can sometimes be feasible to build detention features as part of new development that also serve existing development.

- **Infiltrate stormwater.** The most basic approach to maintain stormwater infiltration and groundwater recharge is to protect or enhance high and very high groundwater recharge potential areas. Map 3.1 compares areas of planned development with current groundwater recharge potential. Areas of planned development in areas of high and very high groundwater recharge potential should be required to design and install infrastructure maintaining or enhancing overall stormwater infiltration.

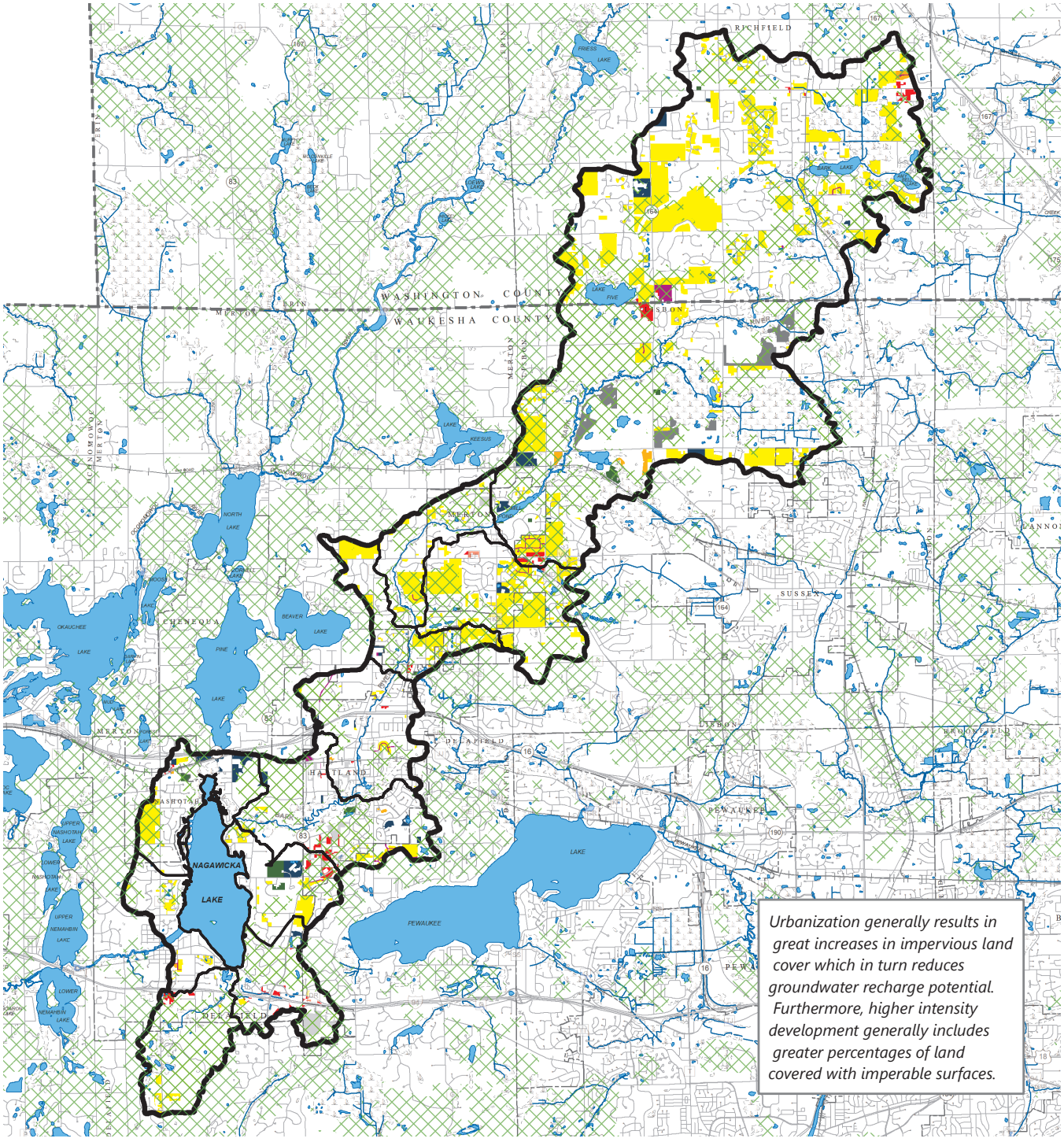
  To maintain or enhance infiltration, water should not be allowed to rapidly leave the land surface and soil health should be maintained or enhanced. Intensive development, drainage ditches, tiling and other soil drainage schemes, storm sewers, and soil compaction should be avoided, particularly in high and very high groundwater recharge potential areas and/or the impact of such modifications should be carefully mitigated by restoring or enhancing natural detention features with good connection to groundwater flow systems.[169] Positive action should be taken to promote soil health throughout the area contributing surface and/or groundwater to the Nagawicka Lake watershed. Healthy soils are more porous, are less prone to erosion, and, therefore, help improve baseflow and water quality.[170]

---

[169] *Detention features can be built that encourage infiltration of stored water and contribute to groundwater recharge. Such systems are one of only a few artificial methods that meaningfully reduce overall runoff volume. They are best situated in areas of high and very high groundwater recharge potential.*

[170] *More information regarding soil health can be obtained from many sources including the following website: www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health.*

Map 3.1
Development Planned Between 2010 and 2050 and its Influence on Groundwater Recharge Potential



- SINGLE-FAMILY RESIDENTIAL
- MULTI-FAMILY RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- TRANSPORTATION, COMMUNICATIONS, AND UTILITIES
- GOVERNMENT AND INSTITUTIONAL
- RECREATION
- EXTRACTIVE AND LANDFILL
- SURFACE WATER
- WETLAND
- STREAM
- WATERSHED BOUNDARY
- SUBBASIN BOUNDARY
- GROUNDWATERSHED BOUNDARY
- HIGH AND VERY HIGH GROUNWATER RECHARGE AREAS

N

0 5,500 11,000 Feet

Source: SEWRPC

Given the significant quantity of groundwater exported from the watershed via sanitary sewers, maintaining, or more desirably increasing, surface water infiltration is very important. This action not only protects surface-water features and ecological health, but also helps safeguard the water supplies that humans in the region depend upon for drinking water and other uses.

- **Reduce Net Groundwater Demand.** Groundwater supplies all residential, commercial, and industrial water demands in the Nagawicka Lake watershed and surrounding areas. Additionally, much of the area is served by public sanitary sewers that export wastewater from the watershed. Therefore, much of the water drawn from local aquifers is exported from the watershed and no longer can supply baseflow to surface-water features. This is a vexing problem that has few solutions. However, action can be taken to reduce current and future net groundwater demand placed on local aquifers. Examples of such concepts are provided in the following text.

    - Promote enhanced stormwater runoff infiltration.

    - Institute a water conservation campaign focused on water demands now discharged to sanitary sewers.

    - Evaluate if clean-water discharges now directed to sanitary sewers or discharge points outside the watershed can be discharged to areas within the area contributing surface water and groundwater to Nagawicka Lake. An example would be redirecting non-contact cooling water drawn from onsite wells that has not been treated in any way to surface water.[171]

The strategies promoting the quantity, timing, and quality of water reaching surface water features are most efficiently applied to specific areas to have the desired effect. For example, groundwater recharge occurring outside of the groundwatershed of Nagawicka Lake does not support baseflow to the Lake. Nevertheless, groundwater recharge does support baseflow in neighboring lakes and streams. For example, water infiltrating from detention features in the Village of Hartland east of the Bark River supports groundwater systems discharging to Coco Creek and Pewaukee Lake. The complex interplay of surface water and groundwater flow systems creates a situation where different geographic areas have differing potential to protect and enhance water supply and quality. These areas are located in Map 3.2 and strategies that help protect/enhance the Lake's water supply are discussed below.

- The area within the Lake's watershed but outside of the recharge area of shallow groundwater flow systems feeding Nagawicka Lake and the Bark River are best suited to strategies that focus on detaining stormwater runoff and enhancing runoff water quality.

- Areas outside of the surface watershed but within the recharge area of the shallow groundwater flow systems feeding Nagawicka Lake and the Bark River are best suited to strategies that aim to increase stormwater infiltration and reduce net groundwater demand.

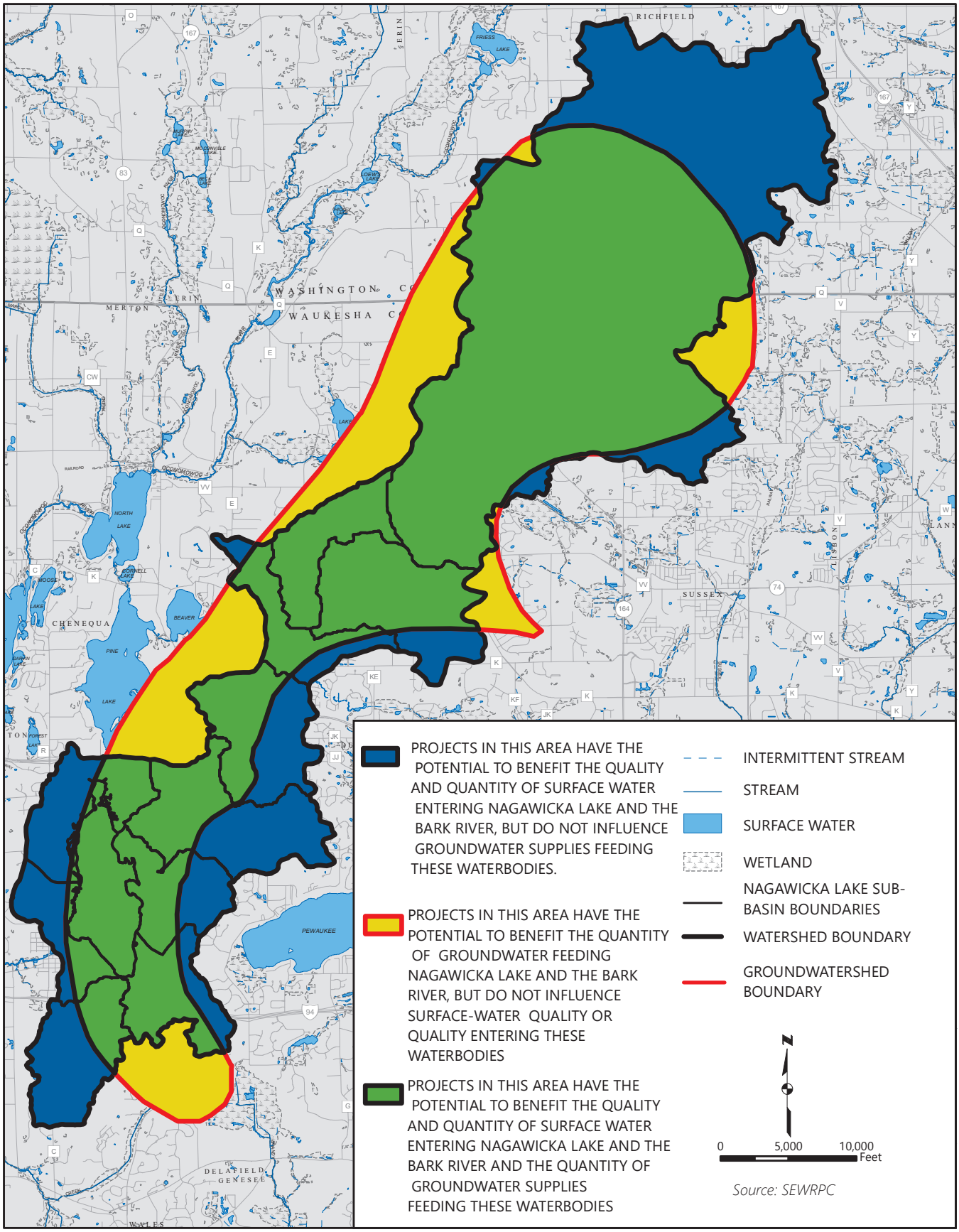
- Projects executed in the area that is within both the Lake's watershed and groundwatershed can benefit both the Lake's surface water and groundwater supply. Project in this area can used a combination of detention, infiltration, and net groundwater demand reduction.

Management Strategies

A management strategy addressing the Lake and River's water supply should capably identify opportunities, quantify change, and evolve. Management actions that help assure the Lake's long-term water supply include the following examples.

[171] *In some cases, municipal water supplies are treated with compounds (e.g., orthophosphate) that helps reduce corrosion in lead pipes. Additionally, disinfectants, fluoride, and other compounds are often added to municipal water supplies. These additives may be detrimental if discharged to surface water or groundwater.*

Map 3.2
How Projects May Benefit Local Water Resource Features



Source: SEWRPC

➤ Recommendation 1.1: Continue to monitor Nagawicka Lake's water surface elevation and the flow of the Bark River

The elevation of the Lake is influenced by several factors including precipitation, evaporation, other weather conditions, the position of the gate at the outlet dam, and, during dry weather, the volume of groundwater discharging to the Lake and River. Variations in these factors are the primary reasons why Lake water levels fluctuate. Having on-the-ground local information relating these factors helps monitor human and environmental stressors on the Lake and River's water supply and could ultimately advance water resource engineering concept development and design. At the present time, the U. S. Geological Survey quantifies the volume of water entering Nagawicka Lake and the City of Delafield monitors the position of the outlet dam gates and the water surface elevation in the Lake. Continued monitoring of the Bark River's flow and Nagawicka Lake's elevation should be assigned a high priority.

➤ Recommendation 1.2: Develop Lake outlet rating curves

To better understand the water budget of the Lake, the quantity of water leaving the Lake should also be monitored. This could be done by developing a series of rating curves relating Lake water elevation, gate position, and flow. Given the long-term value of this investment, developing Lake outlet rating curves should be given a medium priority.

➤ Recommendation 1.3: Manipulate Lake water elevation to avoid ice damage and mimic natural level fluctuations

Aside from short-term fluctuations caused by extreme precipitation and other factors, Nagawicka Lake's water elevation has been held essentially static since 2010. The Lake's water surface elevation is permitted to range between 889.17 and 889.67 feet above National Geodetic Vertical Datum, 1929 adjustment (NGVD 29). Most lake managers hold water elevations at the lower range of their permitted range during winter to minimize shoreline and infrastructure damage caused by ice movement and pressure. The City of Delafield should consider drawing the Lake level down in fall as a pre-emptive measure to help avoid ice damage. Given that ice damage is not known to be a prominent issue on the Lake, this is assigned a low priority.

➤ Recommendation 1.4: Mimic natural water level fluctuations to promote Lake health

Under natural conditions, lake elevations vary seasonally, commonly reaching their lowest levels in late summer. During protracted drought, water levels may be persistently low over periods of time totaling a year or more. By constructing dams with gates, humans attempt to vary lake discharge and maintain high stable water levels throughout the warm season to foster recreation. Some aquatic plants require low water levels during summer to survive. For example, bulrush may persist for years with static water levels, but will ultimately decline if the lake bottom is not periodically exposed. Bulrush seeds require such conditions to germinate. The LWC should consider periodic drawdowns to enhance high value native plant populations, help control nuisance plant populations (e.g., narrow leaf cattail), and allow consolidation and desiccation of nearshore unconsolidated silt and muck. Such action may require revision to the Lake elevation operating order. Given the concerns regarding unconsolidated sediment and cattails around portions of the Lake, this should be considered a medium priority.

➤ Recommendation 1.5: Monitor groundwater elevation and use

The Village of Richfield, in the headwaters of the Bark River watershed, systematically monitors groundwater elevations and uses this information to make management decisions. Other sources of groundwater elevation information are undoubtedly available throughout the watershed (e.g., monitoring wells servicing remediation sites, landfills, quarries). The LWC could request copies of historical and ongoing groundwater elevation measurements to provide additional coverage. Finally, emerging, affordable technologies are available to collect groundwater information in water supply wells.[172] Implementing an expanded monitoring program should be considered a medium priority.

The groundwater supplying the Lake and River are also heavily used for potable and industrial water supply, a situation that likely measurably diminishes the amount of groundwater entering natural

[172] *An example of groundwater elevation monitoring equipment can be found at the following website: www.wellntel.com. This reference does not constitute an endorsement of the products offered by this firm, but rather is provided for general illustration. The LWC could consider encouraging participation by offering incentives to those contributing data.*

waterbodies. Municipal and private high-capacity wells must report the volume of water pumped each year. The LWC should request copies of production records in the watershed and track historical, current, and future human groundwater demands. This will help chart the degree of stress placed on the water supplies feeding the Lake and River and should be considered a medium priority.

➤ **Recommendation 1.6: Implement measures promoting stormwater storage and infiltration in existing urban areas**

Implementing this recommendation could involve the following elements:

- **Enhance the ability of rainfall and snowmelt to be detained, filtered, and/or infiltrated into soils.** This could be most easily achieved by installing modern stormwater best management practices (BMPs) associated with low-impact development, including rain gardens and other stormwater infrastructure specifically designed and carefully located to slow runoff, improve water quality, and promote infiltration.[173] Examples of simple infiltration measures include voluntarily directing stormwater to areas of permeable soil and favorable topography or minimizing impermeable surfaces. An example of redirecting stormwater is disconnecting roof downspouts from storm sewers. Such initiatives can be promoted by active educational outreach, providing instructions and supplies to property owners, and/or through subsidies. Some practices and projects, especially on public property, may qualify for partial funding through the WDNR Healthy Lakes & Rivers program. Given the relatively low cost and relative ease of implementation, this recommendation should be given a high priority throughout the watershed, with particular emphasis given to the portion of the watershed that is also within the groundwatershed.

- **Integrate advanced stormwater management practices into local permitting processes.** A step toward a more comprehensive approach that benefits human habitation and waterbody health would be an ordinance requiring onsite stormwater management practices such as detention, permeable conveyance, limits to impervious surface, porous pavement, or other measures as a condition of issuance of a building permit affecting the overall impermeable surface area of a parcel. Such ordinances should be actively enforced when they exist or should be incorporated into existing ordinances. This should be considered a high priority.

- **Retrofitting existing stormwater management systems with features that enhance water quality and/or modulate runoff rates.** Public works projects can be completed that modernize and improve stormwater management within areas of existing urban development. Retrofitting elements such as stormwater retention/infiltration basins, bioswales, permeable conveyance, and other infrastructure elements can help reduce the impact of existing development on water quality and quantity. In certain instances, stormwater infrastructure built for new development can be located and sized to manage stormwater runoff from existing development. Such projects are commonly difficult to execute and costly but given the amount of sediment pollutants identified to emanate from areas of existing development, such approaches could significantly reduce overall pollutant loads to the Lake and River. Therefore, this recommendation should be assigned a range of priorities in relationship to the associated benefits. With this in mind, the Commission recommends the following priorities:

    - High priority in sub-basins 10 and 11 (Lake-direct drainage basins located to the west of the Lake)

    - Medium priority in sub-basins 7 and 8 (Lake-direct drainage basins located to the east of the Lake) and in sub-basins 5 and 6 (the Village of Hartland)

    - Low priority in all remaining sub-basins

[173] *Rain gardens are depressions that retain water, are vegetated with native plants, and help water infiltrate into the ground rather than enter the Lake through surface runoff. Rain gardens can help reduce erosion and the volume of unfiltered pollution entering the Lake and can also help augment baseflow to the Lake.*

➤ Recommendation 1.7: Reduce the impact of existing land use and future urban development on groundwater supply

This recommendation can be implemented by:

- **Promoting water conservation and avoid discharge of potable water to sanitary sewers**. Instead, discharge clean water to adsorptive soil areas, storm sewers, or surface water features. This recommendation should receive a high priority.

- **Carefully controlling new development in the watershed's best groundwater recharge potential areas.** This helps assure local and sometimes regional groundwater flow systems are protected. Control can include excluding certain types of development, maintaining recharge potential through thoughtful design, and minimizing impervious surface area. Consider purchasing or obtaining protective or conservation easements on open lands with high and very high groundwater recharge potential. Promote policies that protect or enhance infiltration on public lands. The recommended priorities for preserving recharge areas are:
  - High priority should be given to areas identified as having high and very high groundwater recharge potential within the groundwatershed feeding Nagawicka Lake and the Bark River.
  - Medium priority should be given to moderate groundwater recharge potential areas within the groundwatershed feeding the Lake and River.
  - Low priority should be assigned to low groundwater recharge potential areas within the groundwatershed feeding the Lake and River and all areas outside the groundwatershed feeding Nagawicka Lake.

- **Requiring compliance with the infiltration and groundwater management regulations and recommendations** found in municipal ordinances (high priority).

- **Encouraging developers to actively incorporate infiltration in new stormwater infrastructure** (high priority). Such infrastructure is best located on area of high and very high recharge potential. Infiltrated water must be good quality.

- **Encouraging local government to consider balancing groundwater recharge and groundwater demand as an integral part of new development and infrastructure replacement proposals.** Some Southeastern Wisconsin communities have promulgated ordinances that require integrated analysis of groundwater and surface water impact in the process through which developers obtain permission to build new buildings and subdivisions (high priority).[174]

- **Critically examining proposals that export water from the groundwatershed** (high priority).

➤ Recommendation 1.8: Promote good soil health

This is most widely applicable to agricultural lands within the watershed, but the principles can also be applied to other lands such as parks and lawns (high priority). Consider offering advice and possibly financial incentives to support adoption of agricultural BMPs like cover crops and no-till agriculture. While all agricultural land can benefit from these practices, applying these practices to lands closest to waterbodies tributary to Nagawicka Lake will likely benefit the Lake's water quality the most. Appendix E prioritized agricultural tax parcels for implementation of agricultural BMPs while Figure 3.1 shows the total acreage for each priority class by sub-basin. Section 3.4, "Pollutant Sources and Loads" provides more information on soil health practices and organizations promoting soil health initiatives in Southeastern Wisconsin.

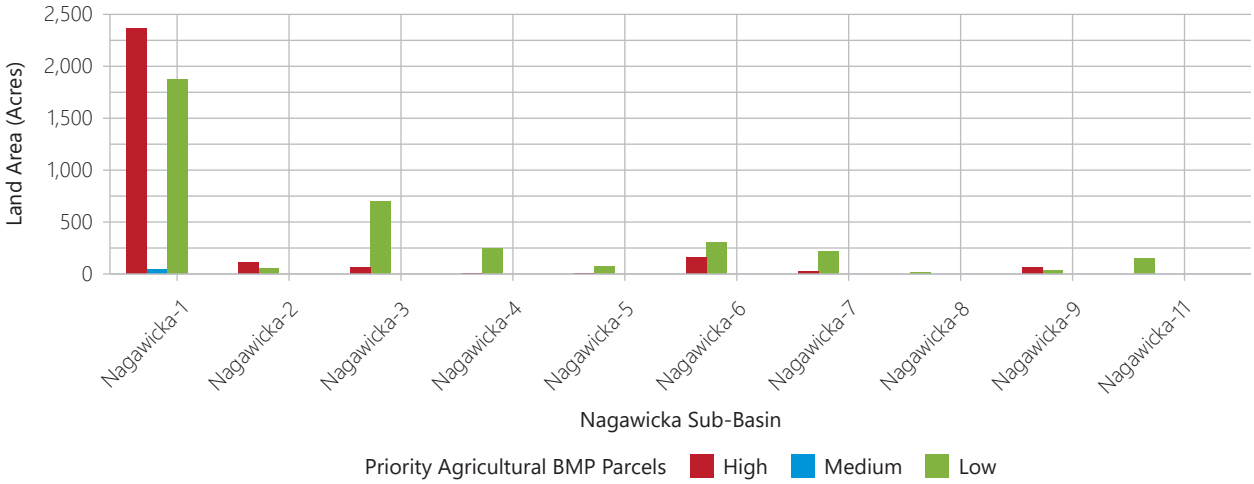
➤ Recommendation 1.9: Purchase land or land conservation easements

Target agricultural and other open lands within Nagawicka Lake's groundwatershed that are identified as having very high or high groundwater recharge potential (medium priority).

---

[174] *The Village of Richfield, located within the Bark River watershed in Washington County, is such an example. More information may be found at the Village's website: www.richfieldwi.gov/300/Groundwater-Protection.*

Figure 3.1
Total Acres of Agricultural Best Management Practices (BMP) Parcels for Nagawicka Sub-Basins



Source: SEWRPC

➤ **Recommendation 1.10: Continue to protect sensitive areas**
These sensitive areas provide numerous water quality, water quantity, and habitat benefits. Enforce town, village, and city zoning ordinances as discussed in Section 3.3, "Water Quality." This recommendation should be given a high priority.

As with the other recommendations made in this chapter, any unanticipated, long-term, or large future changes in the Bark River's flow or the water elevation of Nagawicka Lake would spur the need for re-evaluation of these recommendations. Consequently, flow and water elevation data should be periodically examined, and the suitability of water quantity recommendations should be re-evaluated. This process should be assigned a high priority.

3.3 WATER QUALITY

The fact that Lake residents are concerned with various water-quality-related issues (e.g., sources of pollution in the watershed, the volume of aquatic plant growth, algal growth) suggests that Lake water quality management is warranted. As explained in Chapter 2, management efforts to improve Nagawicka Lake's water quality should focus on strategies that enhance water quality monitoring and manage phosphorus.

Water Quality Monitoring

➤ **Recommendation 2.1: Enhance comprehensive water quality monitoring within Nagawicka Lake**
Water quality monitoring is an important tool that helps quantify the Lake's current condition, helps lake managers decipher longer term change, and allows the factors responsible for change to be identified. Monitoring is integral to management efforts aiming to maintain and improve Lake health. Therefore, monitoring water quality should be a high priority.

Water quality data has been collected for many years at the deepest location in the Lake. To allow historical data to be contrasted to current conditions, and, thereby, allow trends to be identified, samples should continue to be collected at the "deep hole" site. At a minimum, water quality samples should be collected and submitted to a laboratory in early spring shortly after ice out (e.g., early April) and at least once during mid-summer when the Lake is strongly stratified (e.g., late July). Field measurements (e.g., water clarity, temperature, and dissolved oxygen) should be collected much more frequently (e.g., at least twice per month during open water periods). At a minimum, water quality samples should be analyzed for the following parameters:

- Field measurements
    - Water clarity (i.e., Secchi depth)
    - Temperature (profiled over the entire water depth range at the deepest portion of the Lake with more frequent readings near the thermocline)
    - Dissolved oxygen (profiled over the entire water depth range at the deepest portion of the Lake with more frequent readings near the thermocline)
    - Specific conductance (near-surface sample, profiles with depth if equipment is available)
    - pH (near-surface sample, profiles with depth if equipment is available)
- Laboratory samples
    - Total phosphorus (near-surface sample with supplemental samples collected during summer near the deepest portions of the Lake)
    - Total nitrogen (near-surface sample)
    - Chlorophyll-*a* (near-surface sample)
    - Chloride (near-surface sample)
    - Alkalinity (near-surface sample)

Laboratory tests quantify the amount of a substance within a sample under a specific condition at a particular moment in time and provide valuable benchmarks and trend-defining values. Phosphorus, nitrogen, and chlorophyll-*a* analyses are the basic suite of parameters used to determine and track overall lake health. These parameters are tested in most lakes and are useful to contrast the Lake's health to other waterbodies of interest. Chloride is a particular concern in the Region and is the focus of an ongoing Commission study.[175] Excessive chloride concentrations are indicative of heavy human influence and are commonly associated with environments more favorable to undesirable aquatic invasive species. Alkalinity is of particular importance to the process that drives in-lake phosphorus sequestration. High alkalinity levels must be maintained to preserve the Lake's natural ability to sequester phosphorus.

Field measurements are often reasonable surrogates for common laboratory tests. For example, water clarity decreases when total suspended solids and/or chlorophyll-*a* concentrations are high, samples with high concentrations of total suspended solids commonly contain more phosphorus, and water with higher specific conductance commonly contains more salt and, therefore, more chloride. Periodically sampling water and running a targeted array of laboratory and field tests not only provides data for individual points in time but can also allow laboratory results to be correlated with field test results. Once a relationship is established between laboratory and field values, field data can be used as an inexpensive means to estimate the concentrations of key water quality indicators normally quantified using laboratory data.

The Clean Lakes Monitoring Network (CLMN) provides training and guidance regarding monitoring lake health.[176] Volunteers commonly monitor water clarity, temperature, and dissolved oxygen throughout the open water season (preferably every 10 to 14 days) and basic water chemistry (i.e., phosphorus and chlorophyll-*a* concentrations) four times per year (two weeks after ice-off and during the last two weeks of June, July, and August).

---

[175] *SEWRPC Planning Report No. 57,* A Chloride Impact Study for the Southeastern Wisconsin Region*, in progress.*

[176] *More information regarding the CLMN may be found at the following website: uwsp.edu/cnr-ap/UWEXLakes/Pages/programs/clmn/default.aspx.*

Supplemental temperature/oxygen profiles collected at other times of the year (e.g., other summer dates, nighttime summer, fall, winter) can be helpful. For example, temperature/oxygen profiles collected during midsummer nights, just before sunrise, help evaluate diurnal oxygen saturation swings. Additionally, oxygen/temperature profiles should occasionally be measured in other portions of the Lake during summer to help evaluate the homogeneity of temperature and oxygen concentrations throughout the Lake. The locations of such supplemental sampling points need to be carefully selected and documented.

Conductivity profiles collected during late fall, winter, and early spring would help quantify the impact of salt released into the Lake. In addition, the Lake's chloride concentration should also be monitored at least once per year when the Lake is fully mixed. Monitoring chloride concentrations allows the rate of concentration increase and variability over time to be quantified. This will help discern the overall impact of cultural influence on the Lake and to evaluate if chloride concentrations are approaching levels that could foster negative changes in the Lake's ecosystem.

Regular water quality monitoring helps Lake managers identify variations in the Lake's water quality and improves the ability to understand problems and propose solutions. Given the changing landscape in which Nagawicka Lake is situated, water quality and the conditions influencing water quality can change. Regular review and revision of water quality monitoring recommendations should be considered a high priority**.**

➤ **Recommendation 2.2: Re-establish water quality monitoring at the US Geological Survey gaging station on the Bark River just upstream of Nagawicka Lake**

The US Geological Survey gaging station now quantifies the rate and volume of water entering the Lake from the Bark River. This provides an opportunity to quantify the mass of constituents reaching the Lake from the River. Unfortunately, collecting continuous parameter-specific concentrations (e.g., phosphorus, chloride), while desirable, is likely not practical for the LWC because of excessive cost and complexity. However, relatively inexpensive and easy-to-operate monitoring can be used to collect information that help managers judge the River's loading to the Lake. For example, Commission staff installed specific conductance monitoring equipment at the gaging station under the Regional chloride study. The Commission is collecting samples at this location for determination of chloride concentrations, allowing development of a mathematical relationship between conductivity values and chloride concentrations. When such a relationship is successfully established, the conductivity values can be used to estimate the mass of chloride delivered to the Lake from the Bark River. Incorporating the Commission's future conductivity values and chloride estimates into future management decisions should be a high priority.

➤ **Recommendation 2.3: Install continuous turbidity monitoring program on the Bark River**

The LWC should consider installing a continuous reading turbidity monitoring device to estimate the amount of suspended sediment contributed to the Lake by the Bark River. Turbidity values may be able to be correlated with total suspended solids and phosphorus loads if appropriate calibration sampling is completed. Oxygen concentrations and temperature should also be periodically measured at set stations along the Bark River, especially during the spring and summer, to evaluate habitat condition. Turbidity monitoring at the gaging station and measuring temperature and oxygen concentrations along the river course should be considered by the LWC and assigned a medium priority.

Phosphorus Management

➤ **Recommendation 2.4: Reduce nonpoint source external phosphorus loads**

Nagawicka Lake has a large watershed, and, therefore, it can receive significant sediment and pollutant loads from the Bark River and tributaries that discharge directly to the Lake. The urbanized Lake-direct tributaries contribute far more phosphorus per acre of land than the remainder of the watershed. However, the largest external mass load of phosphorus enters the Lake via the Bark River. Nonpoint phosphorus loads should be reduced to the maximum extent practicable, and reduction strategies should be assigned high priority. This issue is discussed in more detail, and strategies to reduce loads are presented in Section 3.4, "Pollutant Sources and Loads."

➤ **Recommendation 2.5: Manage in-Lake phosphorus sources**

Available evidence suggests that phosphorus internal loading and recycling contributes about the same amount of phosphorus to the Lake's water column as do external nonpoint sources. Therefore, actions taken to reduce internal phosphorus cycling can also have a profound effect on water quality and aquatic plant/algae abundance. Overall water quality and habitat value could likely be enhanced by decreasing the Lake's limiting plant nutrient (phosphorus). This in turn would help the Lake be less eutrophic, reduce the incidence and severity of algal blooms, lessen stress on the Lake's fish and aquatic life communities, help assure that natural plant-induced phosphorus sequestration processes continue, and sustain a high-quality ecosystem with more long-term resilience. Reducing excess phosphorus is key to this dynamic; therefore, managing in-Lake phosphorus should be assigned a high priority. Additional data may need to be collected to evaluate internal loading dynamics and monitor effectiveness more fully. For example, additional water chemistry profiles and sediment samples from the deep portions of the Lake may need to be collected to better quantify internal loading rates.

While a large variety of techniques can be used to reduce internal recycling of phosphorus, two or three approaches appear to be most promising for Nagawicka Lake. Chemical inactivation using alum is not likely to provide lasting control, since external phosphorus loads are very significant. It should be remembered that a combination of approaches, as opposed to choosing a single strategy, will typically provide the best results.

➤ **Recommendation 2.6: Removing nutrients through aquatic plant harvesting**

Removing nutrients through aquatic plant harvesting should be considered a high priority in Nagawicka Lake. Plant harvesting has the potential to remove significant amounts of phosphorus from the Lake, offsetting phosphorus loading from external and internal sources, and potentially reducing the availability of legacy phosphorus. Chemical herbicides should be avoided since they allow nutrients to remain in the Lake in the form of dead plant material. A new small aquatic plant harvester specially designed for tight quarters and shallow waters may be a good alternative in areas inaccessible to current harvesting equipment. See Section 3.5, "Aquatic Plant Management," for additional information.

➤ **Recommendation 2.7: Promoting conditions conducive to muskgrass growth**

Muskgrass (*Chara* spp.) growth sequesters phosphorus and is a significant factor in some lakes' ability to absorb high phosphorus loads yet maintain good water quality. Muskgrass commonly favors areas of groundwater discharge, therefore, the volume of groundwater discharge to the Lake must be maintained. Clearer water can contribute to increased muskgrass growth, forming a positive self-reinforcing feedback loop. Muskgrass should not be a target of aquatic plant harvesting or herbicide treatment. This recommendation should be assigned a high priority.

➤ **Recommendation 2.8: Implementing hypolimnetic withdrawal and on-shore treatment**

Implementing hypolimnetic withdrawal and on-shore treatment involves drawing water from deep anoxic areas of a lake, piping it to a convenient location on the shoreline, and manipulating water chemistry using natural processes and/or induced physical and/or chemical means to cause phosphorus to come out of solution. Given the large volume and extent of deep-water areas in Nagawicka Lake, and the continuing loading from the Lake's large watershed, hypolimnetic withdrawal and treatment is presently impractical, and is assigned a low priority, and is therefore not described in detail.

As with the other recommendations made in this chapter, any unanticipated, long-term, or large future changes in the tributaries' flow or the water elevation of Nagawicka Lake would spur the need for re-evaluation of these recommendations. Consequently, flow and water elevation data should be periodically examined, and the suitability of water quantity recommendations should be re-evaluated. This process should be assigned a high priority. Implementing these recommendations will significantly contribute to tracking and improving water quality in Nagawicka Lake.

3.4 POLLUTANT SOURCES AND LOADS

Nagawicka Lake is a fairly typical hard-water, alkaline lake with relatively good water quality and with no significant point source pollution. Anticipated land use changes between current and planned land use suggest that 4,537 acres of rural, mainly agricultural, lands in the Lake's watershed will be converted to

urban (mostly residential) use. This change will likely influence the Lake's water quality in a number of ways, including an overall decrease in sediment loading to the Lake and an increase in metal pollutant loading. Available data shows that a great deal of phosphorus is stored in the Lake's bottom sediment, some of which could re-enter Lake water under anoxic conditions. Although the Bark River is the single largest contributor of sediment and phosphorus to the Lake, urbanized Lake-direct drainage areas to the west of the Lake contribute far more sediment and phosphorus to the Lake per individual acre of drainage basin. This points to the need to the practicality of investing money where it has the capacity to be the most effective. Therefore, certain areas should be prioritized for active management action.

Rural Upland Sediment and Nutrient Sources

General Concepts and Importance

As explained in Chapter 2, riparian corridors have an important role in controlling the amount of sediment reaching lakes and streams. Well-vegetated buffers, floodplains, and wetlands can help capture much of the sediment, nutrients, and other pollutants draining from and sourced within upland areas. While it is vitally important to maintain, and better yet enhance, the ability of riparian corridors to reduce sediment, nutrient, and pollutant loads to streams, it is arguably even more important to reduce the volume of these pollutants released from upland areas. Post-European settlement land uses greatly increased the amount of sediment and nutrients released from upland areas throughout Southeastern Wisconsin. This is largely related to removing native forest and grassland cover over broad areas and replacing perennial land cover with annual crops, livestock pasture, and other intensive agricultural land uses. Agricultural land uses are the largest contributors of sediment and phosphorus to most Southeastern Wisconsin waterbodies.

While eroding streambanks and stream channels may be visually striking examples of how human land use accelerates soil loss, the actual volume of sediment delivered to waterbodies by such features is generally dwarfed by the continual, slow, insidious erosion of a few millimeters of soil per year over broad expanses of upland landscape. To illustrate this point, the USDA Natural Resource Conservation Service (NRCS) estimates that average annual cropland soil loss in Wisconsin is 3.1 tons per acre per year, which translates to an average soil loss of roughly 1/50th of an inch per year. While this value sounds small, this value is the same as seven to nine tri-axle dump truck loads of soil leaving a 40-acre field each year. This sediment, composed primarily of precious and nutrient rich topsoil, is deposited in downslope locations such as riparian areas, rivers, and lakes. This dramatically points to the great value of any initiative that aims to reduce upland soil erosion.

Mitigation Strategies

The importance of reducing soil erosion in upland areas has been widely embraced for nearly a century. In recognition of the harm being done to the nation's landscape and the people who depended upon it, the United States Congress appropriated five million dollars in the heart of the Great Depression (i.e., 1933) to establish the Soil Erosion Service. Wisconsin was on the vanguard of this initiative, with the Coon Creek project area in Western Wisconsin being a pioneering incubator of concepts and practices. While practices have been refined over time, on account of the great importance of this vital topic, the interest in this initiative has not waned. Hundreds of practices are now approved to help combat soil erosion, many of them supported through cost sharing grants. While it is beyond the scope of this project to explain the details of every potential practice and source of funding, the NRCS provides information on available funding programs through its website.[177]

In the past decade, several formerly obscure yet novel soil erosion reduction initiatives have been gaining prominence. These initiatives can be categorized under two broad categories: soil health and producer-led conservation initiatives. Each initiative has broad application in the Nagawicka Lake watershed and is briefly summarized in the following text.

<u>Soil Health</u>

Soil health initiatives focus on restoring a soil's natural ability to absorb and store precipitation, process and store nutrients, maintain healthy soil structure, support access of heavy equipment, and lessen dependence on tilling and introduced nutrients and pesticides. Soil health initiatives require producers to learn new processes and often require several years to realize the tangible benefits improved soil health can offer

[177] *To see these programs, visit www.nrcs.usda.gov/wps/portal/nrcs/main/wi/programs/financial.*

producers. Practitioners in Southeastern Wisconsin report decreased production cost, stable or increased crop yield, and therefore, increased overall farm profit per acre. From an environmental perspective, soil health initiatives decrease runoff, stabilize soil structure reducing the susceptibility of soils to erosion, and lessen or eliminate the need for tilling and artificial nutrient/pesticide applications. These changes decrease the amount of sediment, nutrients, and pesticides carried to waterbodies and sustains or improves groundwater recharge. On an overall basis, successfully employed soil health initiatives are one of the few truly symbiotic conservation initiatives—producers reap economic benefit while at the same time fostering environmental health.

Soil health initiatives include a broad spectrum of activities such as interseeding, cover crop establishment, modified tillage, nutrient, and pest management practices. Many events are sponsored on local, regional, and national levels to educate producers on the principles and practices of soil health. For example, the NRCS hosts a webpage devoted to distributing soil health information.[178] Local NRCS agents are also well versed in this initiative and can be an excellent resource to consult. Another national source of soil health information is the Soil Health Academy, an organization that sponsors local and regional events across the nation.[179]

County land managers are also excellent potential sources of information. Several Southeastern Wisconsin counties are actively engaged in soil health initiatives. Ozaukee, Racine, and Washington Counties have been particularly active in supporting soil health initiatives. Links to these counties' land management departments and/or soil health initiative websites are provided below.

- Ozaukee County:
  www.co.ozaukee.wi.us/295/Land-Water-Management

- Racine County:
  www.racinecounty.com/departments/public-works-and-development-services/land-conservation

- Washington County:
  www.co.washington.wi.us/departments/planning_and_parks/land_resources

Beyond government agencies, nonprofit organizations and private practitioners/consultants are available to assist interested producers to evaluate soil health initiatives, plan execution, implement practices, and monitor results. For example, a producer led watershed group in Waukesha County has partnered with the following organizations:

- Oconomowoc Watershed Protection Program:
  oconomowocwatershed.com

- Tall Pines Conservancy:
  tallpinesconservancy.org

Producer-Led Watershed Groups

Over the years, most agricultural conservation initiative grant funding was distributed through local, state, or federal government agencies. Beginning in 2016, the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) initiated a grant program directed to groups of at least five farmers collaborating with conservation agencies, institutions, or nonprofit organizations that collectively endeavor to reduce farm field runoff and increase voluntary participation in conservation initiatives.[180] Throughout Southeastern Wisconsin, producer-led watershed groups have been taking leading positions in the soil health initiative. Links to these groups' websites are listed below.

- Clean Farm Families, Milwaukee River Watershed, Ozaukee County:
  www.cleanfarmfamilies.com

[178] *For more information, see www.nrcs.usda.gov/wps/portal/nrcs/main/wi/soils/health.*

[179] *For more information, see soilhealthacademy.org.*

[180] *datcp.wi.gov/Pages/Programs_Services/ProducerLedProjects.aspx.*

- Cedar Creek Farmers, Cedar Creek Watershed, Washington County: cedarcreekfarmers.wixsite.com/website

- Watershed Protection Committee of Racine County, Fox and Root River Watersheds, Racine County: www.wpcracinecounty.org

- Farmers for Lake Country, Oconomowoc River Watershed, Waukesha County: farmersforlakecountry.org

These producer-led initiatives have seen remarkable success and are an excellent mechanism to introduce new ideas at the grass-roots level.

Linking the Rock River TMDL to Implementing Water Quality Improvements

The U.S. Environmental Protection Agency (USEPA) and the WDNR identified the Bark River watershed as a significant contributor of phosphorus and sediment to the Rock River. Certain Bark River reaches are listed as impaired for low dissolved oxygen concentrations. The USEPA and the WDNR established a total maximum daily load (TMDL) in 2011 to improve conditions producing low dissolved oxygen and degraded habitat in the Rock River basin.[181] A TMDL allocates the allowable load between point sources such as municipal wastewater treatment plants, industrial dischargers, concentrated animal feeding operations, and municipal separate storm sewer systems (MS4s); nonpoint sources such as agricultural sources, urban sources not covered under a discharge permit, and natural background loads; and a margin of safety. The Rock River TMDL addresses impairments such as oxygen depletion, nuisance algae growth, reduced populations of submerged aquatic vegetation, water clarity problems, and degraded habitat resulting from high concentrations of total phosphorus and sediment.

This TMDL established annual baseline total phosphorus and total suspended sediment loads and sets reduction goals for nonpoint sources, wastewater treatment facilities, and MS4s for both TP and sediment. The TMDL covers 84 sub-basins of the Rock River Basin, including sub-basin 55 where the Nagawicka Lake watershed is located (Map 3.3). Annual total phosphorus load reduction goals for the Nagawicka Lake watershed are 79 percent (1,786 lbs.) for wastewater treatment facilities, 68 percent (894 lbs.) for MS4s, and 54 percent (518 lbs.) for nonpoint sources. The TMDL also requires baseline sediment loads reductions of 43 percent (139 tons) from MS4s, 39 percent (80 tons) from nonpoint sources, and 28 percent (11 tons) for wastewater treatment facilities.[182] Of these nonpoint source loads, non-permitted urban sources contributed 14 percent (73 lbs.) of the total phosphorus and 11 percent (9 tons) of the sediment.[183] These load reduction goals should be considered the minimum standard that communities and permitted entities strive to attain. Additionally, while these load reductions targets are important for establishing water quality goals, it is equally important to recognize that continued phosphorus and sediment monitoring are the ultimate determinant of water quality within the watershed.

Choosing a management strategy is critical to meet these water quality goals. As a local example within the Rock River basin, the City of Oconomowoc has identified adaptive management as the preferred compliance alternative to meet its Wisconsin Pollutant Discharge Elimination System (WPDES) permit requirements for its wastewater treatment facility and MS4s under Chapters NR 217, "Effluent Standards and Limitations for Phosphorus," and NR 216, "Storm Water Discharge Permits," respectively, of the *Wisconsin Administrative Code*. The City submitted a preliminary Watershed Adaptive Management Request Form 3200-139 on February 23, 2015, and the WDNR approved their Adaptive Management Plan (AMP) on September 15, 2015. The AMP spans three WPDES permit terms or 15 years, with the understanding that progress can be demonstrated by the beginning of the third term. In order to achieve these water quality goals, the City has developed the Oconomowoc Watershed Protection Program to build capacity and develop collaborative projects within the watershed.

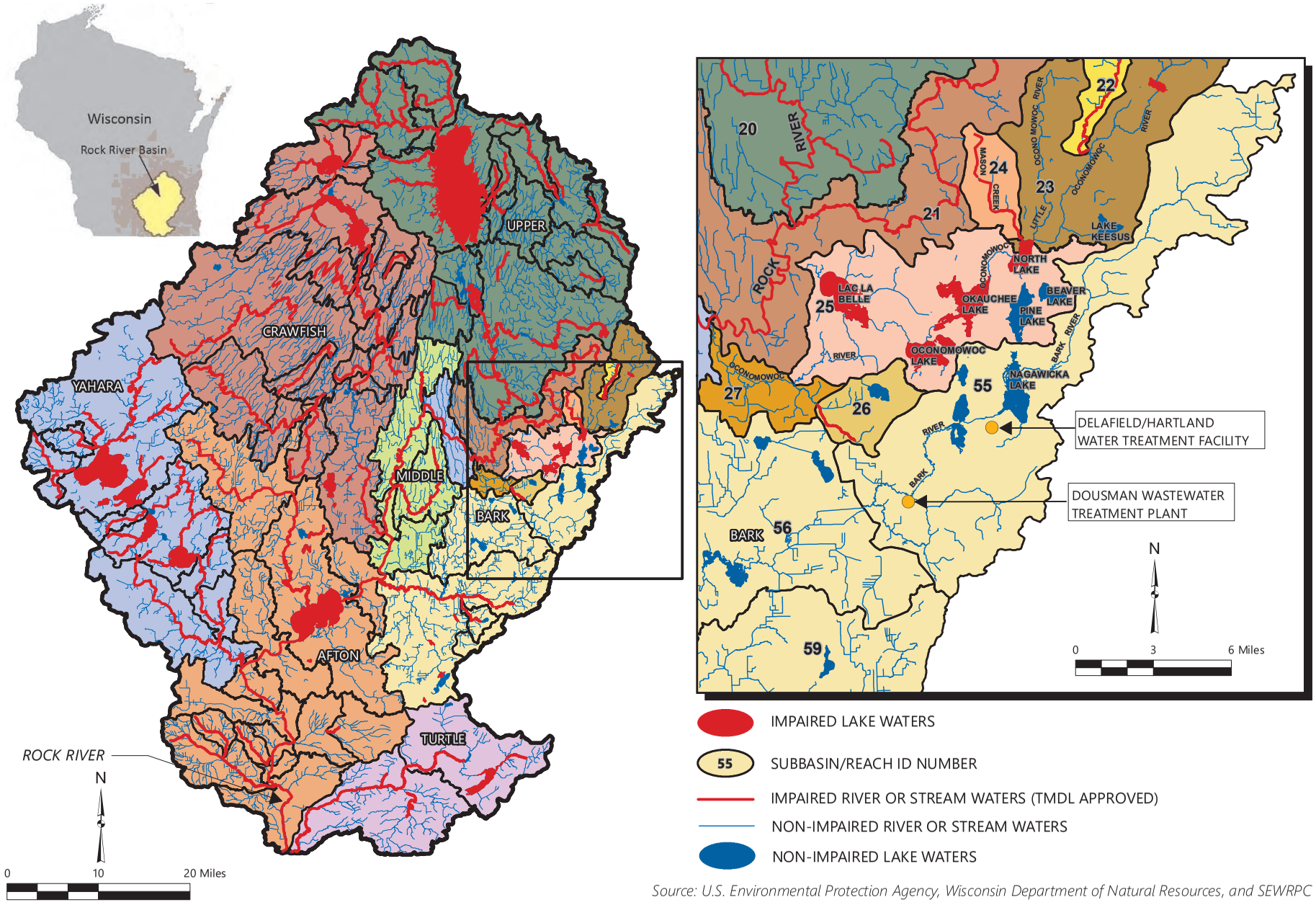
---

[181] *USEPA and WDNR,* Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids in the Rock River Basin Columbia, Dane, Dodge, Fond du Lac, Green, Green Lake, Jefferson, Rock, Walworth, Washington, and Waukesha Counties*, Wisconsin, prepared by the CADMUS Group, July 2011.*

[182] *Ibid.*

[183] *Ibid.*

Map 3.3
Sub-Basins and Impaired Reaches of Wisconsin's Rock River Watershed: 2018



Source: U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, and SEWRPC

Given its similar nature and goals, local partners within the Bark River watershed should consider the Oconomowoc River watershed adaptive management program as a framework to implement the management actions recommended in this plan. For example, a similar adaptive management approach could be pursued by the DelaHart wastewater treatment facility to meet its WPDES permit requirements—such an approach would require collaboration amongst individuals and municipalities in the Nagawicka Lake watershed. If successfully implemented, such an approach could save the DelaHart facility money and could improve water quality throughout the Nagawicka Lake watershed. Collaborative projects could be implemented throughout the Nagawicka Lake watershed, as load reduction anywhere within Lake watershed will count towards meeting the goals for the Bark River watershed as a whole. Recommendations for best management practices that could be implemented as adaptive management projects are summarized in the following text.

Watershed Level Recommendations

Since certain features naturally filter or remove pollutants before runoff reaches waterbodies, it is important to evaluate where such features exist within the Lake's watershed and to what degree they may be able to mitigate pollutant loading of metals, nutrients, or sediment. It should be noted that these features may overlap and may provide multiple benefits.

- **Recommendation 3.1: Protect and enhance buffers, wetlands, and floodplains**

  Protecting these features helps safeguard areas that already benefit the Lake and its tributary network and require little to no additional money and labor to maintain. For this reason, protecting such areas should be considered high priority. Enhancing these features is often a cost-efficient way of increasing the level of waterbody protection and should be considered a medium priority. Efforts should begin by targeting residential runoff from properties ringing the Lake and various sources from properties abutting the Bark River. Efforts may extend to adjacent properties as suitable. Implementation of this recommendation could involve the following steps:

  - Continue to carefully control and limit development in SEWRPC-delineated primary environmental corridors to protect existing natural buffers, floodplains, and wetlands systems (see Map 2.20). Such development limitations are required under Chapter NR 121, "Areawide Water Quality Management Plans," of the *Wisconsin Administrative Code*, and they may be accomplished through local zoning.

  - Continue to enforce zoning standards set forth in Chapter NR115, "Wisconsin's Shoreland Protection Program," of the *Wisconsin Administration Code* (i.e., 75 feet from the ordinary high-water mark along navigable waters) in the watershed.[184]

[184] *The Wisconsin Legislature enacted significant changes to shoreland zoning laws in the 2011, 2013, and 2015 legislative sessions. These changes have generally resulted in a more limited role for the WDNR and counties, and a greater role by the State legislature in directly establishing shoreland standards. Of particular importance are 2011 Wis. Act 167, 2013 Wis. Act 80, 2015 Wis. Act 41, 2015 Wis. Act 55, 2015 Wis. Act 167, and 2015 Wis. Act 391. Previously, county ordinances were required to meet minimum standards set by the WDNR, but counties could enact stricter standards. That began to change with the 2011 Wisconsin Act 170, which prevented counties from adopting stricter standards than those in NR 115 for nonconforming structures and substandard lots. Since 2011, the trend of enhancing the role of the State legislature in the development of shoreland zoning has continued. For example, some of the more stringent standards adopted by counties, such as setbacks in excess of 75 feet, are no longer valid. Currently, under 2015 Wis. Act 55, a shoreland zoning ordinance may not regulate a matter more restrictively than it is regulated by a State shoreland-zoning standard unless the matter is not regulated by a standard in Chapter NR 115, "Wisconsin's Shoreland Protection Program," of the* Wisconsin Administrative Code*. (Examples of unregulated matters may involve wetland setbacks, bluff setbacks, development density, and stormwater standards.) In addition, under Act 55, a local shoreland zoning ordinance may not require establishment or expansion of a vegetative buffer on already developed land through mitigation; counties must allow property owners to establish 35-foot wide "viewing corridors" within each 100 feet of shoreland buffer zone and allow multiple viewing corridors to run consecutively in cases where shorelines run in excess of 100 feet; and, whereas the impervious surfaces standard remains at no more than 15 percent of the lot area, sidewalks, public roadways, and areas where runoff is treated by a device or system or is discharged to an internally drained pervious area, must not be included in the calculation of impervious surface and there are exceptions to the 15 percent standard for highly developed areas. According to the Wisconsin Legislative Council, 2015 Wis. Act 41 "authorizes towns to enact zoning ordinances that apply in shorelands, except that it generally prohibits a town zoning ordinance from imposing restrictions or requirements with respect to matters regulated by a county zoning ordinance that affect the same shorelands.*

- Provide information to lake and river shoreland property owners and landowners along mapped tributaries. This information should describe the benefits that near-shore aquatic and terrestrial buffers provide to waterbodies and help encourage landowners to protect buffers where they still occur and enhance, restore, or create buffers in other favorable areas where none remain. This information could include installation instructions and typical costs. Such programs would be most productive if accompanied by an incentive program that helps share the cost of installation or provides tax incentives.

  A few examples of programs that could enhance buffers in the watershed include installing rain gardens in residential areas, utilizing Farm Service Agency programs such as the Conservation Reserve Program and affiliated Conservation Reserve Enhancement Program in agricultural areas, and promoting adoption of soil health approaches throughout the watershed by sponsoring workshops and offering equipment for rent. Such initiatives use vegetation to decrease runoff volume as well as slow and filter stormwater runoff. If thoughtfully designed and located, groundwater recharge may also be enhanced. Grants may also be obtained for novel initiatives such as cropped buffers, where farmers receive a compensatory payment for growing crops that help filter runoff.

- Consider a shoreline best management practice and shoreline buffer enhancement program. This program could encourage developing rain gardens or buffers along shorelines. Rain gardens can sometimes be combined with buffer strips for added benefit. The WDNR Healthy Lakes & Rivers grant program could help fund some of these efforts.

- Consider obtaining conservation easements and continue purchasing wetlands, floodplains, and uplands in key areas. Buffers can be preserved indefinitely and can have their ecological value enhanced to improve their habitat, filtering, and hydrologic functions (see Appendix F).

➤ Recommendation 3.2: Protect buffer, wetland, and floodplain function

Control invasive species that threaten the ecological value of buffers, wetlands, and floodplains. Additionally, relax human-imposed constraints placed upon watercourses. These efforts should be considered a medium priority. An example invasive species recommendation is to monitor and control reed canary grass (*Phalaris arundinacea*) in wetlands and shorelands. This species, a two- to nine-foot-tall grass, spreads and quickly displaces native wetland plants that help treat polluted water and which provide valuable wildlife habitat. Consequently, a visual survey of appropriate watershed and shoreline locations is recommended to determine whether reed canary grass is a problem. If it is found to be an issue, the infestation should be promptly eradicated.[185] Human-imposed constraints commonly manifest themselves as stream reaches that are ditched, aggressively eroding, and debris choked, incised, and or diked. Such reaches should be targeted for naturalization.

➤ Recommendation 3.3: Protect remaining woodlands

Perhaps the largest threat posed to woodlands in Southeastern Wisconsin is the combined problem of 1) diseases and insects that destroy the native tree canopy and 2) invasive plants such as buckthorn (common buckthorn (*Rhamnus cathartica*) and glossy buckthorn (*Frangula alnus*)) that inhibit or prevent native tree regeneration. Introduced pests have attacked ash, elm, butternut, and oak species. New pests are on the horizon that target black walnut, beech, and other trees. Existing woodlands should be kept free of invasive plant species and actions can be taken to prepare the woodland for the arrival of pests. For example, increasing the diversity of tree species through careful stand management and/or planting can help assure that complete canopy loss does not occur in the future. Actively employing these recommendations should be assigned a medium priority. State programs are available to assist woodland owners with stand management, tax implications, and professional forestry advice.[186]

---

[185] *Reed canary grass can be controlled through burning, modifying hydrology (e.g., flooding), tilling, grazing, mulching, shading (with tree and shrub plantings), manual removal, mowing, and/or chemical treatment. These methods are commonly used in appropriate combination. More information can be found at the following website: www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_035064.pdf.*

[186] *The following website provides an overview of WDNR forestry information and programs: dnr.wi.gov/topic/ForestLandowners.*

➤ **Recommendation 3.4: Maintain stormwater detention basins**

This should be considered a high priority, especially given anticipated increases in urban land uses. Maintaining stormwater basins includes managing aquatic plants, removing and disposing of flotsam/jetsam, ensuring adequate water depth to settle and store pollutants, and actively and aggressively managing excess sediment. Specifications associated with the design of stormwater detention basins and maintenance requirements ensure that basins are functioning properly.[187] It is important to remember that stormwater detention basins occasionally require dredging to maintain characteristics that protect downstream waterbodies. Dredging frequency is highly variable and depends upon the design of the basin and the characteristics of the contributing watershed. Responsible regulatory entities should inspect the basins in a manner consistent with current practices; however, ensuring that the owners of these basins know the importance of meeting these requirements (through educational outreach) can help ensure continued proper functioning of the ponds. Coordinating with municipalities and neighborhood associations can play an important role.

➤ **Recommendation 3.5: Promote urban nonpoint source abatement**

In addition to local stormwater ordinances and stormwater management planning, another cost-effective way to abate nonpoint source pollution is for all municipalities within the Nagawicka Lake watershed to work toward satisfying all conditions required by the WPDES MS4 discharge permitting process. This should be considered a high priority issue, with particular focus Lake direct tributary areas.

➤ **Recommendation 3.6: Promote native plantings in and around existing and new stormwater detention basins**

Establishing native plants in these situations improves filtration of detention waters, reduces pollutant loading, and provide wildlife habitat. In addition, detention basin landscaping practices should be modified to reduce or eliminate fertilizing basin slopes should limit herbicide use and should focus cutting on invasive species. This practice should be considered a medium priority.

➤ **Recommendation 3.7: Combine riparian buffers with other structures and practices**

A much higher level of pollution removal can be achieved by employing "treatment trains," where riparian buffers are combined with better-managed detention basins or new practices such as floating island treatments (see Figure 3.2), grassed swales, and infiltration facilities. Such layering of practices and structures is a more effective way to mitigate the effects of urban stormwater runoff than such practices being used in isolation. This action should be assigned a high priority.

➤ **Recommendation 3.8: Retrofitting existing and enhancing planned stormwater management infrastructure to benefit water quality**

Water quality can benefit by extending detention times, spreading floodwater, and using features such as grassed swales to convey stormwater. Implementing such works requires close coordination with the municipalities within the Nagawicka Lake watershed. This should be considered a high priority.

➤ **Recommendation 3.9: Collect leaves in urbanized areas**

This recommendation should be assigned a high priority. Leaves have been shown to be a very large contributor to total external phosphorus loading to lakes in urban settings. Stockpiling leaves in the street where they may be crushed and washed into the Lake or burning leaves in shoreline and ditch areas can create situations where a strong pulse of phosphorus is delivered to the Lake by late autumn rains. Residents should be encouraged to take advantage of yard waste collection and leaf disposal programs in existence in those municipalities in the watershed that conduct such programs.

➤ **Recommendation 3.10: Stringently enforcing construction site erosion control and stormwater management ordinances and creatively employing these practices**

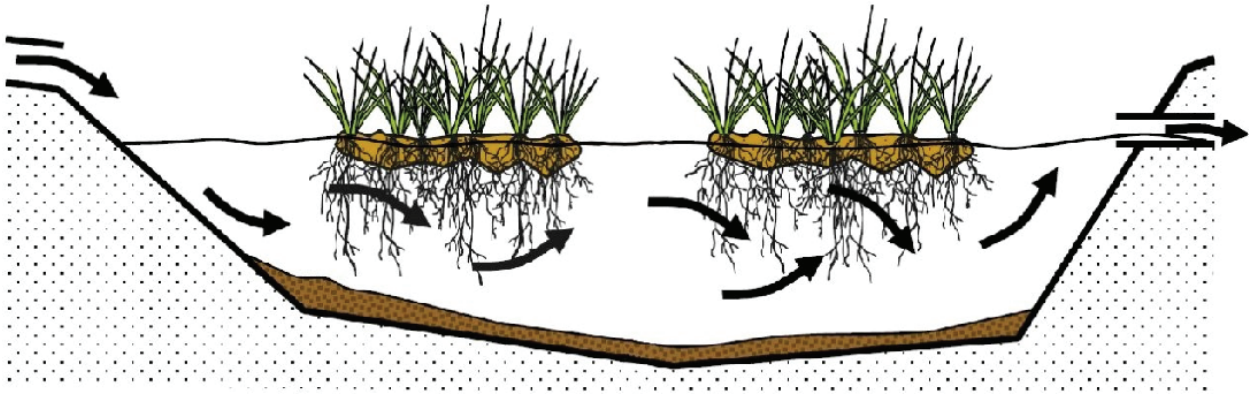
Ordinances must be enforced by the responsible regulatory entities in a manner consistent with current practices; however, local citizens can help by reporting potential violations to the appropriate authorities. This should be considered a high priority.

---

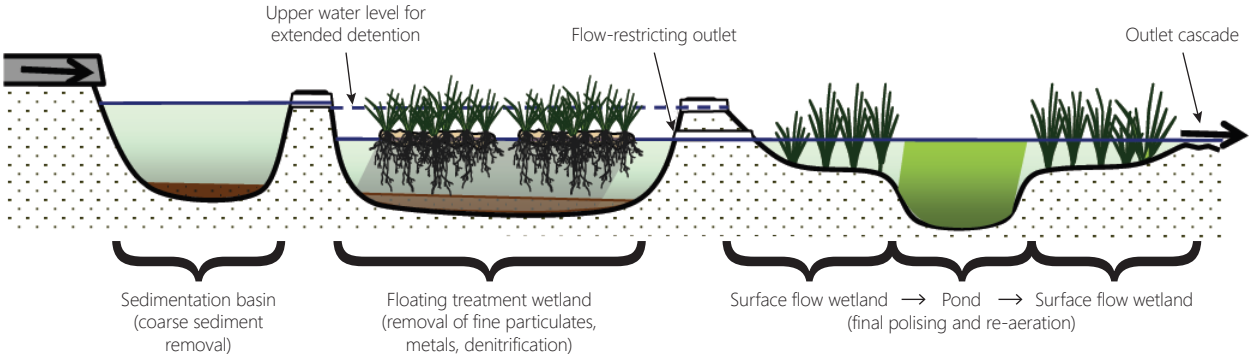
[187] *Technical standards for design and maintenance of wet detention basins and other stormwater management practices can be found at dnr.wi.gov/topic/stormwater/standards/postconst_standards.html.*

Figure 3.2
Floating Treatment Wetland Functional Schematic

Emergent plants are grown within a floating artificially constructed material within a wet detention stormwater basin. The roots are directly in contact with the water column and can intercept suspended particles. The roots also provide a high surface area for microbiological activity that aid in adsorbing pollutants.



Conceptual longitudinal cross-section through a "newly designed" stormwater treatment system incorporating floating wetlands, ponds, and surface flow wetlands (not to scale).



Source: I. Dodkins, A. Mendzil, and L. O'Dea, Floating Treatment Wetlands (FTWs) in Water Treatment: Treatment Efficiency and Potential Benefits of Activated Carbon, *FROG Environmental LTD., March 2014; T.R. Headley and C.C. Tanner, "Constructed Wetlands With Floating Emergent Macrophytes: An Innovative Stormwater Treatment Technology,"* Critical Reviews in Environmental Science and Technology, *42: 2261-2310, 2012 and SEWRPC*

Agricultural land use is forecast to transition to largely residential use. Whereas this may have been perceived as a negative to Lake health in the past, stormwater management practices used in urbanizing landscapes can tangibly lessen pollutant loads and positively modulate runoff volumes when compared to existing agricultural land use. Therefore, if carefully and stringently enforced, stormwater management practices in the watershed areas planned for urban development may reduce the overall pollutant loads to waterbodies and enhance dry weather baseflow. Moreover, future stormwater detention basins can be designed and located to enhance values beyond the requisite and site-specific pollutant trapping and runoff detention value. For example, if a detention pond is located adjacent to a natural area, a stormwater basin can provide valuable habitat function. Similarly, stormwater detention basins can be located in areas prone to contribute to groundwater recharge, helping sustain valuable groundwater-derived baseflow to local lakes, streams, and wetlands. Bioswales, unlined ditches, and a battery of other "green" stormwater management practices can add to the overall positive effect of modern stormwater management.

Sub-Basin Level Recommendations

Since some sub-basins bring more sediment and pollutants into the Lake system than others, it is important to develop specific goals to mitigate potential pollutant loading that reflect differences in each sub-basin or local physiography.

➤ **Recommendation 3.11: Prioritize pollutant load reduction practices by sub-basin pollutant loading**
To help assure critical needs are addressed first, and that funds are efficiently invested, new infrastructure or active management practices that help reduce pollutant loads should be favored in areas that yield the most pollutants contributed per acre of watershed. Map 3.4 illustrates the prioritization of watershed sub-basins for pollutant load reduction. For non-agricultural infrastructure and active management practices, investment should be prioritized as follows:

1. Sub-basins 7, 8, 10, and 11

2. Sub-basins 2, 3, 4, 5, and 6

3. Sub-basins 1 and 9

For agricultural practices, areas closest to waterbodies and within floodplains should be prioritized (see Appendix E). Finally, practices that promote groundwater recharge should favor areas of high or very high groundwater recharge (see Map 3.1).

Shoreline Maintenance Level Recommendations

➤ **Recommendation 3.12: Maintain shoreline protection and prevent streambank erosion**
As described in Chapter 2, most of Nagawicka Lake's shoreline is protected by "hard" (i.e., wood, metal, concrete) manmade riprap or bulkhead. Such structures can be effective means of protecting human manipulated shorelines from erosive wave action, especially along low banks area and shallow waters. Such structures are not permanent and need to be adequately maintained to continue to function as designed. However, shoreline protection also needs to protect waterbodies from excessive sediment, nutrient, and pollutant loads carried in runoff. As an alternative to hard structures, properly vegetated buffer strips are recommended.

Shoreline property owners need to better understand how vegetated riparian buffers can both check shoreline erosion and reduce the amounts of sediment and pollutants reaching the adjacent waterbody. This is especially important in those areas where the shoreline is unprotected (e.g., where lawn is manicured to the water's edge). Map 2.27 locates specific areas around Nagawicka Lake where eroding and unprotected shoreline exist. In general, priority should be given to adding natural shoreline protection to areas that lack protection or are actively eroding, repairing, or maintaining already installed shoreline protection structures when and where feasible, installing "soft" shoreline protection such as a well-designed array of native vegetation, and expanding riparian buffers. These actions are considered high priorities.

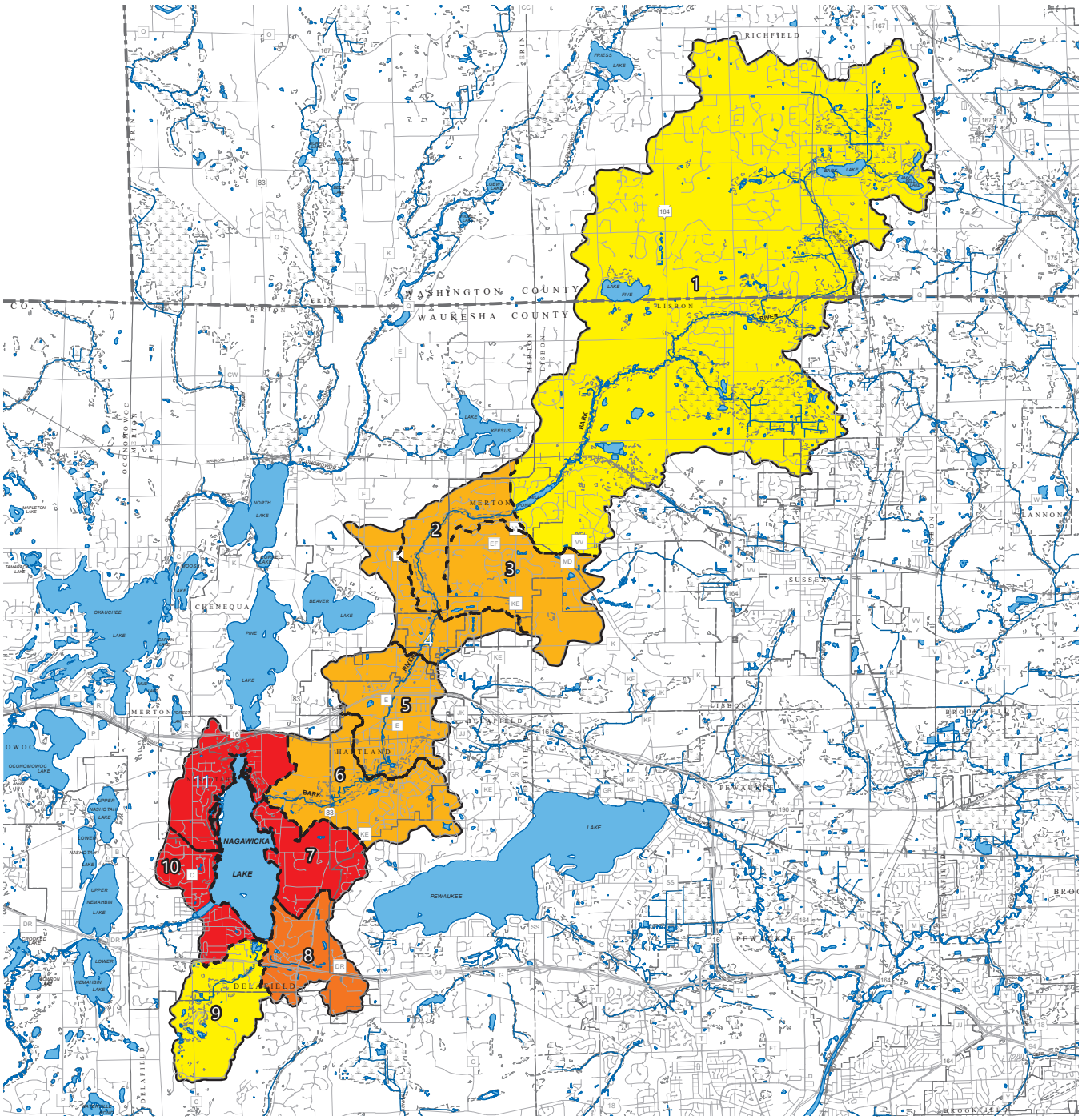
➤ **Recommendation 3.13: Reduce refracted wave energy**
Shorelines armored with concrete, steel, wood, and other straight and hard materials tend to reflect wave energy back into the Lake. This refracted energy eventually reaches another shoreline where it is either absorbed or again refracted back into the Lake. Such conditions can magnify the erosive power of waves. Many actions can be taken to reduce wave energy refraction. Examples include using irregular materials and surfaces that help absorb and dissipate wave energy, planting emergent or floating leaf plants to dissipate energy before it reaches the shoreline, and substituting hard shoreline armor for plants and woody structure. Perhaps the most practical way of approaching this issue is to require wave-energy absorbing features in new or repaired shoreline protection plans. This should be assigned a medium priority.

➤ **Recommendation 3.14: Encourage pollution source reduction efforts (best management practices) along shorelines**
Such efforts would include developing goals consistent with the guidelines of the Healthy Lakes & Rivers Program.[188] These efforts are recommended as a high priority.

➤ **Recommendation 3.15: Enforce ordinances**
Ordinances concerning building setbacks and mitigation measures should be enforced. This is recommended as a high priority.

[188] *For more information on the Healthy Lakes & Rivers Program, see healthylakeswi.com.*

Map 3.4
Pollutant Load Reduction Project Prioritization by Watershed Sub-Basin



SUB-BASIN PROJECT PRIORITY

- VERY HIGH PRIORITY
- HIGH PRIORITY
- MEDIUM PRIORITY
- LOW PRIORITY

- SURFACE WATER
- STREAM
- WATERSHED BOUNDARY
- SUB-BASIN BOUNDARY
- WETLAND
- 1 SUB-BASIN NUMBER

N

0 0.5 1 2 Miles

Source: SEWPRC

3.5 AQUATIC PLANT MANAGEMENT

This section summarizes the information and recommendations needed to manage nuisance plant, Eurasian watermilfoil (EWM) (*Myriophyllum spicatum*), and curly-leaf pondweed (CLP) (*Potamogeton crispus*) growth in the Lake. Accordingly, it presents a range of alternatives that could potentially be used, and provides specific recommendations related to each alternative. The measures discussed focus on those that can be implemented by the LWC in collaboration with the WDNR and Lake residents. The aquatic plant management component of this report is limited to approaches that monitor and control nuisance aquatic plant growth in the Lake after growth has already occurred. Other sections in this chapter will describe other management strategies that can help prevent degradation of the Lake's water quality and aquatic plant community. Examples of such management actions include strategies to reduce phosphorus loads to the Lake and measures to prevent accidental introduction of new invasive plants and animals. In short, this section helps interested parties understand the particular plant management measures to be used in and around Nagawicka Lake and can be a valuable resource when developing future aquatic plant management efforts and requisite permit applications.

The individual recommendations presented below, and which collectively constitute the recommended aquatic plant management plan, balance three major goals:

- Improving navigational access within the Lake
- Protecting the native aquatic plant community
- Controlling CLP, EWM, and hybrid watermilfoil populations

Plan provisions also ensure that current recreational uses of the Lake (e.g., swimming, boating, fishing) are maintained or promoted. The plan recommendations described below consider common, State-approved, aquatic plant management alternatives, including manual, biological, physical, chemical, and mechanical measures.

Plant Management Recommendations for Nagawicka Lake

The most effective plans to manage nuisance and invasive aquatic plant growth rely on a combination of methods and techniques. A "silver bullet" single-minded strategy rarely produces the most efficient, most reliable, or best overall result. Several factors complicate aquatic plant management in the Lake. These factors include the following:

- Portions of WDNR-designated sensitive areas are located along highly developed shorelines
- The only fishing pier on the Lake accessible to people with disabilities and compliant with the Americans with Disabilities Act (ADA) of 1990 requirements is located in a WDNR-designated sensitive area
- Unmapped shallow water areas extending well into the Lake near the mouth of the Bark River are prone to nuisance aquatic plant growth and impede navigation near the center of the Lake[189]
- Plant beds near the mouth of the Bark River consistently host large populations of EWM and CLP

This plan recommends three primary aquatic plant management techniques, each of which must be adapted for unique conditions present in portions of the Lake. Recommended aquatic plant management elements include the following.

[189] *Due to outdated bathymetric information combined with implementation of dredging projects throughout Nagawicka Lake, actual water depths observed in the field must take precedence over mapped water depths when making real-time decisions. It is also important to note that the location and extent of dredging projects must be consistent with the WDNR-approved Chapter 30 Permit Application (Project I.D. 06D006), revised May 2008 for the City of Delafield, prepared by Foth Infrastructure & Environment, LLC.*

- Aquatic Plant Harvesting (Deep Cut, Top Cut, and Diver Assisted Suction Harvesting (DASH))
    - Access Lanes
    - Recreational Areas
    - Nearshore Areas
    - High-Use Sensitive Areas
    - Invasive Plant Control
    - Bark River Delta
    - Late Season Harvesting
- Manual Removal (Raking and Hand-Pulling)
    - Individual Property Owners
    - Collective Manual Removal Programs
- Early Spring Chemical Treatment
    - Invasive Plant Control
    - Navigation Lanes in Sensitive Area 1

These methods are combined to create the recommended Nagawicka Lake aquatic plant management program. Program elements are described in more detail below.

➤ **Recommendation 4.1: Aquatic plant harvesting to create access lanes**

This should be considered a high priority. As can be seen on Figures 3.3 through 3.6, harvesting is recommended to create access channels in areas of the Lake that host dense aquatic plant growth, impeding boat access to and within the main body of the Lake. The lanes should extend to open water (i.e., water about 10 feet deep) or a maximum of 300 feet from shore (a distance coinciding with the buoy line), whichever is closer to shore. The LWC currently uses an Aquarius Systems HM-420 VS harvester and acquired a new Inland Lake Harvester ILH7-450 for a 1-year trial period in 2018.[190] After this time, the use of two harvesters will be reevaluated (see Appendix G-harvester information for harvester specifications).

Harvesting in Sensitive Areas 1, 2, and 3 must leave a minimum of one foot of growing plant material at the Lake bottom. Access lanes in Sensitive Area 1 are to be 20 feet wide measured from the lakeward end of piers toward the center of the Lake (Figure 3.5). Harvesting in Sensitive Area 2 is restricted to access channels no greater than 20 feet wide down the center of the navigation channels (Figure 3.5). Harvesting in Sensitive Area 3 is restricted to a 30-foot-wide access lane to the "Kettle" and 20-foot maximum width access channels cut near the northeast and eastern shorelines.

A specific harvesting plan is proposed for Zastrow Bay on the Lake's east-central shoreline (Figure 3.6). Zastrow Bay may be harvested in three locations: the northwest, northeast, and southeast fingers of the Bay. Harvesting in the northwest finger will include a centrally located 40-foot-wide entry lane that then splits into a 30-foot-wide lane along the eastern shore and a 20-foot-wide lane along the western shore. Additionally, a 10-foot-wide access lane may be cut for the pier located on the southwestern shore. In the northeast finger of Zastrow Bay, a 20-foot-wide entry lane may be harvested into the

[190] *Mention of product names is for informational purposes and does not constitute an official endorsement by the Southeastern Wisconsin Regional Planning Commission.*

Figure 3.3
Nagawicka Lake Aquatic Plant Management Overview: 2017 – 2021

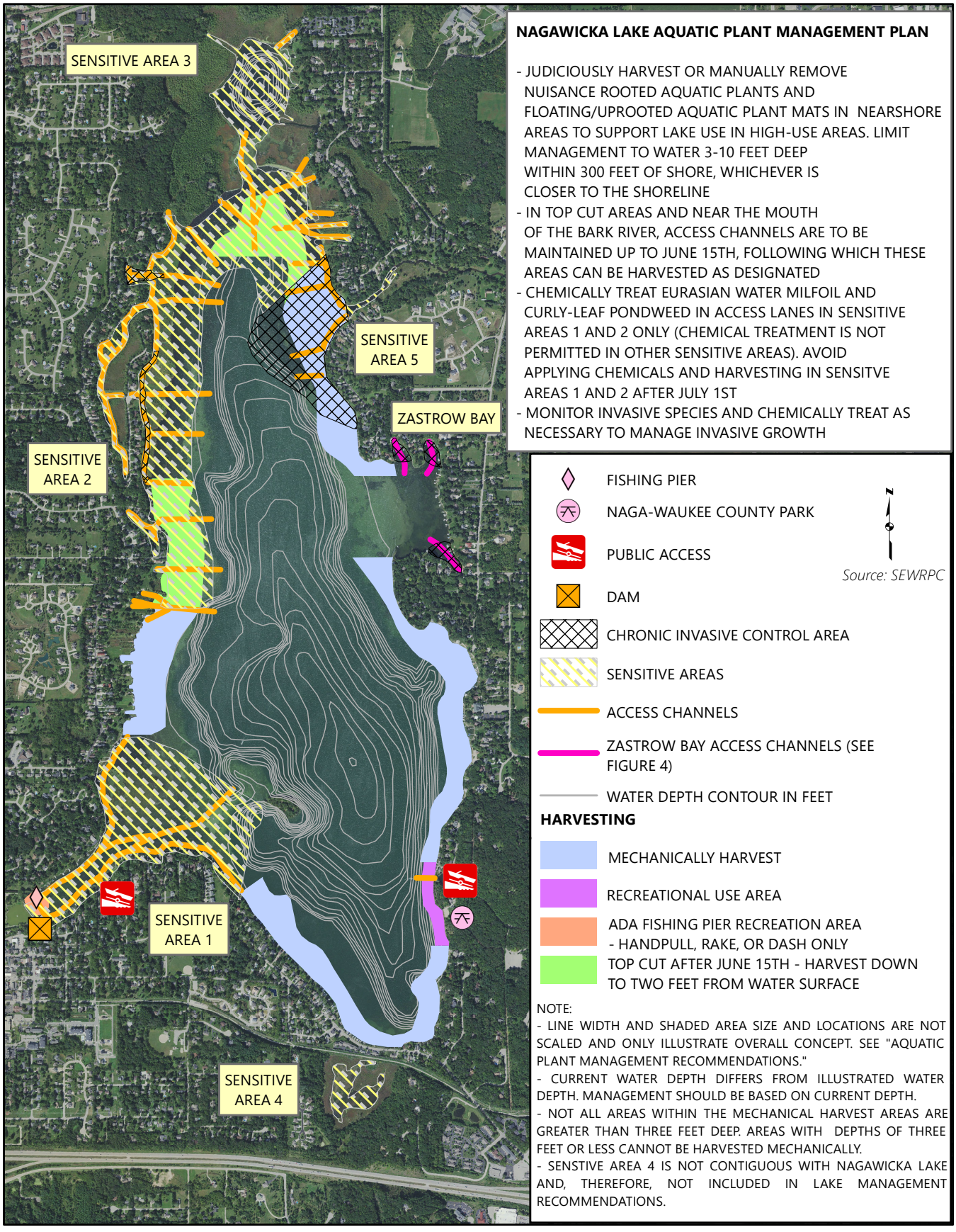


Figure 3.4
St. John's Bay Aquatic Plant Management Overview: 2017 – 2021

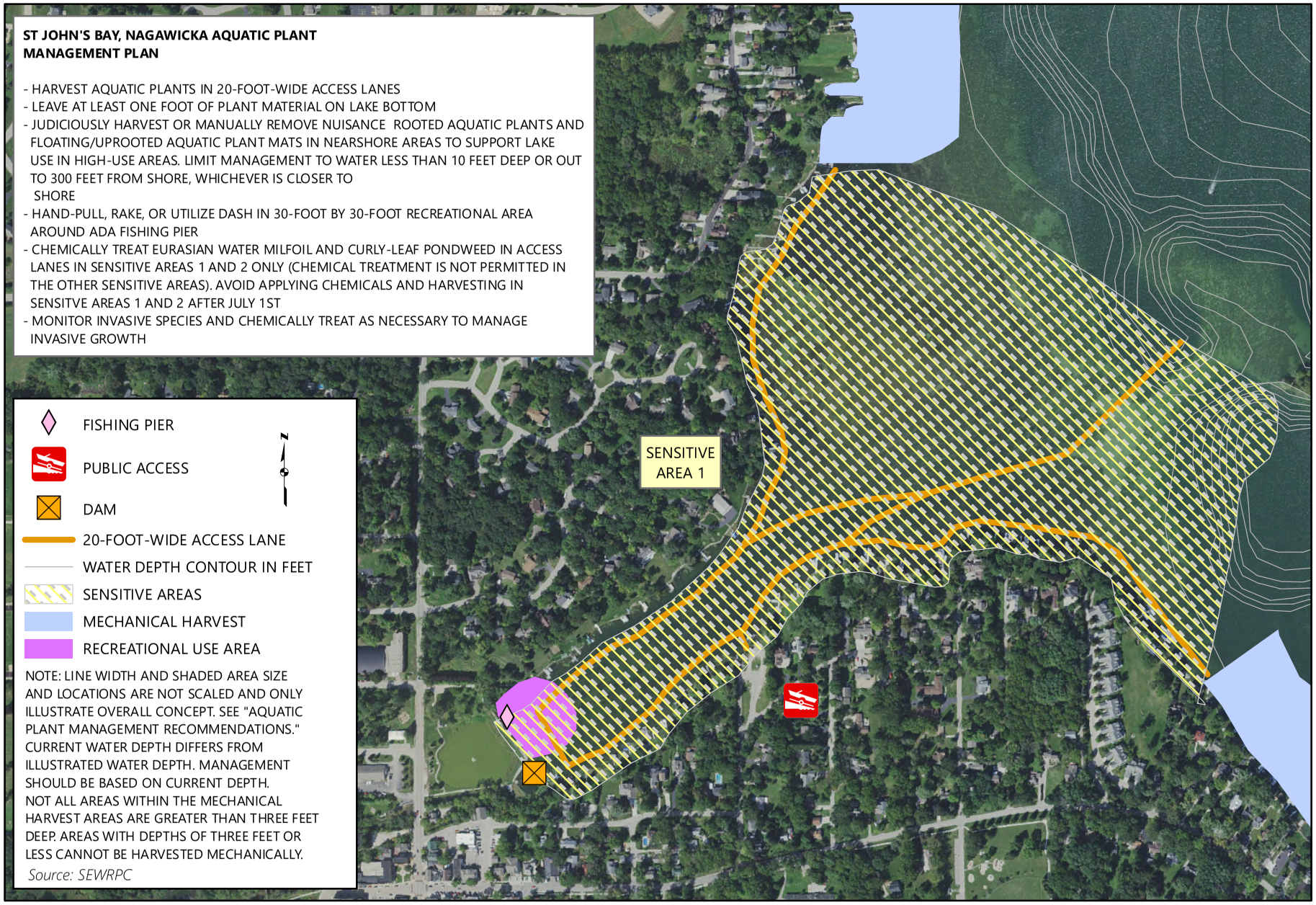


Figure 3.5
Sensitive Areas 2, 3 and 5 Aquatic Plant Management Overview: 2017 – 2021

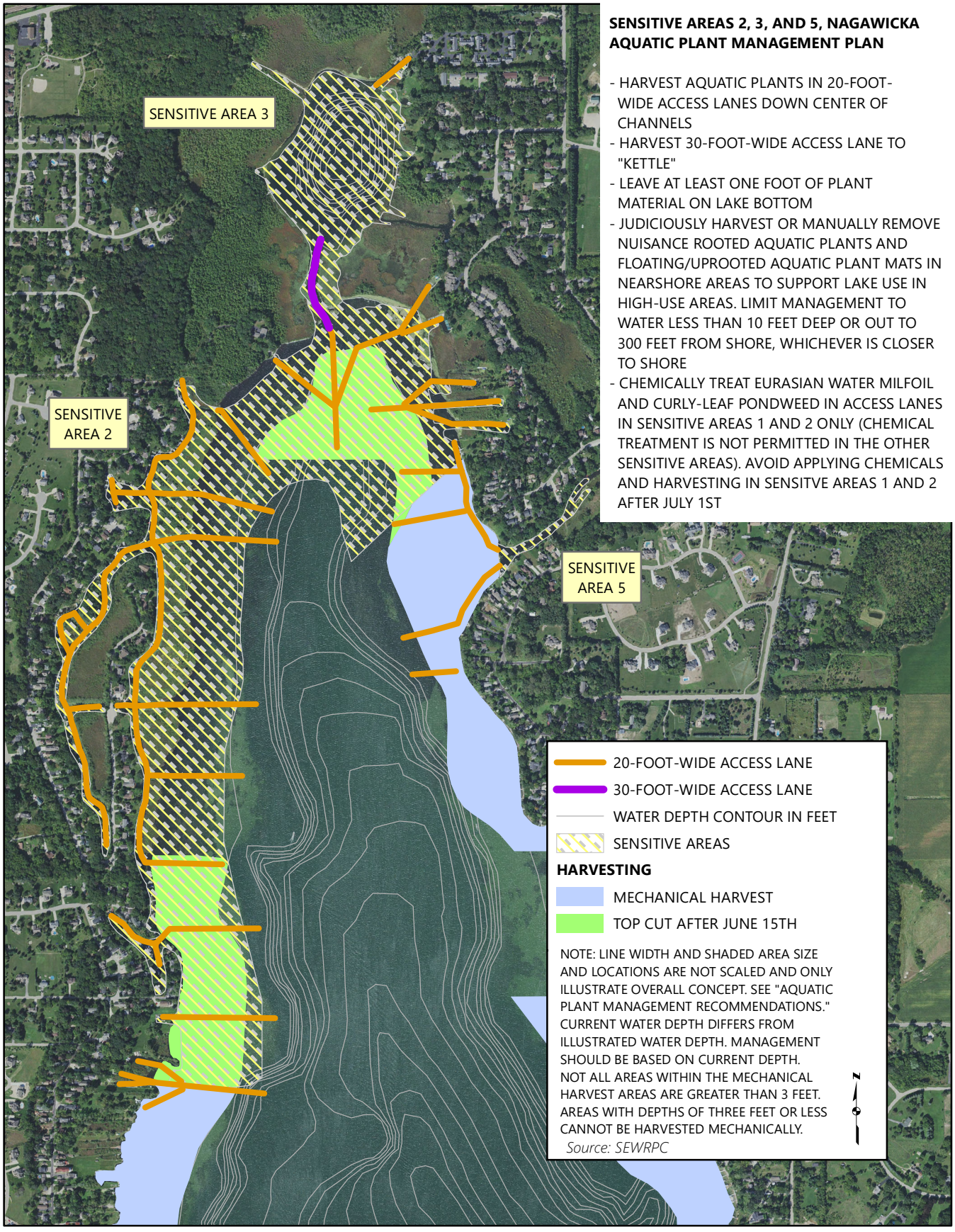
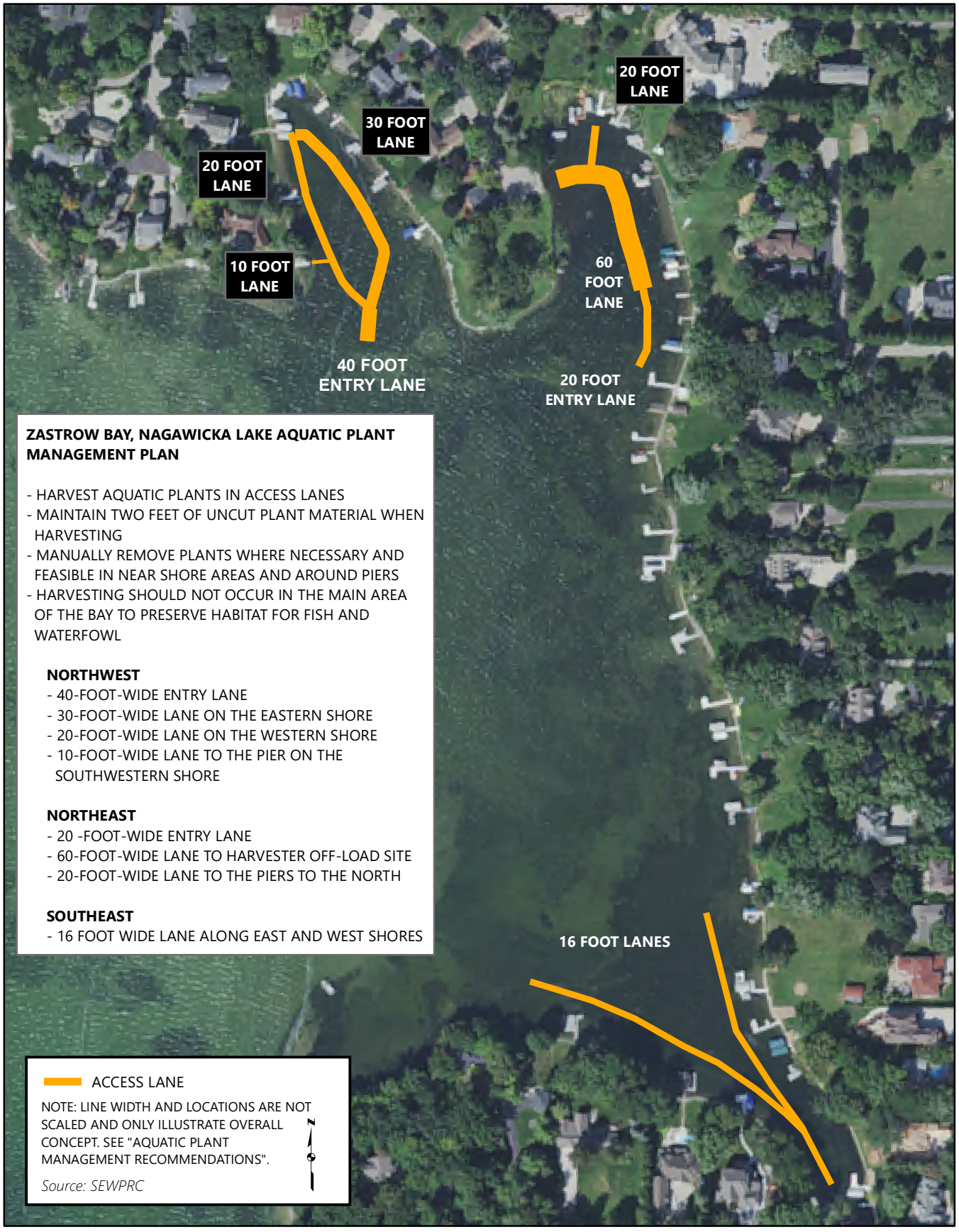


Figure 3.6
Zastrow Bay Aquatic Plant Management Overview: 2017 – 2021



bay along the east shoreline that will curve into a 60-foot-wide lane to the harvesting off-load site. A 20-foot-wide access lane may be cut for pier access on the northcentral portion of the finger. Harvesting in the southeast finger of Zastrow Bay can include one 16-foot-wide access lane along the east side of the finger and one 16-foot-wide lane along the west side, with those lanes converging and terminating at the end of the finger. At least two feet of uncut living plant material must remain growing at the Lake bottom in each finger of Zastrow Bay. Plant roots must not be removed or disrupted. Harvesting should not occur in the main portion of Zastrow Bay to preserve a stable, healthy aquatic plant community for fish rearing, spawning, feed and cover, and a food source for waterfowl.

➤ **Recommendation 4.2: Continue aquatic plant harvesting to enhance recreational use**

A 30-foot-wide access channel may be harvested from the entrance to the Naga-Waukee County Park boat launch and may extend for a length of no more than 150 feet. No other harvesting may occur along the shoreline at Naga-Waukee Park. At least one foot of living plant material must remain attached to the Lake bottom after harvesting. Chemicals may be used in the early spring in areas too shallow to employ harvesters. This is recommended as a low priority.

Due to shallow water depth, no mechanical harvesting may occur around the ADA fishing pier in St. John's Bay. A 30-foot by 30-foot area may be removed around the ADA fishing pier using DASH (suction harvesting), hand-pulling, and/or raking. Water around this pier is reportedly extremely shallow, exacerbating the nuisance plant growth problem and limiting its value as a fishing pier. It may be wise to relocate this pier to a different publicly accessible area with deeper water near the shoreline (e.g., Naga-Waukee Park).

➤ **Recommendation 4.3: Harvest nearshore nuisance plant growth**

Nuisance plant growth refers to dense mats of plants growing within 18 inches of the Lake's water surface. Aquatic plants may be actively controlled to support desired Lake uses in high-use shoreline areas. Management must be limited to water depths between three and 10 feet or a maximum of 300 feet from shore, whichever is closer to shore. Uprooted/floating vegetation may be harvested and vegetation impeding navigation may be top cut but at least two feet of living rooted plant material must remain after top-cut harvesting. Aside from Zastrow Bay, ten-foot-wide access lanes may be cut from private piers to open water. As stated previously, no harvesting whatsoever shall occur within the main body of Zastrow Bay. These areas are shown in Figures 3.3 through 3.6 as "top cut" or "mechanical harvest." In top cut areas (which are located within WDNR-designated sensitive areas), nuisance plant growth can be cut to a depth up to two feet below the water surface and should not be harvested until after June 15th to preserve fish spawning habitat. In mechanical harvest areas, nuisance plant growth may be cut to a deeper depth, but at least one foot of vegetation and plant roots must remain attached to the Lake bottom. This recommendation is a high priority.

Plants will be harvested using the equipment described earlier in this section. Areas too shallow for harvester access may be manually harvested (discussed below) or mechanically harvested with a small, maneuverable, shallow-draft harvester (e.g., Inland Lakes ILH5x4-100—"Mini" Series or similar). Information regarding small, shallow draft harvesting equipment can be found in Appendix G. This information is supplied to illustrate general types of equipment now available on the market and is not an endorsement for any particular make or model. The LWC should thoroughly review and vet any equipment it intends to use, lease, or purchase to assure it best meets its unique needs and desires.

➤ **Recommendation 4.4: Deep-cut harvesting may occur in the Bark River delta in designated access lanes after September 30**

This harvest practice must leave at least one foot of rooted aquatic vegetation at the Lake bottom and must not remove plant roots. This recommendation is a medium priority.

➤ **Recommendation 4.5: Apply early spring chemical treatment in access channels only in Sensitive Areas 1 and 2 if nuisance plant growth impedes Lake access**

Sensitive Areas 1 and 2 are the only sensitive areas where chemicals may be used to control aquatic plants. Treatment should be limited to EWM- and CLP-infested areas in navigation lanes. If chemical treatment is used in Sensitive Areas 1 and 2, it should only occur in the early spring when human contact and risks to native plants are most limited, and not after July 1. A WDNR permit and WDNR staff

supervision are required to implement this alternative. Lakeshore property owners must be notified of planned chemical treatment schedules and permit conditions before chemicals are applied to the Lake. This recommendation is a low priority.

- **Recommendation 4.6: Control growth of invasive plant species**
  This recommendation is a high priority. While the 2016 aquatic plant survey did not reveal a need to actively control EWM or CLP, these plants should still be monitored and managed as described below. As aquatic plant community species change, the need for management changes. This is particularly true around the mouth of the Bark River where EWM and CLP are known to be dense, and in heavily used shallow areas. Populations should be controlled with top-cut harvesting and early spring chemical treatments.

  Fall chemical treatments historically have been utilized to control the resurgence of late season CLP populations around the Bark River. The WDNR is currently studying effectiveness of fall chemical treatment under certain conditions. The LWC should consider these results when available to decide if fall chemical treatment is appropriate for the Lake.

- **Recommendation 4.7: Manually remove nuisance plant growth in nearshore areas**
  This recommendation should be considered in areas too shallow, inaccessible, or otherwise unsuitable for other plant control methods. "Manual removal" is defined as aquatic plant control using hands or hand-held non-powered tools. Given what is known of plant distribution, this option is given a medium priority. Riparian landowners need not obtain a permit to manually remove aquatic plants if they confine this activity to a 30-foot width of shoreline (including recreational use areas such as piers) that does not extend more than 100 feet into the Lake and if they remove all pulled plant materials from the Lake.[191] A permit is required if the property owner lives adjacent to a sensitive area or if the LWC or other group actively engages in such work on the owner's behalf.[192] Prior to the "raking/hand-pulling" season, an educational campaign should be help assure that shoreline residents appreciate the value of native plants, understand the relationship between algae and plants (i.e., more algae will grow if fewer plants remain), have basic aquatic plant identification skills, and are familiar with the specifics about the actions they are allowed to legally take to "clean up" their own shoreline.[193]

Figures 3.3 through 3.6 illustrate the overall aquatic plant recommendations for Nagawicka Lake.[194] To assure sustainable recreational use and the long-term health of the Lake, the following conditions apply to all aquatic plant harvesting practices and have a high priority.

- **Recommendation 4.8: Harvesting must maintain, at minimum, one foot of living rooted aquatic plant material after harvesting**
  No plant roots may be removed as removal damages native plant communities and stirs sediment into lake water.

- **Recommendation 4.9: Maintain and operate harvesting equipment in conformance with manufacturer's recommendations**
  Specifications of the new harvester are included in Appendix G. For example, never operate the harvester in water shallower than the maximum draft range of the harvester (e.g., 20 inches for the ILH7-450 Aquatic Weed Harvester) and never operate with the cutter head or paddle wheels at or near the lake bottom.

---

[191] *The manual removal area limitation for nearshore aquatic plants applies to shorelines where native plants are present. The removal area limitation does not apply to areas populated solely with nonnative and invasive plants.*

[192] *If a lake district or other group wants to remove invasive species along the shoreline, a permit is necessary under Chapter NR 109, "Aquatic Plants: Introduction, Manual Removal and Mechanical Control Regulations," of the* Wisconsin Administrative Code, *as the removal of aquatic plants is not being completed by an individual property owner along his or her property.*

[193] *Commission and WDNR staff could help review documents developed for this purpose.*

[194] *Line width and locations are not scaled and only illustrate overall concept. The actual size, orientation, and depth of plant management activities depend upon sensitive area restrictions and permit conditions and site-specific factors. Site-specific factors include the composition of the plant community, water depth, shoreline configuration and obstacles, and other factors.*

➤ **Recommendation 4.10: Inspect all cut plants for live animals and immediately return live animals to water**

A second staff person equipped with a net should accompany and assist the harvester operator. Animals can be caught in the harvester and harvested plants, particularly when cutting large plant mats. Consequently, carefully examine cut materials to avoid inadvertent harvest of fish, crustaceans, amphibians, turtles, and other animals.

➤ **Recommendation 4.11: Avoid harvesting in the early spring as much as possible**

This benefits the Lake's fishery by avoiding disturbing spawning fish**.** Studies suggest that harvesting activities can significantly disturb the many fish species that spawn in early spring.

➤ **Recommendation 4.12: All harvester operators must successfully complete training course to help ensure adherence to harvesting permit specifications and limitations**

Completing training helps assure adherence to harvesting permit specifications and limitations. The regional WDNR aquatic invasive species coordinator and/or the City of Delafield's Public Works Department should provide training to all summer harvester operators. At a minimum, training should cover the following:

- Explain "deep-cut" versus "shallow-cut" techniques and when to employ each in accordance with this plan
- Review of the aquatic plant management plan and associated permits with special emphasis focused on the need to restrict cutting in shallow areas
- Discuss equipment function, capabilities, limitations, hazards, general maintenance, and the similarities and differences between the various pieces of equipment they may be expected to operate
- Help operators identify boundaries of WDNR-designated Sensitive Areas and familiarity with special regulations pertaining to these areas
- Assure that operators can confidently identify aquatic plant and understand the positive values such plants provide to the Lake's ecosystem, which in turns encourage preservation of native plant communities
- Reaffirm that all harvester operators are legally obligated to accurately track and record their work for inclusion in permit-requisite annual reports.

Additionally, the training program should integrate other general and job-specific content such as boating navigational conventions, safety, courtesy and etiquette, and State and local boating regulations. Other topics salient to this course include first aide training, safety training, and other elements that promote safe, reliable service.

➤ **Recommendation 4.13: Continue plant pickup program and encourage shoreline resident participation**

Harvesting, boat motors, and navigation can fragment plants. Plant fragments may float in the Lake, accumulate on shorelines (particularly the northeastern shoreline), and help spread undesirable plants. The harvesting program should continue to include a comprehensive plant pickup program that all residents can use. This helps assure that harvesting does not create a nuisance for Lake residents. The program typically includes residents raking plants, placing them in a convenient location accessible to the harvester (e.g., the end of a pier), and regularly scheduled pickup of cut plants by the harvester operators. This effort should be as collaborative as practical and harvester operators should consider focusing pickup efforts in the northeastern shoreline areas after weekends because plant fragments tend to preferentially accumulate in these areas on account of prevailing wind patterns. In addition, pickup should focus on the outlet dam area, where floating plant fragments have accumulated and may be passing through the outlet dam, as noted in Chapter 2. Installing a shallow net or cable across the bay in front of the dam may help catch floating plant fragments before they reach the dam's outlet works.

➤ **Recommendation 4.14: All plant debris collected from harvesting activities must be collected and properly disposed at designated disposal sites**

Map 3.5 locates designated disposal sites; however, if requested, the City of Delafield also delivers harvested plants to residents, contractors, farmers/gardeners, landscapers, and others. Such disposal areas are not mapped. Aquatic plant material may not be deposited within identified floodplain and wetland areas.

Native Plant Community and Invasive Species Recommendations

A number of actions should be taken to retain native aquatic plants whenever practical and focus control efforts on aquatic invasive plants. All are considered high priority. These recommendations include:

➤ **Recommendation 4.15: Protect native aquatic plants to the highest degree feasible through careful implementation of aquatic plant management and water quality recommendations**

Nagawicka Lake supports a wide array of aquatic plant species that provide excellent habitat and are integral to the health of the Lake's ecosystems. Muskgrass growth is particularly beneficial as it enhances marl formation and attendant sequestration of phosphorus from the water column.

➤ **Recommendation 4.16: Actively manage invasive species to protect native plants and wildlife**

Invasive species are highly damaging to native plant and wildlife communities and are a nuisance to Lake recreation. Consequently, active invasive species management is recommended. The most problematic invasive species currently in, or around, Nagawicka Lake are EWM, CLP, reed canary grass, and purple loosestrife (*Lythrum salicaria*). All of these may be treated using manual or chemical methods. Mechanical and chemical aquatic plant control methods should follow best management practices to avoid spreading invasive plants and to lower the stress imposed by invasive species on the native plant community. Purple loosestrife can be biologically controlled with purple loosestrife beetles.[195]

➤ **Recommendation 4.17: Avoid disrupting bottom sediment or leaving large areas of bottom sediment devoid of vegetation**

Invasive species tend to thrive on disturbed lake bottom. Many invasive species aggressively colonize bare lake, creating an opportunity to spread invasive species or allow recolonization of treated areas. EWM in particular thrives in such areas. For this reason, care should be taken to remove vegetation judiciously and sensitively from problem areas.

➤ **Recommendation 4.18: Implement chemical control methods in early spring**

EWM, hybrid watermilfoil, and CLP grow earlier in the year than most native aquatic plants. Implementing control methods as early as practical in the spring can help minimize damage to native aquatic plant communities. Moreover, early spring chemical applications are more effective due to colder water temperatures, a condition enhancing the herbicidal effect and reducing the concentrations needed for effective treatment. Early spring chemical treatment also helps reduce human exposure through lower human contact with Lake water when water temperatures are still cold. Lastly, early season eradication of CLP helps lower production of turions (a dormant plant propagule), the dominant reproductive method of this plant.

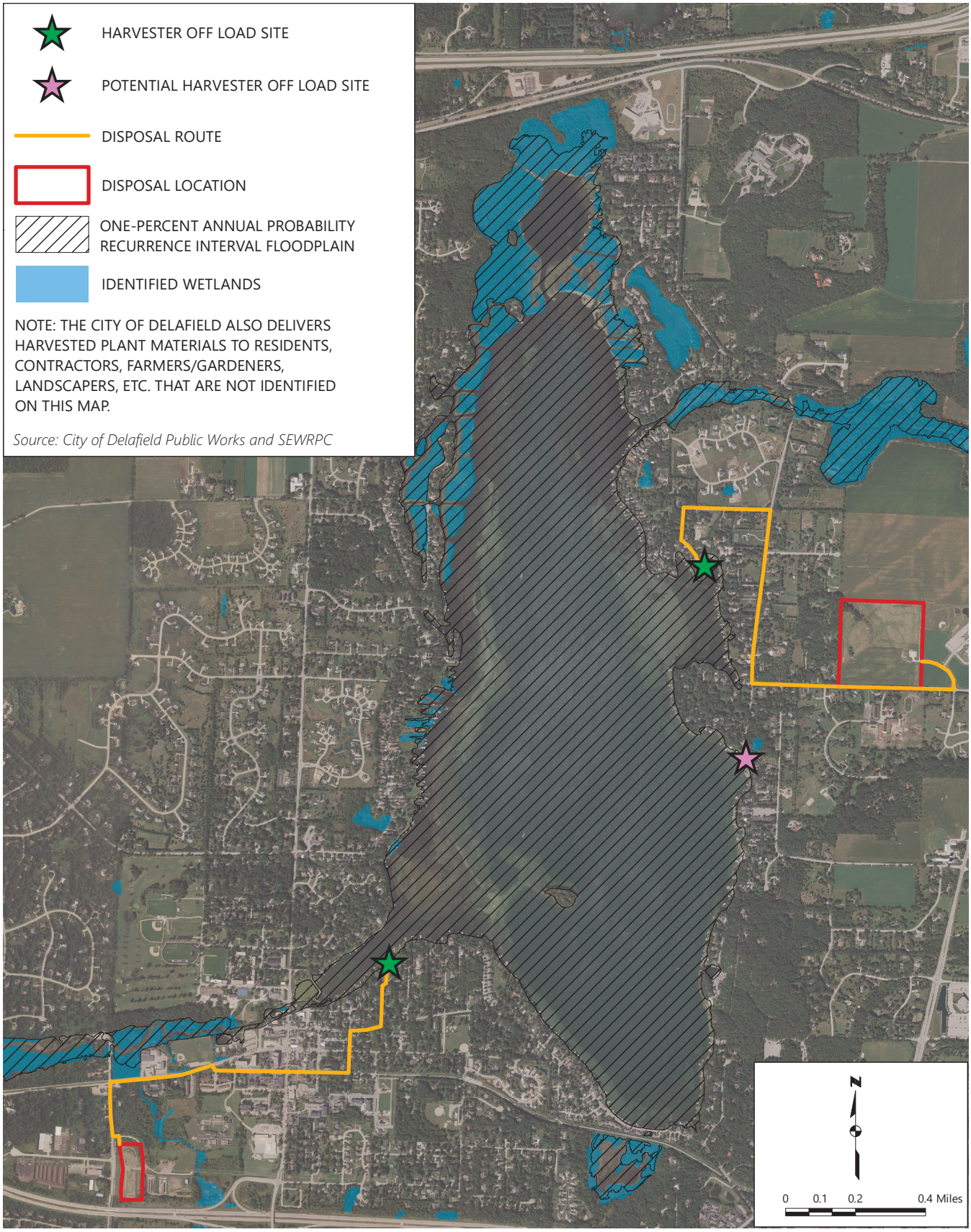
➤ **Recommendation 4.19: Prevent introduction of new invasive species**

Introduction of new invasive species is a constant threat. Preventing introduction is crucial to maintaining healthy lakes. Starry stonewort (*Nitellopsis obtusa*) (see Figure 2.77), as discussed in Chapter 2, is the newest invasive species posing a distinct risk to Nagawicka Lake particularly following its introduction into nearby lakes. To help decrease the chance of introducing new invasives the following recommendations are given high priority:

- **Educate residents** how they can help prevent invasive species from entering the Lake.
- **Enroll volunteers to participate in the Clean Boats, Clean Waters program** (a State program targeting invasive species prevention) to proactively encourage Lake users to clean boats and

[195] *More information about purple loosestrife beetles, and how to join a biocontrol program to grow and release beetles can be found on the WDNR website: dnr.wi.gov/topic/Invasives/loosestrife.html.*

Map 3.5
Mechanical Harvesting Disposal Site Locations, Off-Load Sites, and Haul Routes, Nagawicka Lake: 2017 – 2021



equipment before launching and using them in Nagawicka Lake.[196] This will help lower the probability of invasive species entering the Lake.

- **Target launch sites.** Since boat launches are likely entry points for alien species, boat launch sites should be targeted for focused aquatic plant control.

- **Take immediate action to evaluate and eradicate newly identified invasive species.** If a new alien species infestation is found in the Lake, efforts to eradicate the new species should immediately be evaluated and, if possible, be employed to help prevent establishment. The WDNR has funding that can aid in early eradication efforts, particularly as it pertains to aquatic plants (Table 3.2). Therefore, citizen monitoring for new invasive species is recommended. The Wisconsin Citizen Lake Monitoring Network (CLMN) provides training to help citizens participate in these efforts.

- **Re-evaluate the aquatic plant management plan every five years.** This requires a new point-intercept survey and thoughtful re-examination of aquatic plant species composition and abundance.

Finally, as described in water quality sections of this report, excessive nutrient concentrations promote nuisance-level abundance and growth of aquatic plants. Accordingly, efforts to improve water quality – which often go hand-in-hand with improving the overall quality of the Lake and its watershed – can also reduce the amount of aquatic plant growth in the Lake. Consequently, implementing the recommendations highlighted in Section 3.3, "Water Quality" is an important facet of overall aquatic plant management and is assigned a high priority.

3.6 CYANOBACTERIA AND FLOATING ALGAE

Excessive and/or toxic algae is presently not a priority issue of concern in Nagawicka Lake. To maintain desirable algal populations, this section recommends monitoring algal growth, helping Lake residents recognize and respond to excessive/toxic algae, and taking management actions that help prevent undesirable algal growth in the future. Recommendations consistent with this approach are listed below.

➤ **Recommendation 5.1: Control Lake water phosphorus concentrations**
Algal growth in Nagawicka Lake is limited by phosphorus availability. Several techniques are discussed in the Section 3.3, "Water Quality," to help maintain or reduce Lake water phosphorus concentration. Lower phosphorus concentrations generally decrease the potential for algal blooms. Implementing these recommendations helps the Lake maintain healthy algal populations. Implementing actions that help control Lake water phosphorus concentrations are therefore assigned a high priority.

➤ **Recommendation 5.2: Continue to monitor algal abundance**
This effort should focus on monitoring chlorophyll-*a*, as was described in the water quality monitoring recommendation (high priority). If large amounts of suspended or floating algae are found in the future (e.g., "pea soup" green water), samples should be collected to allow algal types to be identified. This can be considered a low priority at present, but if algae become abundant, it should be elevated to a high priority. Algal identification helps determine if abundant algae is a toxic strain.

➤ **Recommendation 5.3: Warn residents not to enter water during algal blooms**
This should be considered a high priority unless testing positively confirms the absence of toxic algae. Therefore, methods for rapidly communicating unhealthful water conditions unconducive to body contact should be developed.

➤ **Recommendation 5.4: Maintain or improve overall water quality**
Implementing recommendations provided in Section 3.3, "Water Quality" to improve water quality and reduce the risk of algal blooms developing. This should be assigned a high priority.

[196] *Further information about Clean Boats, Clean Waters can be found on the WDNR website at: dnr.wi.gov/lakes/cbcw.*

Table 3.2
Example WDNR Grant Programs Supporting Lake Management Activities

Category	Program	Grant Program	Maximum Grant Award	Minimum Grantee Match (percent)	Application Due Date
Water	Surface Water Grants	Aquatic Invasive Species (AIS) Prevention and Control	Clean Boats, Clean Waters: **$24,000**	25	November 1
			Established Population Control: **$150,000**	25	November 1
			Early Detection and Response: **$25,000**	25	Year-Round
			Research and Development annual funding limit: **$500,000**	25	November 1
		Surface Water Education	**$5,000** per project **$50,000** per waterbody	33	November 1
		Surface Water Plan	**$10,000**	33	November 1
		Comprehensive Management Plan	**$25,000**	33	November 1
		County Lake Grant	**$50,000**	33	November 1
		Ordinance Development	**$50,000**	25	November 1
		Management Plan Implementation	Lakes: **$200,000** Rivers: **$50,000**	25	November 1
		Healthy Lakes & Rivers	**$1,000** per practice **$25,000** per waterbody	25	November 1
		Surface Water Restoration	Lakes: **$50,000** Rivers: **$25,000**	25	November 1
		Land Acquisition and Easement	Lakes: **$200,000** Rivers: **$50,000**	25	November 1
	Citizen-Based Monitoring Partnership Program	--	**$5,000**	None	Spring
	Targeted Runoff Management	--	Small-Scale: **$225,000**	30	May 15
			Large-Scale: **$600,000**	30	May 15
	Urban Nonpoint Source & Stormwater Management	--	Planning: **$85,000** Property Acquisition: **$50,000** Construction: $**150,000**	50	May 15
Conservation and Wildlife	Knowles-Nelson Stewardship Program	Habitat Areas	--	50	March 1
		Natural Areas	--	50	March 1
		Streambank Protection	--	50	March 1
		State Trails	--	50	March 1
Boating	Boat Enforcement Patrol	--	Up to **75% reimbursement**	None	Various
	Boating Infrastructure Grant	--	Up to **$200,000 per state**	50	June 1
Recreation	Knowles-Nelson Stewardship Program	Acquisition and Development of Local Parks	--	50	May 1
		Acquisition of Development Rights	--	50	May 1
		Urban Green Space	--	50	May 1
		Urban Rivers	--	50	May 1
	Sport Fish Restoration	Boat Access	Varies annually	25	February 1
		Fishing Pier	Varies annually	25	October 1

Note: This table incorporates information from NR 193, which was made effective on June 1st, 2020. More information regarding these example grant programs may be found online at the following address: dnr.wi.gov/aid/grants.html. Additional federal, state, and local grant opportunities are available. Eligibility varies for each grant program.

Source: Wisconsin Department of Natural Resources and SEWRPC

➤ **Recommendation 5.5: Maintain a healthy aquatic plant community to compete with algal growth**
This can be promoted by implementing recommendations provided in Section 3.5, "Aquatic Plant Management." This should be assigned a high priority.

Implementing the above recommendations will help prevent excessive algal growth in Nagawicka Lake and should not preclude or significantly inhibit Lake use. If future monitoring reveals excessive or greatly increased algal growth, or should toxic algae be identified, these recommendations should be reevaluated (high priority). Reevaluation should include rethinking all relevant Lake management efforts.

3.7 FISH AND WILDLIFE

Fish and wildlife depend upon the Lake's health. Abundant and healthy fish and wildlife increases the Lake's recreational value, aesthetic appeal, overall enjoyment by humans, and the functionality of the Lake as an ecosystem. To enhance fish and wildlife quality and abundance within the Nagawicka Lake watershed, the following recommendations are made:

➤ **Recommendation 6.1: Understand fishery information, actively participate in the WDNR's planning processes, and support management recommendations**
Many recommendations were made by the WDNR as part of the most recent published fishery evaluation.[197] Examples include the following actions.

- Transition to a more restrictive walleye length and bag limit to protect females for multiple spawning seasons and potentially increase natural recruitment
- Convert from stocking small fingerling to large fingerling walleyes to increase survival and overall adult abundance
- Monitor walleye population for contribution of stocked versus naturally reproduced fish within each year class
- Continue regular stocking of large fingerling northern pike to increase survival and improve overall abundance
- With high mortality rates above the 26-inch minimum size limit, restrict angler harvest to one northern pike per day with a 32-inch minimum length limit
- Continue to monitor bass and panfish populations through catch rates, average sizes, and abundance estimates
- Monitor white sucker population and spawning success because of their importance as a forage species for gamefish
- Protect and improve habitat and water quality to promote diverse and healthy fish communities

The LWC may be able to provide the WDNR with information useful to fish management strategies. For example, The LWC could act as an avenue to report observed spawning areas, creel reports, angler pressure, baitfish and forage abundance, and other conditions. Supporting WDNR initiatives should be given a high priority.

➤ **Recommendation 6.2: Protect valuable in-Lake fish habitat and avoid disturbing vulnerable fish**
Fish require a variety of habitats to successively engage in all life-cycle critical functions. For example, the places where fish breed may be very different than those where those fish feed. Fish often enter shallow water and may be quite vulnerable to harm at certain times of the year. While the types of habitat vary by season and by fish species, a few types of habitat are clearly related to preserving populations of popular

[197] *B. Heussner, S. Gospodarek, and A. Notbohm (WDNR),* Comprehensive Survey Report of Nagawicka Lake – Waukesha County, *August 13, 2013.*

fish. For example, shallow sandy and gravelly areas in the Lake are important to spawning bass and many panfish; these areas should be protected and left unmolested during spawning season. The health of the bass and panfish fishery can be promoted by educating the public to limit excessive human activity in such areas during spawning periods. WDNR fisheries staff can help the LWC identify the locations of these areas and the timing of protective measures. Another example of a pre-emptive strategy is to take action to prevent excessive sedimentation and water temperatures in the Bark River, conditions that could hinder the stream's valuable contribution to naturally reproduced fish stocks. Activities such as these examples should be considered a high priority.

➤ **Recommendation 6.3: Mitigate water quality stress on aquatic life and maximize areas habitable to desirable fish**

The primary ongoing in-Lake issue in this category is the low and supersaturated oxygen saturation values found in the Lake during some seasons at certain depths. Excessive Lake fertility likely is the primary contributor to near-surface oxygen supersaturation and deep-water anoxia. Therefore, measures that improve water quality can meaningfully promote health fish populations and should be given a high priority.

Since the Bark River is an important spawning and nursery area for the Lake's fish population, action should also be taken to protect water quality in the river. Perhaps the most pressing river threats are the loss of tree canopy to exotic pests (which could raise water temperature to undesirable ranges) and increasing salt concentrations. The water quality recommendations discussed earlier in this chapter call for measures to address these conditions Implementation of those recommendations should be considered a high priority. Other stressors may develop in the future (e.g., new invasive species and other water quality concerns) and conditions should be carefully monitored for their impact on aquatic life (medium priority).

➤ **Recommendation 6.4: Continue active management actions that safeguard and/or improve long-term water quality and may promote reintroduction of cisco (*Coregonus artedi*)**

This recommendation is a specific subset of the previous recommendation. The recommendations made in Section 3.2, "Hydrology/Water Quantity," Section 3.3, "Water Quality," and Section 3.4, "Pollutant Sources and Loads" synergistically provide conditions favoring a healthy and sustainable fishery in the Lake and River. Although it will take much time and devoted effort, and may prove elusive, conditions could theoretically sufficiently improve to provide conditions supporting a two-story fishery. If such conditions are achieved, consideration should be given to re-establishing cisco in the Lake. Although this goal is important, the long-term perspective and its reliance on success of many other management initiatives cause it to be assigned a low priority.

➤ **Recommendation 6.5: Identify and remove instream barriers to passage of fish and other aquatic organisms**

Even ephemeral streams, which only flow seasonally, often provide fish passage and two-way access to spawning and nursery grounds. The Bark River is a life-cycle critical resource to some fish species and is a favored resource for many others. Fish species known, or likely, to use the Bark River include white suckers, walleye pike, northern pike, and other forage fish. Even small intermittent streams and ditches commonly provide important habitat function. For example, temporarily flooded grassy areas can be favored spawning areas for northern pike.

Barriers to fish and aquatic organisms are often categorized by permanence. Barriers that occasionally block fish passage, and which may be temporary in nature, include debris jams, sediment and railroad ballast accumulations, and channel overgrowth by invasive plants. Permanent barriers include many dams and culverts that are perched, too steep, too small, or too long. These barriers vary greatly in their ease and cost of removal and in the ability to meaningfully enhance aquatic ecological health and vitality through their removal.

A typical best management practice is executed in stages. First, a comprehensive inventory of potential barriers and the value of potentially inaccessible upstream habitat is completed. Next, the utility and condition of the structure or channel configuration is examined, and cost and benefits of remediation are estimated. Finally, a list of barrier remediation projects is produced. Projects identified as having the

greatest ecological/societal benefit, lowest cost, and least logistical and public relation difficulties are prioritized for replacement, modification, or removal. Ozaukee County's Fish Passage Program is well developed and a good resource when establishing a fish passage program.[198] Identifying, prioritizing, and ultimately remediating fish passage barriers should be considered a high priority.

- **Recommendation 6.6: Improve in-Lake aquatic habitat by maintaining, encouraging, or installing large woody structure and/or vegetative buffers along shorelines**

  The vegetative communities along the Lake's shoreline have been simplified through traditional landscaping practices, a situation that reduces aquatic organism habitat value. Improving in-Lake habitat should be considered a medium priority**.** Implementing this recommendation could include educational or incentive-based programs to encourage riparian landowners to install "fish sticks"[199] (Figure 3.7), to allow fallen trees to remain in the water, and to develop buffer systems along the shoreline. WDNR grant money to install fish sticks projects is available on a competitive basis through the Heathy Lakes & Rivers program. Installing buffers will have the added benefit of deterring geese from congregating on shoreline properties and promoting improved water quality.

- **Recommendation 6.7: Adopt best management practices to improve wildlife habitat**

  This should be considered a medium priority, although this should increase to high priority if wildlife populations decline. The acceptance and employment of best management practices can be fostered through voluntary, educational, and/or incentive-based programs for properties adjacent to shoreline areas and by directly implementing these practices on public and protected lands. Some special interest NGOs (e.g., Walleyes for Tomorrow, Pheasants Forever, Ducks Unlimited, Trout Unlimited) foster habitat improvement projects and collaborate with land owners to install beneficial projects. As part of implementing this element, a list of best management practices and relevant NGOs should be compiled and provided to landowners.

- **Recommendation 6.8: Promote aquatic plant management plan implementation to avoid inadvertent damage to native species**

  Native aquatic plant species can help protect water quality and provide food and shelter for fish and wildlife. Avoiding inadvertent damage to native species is essential to maintaining a clean and healthy lake. This should be assigned a high priority.

- **Recommendation 6.9: Preserve, enhance, and expand wetland and terrestrial wildlife habitat while making an effort to maintain or enhance ecological connectivity between natural areas**

  This could be achieved by implementing the buffer and wetland protection recommendations provided in Section 3.4, "Pollutant and Sediment Sources and Loads." Benefit could also be accrued by hydraulically reconnecting floodplains to ditched and straightened tributary streams. These reconnected floodplains detain floodwater, improve water quality, may promote groundwater recharge, and provide seasonally wet areas that are of great value for a wide range of birds, fish, amphibians, insects, and terrestrial animals. This should be assigned a high priority.

- **Recommendation 6.10: Monitor the diversity and abundance of fish and wildlife**

  Monitoring would help future Lake managers detect change. Consequently, continued monitoring of fish populations and periodic recording of the types of animals found on and in the Lake and within its watershed is also a high priority. Monitoring data can be collected from government agencies, NGOs (e.g., Audubon Society), and from volunteers around the Lake and throughout the watershed.

---

[198] *See website at www.co.ozaukee.wi.us/619/Fish-Passage.*

[199] *Natural shorelines generally have hundreds of fallen trees per mile along the shoreline. "Fish sticks" is a term coined for engineered installation of woody debris (logs) along lake shorelines to mimic these natural conditions. Generally, these projects involve anchoring logs into the shore so that the log is oriented perpendicular to the shoreline. See healthylakeswi.com/best-practices/#fish.*

Figure 3.7
Fish Sticks Projects Examples

Source: SEWRPC

3.8 RECREATIONAL USE AND FACILITIES

Nagawicka Lake supports diverse recreational activities. For example, the Lake is used for swimming, kayaking, water-skiing, high-speed boating, cruising, and fishing. Maintaining the Lake's ability to provide safe, high quality recreational pursuits is a priority issue. In conformance with this goal, the following recommendations are made.

- **Recommendation 7.1: Encourage safe boating practices and boating pressure on navigable portions of the Lake**
  Although use conflicts, safety concerns, and environmental degradation were not presented as issues of concern during the preparation of this plan, if boat densities increase to undesirable levels in the future, boating ordinances and regulations should be reviewed, and if necessary, modified. Such ordinances and regulations should be conscientiously enforced to help reduce the potential for problems related to boat overcrowding during periods of peak boat traffic. Since problems are not known to currently exist, but because boat densities are relatively high during peak periods, this should be considered a medium priority issue.

- **Recommendation 7.2: Maintain and enhance swimming opportunities by engaging in "swimmer-conscious" management efforts**
  This can be supported by adopting the aquatic plant management recommendations made earlier in this chapter (see Section 3.5, "Aquatic Plant Management"), improving water quality (Section 3.3, "Water Quality"), and controlling algae (see Section 3.6, "Cyanobacteria and Floating Algae"). This should be considered a medium priority issue.

- **Recommendation 7.3: Maintain and enhance fishing by protecting and improving aquatic habitat and ensuring the fish community remains viable**
  This recommendation can be achieved by implementing the aquatic wildlife recommendations provided in Section 3.7, "Fish and Wildlife." This is a medium priority issue.

- **Recommendation 7.4: Maintain public boat launch sites**
  Boat traffic on Nagawicka Lake is highly variable throughout the season and from weekday to weekend. The Lake is popular not only with boaters who live on the Lake, but also with those who trailer watercraft to the Lake. For this reason, launch site maintenance should be considered a high priority. This could include incorporating elements that help reduce the chance of spreading invasive species such as deploying trained volunteers to inspect boats and distributing literature (e.g., the Clean Boats, Clean Waters program) during high use periods. Such activities could help reduce the chance of spreading invasive species.

➤ **Recommendation 7.5: Existing boating regulations should be reviewed for compatibility with current conditions and expectations and ordinances should be conscientiously enforced**

Although boating-related use conflicts, safety concerns, and environmental degradation were not presented as issues of concern during the preparation of this plan, if boat densities frequently increase to undesirable levels, boating ordinances and regulations should be reviewed, and if necessary, modified. Boat counts suggest that Nagawicka Lake is subjected to boat densities at the upper end or even slightly exceeding desirable use levels during peak use periods. Excessive boat density decreases the ability of the Lake to support a wide range of activities safely, sustainably, and satisfactorily. This means that the potential for use conflicts, safety concerns, and environmental degradation is slightly higher than desirable on Nagawicka Lake during some weekends and holidays. Existing boating ordinances should be reviewed with compatibility with current Lake conditions (medium priority). Given the variability of boating density, stringent ordinance enforcement should be considered a low priority for week days, but a high priority for summer weekends and holidays.

➤ **Recommendation 7.6: Consider increasing launch fees during peak use periods**

Demand for power boating on Nagawicka Lake appears to exceed desirable supply at least occasionally during peak use periods. Common economic theory suggests that demand can be reduced if costs increase. Launch fees can include the basic price paid to launch a boat and other factors such as convenience (see *Wisconsin Administrative Code* NR 1, Natural Resources Board Policies, for more information. NR 1.91, Public Boating Access Standards, describes permissible fee structures in great detail). Certain changes can be made that both benefit the long-term health of the Lake and may place negative pressure on demand. Examples of such changes include the following:

- Review water-based recreation ordinances and modify as necessary. Stringently enforce the regulations, especially during holidays and weekends. Grants are available to help offset the cost of revising and developing ordinances and help defray the cost of water patrols.

- Maintain motorized boat launch fees at the maximum permissible rate during weekends and holidays. Consider launch surcharges (such as the following), particularly on weekends and holidays, to adjust fees:

    - Twenty per cent surcharge for launch sites with toilet facilities. Potentially also apply to weekday rates to enhance revenue available for providing weekend/holiday launch attendants.

    - Large boat surcharges. An attendant would need to be on site for effective application. Allowable large boat surcharges are 30 percent for boats 20 to 26 feet long, and 60 percent for boats longer than 26 feet.

    - Have an attendant on duty during all summer weekends and holidays. The attendant's primary duty would be to implement Clean Boats, Clean Waters watercraft inspections and distribute literature to help Lake users understand invasive species issues. A surcharge of 20 percent may be charged when an attendant is on duty, and the attendant can also be responsible for launch surcharges for large boats.

      Increasing launch fees is assigned an overall medium priority, the implementation of which is dictated by the desires of the boat launch owner (Waukesha County) and the needs and perceptions of Lake users.

3.9 PLAN IMPLEMENTATION

Some recommendations can be implemented through regulation while others involve proactively implementing new management efforts. Both are discussed in the following text.

Regulations

Relative to this plan, regulatory implementation refers to maintaining and improving water quality, water quantity, wildlife populations, and other objectives through application of local, State, and Federal rules and laws. A number of regulations already govern activities within the Nagawicka Lake watershed including

zoning and floodplain ordinances, boating and in-Lake ordinances, groundwater use, and State regulations related to water quality. These regulations already help protect the Lake by mitigating pollution, encouraging or limiting development to projects which consider the large picture perspective, and encouraging use of best management practices.

Local Ordinances

Zoning ordinances dictate where development can take place, the types of development allowed, and the technical standards that need to be met for development to proceed. Consequently, zoning can be a particularly effective tool to protect buffers, wetlands, uplands, shorelands, and groundwater resources if environmental goals are integrated into ordinance development, formulation, and enforcement. One way to integrate environmental considerations is for local zoning authorities and other regulatory agencies to recognize SEWRPC-designated environmental corridors (see Figure 3.8). Environmental corridors can be integrated into conservancy zoning district regulations to help determine where development is permitted and not permitted, and to determine the intensity of development allowed.

The Nagawicka Lake watershed contains a dozen local units of governments with different regulatory authorities that influence Lake protection including Waukesha and Washington Counties, the City of Delafield, the Villages of Chenequa, Hartland, Merton, Nashotah, Richfield, and Sussex, and the Towns of Merton, Lisbon, and Delafield (see Map 2.1 and Table 2.8). Waukesha County has zoning authority for much of the watershed. This is advantageous because the general zoning ordinance for Waukesha County specifically states that environmental corridors in the Environmental Corridor District are to be protected and maintained. The fact that environmental corridors are accounted for in zoning decisions means that many critical and/or sensitive areas within the Nagawicka Lake watershed are well protected (see Map 2.20).

In addition to general zoning, shoreland zoning, construction site erosion control, and stormwater management ordinances also play a key role in protecting the resources within the watershed. Shoreland zoning, for example, which is primarily administered by Waukesha and Washington Counties, follows State standards to establish building setbacks around navigable waters.[200] Additionally, stormwater management and construction erosion control ordinances help minimize negative impacts of development on water resources, such as water pollution and flooding.

Several important recommendations under this plan relate to municipal or county ordinance enforcement (e.g., shoreline setbacks, zoning, construction site erosion control, drainage, and boating). Local governments often have limited resources at their disposal to assure rules are respected and properly applied. Consequently, the following recommendations are aimed at local citizens, Lake users, and management groups, and are made to enhance the ability of the responsible entities to successfully monitor and enforce existing regulations:

- **Recommendation 8.1: Maintain and enhance relationships with County and municipal zoning administrators and law enforcement officers**
  This helps build open relationships with responsible entities and facilitates efficient communication and collaboration whenever needed. This should be assigned a high priority.

- **Recommendation 8.2: Keep abreast of activities within the watershed that can affect the Lake**
  Certain activities (e.g., construction, filling, erosion) could potentially affect the Lake. Maintaining good records (e.g., notes, photographs) and judiciously notifying relevant regulatory entities of problems when deemed appropriate is recommended as a high priority.

[200] *The 2015-2017 State Budget (Act 55) changed State law relative to shoreland zoning. Under Act 55 a shoreland zoning ordinance may not regulate a matter more restrictively than it is regulated by a State shoreland-zoning standard unless the matter is not regulated by a standard in Chapter NR 115, "Wisconsin's Shoreland Protection Program," of the* Wisconsin Administrative Code*. (Examples of unregulated matters may involve wetland setbacks, bluff setbacks, development density, and stormwater standards.) In addition, under Act 55, a local shoreland zoning ordinance may not require establishment or expansion of a vegetative buffer on already developed land and may not establish standards for impervious surfaces unless those standards consider a surface to be pervious if its runoff is treated or is discharged to an internally drained pervious area.*

Figure 3.8
SEWRPC Environmental Corridor Synopsis

SEWRPC embraced and applied the environmental corridor concept developed by Philip Lewis (Professor Emeritus of Landscape Architecture at the University of Wisconsin-Madison) with the publication of its first regional land use plan in 1966. Since then, SEWRPC has refined and detailed the mapping of environmental corridors, enabling the corridors to be incorporated directly into regional, county, and community plans and to be reflected in regulatory measures. The preservation of environmental corridors remains one of the most important recommendations of the regional plan. Corridor preservation has now been embraced by numerous county and local units of government as well as by State and Federal agencies. The environmental corridor concept conceived by Lewis has become an important part of the planning and development culture in southeastern Wisconsin.

Environmental corridors are divided into the following three categories.

- Primary environmental corridors contain concentrations of our most significant natural resources. They are at least 400 acres in size, at least two miles long, and at least 200 feet wide.
- Secondary environmental corridors contain significant but smaller concentrations of natural resources. They are at least 100 acres in size and one mile long, unless they link primary corridors.
- Isolated natural resource areas contain significant remaining resources that are not connected to environmental corridors. They are at least five acres in size and at least 200 feet wide.

Key Features of Environmental Corridors

- Lakes, rivers, and streams
- Undeveloped shorelands and floodlands
- Wetlands
- Woodlands
- Prairie remnants
- Wildlife habitat
- Rugged terrain and steep slopes
- Unique landforms or geological formations
- Unfarmed poorly drained and organic soils
- Existing outdoor recreation sites
- Potential outdoor recreation sites
- Significant open spaces
- Historical sites and structures
- Outstanding scenic areas and vistas

Source: SEWRPC

➤ **Recommendation 8.3: Educate watershed residents about relevant ordinances. Update ordinances as necessary to face evolving use problems and threats**

This helps assure that residents know why rules are important, that permits are required for almost all significant grading or construction, and that such permits offer opportunity to regulate activities that could harm the Lake. This should be considered a high priority.

State Regulations

The State Legislature required the WDNR to develop performance standards for controlling nonpoint source pollution from agricultural and nonagricultural land and from transportation facilities.[201] The performance standards, which are set forth in Chapter NR 151, "Runoff Management," of the *Wisconsin Administrative Code*, set forth requirements for best management practices. Similar regulations cover construction sites, wetland protective areas, and buffer standards.

Water quality objectives are presented in *Wisconsin Administrative Code* Chapter NR 102, "Water Quality Standards for Wisconsin Surface Waters." These rules set water quality standards that promote healthy aquatic ecosystems and public enjoyment of waterbodies. Some of the standards set in this rule applicable to Nagawicka Lake include the following:

- Dissolved oxygen concentrations greater than or equal to 5.0 mg/L
- pH between 6.0 and 9.0 SU
- Fecal coliform geometric mean less than or equal to 200 colonies per 100 milliliters, single sample maximum less than or equal to 400 colonies per 100 milliliters
- Total phosphorus concentration (summer epilimnion) of 20 µg/L (or 0.020 mg/L)
- Chloride acute toxicity concentration of 757 mg/L, chronic toxicity concentration of 395 mg/L

Chapter NR 102 further stipulates maximum temperatures for each month, with the highest standards applying to July and August when the following maxima apply: ambient water temperature of less than or equal to 77°F, sublethal water temperature of less than or equal to 80°F for one week or less, and acute water temperature of less than or equal to 87°F for one day or less.

The regulations described above play a crucial part in maintaining the health of Nagawicka Lake and the resources within its watershed. However, even though developers, residents, and Lake users are legally obligated to adhere to the ordinances, limited resources within enforcement bodies at State, County, and municipal levels can sometimes make the task of ensuring compliance difficult.

Proactive Management Efforts

In addition to continued and enhanced regulatory enforcement, a number of recommendations seek to proactively improve conditions within the Lake and its watershed through voluntary management efforts. However, several challenges can limit the ability of Lake residents and the LWC to engage in certain management efforts recommended in this plan. Some of these challenges include:

[201] *The State performance standards are set forth in the Chapter NR 151, "Runoff Management," of the* Wisconsin Administrative Code*. Additional code chapters that are related to the State nonpoint source pollution control program include: Chapter NR 152, "Model Ordinances for Construction Site Erosion Control and Storm Water Management" (This Chapter will be revised in response to the 2013 Wisconsin Act 20 as noted in WDNR Guidance #3800-2014-3, "Implementation of 2013 Wisconsin Act 20 for Construction Site Erosion Control and Stormwater Management," October 2014.); Chapter NR 153, "Runoff Management Grant Program;" Chapter NR 154, "Best Management Practices, Technical Standards and Cost-Share Conditions;" Chapter NR 155, "Urban Nonpoint Source Water Pollution Abatement and Storm Water Management Grant Program;" and Chapter ATCP 50, "Soil and Water Resource Management." Those chapters of the* Wisconsin Administrative Code *became effective in October 2002. Chapter NR 120, "Priority Watershed and Priority Lake Program," and Chapter NR 243, "Animal Feeding Operations," were repealed and recreated in October 2002.*

- **Lack of adequate funding.** Concerns have been expressed regarding the costs associated with management efforts recommended under this plan. Costs may be partially offset by grants in some instances. Adopting an adaptive management approach with wastewater treatment facilities within the Bark River watershed may also provide cost-sharing opportunities to implement best management practices.

- **Institutional cooperation and capacity.** Institutional capacity refers to assets available through agencies, universities, schools, service groups, and NGOs that can be used to implement projects. These assets can be defined in terms of knowledge, staff, equipment, and other resources.

  As stated on their website, the LWC "studies all problems and issues relating to Nagawicka Lake and the Bark River within the city limits." One of the primary missions of the LWC is directing activities associated with aquatic plant management and dredging. The LWC includes representation from both the City of Delafield and Village of Nashotah, and, hence, has the capacity to represent all riparian property owners. However, the LWC does not include specific representation from the Waukesha County Parks and Land Use Department, who owns and operates Naga-Waukee Park. This park is one of the largest riparian parcels on the Lake, is the sole public access point, and is vitally important to a large segment of Lake users.

- **Inadequate numbers of volunteers.** To increase the advocacy, learning opportunities, and volunteer numbers for labor intensive or broad-based projects (e.g., hand pulling wetland invasive species monitoring), it is desirable to reach a broad stakeholder group and involve members of the LWC, Lake users, the general public, organizations, and agencies with an interest in the water resources of the Nagawicka Lake watershed. The planning process for Nagawicka Lake reveals that many stakeholders have strong connections to the Lake. However, participants in the planning process were almost entirely composed of lakeshore or near-lakeshore residents. To increase the advocacy and volunteer base for projects, it will be necessary to reach a group that extends beyond lakeshore residents. For example, a group could be formed that focuses on the Bark River.

Since lack of funding, institutional capacity, and outreach commonly hinder local citizens and management groups from effectively executing Lake management projects, the following suggestions are offered to enhance project execution:

➤ **Recommendation 8.4: Apply for grants to help implement plan-recommended programs**
This should be considered a high priority. This process requires coordination, collaboration, creativity, and investment of stakeholder time to be effective. Table 3.2 provides a list of WDNR-sponsored grant application opportunities that can potentially be used to implement plan recommendations. Examples of other possible funding sources include charitable institutions, businesses, a large number of Federal agency grants, and in-kind donations. It is often desirable to collaborate with project partners to increase project appeal to potential funding sources; adopting an adaptive management plan could be extremely beneficial in this regard.

Individual lakeshore property owners may also be eligible for funding through the WDNR Healthy Lakes & Rivers Program, but the LWC must apply on the property owners' behalf. The LWC, through its affiliation with the City of Delafield and the Village of Nashotah, is a qualified sponsor and the State of Wisconsin's Healthy Lakes & Rivers Implementation Plan has been fully integrated into the comprehensive planning goals and recommendations of this plan. At least one Healthy Lakes & Rivers project, a native planting along the northern shoreline, has already been implemented. In addition, the LWC is eligible for a Board of Commissioners of Public Lands loan program to implement projects for the Lake.

➤ **Recommendation 8.5: Broaden Lake Welfare Committee representation**
Include a representative of the Waukesha County Land Use and Parks Department as a regular member of the LWC. This will help allow the needs of desires of a large group of potentially unrepresented Lake users to be heard and should be considered a high priority.

➤ **Recommendation 8.6: Encourage Lake users and residents to actively participate in future management efforts**

Not only does this effort help assure community support, but also supplements the donor and volunteer pool currently working toward improving the Lake. This should be considered a medium priority. Broad-based resident engagement on future efforts benefits the Lake, but also benefits the value of their properties.

➤ **Recommendation 8.7: Encourage key players to attend meetings, conferences, and/or training programs to build lake management knowledge and to enhance institutional knowledge and capacity**

Recognizing the limited financial resources and time normally available for such activities, this element is assigned a medium priority. Some examples of capacity-building events are Wisconsin Water Week (which targets local lake managers) and the "Lake Leaders" training program (which teaches the basics of lake management and provides ongoing resources to lake managers). Both of these are hosted by the University of Wisconsin-Extension. Additionally, in-person and on-line courses, workshops, training, regional summits, and general meetings can also be of value. Attending these events should include follow-up documents/meetings to help assure that the lessons learned are communicated to the larger Lake group.

➤ **Recommendation 8.8: Continue to reinforce stakeholder inclusivity and transparency with respect to all Lake management activities**

If stakeholders do not fully understand the aims and goals of a project, or if they do not trust the process, excess energy can be devoted to conflict, a result that benefits no one. For this reason, this element is assigned a high priority. These efforts should be implemented through public meetings, social media, newsletters, emails, and any other mechanism that helps disperse and gather a full suite of information and builds consensus. In this way, all data and viewpoints can be identified and considered, and conflicts can be discussed, addressed, and mitigated before finalizing plans and implementing projects.

➤ **Recommendation 8.9: Foster and monitor efforts to communicate concerns, goals, actions, and achievements to future Lake managers**

Institutional knowledge is a powerful tool that should be preserved whenever possible; therefore, this recommendation is assigned a high priority. Open communication helps further increase capacity of Lake management entities. This may take the form of annual meetings, internet websites, social media, newsletters, emails, reports, and any number of other means that help compile and report actions, plans, successes, and lessons learned. Institutional knowledge can be preserved through the minutes of lake organization meetings; therefore, these records should be kept indefinitely.

➤ **Recommendation 8.10: Develop an action plan**

Advancing any lake protection plan requires the implementing agency to have competent technical guidance, management skill, and political savvy. To be truly effective, plan implementation must identify tangible goals and quantifiable metrics to measure progress and relative success. Developing an action plan with timelines, goals, and identified responsible parties is a significant step toward plan implementation. Target metrics can help the implementing agencies and funders gauge progress over time and can help motivate participants, ensuring that the plan is carried through in the long term. Additionally, an action plan can help ensure that all responsible parties are held accountable for their portions of the plan's implementation. When developing an action plan, it is important to know what on-the-ground implementation involves. Developing and using an action plan should be assigned a high priority.

As a final note, to promote plan implementation, the LWC and the City of Delafield should actively reach out and educate Lake residents, users, watershed municipalities, the DelaHart wastewater treatment plant, and NGOs regarding the content and goals of this plan. A campaign to communicate the most important information should therefore be given high priority. This outreach/education effort must include a message that recognizes and stresses that this plan is a dynamic document that uses the best available information, goals, and situation at a set point in time. As such, the plan should continually evolve to incorporate new ideas and new data.

3.10 SUMMARY AND CONCLUSIONS

The future will bring change to Nagawicka Lake and its watershed. Projections suggest that some of the agricultural land use in the watershed of today will give way to urban residential land use. It is critical that proactive measures be pursued to lay the groundwork for effectively dealing with and benefiting from future change. Working relationships with appropriate local, County, and State entities need to be nurtured now and in the future. These relationships ultimately will help protect critical natural areas in the watershed during development, will help initiate actions (such as residential street leaf litter pickup and disposal), and will help instill attitudes among current and future residents that will foster cooperation and coordination of effort on many levels.

To help implement plan recommendations, Table 3.1 summarizes all recommendations and their priority level. Additionally, Appendices D and E, in combination with the aquatic plant management recommendations (see Figures 3.3 through 3.6), indicate where recommendations should be implemented. These guides will provide current and future Nagawicka Lake managers with a visual overview of where to target management efforts.

As stated in the introduction, this chapter is intended to stimulate ideas and action. Therefore, these recommendations should provide a starting point for addressing the issues identified in Nagawicka Lake and its watershed. Successfully implementing this plan requires vigilance, cooperation, and enthusiasm, not only from local management groups, but also from State and regional agencies, Waukesha and Washington Counties, municipalities, and Lake residents, Lake users, and the general public. Implementation of the recommended measures will provide the water quality and habitat protection necessary to maintain or establish conditions in the watershed that are suitable for maintaining and improving the natural beauty and ambience of Nagawicka Lake and its ecosystem. This, in turn, benefits the Region's human population today and in the future.