MANITOWOC COUNTY SHORELAND RESTORATION DEMONSTRATION PROJECT

LAKE PROTECTION GRANT NO. LPT-191-02

Prepared for

Manitowoc County Lakes Association

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NES Ecological Services
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Purpose

This report was prepared by NES Ecological Services (NES) on behalf of Manitowoc County Lakes Association (MCLA), with assistance from the Manitowoc County Soil and Water Conservation Department (MCSWCD), to fulfill obligations related to a Lake Protection Grant awarded to MCLA by the Wisconsin Department of Natural Resources (WDNR). It is the hope of NES and MCLA that this report can be used to address the current and future land development pressures associated with the shorelines of Manitowoc County's lakes. The ultimate goal of this grant was to be the production of a publication that: 1) could be used to educate the citizens of Manitowoc County about the important interactions that occur between a lake and its shoreline, 2) demonstrate the benefits and options involved with shoreland restoration, and 3) provide an easily understood source that describes Manitowoc County's lake classification system, shoreland zoning ordinances, and associated shoreland mitigation programs. Unfortunately the desired publication could not be produced because Manitowoc County has not yet developed a finalized shoreland zoning ordinance or shoreland mitigation program. Although these components have not yet been completed, they are being undertaken and drafts have been produced. The first two objectives of the grant, educating the citizens of Manitowoc County about shoreland/lake interactions and demonstrating different options that can be used to conduct shoreland restorations have been completed and are reported on in this document. Additionally, Manitowoc County's lake classification system methodology along with drafts of their proposed shoreland zoning ordinances and shoreland mitigation programs are included as an Attachment of this document to provide evidence that these matters are progressing.

Introduction

The development of Wisconsin's shorelands has increased dramatically over the last century, and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to the destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects. The maintenance of the newly created area decreases water quality by considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreline. Removal of native plants from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving associated lake sediments vulnerable to wave action. Furthermore, the dumping of sand to create beach areas destroys spawning, cover, and feeding areas utilized by aquatic wildlife. The removal of fallen trees and other woody debris from shoreline areas in an attempt to maintain a clean appearance also removes habit and food for aquatic and terrestrial flora and fauna. Combined, these actions have helped lead to noticeable decreases in the quality of Wisconsin's lakes.

In recent years many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic predevelopment conditions. An area of shore restored to its natural condition, both in the water and on shore, is commonly called a *shoreland buffer zone.* The shoreland buffer zone creates or restores the ecological habitat and benefits lost by traditional suburban landscaping. Many Wisconsin counties have realized the importance of shoreland buffer zones and have instituted incentives, in the form of zoning variances, for lakefront property owners that agree to restore natural vegetation on their property. Generally these programs require the property owner to acquire a certain number of *mitigation points* depending on the planned activity, the lake's sensitivity to water quality problems, and the development pressures associated with the lake. The two latter categories are usually determined through a given county's *lake classification* system. Unfortunately, the lake classification system and mitigation procedures are often quite complicated and not completely understood by the general public.

Manitowoc County, Wisconsin has a total of 101 named and unnamed lakes with a total water surface area of 1,492 acres. Many of these lakes are heavily developed because of the County's close proximity to several large urban areas, including Milwaukee, Manitowoc, Sheboygan, Green Bay, and the Fox Cities. This development has led to decreases in water quality and wildlife habitat for the reasons outlined above at many of the county's lakes.

In recognition of the current and future development pressures on the county's lakes, and the need to maintain and improve the quality of its lakes, Manitowoc County applied for and was rewarded a Lake Protection Grant through the Wisconsin Department of Natural Resources (WDNR). The purpose of this grant was to:

- Demonstrate the benefits and options involved with shoreland restoration
- Educate Manitowoc County lakefront property owners about being responsible lake stewards
- Provide information that is easily obtained and understood about Manitowoc County's lake classification system, shoreland zoning ordinances, and mitigation program

For reasons mentioned in the "Purpose" section, only the first two objectives of this grant have currently been fulfilled; however, the final objective has undergone substantial progress.

Because only the first two objectives have been completed, the methods used to classify the county's lakes and a description of its shoreland zoning ordinances are not discussed in the text of this document; however, a draft of the county's lake classification system and its proposed shoreland zoning ordinances are included as an appendix at the end of this document. The sections that follow will suggest restoration methods and materials that can be used by Manitowoc County landowners to restore their shoreline. In addition, various government agencies and conservation organizations that may provide financial or technical support to landowners wishing to conduct shoreland restoration are included at the end of this document, as are a glossary of related terms and a list of relevant references.

Guidelines for Shoreland Restoration in Manitowoc County

Shoreland and Lake Interactions

Increased development pressures around Manitowoc County lakes have led to the destruction or degradation of shorelands around many of the county's 101 lakes. The destruction and/or degradation of the county's shorelands substantially impacts its lakes and their associated *ecological communities*. Potential impacts to a lake and its surrounding *landscape* that can be caused by shoreland destruction or degradation include decreased water quality, erosion of shorelines, a loss of fish and wildlife habitat, and an overall decrease in *biotic diversity*. These negative impacts occur because plants growing along a shoreline, which are often removed or mowed during the development process, affect the flow of sediment and other materials to and from lakes, provide habitat for fish and wildlife, and stabilize soils. In addition, shoreland vegetation often times improves a site's aesthetic value by preserving natural shoreline beauty and by acting as a visual screen to neighboring properties and passing boaters. The act of replanting a site's shoreline and associated shallow water and upland areas to create conditions and environments similar to those that existed prior to destruction or degradation is referred to as shoreland restoration in this document.

Conducting Shoreland Restorations

Getting Started

There are two basic ways in which a landowner can conduct a shoreland restoration – either independently or with the help of a qualified professional(s). Whether a land owner decides to

conduct the shoreland restoration independently or to use a professional, certain site characteristics should be examined before implementing any restoration related action. These include an examination of the plants growing in or around a site, the type of soil that will be planted into, the amount of sunlight a site will receive, and the different water regimes that exist within a site. As will be shown later, the type of plants used in the restoration will depend heavily on these characteristics. Once these characteristics are known, a *restoration plan* can be developed. As is true with all restoration activities, shoreland restorations should have an over-riding goal. A good goal for these shoreland restorations would be to establish a buffer of native plants along the shoreline.

As mentioned earlier, a quick survey of a site's existing plants should be undertaken prior to developing a restoration plan. Doing so will aid in choosing restoration methods. For instance, if a healthy population of *native plants* are growing at or near a site it may be unnecessary to develop a planting plan. In the same breath, if a large amount of *exotic* plants are growing in or around a site, a planting and *maintenance plan* may need to be developed. In most cases a planting and maintenance plan will be required. In these cases, the native plants that are already established at a site will provide a good indication of the plant species that are adapted to the area's conditions.

Selecting Plants

When implementing shoreline restoration projects, selecting the appropriate plant species is a critical step in the planning process. Using native plants in a restoration will create a shoreline that functions similarly to a lake's naturally occurring shorelands. Furthermore, selecting the appropriate combination of native plants can sometimes mean the difference between long-term restoration success or failure. For instance, certain native plants grow best in permanently flooded environments, while other native species thrive in environments that are flooded for only a couple of weeks per year. Finally, there are certain natives that cannot survive any amount of flooding.

Planting non-native or exotic plants is strongly discouraged. Often times exotic plants are not adapted to handle the environmental extremes that occur in Manitowoc County. For this reason, exotic species usually are not able to persist for more than one or two years; however, certain non-native species can persist in the region's environment. Often times these persistent, non-native species are able to out-compete native plants because there are no diseases or predators to control their populations, or because they have developed certain evolutionary traits that allow them to take advantage of certain conditions. For instance, curly-leaf pondweed (*Potamogeton crispus*), an exotic *submergent species* introduced to the United States from Europe, has developed an evolutionary trait that allows it to grow under the ice during Wisconsin's winter, giving it a distinct advantage over the region's native submergent plant species, which typically do not begin growing until the spring. In areas where exotic plants species out-compete the native *flora*, there are typically decreases in wildlife numbers, especially birds and fish. The spread of exotic species has become so widespread that some experts believe it will become the biggest threat to the world's ecological systems.

The term native plant is relative. Certain plants that are native to the northwest portion of Wisconsin may or may not be native to Manitowoc County. As an example, barren strawberry (*Waldsteinia fragarioides*) is a relatively common upland plant in Wisconsin's northern counties, but there are no known observations of this plant in Manitowoc County. For the purposes of this document, native plants refer to those species that have a record of being observed in Manitowoc County. It is strongly recommended that only those plants with a record of occurring in Manitowoc County be used in the county's shoreland restorations.

In addition to choosing plants that are native to Manitowoc County, environmental characteristics of a site need to be considered if a successful planting plan is to be developed. Some plants, such as many of the oak species (*Quercus spp*.), require dry, sandy areas that receive a lot of sun. There are plants of the other extreme, such as skunk cabbage (*Symplocarpus foetidus*), that grow best in shaded, wet areas that have organic or *muck soils*. Most plants grow best in areas that fall in between these extremes. It should also be realized that different combinations of these characteristics frequently co-exist on the same site. For example, species planted in the shallow water zone of a lake will have different environmental requirements than those planted directly on the shoreline, which in turn will have different requirements from those planted in the upland areas of a project. Similarly, portions of a site may be shaded by existing trees or structures, while other portions of the same site may receive little to no shade. A site's planting plan needs to take all of these possibilities into consideration.

The easiest way of acquiring native plants is to purchase them from a local nursery that specializes in growing native species. When purchasing plants from a nursery, it is important to buy from local growers, ideally within 50 miles of the project site. This will ensure that local genetic strains that have become adapted to local conditions are used, rather than individuals of the same species that developed under a different set of environmental conditions. For example, paper birch (*Betula papyrifera*) growing in southern Wisconsin does well on open, southwest facing slopes, but northern strains of the species that are planted in similar conditions are not as successful. If no growers can be found within the recommended 50 miles, the closest plant supplier should be selected. A list of Wisconsin nurseries that grow native plants is shown in Attachment 1.

Nature As A Guide

Natural shorelines typically have different zones of vegetation growing along them based upon differing soil wetness, soil textures, and *photoperiods* (Figure 1 and 2). Collectively, these zones are known as a *hydrosere*. Typically, the in water zone directly adjacent to the shoreline is known as the *Littoral Zone*. This zone is typically dominated by *emergent, submergent* and *floating leaf vegetation.* The land side typically has two or three zones that may be as exaggerated as Figures 1 and 2, but that is usually much narrower. Since Manitowoc County was mostly forested prior to European settlement, it is likely that most of the county's lakes had shorelands that were similar to Figure 1 before being altered by man. In this type of landscape, the land side of the shoreline transitions from a shrub community, to a wet forest community, and finally to an upland forest. Although most shorelines in the county likely resembled Figure 1, it is just as likely that several of the county's lakes had a shoreland that resembled Figure 2. This type of shoreland transitioned from the littoral or shallow water zone, to a sedge or wet

meadow, and then finally to the surrounding uplands. A combination of Figures 1 and 2 were also probably common, with the transition being shallow water zone to sedge meadow, sedge meadow to shrub community, shrub community to wet forest community, and finally wet forest to upland forest.

To help in the development of shoreland planting plans in the County, NES inventoried the shoreland plant communities of five Manitowoc County lakes. Results of the inventory are shown in Attachment 2. This inventory should by no means be the sole source used for developing shoreland planting plans in Manitowoc County; rather, it should be viewed as a guideline.

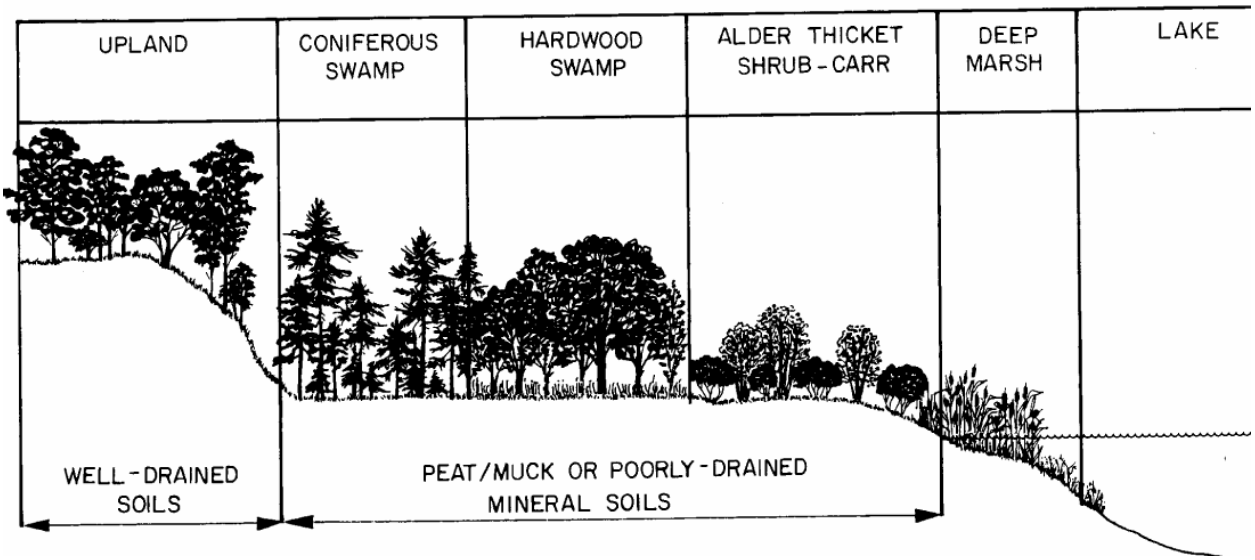

Figure 1. A generalized cross section of forest communities associated with Wisconsin lakes. From Eggers and Reed, 1997.

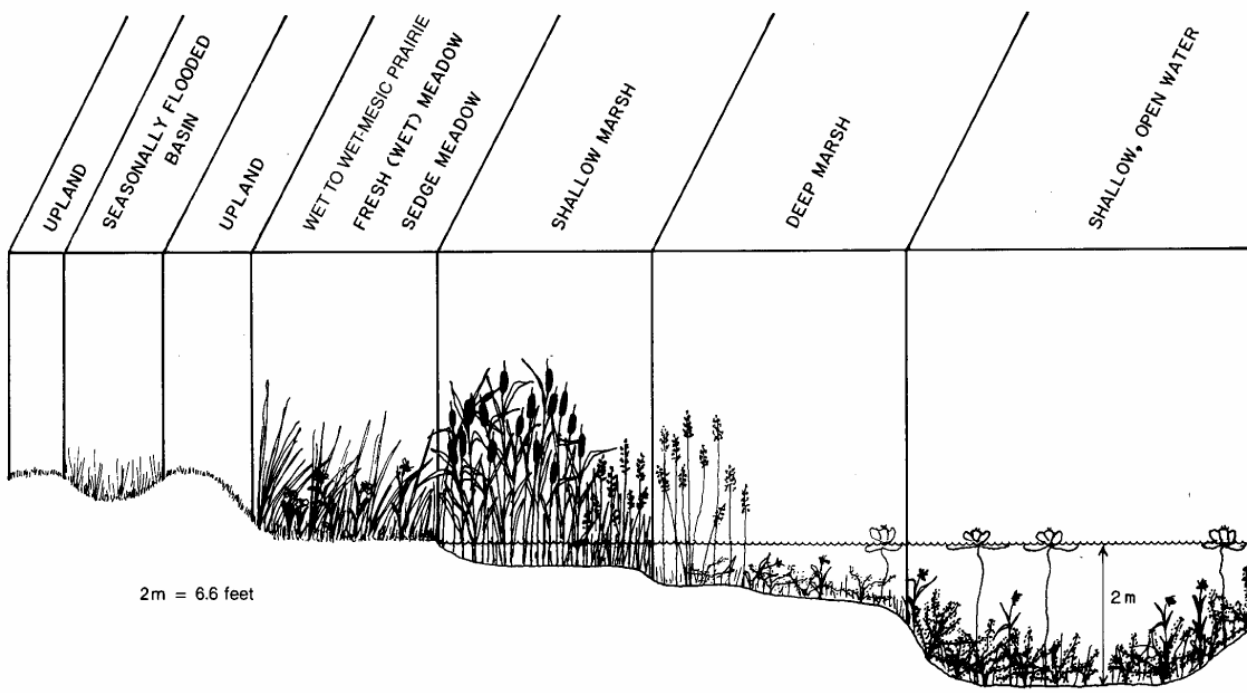

Figure 2. A generalized cross section of open communities associated with Wisconsin lakes. From Eggers and Reed, 1997

Although not *quantitative* in nature, the list of plants generated from the inventory does show the native plants that are found at most, if not all of Manitowoc County's lakes, suggesting that their use in planting plans will result in the successful establishment of a native plant buffer around the county's lakes. Over 90 different native plant species were observed along the upland and shallow water areas of these lakes' shorelines. Of these, 34 species were observed at over half the lakes. Those plant species that were observed at over half the sites are shown in Table 1. Although observed at over half the sites, some of the species listed in Table 1 may not be the best choice for shoreland restoration plantings. Plants that fit this category include potentially *invasive* species such as broad-leaved cattail, *annual* species such as beggars tick or spotted touch-me-not, and American elm, which tends to be a relatively short lived tree species. Along with showing the most common plants observed during the shoreland inventory, Table 1 also provides information related to the general environmental requirements of the listed species, along with the hydrosere zone in which they typically grow.

Table 1. Species identified at over half of the shoreland study sites.

Specific Name	Common Name	Preferred Soil/Moisture Regime	Light Requirements	Hydrosere Zone	Growth Form	Invasive Potential
Acer rubrum	Red maple	All mineral soils	Full to partial	Shrub/Forested	Tree	Low
Alnus rugosa	Speckled alder	All wet soils	Full to partial	Shrub	Shrub	Medium
Asclepias incarnata	Marsh milkweed	All wet mineral soils	Full sun	Wet Meadow	Tall Forb	Low
Athyrium filix-femina	Lady fern	Moist, clayey, loamy,	Partial sun	Shrub/Forested	Low Forb	Low
Betula papyrifera	Paper birch	All mineral soils	Full sun as	Forested	Tree	Low
Bidens spp.	Beggar ticks	Wet mineral soils	Full to partial	Wet Meadow	Low Forb	Low
Calamagrostis canadensis	Canada blue-joint grass	All wet soils	Full to partial	Wet Meadow	Grasslike	Low
Carex comosa	Bristly sedge	All wet soils and	Full sun	Wet Meadow/Marsh	Grasslike	Low
Ceratophylulm demersum	Coontail	Shallow water areas	Clear to murky	Shallow Water Zone	Aquatic submergent	Low
Chara sp.	Muskgrass	Shallow water areas	Clear to murky	Shallow Water Zone	Aquatic submergent	Low
Cicuta bulbifera	Bulbet water-hemlock	Wet clayey, loamy, and	Full sun	Wet Meadow/Marsh	Aquatic emergent	Low
Comarum palustre	Marsh cinquefoil	Mucky soils and	Full to partial	Wet Meadow/Marsh	Aquatic emergent	Low
Cornus stolonifera	Red-osier dogwood	All soils	Full to partial	Shrub	Shrub	Medium
Eleocharis sp.	Spike rush	Wet soils, shallow	Full sun	Wet Meadow/Marsh	Aquatic emergent	Low
Eupatorium maculatum	Spotted Joe-Pye-weed	All clayey and loamy	Full to partial	Wet Meadow	Tall Forb	Low
Fraxinus nigra	Black ash	Wet clayey, loamy, and	Full to partial	Shrub/Forested	Tree	Low
Fraxinus pennsylvanica	Green ash	Moist clayey and loamy	Full to partial	Shrub/Forested	Tree	Low
Impatiens capensis	Spotted touch-me-not	All wet soils	Full sun to	Wet Meadow/Marsh	Low Forb	Low
Iris versicolor	Northern blue flag iris	All wet soils	Full to partial	Wet Meadow/Marsh	Tall Forb	Low
Larix larcinia	Tamarack	Wet clayey, loamy, and	Full sun as	Shrub/Forested	Tree	Low
Leersia oryzoides	Rice cut-grass	All wet soils	Full to partial	Wet Meadow/Marsh	Grasslike	Low
Lycopus uniflorus	Northern water	All wet soils	Full sun to	Wet Meadow/Marsh	Low Forb	Low
Nuphar variegata	Yellow water lilly	Shallow water areas	Clear to murky	Shallow Water Zone	Floating Aquatic	Low
Nymphaea odorata	White water lilly	Shallow water areas	Clear to murky	Shallow Water Zone	Floating Aquatic	Low
Pinus strobus	White pine	All dry soils	Full to partial	Upland Forest	Tree	Low
Populus tremuloides	Trembling aspen	All moist to dry soils	Full sun as	Forested	Tree	Low
Potamogeton illinoiensis	Illinois pondweed	Shallow water areas	Clear to murky	Shallow Water Zone	Aquatic submergent	Low
Potamogeton zosterformis	Flat stem pondweed	Shallow water areas	Clear to murky	Shallow Water Zone	Aquatic submergent	Low
Sagittaria latifolia	Arorwhead	All wet soils and	Full sun	Marsh/Shallow Water	Aquatic emergent	Low
Salix sp.	Willow	Wet to moist clayey,	Full sun as	Shrub	Shrub	Medium
Solidago gigantea	Giant goldenrod	Wet to moist clayey,	Full to partial	Wet Meadow	Tall Forb	Low
Stuckenia pectinata	Sago pondweed	Shallow water areas	Clear to murky	Shallow Water Zone	Aquatic submergent	Low
Thuja occidentalis	White cedar	Wet clayey, loamy, and	Full to partial	Forested	Tree	Low
Typha latifolia	Broad-leaved cattail	All wet soils and	Full to partial	Marsh/Shallow Water	Aquatic emergent	High
Ulmus americana	American elm	Wet to moist clayey	Full to partial	Shrub/Forested	Tree	Low

In addition to creating a list of the most common shoreland plants found in Manitowoc County, it was hoped that the plant inventory could be used as a guide for selecting plants based upon water chemistry and shoreline soil characteristics. A statistical evaluation of the soil type and water chemistry parameters was conducted. Results of this evaluation, and a description of the methods used for analysis are discussed in Attachment 2. The results of this evaluation suggest that most of Manitowoc County's shorelines are covered by plants that are influenced by broad geographic and geologic factors, such as temperature fluctuations, growing season length, soil texture, and soil drainage class, rather than geographically narrow factors such as water or soil chemistry.

Site Preparation

Depending on a site's pre-restoration state, extensive or minimal site preparation will be required prior to conducting native plantings. Perhaps the most important preparation step is the elimination of non-native species from a site. If only a small amount of exotic species are present, eliminating them may be accomplished by pulling or spot herbicide treatment. If large amounts of exotic species are present, the easiest way to eliminate them is through herbicide treatments. The use of herbicides should be done with caution and all directions and limitations for use should be read and understood before conducting treatments.

Once exotic species are removed it may be necessary to prepare the soil for planting through tilling or other similar means. This will typically be required in areas that were planted to lawn or that were comprised exclusively of exotic grasses. If tilling or other similar actions are conducted at a site, it is imperative that exposed soils are not allowed to erode into lakes or other low lying areas. In some instances extra precautions such as silt fence or *erosion fabric* may need to be installed. It is recommended that professionals be consulted if a site has high erosion potential. The local Natural Resource Conservation Service (NRCS) office or the MCSWCD should be able to provide guidance related to erosion control.

In addition to tillage, some soils may require additional preparation. For instance, if a site's topsoil has been removed through erosion or past landscaping practices it may be necessary to add a mulch of decomposed leaves or woody debris to the soil. This will simulate the original topsoil of the region, which was largely formed under an almost complete tree canopy comprised of northern mesic forest species such as sugar maple (*Acer saccharum*), basswood (*Tilia amiercana*), and beech (*Fagus grandifolia*). It is important to note that some state and local laws may prevent the addition of mulch within certain areas, especially wetlands. Similarly to tilled soils, it is important to prevent the washing of mulching material into lakes or low lying areas. As in the case of exposed soils, the local NRCS office or the MCSWCD should be able to provide guidance related to controlling the erosion of mulching materials.

Maintenance

The maintenance of a given site will vary depending on the plants selected for the restoration. In general, maintenance can be divided into two time periods – short term (the first three years) and long term (following the third year). For the most part, short term maintenance will be the same for all types of restorations. The main action that should take place during the short term maintenance is preventing the establishment of exotic plants within the shoreland buffer. This is most effectively done by removing non-natives from a restoration through pulling or selective cutting. If large scale infestations occur, mowing or chemical treatments may be required. These latter methods should be conducted at a time that will maximize the damage to exotic plants while minimizing effects to the native plantings. Special care should be exercised when mowing in areas that are planted with trees or shrubs, as damaging these plants at such a young age may result in their mortality. Along with preventing the establishment of exotic species, there will be a need to implement a normal watering schedule during the plantings first two months. In the second and third years watering should only be required during drought conditions.

Long term maintenance involves management of the restoration. Two types of long term maintenance can be conducted. The easiest and most natural method is to let the restoration develop on its own. If this technique is used some of the species from the original planting may disappear due to *competition* with other natives. Although some of the plants from the original planting may be lost, this technique most closely follows nature and would most likely lead to a more natural looking shoreland. The second type of long term maintenance involves controlling the way a planting develops. This can be done by cutting back plants that are outcompeting other natives. For instance, red-osier dogwood (*Cornus stolonifera*) often forms dense stands and can cause shading that is detrimental to species adapted to open conditions. If this in not an acceptable outcome, the spread of red-osier dogwood could be controlled by cutting and pruning techniques. In both types of long term maintenance options, yearly examinations should be conducted to ensure that exotic species are not becoming established within the plantings. If exotics are found, they should be removed immediately.

Case Studies

In order to provide examples to the citizens of Manitowoc County, NES Ecological Services, MCLA, and MCSWCD conducted five shoreland restorations at four different Manitowoc County Lakes. Two of the restorations were conducted on county owned lands, while the remaining three took place on private land holdings. The following section describes the methods that were used at each site, lists the species used at each planting, gives an annual account of each site's development, and provides a description of the positive and negative outcomes that occurred at each site. A site map showing the location of the case studies is included as Attachment 3, and the plant lists and associated planting plans for each site are shown in Attachment 4.

English Lake County Park

This property is owned by Manitowoc County. Prior to restoration, this site was maintained as lawn up to the water's edge and little emergent vegetation was growing along the shoreline (Picture 1). Starting in the spring of 2002, approximately 100 feet of the park's shoreline was restored. Initial site preparation included an herbicide treatment to those portions of the lawn that were to be restored (Picture 2), along with the installation of wavebreaks (Picture 3). The herbicide treatment was necessary to kill off the dense lawn vegetation, while the wavebreaks were installed in an effort to reduce water energy near the shoreline, allowing emergent plantings a chance to become established under sheltered conditions. The upland soils in this area were not tilled prior to seeding. Instead, a seed drill was used to install native seeds (Picture 4). In addition to seeding the area with native grasses and forbs, trees and shrubs were planted. In the uplands, seeded plants started emerging during early summer of the first growing season, especially black – eyed Susan (*Rudbeckia hirta*) (Picture 5), and emergent plants had become established by the fall (Picture 6).

Black-eyed Susan continued to be the most prominent plant in the uplands during the second growing season (2003), and the trees and shrubs showed good growth (Picture 7). A few of the in water plantings survived the first year so the wavebreaks were reinstalled during the second growing season.

By the third growing season (2004) the upland portion of the planting had become invaded by reed canary grass (*Phalaris arundinacea*), while the in water plantings showed good growth (Picture 8). Although further monitoring was not conducted, it is likely that the reed canary grass has continued spread throughout the planting.

The invasion and prominence of reed canary grass at the site displays the importance of conducting at least annual maintenance at shoreland restorations. Continual maintenance would most likely have been necessary to prevent the invasion of this exotic invasive, as a large colony of it exists on the adjacent property to the west; however, if maintenance had been conducted on a regular basis during the first three years it is likely that the spread of reed canary grass would have been far less substantial today.

Although the site now likely supports large populations of reed canary grass, the shoreline of English Lake has been improved by this restoration. *Runoff* from the associated parking lot now passes through the vegetated buffer, which acts a filter by removing much of the sediment that otherwise would have entered the lake. In addition, prior to conducting this restoration the park had a continuous lawn up to the lake edge. This lawn provided little habitat to the area's wildlife. The current vegetated buffer likely provides habitat for small mammals, insects, and some bird species.

Picture 1. English Lake County Park prior to shoreland restoration.

Picture 2. English Lake County Park following herbicide treatment.

Picture 3. Wave break installation at the English Lake County Park.

Picture 4. Installing native seeds at the English Lake County Park using a seed drill.

Picture 5. Plant establishment, primarily black eyed Susan, at English Lake County Park during the first growing season.

Picture 6. Emergent vegetation establishment at English Lake County Park following the first. growing season.

Picture 7. Tree and shrub growth during spring of the second growing season at English Lake County Park.

Picture 8. Giant burreed establishing in the shallow water zone at English Lake County . Park during the second growing season.

Long Lake County Park

This property is owned by Manitowoc County. Prior to restoration, this site was maintained as lawn up to the water's edge, except for a small fringe area that could not be mowed (Picture 9). This land use practice led to severe wave-induced shoreline erosion at the site (Picture 10). Starting in the spring of 2002, approximately 100 feet of the park's shoreline was restored. Initial site preparation included an herbicide treatment to those portions of the lawn that were to be restored, and the installation of wavebreaks and *Biolog* (Picture 11). Biolog is coconut fiber that is molded into a "log-like" shape. It helps stabilize shorelines by forming a barrier between a shoreline and waves, thus cushioning the shoreline against wave energy. In addition to reducing wave energy, Biolog can be used as a planting substrate for native plants. Similar to the English Lake County Park site, a seed drill was used to conduct the upland seeding. Trees and shrubs were also planted, as were various in-water plantings. After the first growing season it was realized that much of planting was failing to flourish due to shade produced by the site's existing large trees (Picture 12) and a lack of adequate top soil. In addition, the in-water plantings failed, largely due to the combined shading effects of the site's mature trees and the large quantities of Eurasian water milfoil (*Myriophylum spicatum*) found within the lake.

Following the second growing season (2003) most of the site's upland area was tilled and approximately 4 inches of partially decomposed wood mulch was added to the soil (Picture 13). The tilling and mulch application were done to improve the site's soil condition. It was hypothesized that using partially decomposed wood mulch would mimic a forest floor, which in nature is largely comprised of decomposed woody material. This was done because woodland plants that could tolerate shade were going to be used in the revised planting plan. Although the first year's plantings had not been successful, the Biolog was performing well, as improvement could be seen in the shoreline's stability.

In the spring of the third season (2004) live woodland species were planted at the site, as were additional trees and shrubs. Based upon the previous failure of the in-water plantings at this site, it was decided that they should not be replanted. During a site visit conducted during the summer of 2005, it was noted that the woodland plantings had survived their first growing season, but a substantial amount of weedy species were also growing within the planting (Picture 14). It is unclear how this planting will develop, especially without proper maintenance.

The undesirable results that occurred following the first planting emphasize the importance of properly evaluating a site's conditions prior to conducting restoration activities. Because soil and light conditions were not fully taken into account the site had to be replanted. Once again, the lack of maintenance is also a concern. The mix of exotic weeds observed growing in the woodland planting during the 2005 site visit make it unclear as to whether the restoration will produce a shoreland buffer dominated by native plants.

Although the planting's future is unclear, the restoration did improve Long Lake's shoreline. The Biolog has buffered the lake's shore from wave energy, creating a more stable shoreline that is less prone to erosion. In addition, the existing plant buffer provides a higher quality wildlife habitat than did the maintained lawn.

Picture 9. Long Lake County Park prior to shoreland restoration.

Picture 10. Long Lake County Park shoreline. Note sloughing of banks.

Picture 11. Installed biolog at Long Lake County Park.

Picture 12. Large shade producing trees at Long Lake County Park.

Picture 13. The addition of partially decomposed wood mulch to Long Lake County Park.

Picture 14. Woodland flowers growing amongst. invading lawn weeds at Long Lake County Park.

Pigeon Lake – Lenzner Property

The Pigeon Lake site is owned by Mr. Steve Lenzner. Prior to restoration, this site was maintained as lawn up to a rip-rap border that continued into the lake (Picture 15). Initial site preparation was begun in mid-summer of 2002 and included an herbicide treatment to those portions of the lawn that were to be restored and the installation of wavebreaks. The soil was prepared for seeding by tilling and erosion blanket constructed of coconut fiber was installed to ensure that exposed soil sediment was not washed into the lake (Picture 16). In addition to seeding the upland area, trees, shrubs, and various forbs were live planted. In water plantings were also conducted. Plant growth was evident within the planting by the end of the first growing season (Picture 17).

Wave breaks were reinstalled during the second growing season (2003) and the upland planting continued to mature (Picture 18). Because the wavebreaks were reinstalled, some of the in water plantings survived through the 2003 growing season. Some of the trees and shrubs planted in the first growing season did not survive the winter and were replaced.

By the third growing season (2004) the upland plantings had become dominated by black-eyed Suzan and most of trees and shrubs had survived (Picture 19). Although the upland plantings did well, the in-water plantings failed because the wavebreaks were not reinstalled, allowing wave energy to damage the young aquatic plants. During a visit conducted during the planting's fourth growing season (2005) it was noted that the site was still dominated by native plants, and species other than black-eyed Susan were becoming more prominent (Picture 20).

As in the first two sites, the in water plantings were largely unsuccessful. This most likely happened because the wavebreaks were not reinstalled during the third growing season, allowing

wave action produced from unimpeded winds and boat traffic to rip the young plantings out of the lake's substrate.

Although the in water plantings failed, it appears that the upland plantings will continue to be dominated by an assortment of native species, therefore achieving the goal of creating a shoreland buffer dominated by native plants. This buffer will provide improved habitat for various pollinating insects, birds, and small mammals, and has improved the aesthetics of the Lezner's shoreline.

Picture 15. Pigeon Lake site prior to shoreland restoration.

Picture 16. Wavebreaks and erosion blanket. that were installed at the Pigeon Lake site.

Picture 17. First years growth at the Pigeon Lake site.

Picture 18. Second growing season at the Pigeon Lake site.

Picture 19. Third growing season at the Pigeon Lake site.

Picture 20. Early summer of the Pigeon Lake site's fourth growing season.

English Lake – Kaestner Property

This site is owned by Gary Kaestner. Prior to restoration this site was maintained as lawn up to a rip-rap border that continued into the lake (Picture 21). The shoreland restoration was begun in 2002 with the installation of wavebreaks, the planting of in water species, an early fall herbicide treatment, and a tree and shrub planting that was conducted in November of 2002.

Upland areas were hand seeded in the spring of 2003 following tilling (Picture 22). The in water plantings suffered from predation by muskrats and were not replanted because the scenario was likely to be repeated in successive years. By the fall of 2003 black-eyed Suzan had become well established at the site, as the planting appeared to benefit from the normal watering it received from the Kaestner family. Additional trees and shrubs were planted in the fall of 2003 to replace those that had died following the first winter.

The planting continued to develop during the third growing season, and black eyed Suzan was once again the most abundant plant growing at the site. Some of the trees and shrubs that were planted in 2003 died, but most had survived and appeared to be in good health.

Once again, the site's in water plantings failed but it appears the upland plantings will become dominated by an assortment of native species, achieving the goal of creating a shoreland buffer dominated by native plants. This buffer will provide improved habitat for various pollinating insects, birds, and small mammals, and has improved the aesthetics of the Kaestner's shoreline.

Picture 21. Kaestner site prior to shoreland restoration.

Picture 22. Tilled area at the Kaestner site. This area was hand seeded with natives after tilling.

Wilke Lake – Corfman/Kieffer Property

This planting was mostly conducted on property owned by Jerry and Pam Corfman, but a portion of it extended onto a neighboring property to the north. Prior to restoration, this site was maintained as lawn up to a rip-rap border that continued into the lake (Picture 23). This site is shaded by several large trees. For this reason, it was decided that a woodland planting should be conducted. Initial site preparation involved an herbicide treatment during the early summer of 2003. Approximately four inches of partially decomposed wood mulch was then added in late summer, 2003 to create conditions that mimicked a forest floor (Picture 24). Trees and shrubs were planted by the Corfman's that same fall. No in water plantings were conducted at the site due to the shade effect created by the trees, and because it was believed the large population of Eurasian water milfoil that exists within the lake would stifle any such attempts.

Live woodland plants were added to the site in the summer of 2004 (Picture 25). The site was watered and weeded on a regular basis by the Corfmans throughout the summer. In a site visit conducted during the summer of 2005 it was evident that the plantings survived the first winter, but their numbers had not increased or spread beyond their original planting positions (Picture 26). If the Corfmans continue to be aggressive in their maintenance, the plantings should increase and spread in 2006 (the third growing season).

This shoreland planting was the last one designed by NES Ecological Services for this project, and the lessons learned during the earlier restoration efforts are evident. First, a proper site evaluation was conducted that resulted in the design of a woodland planting that can tolerate shaded conditions. Second, the failure of in water plantings at the earlier restorations had been evaluated prior to conducting this site's planting. It was realized that the in water plantings at the earlier restorations were failing because of a combination of factors, including shading,

competition, predation, and lack of maintenance (wave break installation). In this case, it was decided that two of these factors, shading and competition from Eurasian water milfoil, would prevent the success of any in water plantings.

Picture 23. Wilke Lake site prior to shoreland restoration.

Picture 24. The addition of partially . decomposed wood mulch to the Wilke Lake site.

Picture 25. Woodland plantings added to the Wilke Lake site during the summer of 2004.

Picture 26. Second growing season at the Wilke Lake site

This site also displays the important role maintenance plays during the early periods of a restoration. By regularly watering and weeding the site during the first two growing seasons, the Corfman's created conditions that will likely allow the plantings to flourish, and eventually become much less needy. If continued maintenance occurs at this site through the third growing season, it should achieve the goal of creating a vegetated shoreland buffer requiring little maintenance that is dominated by native plants.

Case Study Findings

Several important realizations were made while conducting these restorations. Perhaps the most obvious is the importance of conducting a proper site evaluation prior to developing a planting plan. The first Long Lake planting was not successful because of oversights during the initial site evaluation. It was also learned that establishing a population of in water native plants can be extremely difficult. The failures of the in water plantings at these projects are discussed in the Wilke Lake case study, and are likely related to a combination of factors. Perhaps the biggest factor being the difficult physical and time demands related to wavebreak installation.

Perhaps the single most important finding of these case studies is the role maintenance plays in the success of shoreland restorations. Little to no maintenance was performed at the public sites, and based upon the prevalence of non-native species, these two areas appear to be the least successful. The English Lake Park site has been invaded by a substantial amount of reed canary grass and the success of the Long Lake Park site is in doubt due to the prevalence of weedy lawn species within the planting. Although it is unclear exactly how much maintenance was conducted at the other three sites, it is likely that they were at least watered on a regular basis, and in the case of the Wilke Lake site, regular weeding was conducted during the first two growing seasons. All three of these sites have shoreland buffers that are dominated by native species.

In addition to providing examples of how shoreland restorations can be conducted, the case studies allowed NES to educate the citizens of Manitowoc County about the important relationship that exists between a lake's shoreline and it's overall health. A list of meetings attended and materials produced which helped in this education process are shown in Attachment 5.

Glossary

Annual: a plant that completes its life cycle in one growing season then dies

Biolog: coconut fiber that is molded into a "log-like" shape that is used to help stabilize shorelines by forming a barrier between a shoreline and waves, thus cushioning the shoreline against wave energy

Biotic Diversity: the living organisms that utilize a particular habitat

Competition: in ecological terms, two or more individuals contesting for the same resources (light, water, nutrients)

Ecological Communities: an interacting assemblage of living and non-living components found within a given habitat (birds, plants, fish, soils, water)

Emergent Vegetation: a rooted herbaceous plant whose stem extends above the water's surface

Erosion Fabric: a mat-like material placed over exposed substrates that prevents water or wind induced soil movement

Exotic Plants: a plant that evolved in another geographic region and was able to become established through the aid of humans

Floating Leaf Vegetation: rooted plants, such as lilies, that have large, round leaves that float on the water's surface

Flora: the entire complement of plant species that grows in a particular region

Hydrosere: adjacent plant communities growing along a wetness gradient

Invasive Species: a plant species that can aggressively spread - it can be native or exotic

Lake Classification: a method used to group lakes by certain characteristics

Landscape: a continuum of adjacent habitats and communities

Maintenance Plan: a schedule of maintenance activities to be conducted within a restoration site

Mitigation Points: a technique used by some municipalities and organizations to determine the extent of restoration practices that need to be conducted at a site

Muck Soils: a soil that formed from the decomposition of organic material, such as leaves or grasses

Native Plant: a plant species that evolved in a region and that originally occurred in that region

Perennial: a plant species whose individuals survive for three or more consecutive years

Photoperiod: the duration and timing of sunlight occurrences

Quantitative: data that provides exact, numerical amounts or proportions

Runoff: rainwater that flows over the ground surface

Shoreland Buffer Zone: an area left in or restored to a natural state around a lake or river that provides specific ecological functions

Submergent Vegetation: a rooted herbaceous plant that grows under the water's surface

Agencies and Organizations that can provide guidance with shoreland restorations

Organization/Agency	Phone	Web Site
Wisconsin Department of Natural Resources - Green Bay Service Center	920-662-5100	http://dnr.wi.gov/
University of Wisconsin Extension - Manitowoc County	920-683-4168	http://www.uwex.edu/ces/cty/manitowoc/
Manitowoc County Soil and Water Conservation Department	920-683-4183	http://www.co.manitowoc.wi.us/department/dept_home.asp?ID=24
Wisconsin Association of Lakes	608-662-0923	http://www.wisconsinlakes.org/index.htm
Wisconsin River Alliance	608-257-2424	http://www.wisconsinrivers.org/
Manitowoc County Lakes Association	Not Available	Not Available
Cofrin Center for Biodiversity - University of Wisconsin Green Bay	920-465-2272	http://www.uwgb.edu/biodiversity/

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University of Minnesota Extension Shoreland Site –
http://www.extension.umn.edu/water/shore/shoreland.html

University of Wisconsin Extension.

University of Wisconsin Extension Shoreland Restoration Site -
http://www.uwex.edu/ces/shoreland/

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http://www.dnr.state.wi.us/org/water/wm/dsfm/shore/links.htm

Other useful references

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ATTACHMENT 1

Wisconsin Native Plant Nurseries – from WDNR publication "*Wisconsin Native Plant Sources and Restoration Consultants - Seed and plants for prairies, woodlands, wetlands and shorelands*."

Plants Sold By Nurseries That Are Native To Manitowoc County

Native Plant Nurseries located in Wisconsin.

P/C = Plug/Container S = Seed T/S = Trees/Shrubs D = Design SP = Site Preparation I = Installation M = Management B = Prescribed Burns

LOCATED IN WISCONSIN

Nursery	Wetland			Shoreland			Prairie			Woodland			Services				
	P/C	S	T/S	P/C	S	T/S	P/C	S	T/S	P/C	S	T/S	D	SP	I	M	B
Agrecol – 2918 Agriculture Dr., Madison, WI 53718 (608) 226-2544 www.agrecol.com	•	•		•	•		•	•		•	•		•	•	•	•	•
Applied Ecological Services/Taylor Creek Restoration Nursery – 17921 Smith Road, Brodhead, WI 53520 (608) 897-8641 www.appliedeco.com	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
Aquatic Biologists, Inc. – N4828 US Hwy 45, Fond du Lac, WI 54935 (920) 921-6827 www.aquaticbiologists.com	•	•		•	•								•	•	•	•	
Aquatic Resources and Glacial Pond Farms – N 4546 Butternut Lane, Birnamwood, WI 54414 (715) 845-2099	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Arboretum & Natural Gardens – S7375 Hwy 14, Readstown, WI (608) 629-5553 www.readscreeknursery.com	•		•	•		•	•		•	•		•	•	•	•	•	
BioLogic Environmental Consulting, LLC – 2505 Richardson St., Fitchburg, WI 53711 (608) 277-9960	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Bluestem Farm – S5920 Lehman Road Baraboo, WI 53913 (608) 356-0179	•		•				•	•	•	•	•	•	•				
Dragonfly Gardens – 491 State Hwy 46 P.O. Box 192, Amery, WI 54001 (715) 268-4666 http://dragonflygardens.net	•		•	•			•		•	•		•	•	•	•		
Dutch Designs – N5706 Hwy S, Lake Mills, WI 53551 (920) 648-8234	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Eco-Building & Forestry – 1058 DuBay Drive West, Mosinee, WI 54455 (715) 344-2817 www.eco-buildingandforestry.com	•		•	•		•	•		•	•		•	•	•	•	•	
Flower Factory – 4062 Hwy. A, Stoughton, WI 53589 (608) 873-8329	•			•			•			•			•				
Gentian Farm – 2775 18 Avenue, Osceola, WI 54020 (715) 294-2724		•			•		•	•			•		•		•	•	
Great Lakes Nursery Co. – 1002 Hamilton Street, Wausau, WI 54403 (715) 845-7752, toll-free 888-733-3564	•		•	•		•	•		•	•	•	•	•				
Hanson's Garden Village – 2660 Cty Rd. G, Rhinelander, WI 54501 (715) 365-2929	•		•	•		•	•			•			•				
Hild & Associates – 326 Glover Road River Falls, WI 54022 (715) 426-5131 www.hildnatives.com	•	•		•	•		•	•		•	•		•	•	•	•	
J&J Transplant Aquatic Nursery – W 4980 Country Rd. West, Wild Rose, WI 54984 (800) 622-5055 www.tranzplant.com	•	•	•	•	•	•	•	•	•	•	•	•					
Johnson's Nursery Inc – W180 N6275 Marcy Road, Menomonee Falls, WI 53051 (262) 252-4988 www.johnsonsnursery.com	•		•	•		•	•		•	•		•	•	•	•	•	

Native Plant Nurseries located in Wisconsin

P/C = Plug/Container S = Seed T/S = Trees/Shrubs D = Design SP = Site Preparation I = Installation M = Management B = Prescribed Burns

LOCATED IN WISCONSIN (continued)

Nursery	Wetland			Shoreland			Prairie			Woodland			Services				
	P/C	S	T/S	P/C	S	T/S	P/C	S	T/S	P/C	S	T/S	D	SP	I	M	B
Kester's Wild Game Food – 4582 Hwy 116E P.O. Box 516, Omro, WI 54963 (800) 558-8815	•	•		•	•		•	•					•	•	•		•
Kettle Moraine Natural Landscaping – W996 Birchwood Dr., Campbellsport, WI 53010 (920) 533-8939		•			•			•					•		•	•	•
Kinnickinnic Natives – 235 State Rd 65 River Falls, WI 54022 (715) 425-7605				•			•	•		•	•		•		•		
Lacewing – 6087 N. Denmark St., Milwaukee, WI 53225 (414) 358-2562	•	•	•	•		•	•		•	•		•	•	•	•	•	
Lied's Nursery Company Inc. – N63 W22039 Hwy. 74, Sussex, WI 53089 (262) 246-6901 www.lieds.com	•			•			•	•					•	•	•	•	
Lodholz North Star Acres, Inc. – 420 Highway A, Tomahawk, WI 54487 (715) 453-2976			•			•			•			•		•			
Marshland Transplant Aquatic and Woodland Nursery – P.O. Box 1, Berlin, WI 54923 (920) 361-4200	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Monches Farm – 5890 Monches Road Colgate, WI 53017 (262) 966-2787 www.monchesfarm.com	•						•			•							
National Wild Turkey Federation – 265 Lorrie Way, DePere, WI 54115 (920) 427-2335 www.nwtf.org	•	•	•	•	•	•	•	•	•	•	•	•	•				•
Northern Native Plantscapes – 25350 S. Garden Ave., Cable, WI 54821 (715) 794-2548	•		•	•		•	•			•	•	•	•	•	•	•	
Oak Prairie Farms – W4642 Highway 33 Pardeeville, WI 53954 (608) 429-3882 www.oakprairiefarm.com	•	•		•	•		•	•		•	•		•		•		
Prairie Futures Seed Co. – P.O. Box 644 Menomonee Falls, WI 53052 (262) 820-0221				•	•		•	•		•	•		•	•	•	•	•
Prairie Nursery – W5875 Dyke Ave. P.O. Box 306, Westfield, WI (608) 296-3679 www.prairienursery.com	•	•		•	•		•	•		•	•		•	•	•	•	•
Prairie Ridge Nursery – 9738 Overland Road, Mt. Horeb, WI 53572 (608) 437-5245 http://prairieridgenursery.com	•	•		•	•		•	•		•	•		•	•	•	•	•
Prairie Seed Source – P.O. Box 83 North Lake, WI 53064-0083 (414) 673-7166		•			•			•							•		
Tallgrass Native Seed – 2705 11th Ave., Monroe, WI 53566 (608) 325-9374		•						•			•		•	•		•	•
The Plantscapers – E2051 Luxembourg, WI 54217 (262) 845-5196	•		•	•		•	•		•	•		•	•	•	•	•	

Native Plant Nurseries located in Wisconsin.

P/C = Plug/Container S = Seed T/S = Trees/Shrubs D = Design SP = Site Preparation I = Installation M = Management B = Prescribed Burns

LOCATED IN WISCONSIN (continued)

Nursery	Wetland			Shoreland			Prairie			Woodland			Services				
	P/C	S	T/S	P/C	S	T/S	P/C	S	T/S	P/C	S	T/S	D	SP	I	M	B
Wallace – Woodstock Nursery – W6291 State Rd. 95, Neillsville, WI 54456 (888) 803-8733 www.wallace-woodstock.com	•		•	•		•	•		•	•		•			•		
Wildlife Nurseries Inc. – 904 Bauman St., P.O. Box 2724, Oshkosh, WI 54903 (414) 231-3780	•	•		•	•		•	•									
Windy Oaks Aquatics – W377 S10677 Betts Road, Eagle, WI 53119 (262) 594-3033	•			•											•		
Winter Greenhouse – W7041 Olmstead Rd., Winter, WI 54896 (715) 266-4963	•		•	•		•	•		•	•		•					
Woods' Edge Farm – 532 Stanek Road Muscoda, WI 53573 (608) 739-3527 www.woodsedgefarm.com										•		•					

Herbaceous plants sold by Wisconsin nurseries that are native to Manitowoc County

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Actaea packypoda	White Baneberry	Low Forb	White Berries	May-June	1'-2'	Partially shaded to shaded	Dry to medium clayey, loamy, and sandy soils
Actaea rubra	Red Baneberry	Low Forb	Red Berries	May-June	1'-2'	Partially shaded to shaded	Dry to medium clayey, loamy, and sandy soils
Alisma subcordatum	Common Water Plantain	Tall Forb	White	July-Sept	2'-4'	Full sun	Moist to wet clay and loam
Alisma trivale	Northern Water Plantain	Low Forb	White	July-Sept	1'-3'	Full sun	Moist to wet clay and loam
Andropogon gerardi	Big Bluestem	Grass/Grass-like	Bronze	Aug-Oct	5'-8'	Full sun	All dry to moist soils
Anemone canadensis	Canada Anemone	Low Forb	White	May-July	1'-2'	Full to partial sun	Wet to moist clayey, loamy, and sandy soils
Anemone cylindrica	Thimbleweed	Low Forb	White	June-Aug	1'-3'	Full to partial sun	Dry sand or gravel
Angelica atropurpurea	Angelica	Tall Forb	White	June-Aug	2'-8'	F,P	Moist to wet clay or loam
Aquilegia canadensis	Columbine	Tall Forb	Red/Yellow	May-July	1'-3'	Full sun to full shade	Dry to medium loamy or sandy soils
Arisaema triphyllum	Jack-in-the-Pulpit	Low Forb	Green	April-May	1'-2'	Partially shaded to shaded	All wet soils
Arnoglossum atriplicifolium	Pale Indian Plantain	Tall Forb	White	July-Sept	5'-10'	Full to partial sun	Medium to moist sand and loam
Asarum canadense	Wild Ginger	Low Forb	Red	May-June	1'	Partially shaded to shaded	Dry to medium clayey, loamy, and sandy soils
Asclepias incarnata	Marsh Milkweed	Tall Forb	Red	June-Sept	3'-5'	Full sun to full shade	Moist to wet clayey, loamy, and sandy soils
Asclepias syriaca	Common Milkweed	Tall Forb	Purple	June-Aug	3'-4'	Full to partial sun	Dry to medium clayey, loamy, and sandy soils
Asclepias tuberosa	Butterfly Milkweed	Tall Forb	Orange	June-Aug	1'-3'	Full to partial sun	Dry to medium sand or loam
Asclepias verticillata	Whorled Milkweed	Low Forb	White	July-Sept	1'-2'	Full to partial sun	Dry sand or loam
Aster ericoides	Heath Aster	Tall Forb	White	Aug-Oct	1'-3'	Full sun	Dry to medium sand or loam
Aster laevis	Smooth Blue Aster	Tall Forb	Blue	Aug-Oct	1'-3'	Full to partial sun	Dry to medium sand or loam
Aster lateriflorus	Calico Aster	Tall Forb	White	Aug-Oct	1'-4'	Full sun to full shade	Dry to moist clayey, loamy, and sandy soils
Aster macrophyllus	Large-leaf Aster	Tall Forb	White	July-Oct	1'-3.5'	Partially shaded to shaded	Dry to medium clayey, loamy, and sandy soils
Aster novae-angliae	New England Aster	Tall Forb	Purple	Aug-Oct	1'-7'	Full to partial sun	Medium to moist clayey, loamy, and sandy soils
Aster oolentangiensis/azureus	Sky-blue Aster	Tall Forb	Blue	Aug-Oct	1'-4'	Full to partial sun	Dry to moist sand or loam
Aster puniceus	Swamp Aster	Tall Forb	Violet	Aug-Oct	3'-7'	Full sun	Wet to moist clayey, loamy, and sandy soils
Aster sagittifolius	Arrow Leaf Aster	Tall Forb	Light Blue	Aug-Oct	1'-4'	Partially shaded to shaded	Dry to medium sand or loam

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Aster simplex	Marsh Aster	Tall Forb	White	Sept-Oct	3'-5'	Full sun	All wet soils
Bromus ciliatus	Fringed Brome	Grass/Grass-like	Straw	June-July	2'-4'	Full to partial sun	Wet to moist clayey, loamy, and sandy soils
Bromus pubescens	Hairy Woodland Brome	Grass/Grass-like	Straw		2'-5'	Partially shaded to shaded	Medium clay or loam
Bulboschoenus fluviatilis	River bulrush	Grass/Grass-like	Green	June-July	3'-7'	Full to partial sun	Wet to moist clayey, loamy, and sandy soils
Calamagrostis canadensis	Bluejoint	Grass/Grass-like	Straw	June-July	4'-6'	Full to partial sun	All wet soils
Calla palustris	Water Arum	Low Forb	White	June-July	0.5'-1.'	Partially shaded to shaded	Wet organic soil
Caltha palustris	Marsh Marigold	Low Forb	Yellow	May-June	1'-2'	Full sun to full shade	Wet to moist clay or loam
Campanula rotundifolia	Harebell	Low Forb	Blue	June-Sept	1'-2'	Full to partial sun	Dry to medium sand or gravel
Carex aquatalis	Water Sedge	Grass/Grass-like	Green	May-June	2'-3'	Full sun	Wet to moist clay or loam
Carex bebbi	Bebb's Sedge	Grass/Grass-like	Green	June-July	2'-3'	Full to partial sun	Wet to moist clay or loam
Carex comosa	Bristly Sedge	Grass/Grass-like	Green	June-July	2'-3'	Full sun	Wet to moist clay or loam
Carex crinita	Fringed Sedge	Grass/Grass-like	Green	June-Aug	2'-5'	Full sun to full shade	Wet to moist clay or loam
Carex cristatella	Crested Sedge	Grass/Grass-like	Green	May-June	2'-3'	Full to partial sun	Wet to moist clay or loam
Carex eburnea	Ivory Sedge	Grass/Grass-like	Green	May-June	0.5'	Partially shaded to shaded	Dry to medium sand, loam, or gravel
Carex flava	Yellow Sedge	Grass/Grass-like	Green	June-Aug	0.5'-2'	Full to partial sun	All wet soils
Carex hystericina	Porcupine Sedge	Grass/Grass-like	Green	May-June	2'-3'	Full sun to full shade	Wet to moist clay or loam
Carex intumescens	Bladder Sedge	Grass/Grass-like	Green	May-June	1'-3'	Partially shaded to shaded	Moist clay or loam
Carex lacustris	Lake-bank Sedge	Grass/Grass-like	Green	May-July	2'-4'	Full sun to full shade	Wet to moist clay or loam
Carex lasiocarpa	Hairy-fruited sedge	Grass/Grass-like	Green	June-Aug	1'-4'	Full sun	Wet loamy soils
Carex lupulina	Hop Sedge	Grass/Grass-like	Green	May-July	2'-3'	Full sun to full shade	Moist clay or loam
Carex muhlenbergii	Muhlenberg Sedge	Grass/Grass-like	Green	June-July	1'-3'	Full to partial sun	Dry sandy soils
Carex pellita	Wooly Sedge	Grass/Grass-like	Green	May-Aug	1'-3'	Full to partial sun	Wet to moist clayey, loamy, and sandy soils
Carex pensylvanica	Pennsylvania sedge	Grass/Grass-like	Green	May-June	0.5'-1'	Full sun to full shade	All dry to medium soils
Carex projecta	Necklace Sedge	Grass/Grass-like	Green	June-July	1'-3'	Full sun to full shade	Moist clayey, loamy, and sandy soils
Carex scoparia	Pointed Broom Sedge	Grass/Grass-like	Green	June-Aug		Full to partial sun	Moist sand or loam
Carex stipata	Common Fox Sedge	Grass/Grass-like	Green	May-June	1'-3'	Full sun to full shade	All moist soils

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Carex stricta	Tussock Sedge	Grass/Grass-like	Green	May-June	2'-3'	Full sun	All wet to moist soils
Carex vulpinoidea	Brown Fox Sedge	Grass/Grass-like	Green	May-June	1'-3'	Full to partial sun	All wet soils
Castilleja coccinea	Indian Paintbrush	Low Forb	Red/Yellow	May-Sept	1'-2'	Full to partial sun	All soils
Caulophyllum thalictroides	Blue Cohosh	Low Forb	Green	May-June	1'-3'	Full to partial sun	Medium to moist clay or loam
Chelone glabra	Turtlehead	Tall Forb	Cream	July-Sept	2'-3'	Full sun	Moist to wet clayey, loamy, and sandy soils
Cicuta maculata	Water Hemlock	Tall Forb	White	June-Aug	2'-7'	Full sun to full shade	All wet moist soils
Cirsium muticum	Swamp Thistle	Tall Forb	Pink	July-Oct	2'-7'	Full to partial sun	All moist soils
Coreopsis lanceolata	Lanceleaf Coreopsis	Low Forb	Yellow	June-July	1'-2'	Full sun	Dry to medium sand or loam
Danthonia spicata	Povery-Grass	Grass/Grass-like	Straw	May-Aug	0.5'-2'	Full sun	Dry sand or gravel
Desmodium canadense	Showy Tick Trefoil	Tall Forb	Purple	June-Sept	3'-6'	Full sun	Medium to mosit clayey, loamy, and sandy soils
Eleocharis acicularis	Needle Spike Rush	Grass/Grass-like	Green	June-Oct	<1'	Full sun	Wet clayey, loamy, and sandy soils
Eleocharis obtusa	Blunt Spike Rush	Grass/Grass-like	Green	July	1'-2'	Full sun	Wet to moist clay and loam
Eleocharis palustris	Common Spike Rush	Grass/Grass-like	Green	June-Aug	0.5'-4'	Full sun	All wet soils
Elymus canadensis	Canada Wild Rye	Grass/Grass-like	Straw	July-Aug	4'-5'	Full sun	All dry to moist soils
Elymus hystrix	Bottlebrush Grass	Grass/Grass-like	Straw	June-Aug	2'-5'	Partially shaded to shaded	Dry to medium sand or loam
Elymus trachycaulus	Slender Wheatgrass	Grass/Grass-like	Straw	July-Aug	2'-4'	Full sun	Dry sand or gravel
Elymus villosus	Silky Wild Rye	Grass/Grass-like	Straw	July-Aug	1'-3'	Partially shaded to shaded	Medium to moist sand or loam
Elymus virginicus	Virginia Wild Rye	Grass/Grass-like	Straw	July-Aug	2'-4'	Full sun to full shade	Medium to moist clayey, loamy, and sandy soils
Epilobium angustifolium	Fireweed	Tall Forb	Pink	June-Sept	2'-6'	Full sun	Medium, mosit, or wet sand or loam
Epilobium ciliatum	Willow Herb	Tall Forb	White	June-Aug	3'-5'	Full to partial sun	All medium to moist soils
Equisetum arvense	Field Horsetail	Fern/Fern-like	Green		0.5'-2'	Full to partial sun	Dry to moist sand, loam, or clay
Equisetum fluviatile	Swamp Horsetail	Fern/Fern-like	Green		1'-4'	Full sun	All wet soils
Equisetum sylvaticum	Woodland Horsetail	Fern/Fern-like	Green		1'-2'	Partially shaded to shaded	Moist clay or loam
Eriophorum angustifolium	Cotton Grass	Grass/Grass-like	White	July-Aug	1'-3'	Full sun	Moist organic soil
Eupatorium maculatum	Spotted Joe-Pye Weed	Tall Forb	Pink	July-Oct	2'-7'	Full sun	All wet soils
Eupatorium perfoliatum	Boneset	Tall Forb	White	June-Oct	3'-4'	Full sun	All wet soils
Eupatorium rugosum	White Snakeroot	Tall Forb	White	July-Oct	1'-5'	Full to partial sun	All medium to moist soils

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Euphoriba corollata	Flowering Spurge	Tall Forb	White	July-Aug	2'-4'	Full sun	Dry to medium sand or loam
Euthamia graminifolia	Grass-leaved Goldenrod	Tall Forb	Yellow	July-Oct	1'-4'	Full to partial sun	Medium to mosit clayey, loamy, and sandy soils
Gentiana alba	Cream Gentian	Low Forb	White	Aug-Sept	1'-2'	Full to partial sun	Medium clayey, loamy and sandy soils
Gentiana andrewsii	Bottle Gentian	Low Forb	Blue	Aug-Oct	1'-2'	Full to partial sun	Moist to wet clayey, loamy, and sandy soils
Geranium maculatum	Wild Geranium	Low Forb	Lavender	April-June	1'-2'	Full sun to full shade	Dry to medium sand or loam
Glyceria grandis	Reed Manna Grass	Grass/Grass-like	Straw	June-July	3'-5'	Full to partial sun	All wet soils
Glyceria striata	Fowl-manna Grass	Grass/Grass-like	Straw	June-July	1'-5'	Full to partial sun	All wet soils
Helenium autumnale	Sneezeweed	Tall Forb	Yellow	Aug-Oct	2'-5'	Full sun	All wet soils
Helianthus pauciflorus	Showy Sunflower	Tall Forb	Yellow	July-Sept	2'-6'	Full sun	All dry to medium soils
Helianthus strumosus	Pale-leaved Sunflower	Tall Forb	Yellow	July-Oct	2'-6'	Full to partial sun	Dry to medium sand or loam
Heliopsis helianthoides	False Sunflower	Tall Forb	Yellow	July-Sept	2'-5'	Full sun	Dry to moist sand, loam, or clay
Heracleum lanatum	Cow Parsnip	Tall Forb	White	June-July	3'-7'	Full sun to full shade	Medium to moist clay or loam
Hierochloe hirta	Vanilla Sweet Grass	Grass/Grass-like	Straw	July-Aug	1'-2'	Full sun	Medium to moist clayey, loamy, and sandy soils
Hypericum pyramidatum	Great St. John's Wort	Tall Forb	Yellow	July-Aug	2'-5'	Full to partial sun	Moist to wet clay and loam
Iris versicolor	Blue Flag Iris	Tall Forb	Blue	June-July	2'-3'	Full to partial sun	All wet soils
Iris virginica	Southern Blue Flag Iris	Tall Forb	Blue	June-July	2'-3'	Full to partial sun	All wet soils
Juncus arcticus	Baltic Rush	Grass/Grass-like	Green	May-June	1'-3'	Full sun	Wet to moist sand or gravel
Juncus canadensis	Canada Rush	Grass/Grass-like	Green	July-Oct	1'-3'	Full sun	All wet to moist soils
Juncus dudleyi	Dudley's Rush	Grass/Grass-like	Green	May-July	1'-3'	Full to partial sun	All moist soils
Juncus effusus	Common Rush	Grass/Grass-like	Green	June-July	1'-4'	Full to partial sun	All wet soils
Juncus tenuis	Path Rush	Grass/Grass-like	Green	June-July	0.5'-2'	Full to partial sun	All moist to medium soils
Juncus torreyi	Torrey's rush	Grass/Grass-like	Green	June-Oct	1'-2'	Full sun	All moist soils
Koeleria macrantha	June Grass	Grass/Grass-like	Straw	May-June	2'-3'	Full sun	Dry sand or gravel
Liatris aspera	Rough Blazing Star	Tall Forb	Purple	Aug-Sept	2'-3'	Full sun	Dry to medium sand or loam
Lilium michiganense	Turk's-cap Lily	Tall Forb	Orange	June-Aug	3'-6'	Full to partial sun	Wet to moist loam or sand
Lilium philadelphicum	Wood Lily	Tall Forb	Orange	June-Aug	1'-3'	Full to partial sun	Dry sand or gravel
Lobelia cardinalis	Cardinal Flower	Tall Forb	Red	July-Sept	2'-5'	Full to partial sun	Moist to wet sand or loam
Lobelia siphilitica	Great Blue Lobelia	Tall Forb	Blue	July-Sept	1'-4'	Full to partial sun	Moist clayey, loamy, and sandy soils

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Lycopus americana	Water Horehound	Low Forb	White	July-Sept	1'-2'	Full sun	All wet to moist soils
Maianthemum racemosum	False Solomon's Seal	Low Forb	White	May-June	1'-3'	Full to partial sun	Medium clayey, loamy and sandy soils
Maianthemum stellatum	Starry Solomon's Seal	Low Forb	White	May-June	1'-2'	Full to partial sun	Dry to medium sand or loam
Matteuccia struthopteris	Ostrich Fern	Fern/Fern-like	Green		1'-2'	Partially shaded to shaded	Moist loamy and organic soils
Mentha arvensis	Wild Mint	Low Forb	Pink	July-Sept	0.5'-3'	Full sun	All wet to moist soils
Mertensia virginica	Virginia Bleubells	Low Forb	Blue/Pink	April-May	1'-2'	Partially shaded to shaded	All wet soils
Mimulus ringens	Monkey Flower	Low Forb	Purple	June-Aug	1'-3'	Full sun	All wet soils
Mirabilis myctaginea	Wild Four O'Clock	Low Forb	Purple	May-Sept	1'-3'	Full sun	All dry soils
Mitella diphylla	Bishop's Cap	Low Forb	White	May-June	1'-2'	Partially shaded to shaded	All dry to medium soils
Monarda fistulosa	Wild Bergamont	Tall Forb	Lavender	July-Sept	2'-4'	Full to partial sun	Dry to moist sand, loam, or clay
Oenothera biennis	Evening Primrose	Tall Forb	Yellow	June-Sept	2'-6'	Full to partial sun	Dry to medium sand,loam, or clay
Onoclea sensibilis	Sensitive Fern	Fern/Fern-like	Green		0.5'-1'	Full sun to full shade	Moist loamy and organic soils
Osmorhiza claytoni	Sweet Cicely	Low Forb	White	May-June	1'-3'	Partially shaded to shaded	Medium to moist sand and loam
Osmunda cinnamonea	Cinnamon Fern	Fern/Fern-like	Green		1'-4'	Partially shaded to shaded	Moist loamy and organic soils
Osmunda claytonia	Interrupted Fern	Fern/Fern-like	Green		1'-3'	Partially shaded to shaded	Moist loamy and organic soils
Panicum virgatum	Switchgrass	Grass/Grass-like	Straw	Aug-Sept	3'-6'	Full sun	All dry to moist soils
Pedicularis canadensis	Wood Bentony	Low Forb	Yellow	May-June	1'	Full to partial sun	Dry to moist sand, loam, or clay
Pedicularis lanceolata	Swamp Lousewort	Low Forb	Yellow	Aug-Sept	1'-3'	Full to partial sun	All wet to moist soils
Phlox divaricatua	Wild Blue Phlox	Low Forb	Blue	May-June	1'-2'	Partially shaded to shaded	Medium to moist clayey, loamy, and sandy soils
Physostegia virginiana	Obedient Plant	Low Forb	Pink	Aug-Sept	1'-2'	Full sun	Medium to moist clayey, loamy, and sandy soils
Poa palustris	Fowl Blue-Grass	Grass/Grass-like	Straw	May-July	1'-2'	Full to partial sun	Moist clayey, loamy, and sandy soils
Polygonatum biflorum	Solomon's Seal	Low Forb	White/Green	May-June	1'-3'	Partially shaded to shaded	Medium to moist clayey, loamy, and sandy soils
Pontederia cordata	Pickerel-Weed	Tall Forb	Purple	June-Sept	1'-3'	Full to partial sun	Exposed lake sediment and shallows

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Prenanthes alba	Lion's Foot	Tall Forb	White	Aug-Oct	2'-5'	Partially shaded to shaded	Dry to medium loam, sand, or gravel
Ranunculus hispidus	Swamp Buttercup	Low Forb	Yellow	May-Aug	<1'	Partially shaded to shaded	Wet to moist clayey, loamy, and organic soils
Rosa blanda	Smooth Rose	Shrub	Pink	June-July	1'-3'	Full to partial sun	Dry to medium loam, sand, or gravel
Rudbeckia hirta	Black-eyed Susan	Tall Forb	Yellow	June-Sept	1'-3'	Full to partial sun	All dry to moist soils
Rudbeckia laciniata	Wild Golden Glow	Tall Forb	Yellow	Aug-Sept	5'-8'	Full to partial sun	Moist to wet clayey, loamy, and sandy soils
Rudbeckia triloba	Brown-eyed Susan	Tall Forb	Yellow	July-Oct	2'-5'	Full to partial sun	Medium to moist sand and loam
Sagittaria latifolia	Common Arrowhead	Tall Forb	White	July-Sept	1'-4'	Full to partial sun	All wet soils
Schizachyrium scoparium	Little Blue Stem	Grass/Grass-like	Red	Aug-Oct	2'-3'	Full sun	Dry to medium sand or loam
Schoenoplectus acutus	Hard-stem Bulrush	Grass/Grass-like	Green	May-Sept	3'-9'	Full sun	All wet soils
Schoenoplectus pungens	Three-Square Bulrush	Grass/Grass-like	Green	June-Sept	2'-5'	Full sun	Wet to moist sandy or loamy soils
Schoenoplectus tabernaemontani	Soft-stem Bulrush	Grass/Grass-like	Green	May-Sept	3'-8'	Full sun	All wet soils
Scirpus atrovirens	Dark-green Bulrush	Grass/Grass-like	Green	June-Aug	3'-5'	Full to partial sun	Wet to moist clayey, loamy, and sandy soils
Scirpus cyperinus	Wool Grass	Grass/Grass-like	Green	June-Sept	3'-5'	Full sun	All moist soils
Scirpus pendulus	Red Bulrush	Grass/Grass-like	Green	May-July	2'-4'	Full sun	All wet to moist soils
Scuttellaria lateriflora	Mad Dog Skull Cap	Low Forb	Purple	June-Sept	1'-2'	Partially shaded to shaded	All wet to moist soils
Solidago flexiculis	Zigzag Goldenrod	Tall Forb	Yellow	Aug-Sept	2'-4'	Full to partial sun	All dry to medium soils
Solidago nemoralis	Old Field Goldenrod	Tall Forb	Yellow	June-Oct	1'-3'	Full to partial sun	Dry sand or gravel
Solidago speciosa	Showy Goldenrod	Low Forb	Yellow	Aug-Sept	1'-3'	Full to partial sun	Dry to medium sand or loam
Sparganium eurycarpum	Giant Bur-reed	Grass/Grass-like	Green	June-Aug	2'-5'	F	Wet clayey, loamy, and sandy soils
Sporobolus cryptandrus	Sand Drop-Seed	Grass/Grass-like	Straw		2'-3'	Full sun	Dry sand or gravel
Symplocarus foetidus	Skunk Cabbage	Low Forb	Green	April-May	1'-3'	Partially shaded to shaded	All moist soils
Teucrium canadense	Germander	Low Forb	Pink	July-Aug	1'-3'	Full to partial sun	Medium to wet clayey, loamy, and sandy soils
Thalictrum dasycarpum	Purple Meadow Rue	Tall Forb	White	June-July	3'-5'	Full to partial sun	All wet soils
Thalictrum dioicum	Early Meadow Rue	Tall Forb	White	May-June	2'-4'	Partially shaded to shaded	All dry to medium soils
Thelypteris palustris	Marsh Fern	Fern/Fern-like	Green		1'-2'	Full to partial sun	Wet to moist loamy and organic soils

Scientific Name	Common Name	Vegetation Type	Color	Bloom Period	Height	Sun	Soil
Trillium cernuum	Nodding Trililium	Low Forb	White	May-June	0.5'-2'	Partially shaded to shaded	Medium to moist clayey, loamy, and organic soils
Triosteum perfoliatum	Feverwort	Tall Forb	Purple	May-July	2'-4'	Partially shaded to shaded	Medium to dry clayey and loamy soils
Verbena hastata	Blue Vervain	Tall Forb	Blue	July-Sept	3'-6'	Full sun	All wet soils
Verbena stricta	Hoary Vervain	Tall Forb	Blue	July-Sept	2'-4'	Full sun	Dry to medium sand or loam
Vila pedata	Birdsfoot Violet	Low Forb	Blue/Purple	April-June	0.5'	Full to partial sun	Dry sand or gravel
Viola labradorica	Labrador Violet	Low Forb	Lavender	June-Aug	0.5'	Full to partial sun	Dry to medium sand or loam
Zizia aurea	Golden Alexander	Low Forb	Yellow	May-July	1'-2'	Full sun to full shade	All wet soils

Trees and shrubs sold by Wisconsin nurseries that are native to Manitowoc County

Scientific Name	**Common Name**	**Vegetation Type**	**Height**	**Sun**	**Soil**
Abies balsamea	Balsam Fir	Coniferous Tree	35'-80'	Partial sun as seedling	All moist to medium soils
Acer rubrum	Red Maple	Deciduous Tree	40'-65'	Partial sun as seedling	All wet to dry soils
Acer saccharinum	Silver Maple	Deciduous Tree	60'-80'	Full to partial sun as seedling	Moist sand, loam, and clay
Acer saccharum	Sugar Maple	Deciduous Tree	60'-100'	Full to partial sun as seedling	Medium loam and clay
Alnus rugosa	Speckled Alder	Deciduous Shrub	up to 25'	Full sun to full shade	All wet to moist soils
Betula alleghaniensis	Yellow Birch	Deciduous Tree	50'-80'	Partial sun as seedling	Medium to moist loam and clay
Betula papyrifera	Paper Birch	Deciduous Tree	40'-65'	Full to partial sun as seedling	Dry to medium clayey, loamy, and sandy soils
Carya ovata	Shagbark Hickory	Deciduous Tree	60'-70'	Full to partial sun as seedling	Dry to medium sand and loam
Cephalanthus occidentalis	Button-Bush	Deciduous Shrub	up to 15'	Full to partial sun	All wet to moist soils
Cornus amomum	Silky Dogwood	Deciduous Shrub	up to 10'	Full to partial sun	All moist soils
Cornus foemina	Gray Dogwood	Deciduous Shrub	up to 15'	Full to partial sun	Moist to dry clayey, loamy, and sandy soils
Cornus stolonifera	Red-Osier Dogwood	Deciduous Shrub	up to 10'	Full to partial sun	All moist soils
Corylus cornuta	Beaked Hazelnut	Deciduous Shrub	up to 10'	Full sun	Dry to medium sand and loam
Fraxinus americana	White Ash	Deciduous Tree	50'-80'	Partial sun as seedling	Dry to medium loam
Fraxinus nigra	Black Ash	Deciduous Tree	40'-60'	Partial sun as seedling	All wet to moist soils
Fraxinus pennsylvanica	Green Ash	Deciduous Tree	40'-55'	Full to partial sun as seedling	All moist soils
Juniperus virginina	Easter Red Cedar	Coniferous Tree	30'-50'	Full to partial sun as seedling	Dry sand and gravel
Larix laricinia	Tamarack	Coniferous Tree	40'-80'	Full to partial sun as seedling	Wet to moist loamy or organic soils
Ostrya virginiana	Hophornbeam	Deciduous Tree	30'-50'	Partial sun as seedling	Dry to moist loams
Picea glauca	White Spruce	Coniferous Tree	50'-60'	Full to partial sun as seedling	Medium to moist loam or clay
Picea mariana	Black Spruce	Coniferous Tree	25'-30'	Full to partial sun as seedling	Wet to moist loamy or organic soils
Pinus banksiana	Jack Pine	Coniferous Tree	15'-40'	Full sun as seedling	Dry sand
Pinus resinosa	Red Pine	Coniferous Tree	50'-80'	Full sun as seedling	Dry sand and loam
Pinus strobus	White Pine	Coniferous Tree	80'-110'	Full to partial sun as seedling	Dry to medium sand and loam
Prunus pensylvanica	Pin Cherry	Deciduous Tree	15'-30'	Full sun as seedling	Dry sand and loam
Prunus serotina	Black Cherry	Deciduous Tree	40'-65'	Full to partial sun as seedling	Dry to medium sand and loam
Prunus virginiana	Choke Cherry	Deciduous Tree	15'-30'	Full to partial sun as seedling	Dry to medium sand and loam

Attachment 1

Scientific Name	**Common Name**	**Vegetation Type**	**Height**	**Sun**	**Soil**
Quercus alba	White Oak	Deciduous Tree	60'-80'	Full sun as seedling	Dry sand and loam
Quercus bicolor	Swamp White Oak	Deciduous Tree	50'-70'	Full to partial sun as seedling	Moist clayey, loamy and sandy soils
Quercus macrocarpa	Bur Oak	Deciduous Tree	60'-80'	Full sun as seedling	Dry to moist sand and loam
Quercus rubra	Red Oak	Deciduous Tree	65'-100'	Full to partial sun as seedling	Dry to medium sand and loam
Rhus hirta	Staghorn Sumac	Deciduous Shrub	up to 35'	Full sun	Dry to medium sand and loam
Salix exigua	Sandbar Willow	Deciduous Shrub	up to 10'	Full to partial sun	Moist clayey, loamy and sandy soils
Sambucus canadensis	Elderberry	Deciduous Shrub	up to 15'	Full to partial sun	Moist clayey and loamy soils
Spiraea alba	Meadowsweet	Deciduous Shrub	3'-7'	Full to partial sun	All wet to moist soils
Thuja occidentalis	Eastern White Cedar	Coniferous Tree	35'-50'	Full to partial sun as seedling	All moist soils
Tilia americana	Basswood	Deciduous Tree	60'-80'	Full to partial sun as seedling	Medium loam and clay
Tsuga canadensis	Eastern Hemlock	Coniferous Tree	65'-100'	Partial sun as seedling	Medium to moist loam or sand
Vaccinium angustifolium	Low-Bush Blueberry	Low Shrub	1'-2'	Full to partial sun	Dry sand and gravel
Viburnum acerifolium	Mapleleaf Viburnum	Deciduous Shrub	Up to 8'	Partially shaded to shaded	Dry to medium sand and loam
Viburnum lentago	Nannyberry	Deciduous Shrub	12'-25'	Full to partial sun	Medium to moist loam or clay
Viburnum opulus	High Bush Cranberry	Deciduous Shrub	up to 25'	Full sun to full shade	All wet to moist soils

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ATTACHMENT 2

Manitowoc County Shoreland Inventory Results

Statistical Evaluation of Manitowoc County Shoreland Evaluation

Manitowoc County Shoreland Inventory Results

Specific Name	Common Name	Lake Kasbaum	Gass	Spring	Tuma	Weyers
Acer negundo	Box-elder	X			X	
Acer rubrum	Red maple	X		X	X	X
Acer saccharum	Sugar maple	X			X	
Actaea sp.	Baneberry	X				
Alisma plantago-aquatica	Water plantain	X				
Alnus rugosa	Speckled alder	X	X	X	X	X
Anemone canadensis	Canada anemone	X				
Aquilegia canadensis	Canadian columbine	X				
Asclepias incarnata	Marsh milkweed	X	X	X	X	
Aster novae-angliea	New England Aster			X		X
Aster sp.	Aster	X		X	X	X
Athyrium filix-femina	Lady fern	X		X	X	X
Betula alleghaniensis	Yellow birch	X			X	
Betula papyrifera	Paper birch	X	X	X	X	X
Bidens spp.	Beggars tick	X	X	X	X	X
Calamagrostis canadensis	Canada blue-joint grass	X	X	X	X	
Carex bebbii	Bebb's sedge	X				
Carex comosa	Bristly sedge	X	X	X	X	X
Carex crinita	Caterpillar sedge	X				
Carex intumescens	greater bladder sedge	X				
Carex lacustris	Lake bank sedge	X				
Carex stipata	Common fox sedge	X				
Carex stricta	Tussock sedge			X		X
Ceratophylulm demersum	Coontail	X	X		X	X
Chara sp.	Muskgrass	X		X	X	X
Chelone glabra	Turtlehead			X	X	
Cicuta bulbifera	Bulbet water-hemlock		X	X		X
Comarum palustre	Marsh cinquefoil			X	X	X
Cornus stolonifera	Red-osier dogwood	X	X	X	X	X
Eleocharis palustris	Common spike rush	X				
Eleocharis sp.	Spike rush		X	X		X
Epilobium coloratum	Cinnamon willow-herb	X			X	
Equisetum arvense	Common horsetail	X				
Eupatorium maculatum	Spotted Joe-Pye-weed	X		X	X	
Eupatorium peroliatum	Boneset		X	X		
Euthamia graminifolia	Flat-top goldenrod				X	
Fraxinus nigra	Black ash	X		X	X	X
Fraxinus pennsylvanica	Green ash	X	X	X		X
Galium asperellum	Rough bedstraw		X			
Glyceria sp.	Manna grass	X				
Ilex verticillata	Winterberry				X	X
Impatiens capensis	Spotted touch-me-not	X	X	X	X	X
Iris versicolor	Northern blue flag iris	X			X	X
Juncus effusus	Soft rush	X			X	
Juncus sp.	Rush			X		
Laportea canadensis	Wood nettle	X			X	
Larix larcinia	Tamarack	X		X	X	X
Ledum groenlandicum	Labrador tea	X			X	
Leersia oryzoides	Rice cut-grass	X	X			X
Lemna minor	Lesser duckweed		X			
Lycopus uniflorus	Water horehound	X	X	X	X	X
Maianthemum canadense	Wild lilly of the valley	X				
Matteuccia struthiopteris	Ostrich fern				X	
Myriophyllum sibiricum	Northern water millfoil			X		

Specific Name	Common Name	Kasbaum	Gass	Lake Spring	Tuma	Weyers
Najas flexilis	Nodding water-nymph			X	X	
Nuphar variegata	Yellow water lilly	X	X	X	X	X
Nymphaea odorata	White water lilly	X	X	X	X	X
Onoclea sensibilis	Sensitive fern	X			X	
Osmunda claytonia	Interrupted fern					X
Osmunda regalis	Royal fern					X
Parthenocissus quinquefolia	Virginia creeper	X				
Pinus strobus	White pine	X	X	X	X	
Polygonum sp.	Smartweed	X				X
Pontedaria cordata	Pickerel weed	X		X		
Populus tremuloides	Trembling aspen	X	X		X	
Potamogeton illinoiensis	Illinois pondweed	X		X	X	
Potamogeton natans	Common pondweed			X		
Potamogeton zosterformis	Flat stem pondweed	X		X	X	X
Ribes americanum	Black currant				X	
Rosa sp.	Wild rose	X				
Sagittaria latifolia	Arorwhead	X	X	X	X	X
Salix sp.	Willow	X	X	X	X	
Schoenoplectus acutus	Hard-stem bulrush			X		
Schoenoplectus tabernaemonatani	Soft-stem bulrush		X			
Scirpus atrovirens	Black bulrush	X				
Solidago canadensis	Canada goldenrod	X				
Solidago gigantea	Giant goldenrod	X		X	X	
Sparganium eurycarpum	Giant burr-reed		X			X
Spiraea alba	Meadow sweet				X	
Stuckenia pectinata	Sago pondweed	X	X		X	X
Thalictrum sp.	Meadow-rue	X				
Thuja occidentalis	White cedar	X	X	X	X	X
Tilia americana	Basswood	X			X	
Typha latifolia	Broad-leaved cattail	X	X	X	X	X
Ulmus americana	American elm	X	X	X	X	
Urtica dioica	Stinging nettle			X		
Viburnum lentago	Nannyberry	X				
Viola sp.	Violet			X		
Vitis riparia	River bank grape	X				
Wolffia columbiana	Water meal		X			
Brasenia schreberi	Water shield				X	

Shoreland Vegetation Analysis

Overview of Methods and Results

To determine whether water chemistry and soil factors were affecting the flora of Manitowoc County Lakes, NES Ecological Services collected water samples and performed a plant inventory at five of the County's lakes. Water chemistry parameters examined included Secchi disk transparency, temperature, dissolved oxygen, field and lab pH, and field and lab specific conductance. The resulting values for each lake are shown in Table 1 of this appendix.

	Kasbaum	Gass	Spring	Tuma	Weyers	Mean	StDev
Date	9/5/2002	9/5/2002	9/6/2002	9/9/2002	9/12/2002		
Time	10:00	14:30	12:40	10:20	14:00		
Zmax (ft)	62.2	23.5	23.0	24.5	31.2	32.9	16.7
Zsample (ft)	3.0	3.0	3.0	3.0	3.0		
Secchi Disk (ft)	12.0	10.7	15.2	15.5	7.4	12.2	3.4
Temp. (°C)	23.6	23.6	23.3	24.7	23.8	23.8	0.5
D.O. (mg/l)	6.6	6.6	8.5	7.3	7.5	7.3	0.8
pH (field)	8.4	8.3	8.7	9.1	9.1	8.7	0.4
Sp. Cond. (field) (µmhos/cm)	388	519	456	184	318	373	130
Alk. (lab) (mg/l as CaCO3)	142	236	201	78	138	159	61
Sp. Cond. (lab) (µmhos/cm)	389	517	464	187	321	376	129
pH (lab)	8.3	8.3	8.4	8.4	8.8	8.5	0.2
Lake Size (Acres)	9	6	8	15	6	9	4
Predom. Shoreline Soil	vpd muck	vpd muck and pd fluvial	vpd muck	vpd muck	vpd muck		

Table 1. Water quality values detected at the five study sites.

	Kasbaum	Gass	Spring	Tuma	Weyers
Secchi Disk (ft)	0.96	0.83	0.37	0.32	0.15
Temp. (°C)	0.71	0.71	0.34	*0.09*	1
D.O. (mg/l)	0.37	0.37	0.12	1	0.79
pH (field)	0.4	0.27	0.96	0.31	0.31
Sp. Cond. (field) (µmhos/cm)	0.9	0.26	0.52	0.15	0.67
Alk. (lab) (mg/l as CaCO3)	0.78	0.21	0.49	0.18	0.73
Sp. Cond. (lab) (µmhos/cm)	0.92	0.27	0.49	0.14	0.67
pH (lab)	0.48	0.55	0.87	0.79	*0.08*

Table 2. Results of the z-score analysis. Values less than 0.1 were considered significant and are italicized.

Values that differed significantly from the mean were detected by calculating z-scores and use of a z-distribution table. The z-score is the number of standard deviations that a given value is above or below the mean. Values were considered significantly different from the mean if their z-score had a probability of less than 0.1. Z-score calculations were conducted only on water quality characteristics; therefore, parameters such as lake size or z max were not evaluated. Results of the analysis indicate that Tuma Lake was significantly warmer than the other four lakes examined in this study, and that Weyers Lake had a significantly higher pH (Table 2).

To determine if the higher temperature at Tuma Lake or the higher pH at Weyers Lake were affecting their floras, an evaluation was conducted to determine if these lakes had unique plants that were not present at any of the other sites. No plants were found only at Weyers Lake, suggesting that the higher pH value detected, although significantly different from the other sites, was not significant enough to create conditions conducive to supporting unique species.

Brassenia schreberi was only found at Tuma Lake. Although Tuma Lake did have a significantly higher temperature than the other sites, it does not seem likely that this parameter is the cause of its sole appearance. If a greater sample size had been used, it is likely that Brassenia schreberi would have been detected at more lakes.

A review of the Soil Survey of Calumet and Manitowoc Counties revealed that all of the sites are predominantly surrounded by Houghton muck, a very poorly drained organic soil, but that Gass Lake has a rather substantial area of Fluvaqunets, which are poorly drained fluvial soils. Since Gass Lake is the only site not completely surrounded by Houghton muck; it's shoreland flora was examined to determine whether the soil difference has created conditions that support species not found at the other lakes. A review of the site's shoreland flora indicates that three species were found only at Gass Lake. These species were Lemna minor, Wolfia columbiana, and Schoenoplectus tabernaemonatani. Two of these species, Lemna minor and Wolfia columbiana, are very common free floating species whose occurrence is most likely not related to the site's surrounding soil. As in the case of Brassenia schreberi, if a greater sample size had been used it is likely that these two species would have been detected at more lakes. Schoenoplectus tabernaemonatani is believed to prefer stagnant waters with mucky substrates. Since Fluvaquents are deposited by fluvial deposition and generally contain very little organic material, it is unlikely that the presence of this soil at Gass Lake accounts for the presence of Schoenoplectus tabernaemonatani. Like the other species that were found only at Gass Lake, Schoenoplectus tabernaemonatani is very widespread, and would most likely be found at other sites if a larger sample size had been used.

Due to the small sample size, it is hard to make any conclusive decisions about the results of this study; however, it appears that the shoreline vegetation of Manitowoc County is mostly influenced by broad geographic and geologic factors, such as temperature fluctuations, growing season length, soil texture, and soil drainage class, rather than geographically narrow factors such as water or soil chemistry.

References

Borman, S., R. Korth, and J. Temte. 1997. Through the Looking Glass – a Field Guide to Aquatic Plants. Wisconsin Dept. of Nat. Res., Madison, WI.

Eggers, S. and D. Reed. 1997. Wetland Plants and Plant Communities of Minnesota and Wisconsin. U. S. Army Corps of Engineers – St. Paul District, St. Paul, MN.

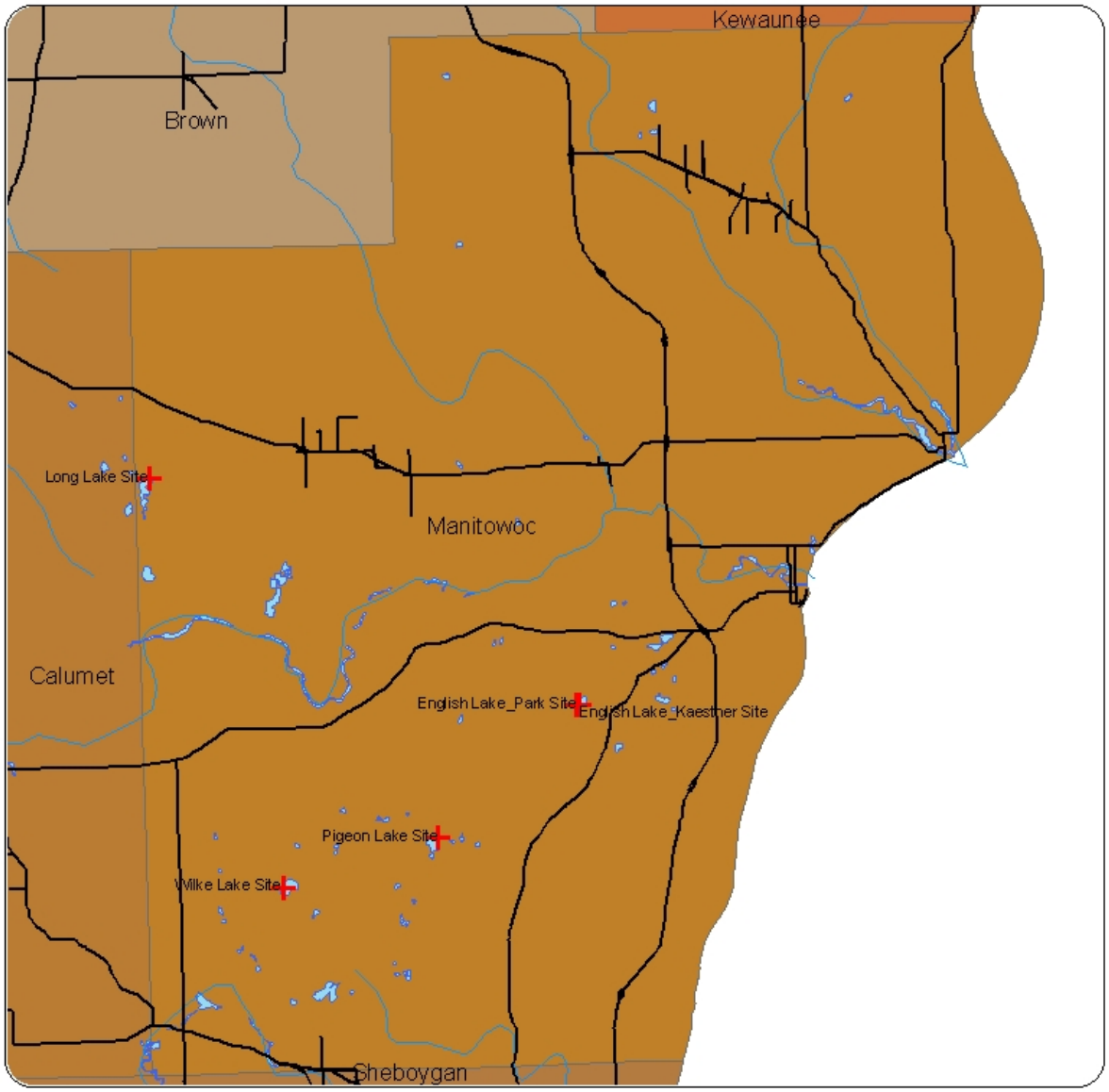
Otter, J. A. 1980. Soil Survey of Manitowoc and Calumet Counties, Wisconsin. National Cooperative Soil Survey.

Triola, M. 1994. Elementary Statistics. Addison-Wesley Publishing Company, Reading, Ma.

3

ATTACHMENT 3

Shoreland Restoration Case Study Locations



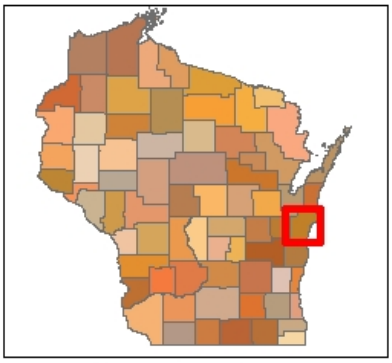
Shoreland Restoration Case Study Loactions

Legend

- Water Body
- State Highway
- Planting Sites

N
W E
S

0 1 2 4 6 8 Miles



Extent of large view shown in red.

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4

ATTACHMENT 4

Shoreland Restoration Case Study Planting Plans (English Lake-Kaestner Property, Pigeon Lake, Long Lake, and Wilke Lake)

Shoreland Restoration Case Study Planting Lists


Potential Site
KAESTER PROPERTY
LAKESHORE RESTORATION
ENGLISH LAKE, MANITOWOC COUNTY, WI
EXISTING FEATURES
SHORELINE
PROPERTY LINE
RIPRAP
N
W
E
S
10 0 10 20 Feet
NES Ecological Services
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English Lake
DOCK
BOAT-
HOUSE
HOUSE
GRASSES AND FORBES
Seeded
ANNUAL RYE (Lolium multiflorum) (Cover Crop)
CANADA WILD RYE (Elymus canadensis)
LITTLE BLUESTEM (Schizachyrium scoparium)
COLUMBINE (Aquilegia canadensis)
COMMON MILKWEED (Asclepias syriaca)
MANY-FLOWERED ASTER (Aster ericoides)
CALICO ASTER (Aster lateriflorus)
GRASS-LEAVED GOLDENROD (Euthamia graminifolia)
WILD BERGAMOT (Monarda fistulosa)
COMMON EVENING PRIMROSE (Oenothera biennis)
BLACK-EYED SUSAN (Rudbeckia hirta)
Live Plantings
WILD GERANIUM (Geranium maculatum)
LADY FERN (Athyrium felix-femina)
TREES
EXISTING TREES
SUGAR MAPLE (Acer saccharum)
RED MAPLE (Acer rubrum)
YELLOW BIRCH (Betula alleghaniensis)
WHITE PINE (Pinus strobus)
SHRUBS
AMERICAN ELDER (Sambucus canadensis)
HIGHBUSH CRANBERRY (Viburnum trilobum)
DOGWOOD OR WILLOW (Cornus sp. and Salix sp.)
EMERGENT VEGETATION
PICKEREL WEED (Pontederia cordata)
COMMON BUR-REED (Sparganium eurycarpum)
COMMON ARROWHEAD (Sagittaria latifolia)
SOFTSTEM BULRUSH (Scirpus validus)
FLOATING-LEAVED VEGETATION
WHITE WATER LILY (Nymphaea odorata)
SPATTERDOCK (Nuphar variegata)
OTHER
16" BIOLOG
englishlk_mngt_plan.apr 6/06/2002

Potential Site

LENZNER PROPERTY
LAKESHORE RESTORATION

PIGEON LAKE, MANITOWOC COUNTY, WI

EXISTING FEATURES

- POSTS
- FIRE PIT
- SHORELINE
- RETAINING WALL
- PROPERTY LINE
- FIRE HYDRANT
- LIGHT
- RIPRAP
- BOAT RAMP
- EXISTING VEGETATION

N W E S

10 0 10 20 Feet

NES Ecological Services
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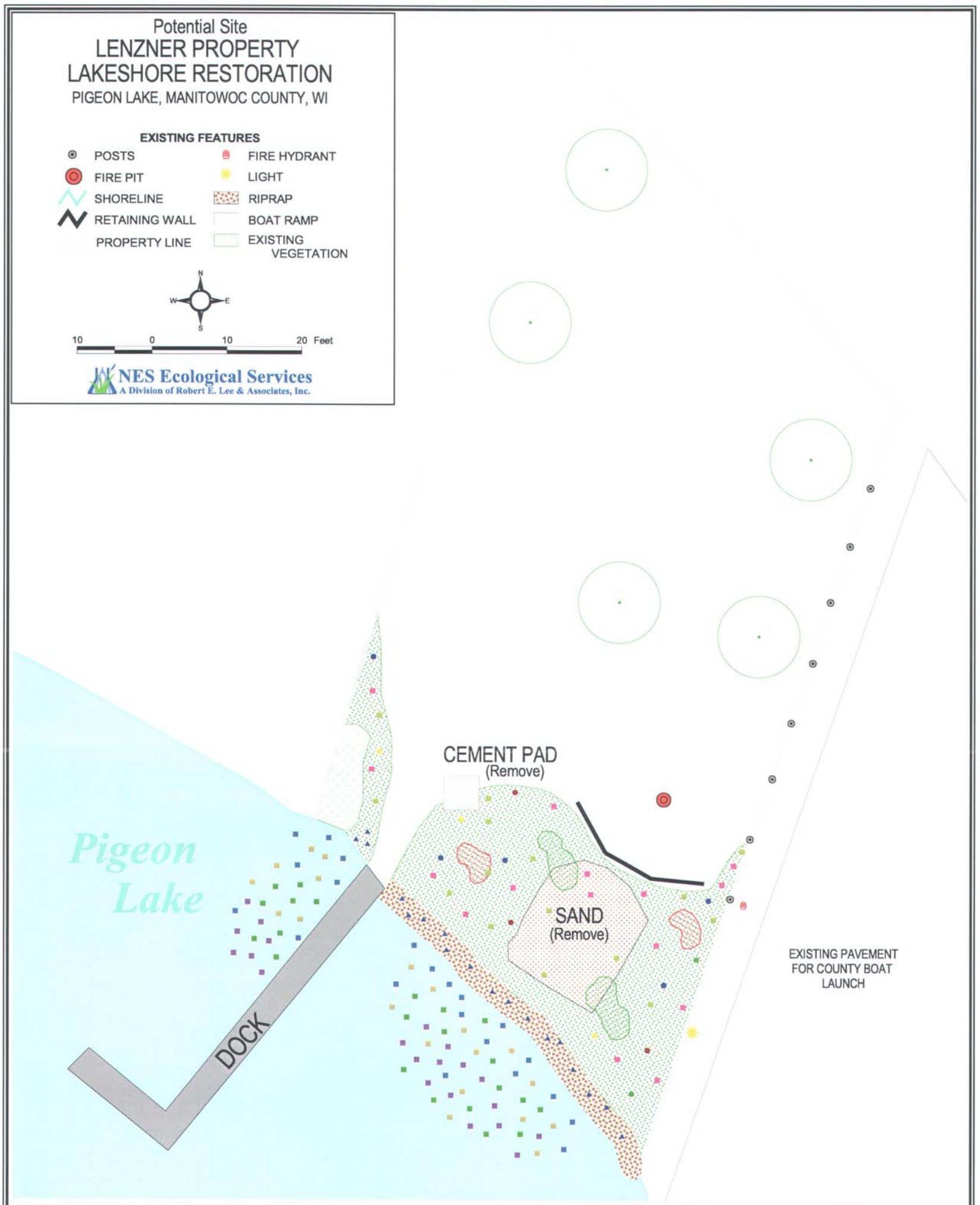

GRASSES AND FORBES

Seeded

ANNUAL RYE (Lolium multiflorum) (Cover Crop)
CANADA WILD RYE (Elymus canadensis)
LITTLE BLUESTEM (Schizachyrium scoparium)
COLUMBINE (Aquilegia canadensis)
COMMON MILKWEED (Asclepias syriaca)
MANY-FLOWERED ASTER (Aster ericoides)
CALICO ASTER (Aster lateriflorus)
GRASS-LEAVED GOLDENROD (Euthamia graminifolia)
WILD BERGAMOT (Monarda fistulosa)
COMMON EVENING PRIMROSE (Oenothera biennis)
BLACK-EYED SUSAN (Rudbeckia hirta)

Live Plantings

WILD GERANIUM (Geranium maculatum)
LADY FERN (Athyrium felix-femina)

TREES

EXISTING TREES
SUGAR MAPLE (Acer saccharum)
RED MAPLE (Acer rubrum)
YELLOW BIRCH (Betula alleghaniensis)
WHITE PINE (Pinus strobus)

SHRUBS

AMERICAN ELDER (Sambucus canadensis)
HIGHBUSH CRANBERRY (Viburnum trilobum)
DOGWOOD OR WILLOW (Cornus sp. and Salix sp.)

EMERGENT VEGETATION

PICKEREL WEED (Pontederia cordata)
COMMON BUR-REED (Sparganium eurycarpum)
COMMON ARROWHEAD (Sagittaria latifolia)
SOFTSTEM BULRUSH (Scirpus validus)

pigeonllk_mngt_plan.apr 5/24/2002

Potential Site

LONG LAKE PARK LAKESHORE RESTORATION

LONG LAKE, MANITOWOC COUNTY, WI

EXISTING FEATURES

SHORELINE

GRILL

CANOPY COVER

LONG LAKE PARK

Study Area Shown in Red

N W E S

10 0 10 20 Feet

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Long Lake

GRASSES AND FORBES

Seeded

ANNUAL RYE (Lolium multiflorum) (Cover Crop)
CANADA WILD RYE (Elymus canadensis)
LITTLE BLUESTEM (Schizachyrium scoparium)
COLUMBINE (Aquilegia canadensis)
COMMON MILKWEED (Asclepias syriaca)
MANY-FLOWERED ASTER (Aster ericoides)
CALICO ASTER (Aster lateriflorus)
GRASS-LEAVED GOLDENROD (Euthamia graminifolia)
WILD BERGAMOT (Monarda fistulosa)
COMMON EVENING PRIMROSE (Oenothera biennis)
BLACK-EYED SUSAN (Rudbeckia hirta)
EARLY MEADOW RUE (Thalictrum dioicum)
FALSE SOLOMON'S SEAL (Smilacina racemosa)

Live Plantings

WILD GERANIUM (Geranium maculatum)

LADY FERN (Athyrium felix-femina)

TREES

EXISTING TREES

SUGAR MAPLE (Acer saccharum)

RED MAPLE (Acer rubrum)

YELLOW BIRCH (Betula alleghaniensis)

WHITE PINE (Pinus strobus)

WHITE ASH (Fraxinus americana)

SHRUBS

CHOKECHERRY (Prunus virginiana)

HIGHBUSH CRANBERRY (Viburnum trilobum)

NANNY BERRY (Virburnum lentago)

DOGWOOD OR WILLOW (Cornus sp. and Salix sp.)
*As Needed

EMERGENT VEGETATION

PICKEREL WEED (Pontederia cordata)

COMMON BUR-REED (Sparganium eurycarpum)

COMMON ARROWHEAD (Sagittaria latifolia)

SOFTSTEM BULRUSH (Scirpus validus)

OTHER

16" BIOLOG

longlk_mngt_plan.apr 6/06/2002

Corfman/Kieffer Site
Preliminary Layout
Wilke Lake

- Existing Trees
- Mulched Area
- Shrub Planting

Live Forb Plantings

- Calico Aster
- False Solomon's Seal
- Jack in the Pulpit
- Jacob's Ladder
- Lady Fern
- Large Trillium
- Large-leaved Aster
- Ostrich Fern
- Pennsylvania Sedge
- Red Baneberry
- Sweet Joe Pye Weed
- Wild Geranium
- Wild Leek
- Wild Strawberry
- Woodland Sunflower

0 3 6 12 18 Feet

1 inch equals 9 feet

NES Ecological Services
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Attachment 4

Kaestner – English Lake Plant List

Species				Plants/
Common	**Scientific**	**Layer**	**Form**	**Ounces**
Sugar Maple (small)	*Acer saccharum*	Tree	Live	2
Sugar Maple (large)	*Acer saccharum*	Tree	Live	1
Yellow Birch	*Betula alleghaniensis*	Tree	Live	4
White Pine (small)	*Pinus strobus*	Tree	Live	2
White Pine (large)	*Pinus strobus*	Tree	Live	2
Red Maple (small)	*Acer rubrum*	Tree	Live	3
Red Maple (large)	*Acer rubrum*	Tree	Live	1
Highbush Cranberry	*Vibernum trilobum*	Shrub	Live	15
American Elder	*Sambucus canadensis*	Shrub	Live	16
Dogwood and Willow	*Cornus sp. and Salix sp.*	Shrub	Live	20
Annual Rye	*Lolium multiflorum*	Cover	Seed	16
Canada Wild Rye	*Elymus canadensis*	Forb	Seed	8
Little Bluestem	*Schizachyrium scoparium*	Forb	Seed	4
Columbine	*Aquilegia canadensis*	Forb	Seed	2
Common Milkweed	*Asclepias syriaca*	Forb	Seed	1
Many-flowered Aster	*Aster ericoides*	Forb	Seed	1
Calico Aster	*Aster lateriflorus*	Forb	Seed	1
Grass-leaved Goldenrod	*Euthamia graminifolia*	Forb	Seed	1
Wild Geranium	*Geranium maculatum*	Forb	Live	120
Wild Bergamot	*Monarda fistulosa*	Forb	Seed	2
Common Evening Primrose	*Oenothera biennis*	Forb	Seed	1
Lady Fern	*Athyrium felix-femina*	Forb	Live	35
Black-eyed Susan	*Rudbeckia hirta*	Forb	Seed	1

Aquatic Plantings				
Species				**Plants/**
Common	**Scientific**	**Community**	**Form**	**Ounces**
Softstem Bulrush	*Scirpus validus*	Emergent	Bare Root	21
Common Arrowhead	*Sagittaria latifolia*	Emergent	Bare Root	14
Common Bur-reed	*Sparganium eurycarpum*	Emergent	Bare Root	14
Pickerel Weed	*Pontederia cordata*	Emergent	Bare Root	21
White Water Lily	*Nymphaea odorata*	Floating-leaf	Tuber	15
Spatterdock	*Nuphar variegata*	Floating-leaf	Tuber	8

Lenzer – Pigeon Lake Plant List

Species				Plants/
Common	**Scientific**	**Layer**	**Form**	**Ounces**
Sugar Maple (small)	*Acer saccharum*	Tree	Live	3
Sugar Maple (large)	*Acer saccharum*	Tree	Live	2
Yellow Birch	*Betula alleghaniensis*	Tree	Live	3
White Pine (large)	*Pinus strobus*	Tree	Live	2
Red Maple (small)	*Acer rubrum*	Tree	Live	1
Red Maple (large)	*Acer rubrum*	Tree	Live	3
Highbush Cranberry	*Vibernum trilobum*	Shrub	Live	15
American Elder	*Sambucus canadensis*	Shrub	Live	15
Red-osier Dogwood	*Cornus stolonifera*	Shrub	Live	6
Gray Dogwood	*Cornus racemosa*	Shrub	Live	6
Annual Rye	*Lolium multiflorum*	Cover	Seed	16
Canada Wild Rye	*Elymus canadensis*	Forb	Seed	8
Little Bluestem	*Schizachyrium scoparium*	Forb	Seed	4
Columbine	*Aquilegia canadensis*	Forb	Seed	2
Common Milkweed	*Asclepias syriaca*	Forb	Seed	1
Many-flowered Aster	*Aster ericoides*	Forb	Seed	1
Calico Aster	*Aster lateriflorus*	Forb	Seed	1
Grass-leaved Goldenrod	*Euthamia graminifolia*	Forb	Seed	2
Wild Geranium	*Geranium maculatum*	Forb	Live	54
Wild Bergamot	*Monarda fistulosa*	Forb	Seed	2
Common Evening Primrose	*Oenothera biennis*	Forb	Seed	1
Lady Fern	*Athyrium felix-femina*	Forb	Live	18
Black-eyed Susan	*Rudbeckia hirta*	Forb	Seed	1

Aquatic Plantings				
Species				**Plants/**
Common	**Scientific**	**Community**	**Form**	**Ounces**
Softstem Bulrush	*Scirpus validus*	Emergent	Bare Root	21
Common Arrowhead	*Sagittaria latifolia*	Emergent	Bare Root	14
Common Bur-reed	*Sparganium eurycarpum*	Emergent	Bare Root	14
Pickerel Weed	*Pontederia cordata*	Emergent	Bare Root	21
White Water Lily	*Nymphaea odorata*	Floating-leaf	Tuber	15
Spatterdock	*Nuphar variegata*	Floating-leaf	Tuber	8

Long Lake – Original Plant List

Species				Plants/
Common	**Scientific**	**Layer**	**Form**	**Ounces**
Sugar Maple (small)	*Acer saccharum*	Tree	Live	11
Sugar Maple (large)	*Acer saccharum*	Tree	Live	4
Yellow Birch	*Betula alleghaniensis*	Tree	Live	9
White Pine (small)	*Pinus strobus*	Tree	Live	7
White Pine (large)	*Pinus strobus*	Tree	Live	3
Red Maple (small)	*Acer rubrum*	Tree	Live	11
Red Maple (large)	*Acer rubrum*	Tree	Live	4
White Ash	*Fraxinus americana*	Tree	Live	12
Chokecherry	*Prunus virginiana*	Shrub	Live	16
Highbush Cranberry	*Vibernum trilobum*	Shrub	Live	15
Nanny Berry	*Virburnum lentago*	Shrub	Live	16
Dogwood and Willow	*Cornus sp. and Salix sp.*	Shrub	Live	30
Annual Rye	*Lolium multiflorum*	Cover	Seed	32
Canada Wild Rye	*Elymus canadensis*	Forb	Seed	16
Little Bluestem	*Schizachyrium scoparium*	Forb	Seed	8
Columbine	*Aquilegia canadensis*	Forb	Seed	4
Common Milkweed	*Asclepias syriaca*	Forb	Seed	1
Many-flowered Aster	*Aster ericoides*	Forb	Seed	4
Calico Aster	*Aster lateriflorus*	Forb	Seed	4
Grass-leaved Goldenrod	*Euthamia graminifolia*	Forb	Seed	1
Wild Geranium	*Geranium maculatum*	Forb	Live	120
Wild Bergamot	*Monarda fistulosa*	Forb	Seed	4
Common Evening Primrose	*Oenothera biennis*	Forb	Seed	2
Lady Fern	*Athyrium felix-femina*	Forb	Live	35
Black-eyed Susan	*Rudbeckia hirta*	Forb	Seed	2
Aquatic Plantings				
Species				**Plants/**
Common	**Scientific**	**Community**	**Form**	**Ounces**
Softstem Bulrush	*Scirpus validus*	Emergent	Bare Root	50
Common Arrowhead	*Sagittaria latifolia*	Emergent	Bare Root	51
Common Bur-reed	*Sparganium eurycarpum*	Emergent	Bare Root	51
Pickerel Weed	*Pontederia cordata*	Emergent	Bare Root	50

Long Lake – Revised (Woodland) Plant List

Species			
Common	**Scientific**	**Form**	**Units**
Lady Fern	*Athyrium filix-femina*	Potted	24
Large-leaved Aster	*Aster macrophyllus*	Potted	24
Wild Strawberry	*Fragaria virginiana*	Potted	52
Wild Geranium	*Geranium maculatum*	Potted	2
False Solomon's Seal	*Smilacina racemosa*	Potted	10
Large Trillium	*Trillium grandiflorum*	Potted	27
Ostrich Fern	*Matteuccia struthiopteris*	Bareroot	30
Wild Leek	*Allium tricoccum*	2" Plug	use salvaged
Calico Aster	*Aster lateriflorus*	2" Plug	30
Sweet Joe Pye Weed	*Eupatorium purpureum*	2" Plug	40
Pennsylvania Sedge	*Carex pensylvanica*	2" Plug	130
Jack in the Pulpit	*Arisaema triphyllum*	Bareroot	30
Woodland Sunflower	*Helianthus strumosus*	Potted	32
Jacob's Ladder	*Polemonium reptans*	Potted	64

Corfman – Wilke Lake Plant List

Species				Plants/
Common	**Scientific**	**Layer**	**Form**	**Ounces**
Lady Fern	*Athyrium filix-femina*	Fern	Potted	12
Ostrich Fern	*Matteuccia struthiopteris*	Fern	Bareroot	15
Large-leaved Aster	*Aster macrophyllus*	Forb	Potted	12
Wild Strawberry	*Fragaria virginiana*	Forb	Potted	26
Wild Geranium	*Geranium maculatum*	Forb	Potted	15
False Solomon's Seal	*Smilacina racemosa*	Forb	Potted	10
Large Trillium	*Trillium grandiflorum*	Forb	Potted	15
Wild Leek	*Allium tricoccum*	Forb	2" Plug	48
Calico Aster	*Aster lateriflorus*	Forb	2" Plug	15
Sweet Joe Pye Weed	*Eupatorium purpureum*	Forb	2" Plug	20
Jack in the Pulpit	*Arisaema triphyllum*	Forb	Bareroot	15
Woodland Sunflower	*Helianthus strumosus*	Forb	Potted	22
Jacob's Ladder	*Polemonium reptans*	Forb	Potted	36
Pennsylvania Sedge	*Carex pensylvanica*	Sedge	2" Plug	65
Red-osier Dogwood	*Cornus stolonifera*	Shrub	Bareroot	5
Serviceberry	*Amelanchier arborea*	Shrub	Bareroot	9
Gray Dogwood	*Cornus racemosa*	Shrub	Bareroot	5
Black Cherry	*Prunus serotina*	Tree	Bareroot	2

English Lake Park Plant List

Common Name	Scientific Name	Quantity to be Planted
Cover Crop		
Canada Wild Rye	*Elymus canadensis*	1.0 lbs
Wild Rye	*Elymus virginicus*	1.0 lbs
Grasses/Sedges		
Little Blue Stem	*Andropogen scoparius*	2.0 oz
Blue-joint	*Calamagrostis canadensis*	4.0 oz
Rice Cutgrass	*Leersia oryzoides*	4.0 oz
Fowl Meadow Grass	*Glyceria striata*	2.0 oz
Caterpillar Sedge	*Carex crinita*	2.0 oz
Lake-Bank Sedge	*Carex lacustris*	2.0 oz
Wool-Grass	*Scirpus cyperinus*	2.0 oz
Forbs		
Spotted Joe-Pye-Weed	*Eupatorium maculatum*	2.0 oz
Boneset	*Eupatorium perfoliatum*	2.0 oz
Calico Aster	*Aster lateriflorus*	1.0 oz
Eastern Lined Aster	*Aster lanceolatus*	1.0 oz
Flat-topped Aster	*Aster umbellatus*	1.0 oz
Grass-leaved Goldenrod	*Euthamia graminifolia*	1.0 oz
Marsh Milkweek	*Asclepias incarnata*	1.0 oz
Black-eyed Susan	*Rudbeckia hirta*	2.0 oz
Smooth Goldenrod	*Solidago gigantea*	1.0 oz
Blue Vervain	*Verbena hastata*	2.0 oz
Pennsylvania Smartweed	*Polygonum pensylvanicum*	1.0 oz
Northern Blue Flag	*Iris versicolor*	1.0 oz
Trees		
Silver Maple	*Acer saccharinum*	15
Black Willow	*Salix nigra*	10
American Elm	*Ulmus americana*	5
Shrubs		
Common Elder	*Sambucus canadensis*	12
Red-osier Dogwood	*Cornus stolonifera*	12
Emergent/Aquatic		
Softstem bullrush	*(Scirpus validus)*	133
Common arrowhead	*Sagitaria latifolia*	89
Burreed	*Sparganium eurycarpum*	89
Wild-Rice	*Zizania aquatica*	133
Water lilly	*various*	70
Pickerel weed	*Pontedaria cordata*	105

5

ATTACHMENT 5

Education Component
MCLA Presentations
Sy Lake Presentation

Manitowoc County LCD

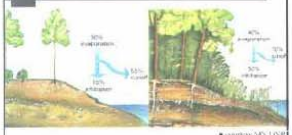
NES Ecological Services
A Division of Robert E. Lee & Associates, Inc.

UW Extension

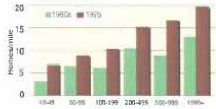
Manitowoc Co. Lakes Project

- Presentation summary
  - Lakeshore issues
  - Lake Planning Grant

Riparian zone influence



Lakeshore Homes: Changes in Density



Undeveloped – Agr., Ort. phosphorus sediment runoff model

- maple-beech forest
- 6% slope to lake
- sandy loam soil

1990s development – Agr., Ort. phosphorus sediment runoff model

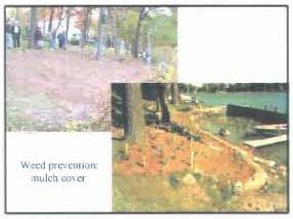
- maintained lawn, soil graded
- 6% slope to lake
- home 3,350 ft² perimeter
- paved drive 770 ft²

Shoreland green frog trends

1

Restoring shorelines

- Wave breaks
- Animal protection
- Erosion control
- Plantings
- Maintenance



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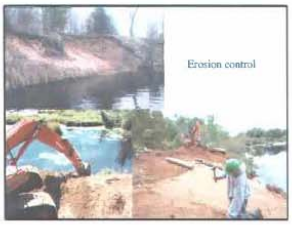


Manitowoc Co. Lakes Project

- Manitowoc County
- NES Ecological Services
- Manitowoc Co. Lakes Association
- US Fish and Wildlife Service
- Wisconsin DNR

Lake Protection Grant

- Wisconsin DNR
- Due date May 1st
- $200,000 maximum
- 75% cost share grant

Lake grant components

- Lakeshore restoration sites (6)
- Manitowoc Co. shoreland booklet

Lakeshore restoration

- Site selection (Feb-March 2001)
  - Six (6) locations
  - Public(1) and residential (5) sites
- English Lake demo (May 2001)
  - Paid for by USFWS
- Demonstration sites (April 2002)

Site selection criteria

- 50+ ft. of shoreline
- Degraded shoreline & aquatic vegetation
- Moderate wind and wave action
- Landowner profile
  - Willingness to participate
  - Patience (2-3 yr process)

3

Lake association contributions

- Landowner contacts
- Volunteer help
  - Planting
  - Maintenance
- Information dissemination
- Cost-share ($400-800 per lake) – can be in-kind services and/or cash

Shoreland booklet

- Native plant list
- Shoreland buffer information
- County lake classification system
- County shoreland ordinances
- County shoreland mitigation rules
- Contact list – public assistance

Estimated costs

Lakeshore restoration	$35,000
+ Shoreland information	$12,000
= Total project cost	$47,000
- 75% cost share (DNR)	$35,250
= Remaining costs (cash and in-kind)	$11,750

Next steps

- Pick sites
- Design and estimate costs
- Lake association approval
- Write grant
- English Lake demonstration project

4


Manitowoc County Lakes Association
Shoreland Restoration Update
Timothy A. Hoyman, CLM
NES Ecological Services


Where We Are Now
• Three sites are nearly completed
English Lake
Long Lake County Park
Pigeon Lake
• Vegetation survey of undeveloped lakes
Kasbauer Lake
Weyers Lake
Tuma Lake
Gass Lake
Spring Lake


Where We Are Going
• Three restoration sites next spring/summer
Wilke Lake
Carstens Lake
Cedar Lake
• Manitowoc County Shoreland Zoning and Restoration Publication

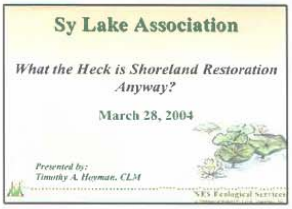






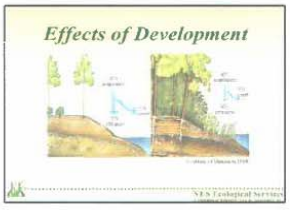



Thank You
Extension


Sy Lake Association
What the Heck is Shoreland Restoration Anyway?
March 28, 2004
Presented by:
Timothy A. Heuman, CLM

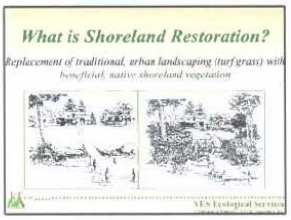

Development on Wisconsin Lakes


78% of 2334 people surveyed responded that natural beauty and peace and quiet were the main reasons for enjoying lakes

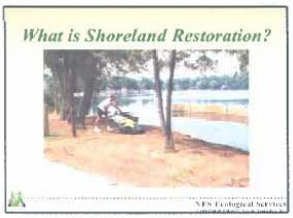

Effects of Development


Effects of Development

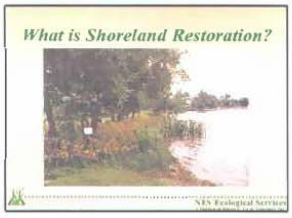

Effects of Development


What is Shoreland Restoration?


What is Shoreland Restoration?

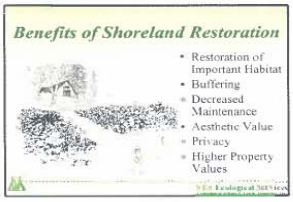

What is Shoreland Restoration?


What is Shoreland Restoration?


What is Shoreland Restoration?


What Shoreland Restoration is NOT
It is not the transformation of shoreland properties to areas that cannot be used by their owners.

•2


Benefits of Shoreland Restoration
• Restoration of Important Habitat
• Buffering
• Decreased Maintenance
• Aesthetic Value
• Privacy
• Higher Property Values


How can NES help?
• Species Determination
• Project Design
• Project Implementation
• Small Scale
• Large Scale


Thank You
Wisconsin Lakes Partnership
Extension

•3

1

Appendix 1

Manitowoc County Documents – Prepared by Manitowoc County

Proposed Lake Classification System
Proposed Shoreland Zoning Ordinances

Project Background & Grant Discussion

LAKES AND RIVERS PROJECT BACKGROUND

Manitowoc County recognizes their diverse water resources. Difficult challenges exist in managing those resources. The County submitted their application for a Lake Protection Grant from the Wisconsin Department of Natural Resources to classify their lakes and rivers. Two main reasons the County saw a need to classify the lakes and rivers, one was to deal with the high development and land use pressure on lake and river shorelines and two, to update the 1968 version of "Surface Water Resources of Manitowoc County".

The citizens of Manitowoc County met with resource management personnel at the county, state and federal level to discuss their concern about managing their water resources and the land that drains to them.

The citizens identified objectives they would like to see incorporated in the classification criteria which included: education, fisheries, land use planning and zoning, agricultural and urban land use impacts, public recreation, surface water quality and groundwater quality.

Grant Proposal

The classification system developed by Manitowoc County has been designed to address the Citizen Resource Concerns, by identifying a benchmark of the current state of condition of our lakes and river. The second element of the classification system will be to quantify these potentials through a ranking focus or an organization of information that will allow resource managers to formulate management objectives. Once the management objectives have been formulated, the last step of the project will be to focus on actions that will need to be taken by groups that either have statutory authorities to address the problems or have a vested interest to motivate those changes.

Water Resource Management has been fragmental in Manitowoc County through a patching system of different programs and many times having overlapping objectives. The Nonpoint

Watershed Programs, Lake Association Inland Lake Projects, Town Land Use Planning, Shoreland Flood Plain Zoning, USDA Wetland Restoration, Conservation Reserve Program, and Stewardship Easements are all examples of the tools being applied in the County. We feel the classification system will organize this chaos and focus the agencies, municipalities and organizations into directed management strategies.

As a result to this application process, we have formed a Manitowoc County Waters Team consisting of the County Soil and Water Conservation Department, County Planning and Parks Department, Natural Resource Conservation Service, DNR Fish Manager and Biologist, Fish and Game Protective Associations, and County Lakes Association. This group will be the primary stakeholders of the project and will insure the implementation of the strategies developed.

The final document will include updating the Departments "Surface Water Resources of Manitowoc County" report. The original report was done in 1968. The document will again consolidate the inventory work and compile all that is known on each lake along with the classification criteria.

PROJECT GOALS

Citizens Resource Concerns

1.) Land Use Planning Needs to Consider Water Resources

Objective: (A) Inventory the degree of development on County lakes; Identify areas of growth, scenic and natural areas, and environmental sensitive areas (habitat, spawning, buffering, flood plain).

(B) To provide County Planning & Parks Dept. and town government with the tools to develop effective zoning regulation and land use protection.

Action: (A) Shoreland Density will be ranked by number of residents per 100 ft. of frontage, to determine the shoreline development factor

(B) Lakes will be classified for their potential development: suitability for septics, zoning that allows development, availability of sewers, proximity to urbanization.

2.) Recreational Use Pressures Continue to increase between personal watercraft, large motors and boating, water skiing, fast boating, relative to sensitive spawning areas, shoreland development, passive boating, (fishing, canoeing, paddle boats, pontoon boating).

Objective: (A) Identify lakes subject to future and existing recreational conflict based on existing regulations, lake use, public facilities, and environmental sensitive areas.

(B) To assist towns, lake associations, districts with criteria, conflict resolution, and model standards for high priority lakes.

Action: (A) Lakes will be inventoried as to acreage, public access, facilities, shoreline fishing, restrooms, handicap access, parks, walkways or trails, picnic facilities, proximity to urban areas.

(B) Lakes will be classified by use pressure using the following five criteria:

(1) number of vehicle parking spaces

(2) existing ordinances will be ranked using the following criteria to measure their effectiveness in preventing conflict:

- sensitive protection, speed control, hours of operation

The criteria will be evaluated to establish a ranking of:

- adequate, needs improvement or no protection.

(3) Environmental sensitive areas such as islands, marshes (inlet/outlet), aquatic plant beds, wildlife habitats.

(4) Aesthetics = level of development, shoreline buffering

(5) Proximity to an urban environment

3.) Define a benchmark of existing aquatic resources and water quality management needs that project or improve the resource.

Objective: (A) Review existing water and land use data, and determine additional data needs to classify the current health of the waters of the County;

(B) To identify future nonpoint protection areas, activities for lake protection and planning projects, establish phosphorus reduction goals, evaluate site erosion and water quality standards, and evaluate fisheries potential.

Action: (A) Classify lakes by phosphorus sensitivity

(B) Classify lakes by their trophic state, (surface total phosphorus, secchi disc transparency, chlorophyll a)

(C) Conduct a watershed analysis of the lakes and the 10 river watersheds of the County.

(1) Watershed classification criteria:

-Livestock density
-% cropland % urban
-% wetland % soil erodibility
-% forest land % buffering

(D) Define management objective for each water resource by the Manitowoc Waters Team.

4.) Safe Drinking Water

Objective: (A) Identify areas sensitive to groundwater contamination, and develop a groundwater protection plan that identified sources of contamination and treatment as well as provide guidance to local land use planning.

Action: (A) Develop the following GIS layers to identify sensitive areas.

1. Depth to bedrock - from Wisconsin Geological Survey
2. Map the soils sensitive to leachability using the NLEAP computer model from Natural Resource Conservation Services computer service.
3. Use existing map of county-wide unused wells.
4. Develop a layer of well samples from the State/UW-Stevens Point Groundwater Center, DNR resources, and nitrate County screen tests.

5.) Education to respect all water resources – to understand the problems an to do problem solving.

Objective: (A) Improve communication, understanding and knowledge of the vulnerability of the resources of Manitowoc County;
(B + C) To take action by the following groups: town government, County Planning and Parks, County Soil and Water Conservation Department; lake organizations, County sportsmen's group, environmental groups, state and federal agencies and all user groups to improve and protect the lakes and associated resources.

Action: (A) Update "Surface Water Resource of Manitowoc County" (1968) to be utilized by sport fishermen, recreationalists, government officials, and resource agency personnel.
(B) Develop demonstration projects for model shoreland protection by the County Lakes Association and Master Gardeners.
(C) Provide training for town, county and lake organizations to identify alternatives and authorities for managing the resource that may include changes in zoning laws, lake regulations, local ordinances; and prioritization of agency work plans and resources.

WATERS CLASSIFICATION

The waters of Manitowoc County will be classified using the following classifications:

- Shoreland development density
- Watershed classification of ten river basin watersheds based on land use.
- Phosphorus sensitivity and total phosphorus comparisons between lakes.
- Trophic classification of each lake.
- Potential development classification.
- Classifications by use pressure that will also rate the existing ordinances adequacy in preventing use conflict.
- Identification of groundwater sensitive areas.

I. Shoreland management conditions will be ranked based on the number of residences/100 feet of frontage. If there were 5200 feet of frontage, 52 dwellings would be acceptable and receive a 3. Less than 52 for 5200 feet would be < three, etc. The lower the number the better the class.

2. Watershed Classification Criteria. We know from experience that land use and cover type influence water quality. Roger Bannerman from DNR has been able to correlate percentages of land use with the predictability of impacts on water quality. Manitowoc County has had five nonpoint watershed projects on ten of the river watersheds. We feel with this information we will be able to correlate the percent of cropland, wetland, woodland, buffering and erodibility with degree of water quality degradation. The County's variability will also help to develop this correlation.

With this information we hope to be able to predict the ability to influence water quality in a watershed. These analyses will facilitate landuse planning that may be needed to protect a watershed or the amount of change necessary to realize water quality.

The Soil and Water Conservation Department has a GIS system, orthophotography, digitized soil survey and ten years of digitized color slides to conduct this inventory.

3. Surface total phosphorus concentrations will be compared between lakes. A scale will be developed and a classification will be assigned. This will be the driving force behind the system that will manage phosphorus input. As an example, if a lake has a low number for phosphorus (good water quality) and high number for landuse impacting the lake; there is an immediate need for watershed improvement to protect the lakes good water quality. A high number for phosphorus in the lake (poor water quality) and high number for landuse (big impact from the watershed), management is going to take awhile and be expensive. A comparison of select lakes in Manitowoc County has been started. The project will expand the number of lakes and provide additional data.

Phosphorus (P) Sensitivity (SENS): The purpose of this analysis is to classify lakes according to their relative sensitivity to phosphorus loading and existing trophic condition. The screening identifies high quality lakes that should receive highest priority for nutrient control management. The analysis first separates lakes into two major categories: lakes that are sensitive to increased phosphorus loading (Class I) and lakes less responsive to changes in phosphorus loading (Class II). Lakes in each general classification are then subdivided into management groups based on data needs or existing water quality conditions.

Class I:
- A = existing water quality fair to excellent; potentially most sensitive to increased phosphorus loading
- B = existing water quality poor to very poor; less sensitive to increased phosphorus loading than Group A
- C = data inadequate or insufficient to assess trophic condition; classification monitoring recommended
- D = stained, dystrophic lake, or aquatic plant-dominated lakes

Class II:
- A = existing water quality fair to excellent; may not be as sensitive to phosphorus loading as Class I lakes
- B = existing water quality poor to very poor; low sensitivity to increased phosphorus loading
- C = data inadequate or insufficient to assess trophic condition
- D = stained, dystrophic lake, or aquatic plant-dominated lakes

These classification groups are used to establish appropriate management recommendations and priorities. (Taken from Manitowoc River Basin Plan-1997 WDNR.)

4. Trophic State Information (TSI) Range and Class: TSI numbers are general indicators of a lake's trophic class. There are three types of TSI's. TSI (TP) is an indicator based on the amount to total phosphorus available in the lake as indicated by lake monitoring. Phosphorus is an indicator of the amount of nutrients available for algae growth. TSI (CHL) is an indicator based on the amount of chlorophyll a (a measure of the amount of algae present) and TSI (SD) is a measure based on the secchi depth (an indicator of water clarity).

To calculate TSI's, lake data from the last 10 years can be retrieved from STORET, Self-Help Lake Monitoring Secchi depth data, Office of Inland Lake Renewal (OILR) feasibility studies and WDNR Bureau of Research data can be utilized. Wisconsin's Lakes: *A Trophic Assessment* by Martin, et. al. (1983) can be reviewed for additional trophic state information. The data can be used to make management decisions that will enhance the health of the lake.

The following equations are suggested:

$TSI(TP) = 60 - [33.2 \times (0.96\text{-}0.54 \log_{10} TP)]$

$TSI(CHL) = 60 - [33.2 \times (0.76\text{-}0.52 \log_{10} CHL\ a)]$

$TSI(SD) = 60 - (33.2 \log_{10} SD)$

Trophic Status Index (TSI) Class: Lakes can be divided into three categories based on trophic state: oligotrophic, mesotrophic, and eutrophic. These categories are general indicator of lake productivity.

Oligotrophic lakes are generally clear, cold and green of many rooted aquatic plants or large blooms of algae. Because they are low in nutrients, oligotrophic lakes generally do not support an extensive fishery of large predator fish.

Eutrophic lakes are high in nutrients. They are likely to have excessive aquatic vegetation or experience algae blooms, sometimes both. They often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow lakes are especially vulnerable to "winter kill", which can reduce the number and types of fish.

Mesotrophic lakes are in an intermediate stage between oligotrophic and eutrophic. The bottoms of these lakes are often devoid of oxygen in late summer months, limiting cold-water fish and resulting in phosphorus cycling from sediments. Lakes with a TSI $\geq$50 are generally considered eutrophic.

All lakes naturally age, or progress from being oligotrophic to eutrophic. Activities in and around lakes can accelerate this process. A TSI value of a lake or group of lakes will indicate where nutrient management is needed or possible.

5. Potential Development Classification. Many of our lakes have been developed, however, all but a few have a portion that could be developed. Currently, much of this protection is a function of who owns the property. In this next century, many of these people will pass on with no guarantee of disposal of their land holdings. The potential classification should identify which undeveloped areas will be protected naturally by wetlands, flood plains or soil suitability and which areas could develop over time.

The digitized Soil Survey allows us to establish criteria from the engineering data that would be suitable for septic systems regardless of the State Sanitary Code. Current Zoning would identify development density if and when it would occur. The Proximity to Urbanization areas would allow us to predict which lakes will be most popular or where year-round residents would be most likely to occur.

6. Use Pressure. Many lakes will be receiving even more pressure as our County's population increases. These pressures will possibly occur as: over-fishing, lack of facilities at

the boat landings, speeding, erosive wakes, noise, boat crowding with fisherman, water skiers, pontoon boats and jet skis.

Existing Town or Lake District ordinances will be evaluated as to their ability to protect spawning sites or environmental sensitive areas and use conflict such as speeding, hours of operation, and wake policies. These criteria should identify lakes that are vulnerable to conflict because current of regulations.

On the lakes that are vulnerable to conflict, we can access the potential for increased lake usage by the capacity of the boat landings and the proximity to urban centers. Other criteria such as knowing the environmental sensitive areas and the current state of aesthetics that may attract more people to the lake and will help us identify the types of conflict that may increase in the future. For example, the presence of environmentally sensitive areas may result in a conflict with nature. Overuse on a serene and natural appearing lake may result in conflicts between user groups. Knowing this will help to develop policy that meets the needs of the lake and user groups.

7. Groundwater Sensitive Areas. Manitowoc County was historically not considered an area such as the Central Sands or Door County with groundwater problems. Nitrate testing at our County Fair and well sampling in the Branch River Watershed have proven otherwise. We have found that certain areas of the County are subject to groundwater contamination.

Groundwater contamination in the Silurian Dolomite Limestone is different than other areas of the State and can be quite localized. Therefore, we feel that a local approach to defining these sensitive areas as part of this classification project is important to developing the next step of managing the resource locally.

The Wisconsin Geological Service will have completed a depth to bedrock map for the County by June, 1998. In addition to this layer, layers of well sampling test results, digitized Soil Survey, soils sensitive to nitrate leaching, and karst features in our GIS system, will help to identify a ground water sensitive area.

Once this area is identified, Manitowoc County can begin to analyze what the causes and treatment are needed to protect the groundwater resource.

Statutory Authority – How Counties Can Classify Lakes:

Manitowoc County's Shoreland Zoning Ordinance was adopted in 1967. That means that it has been 33 years since anyone has evaluated the success of the ordinance in meeting the intended purpose. This is also the first time since the Ordinance has passed that the Public has had an opportunity to be part of a revision process.

THE NAVIGABLE WATERS PROTECTION ACT., (S. 281.31 WIS. STATS.) SPECIFICALLY STATES THAT THE PURPOSE OF SHORELAND REGULATIONS SHALL BE " TO FURTHER THE MAINTENANCE OF SAFE AND HEALTHFUL CONDITIONS; PREVENT AND CONTROL WATER POLLUTION; PROTECT SPAWNING GROUNDS, FISH AND AQUATIC LIFE; CONTROL BUILDING SITES, PLACEMENT OF STRUCTURES AND LAND USES AND RESTORE SHORE COVER AND NATURAL BEAUTY".

Manitowoc County's Ordinance states its purpose is to " further the maintenance of safe and healthful conditions for human habitation; aid in prevention and control of water pollution; protect spawning beds, fish and aquatic life; minimize erosion sedimentation caused by filling, grading, lagooning, dredging, ditching, or excavation; control building sites, placement of structures, and land uses; preserve shore cover and natural beauty; protect stream channels from encroachment."

The Public Trust doctrine, found in the Wisconsin Constitution, holds that the State of Wisconsin has a duty to protect the state's navigable waters for recreation, fishing and scenic beauty.

The debate on zoning and taking of property rights has and will continue to be a contentious one. Courts have clearly established the roles of government regulations for the purpose of protecting the public interests. The process Manitowoc County has chosen is to encourage public participation in the development of an Ordinance that will recognize the needs of the public and riparian landowner. As an example, current law has assumed that nonconforming structures would some day be torn down and done away with. This has not happened in the past 33 years, therefore the new proposal recognizes the need to allow reasonable improvements to the property, but also carry out the purpose of the law to restore shoreland cover and natural beauty.

Wisconsin Department of Natural Resources in conjunction with Wisconsin Association of Lakes has helped counties secure grants for classifying lakes under NR191.

Department of Natural Resources – "Chapter NR 191 Lake Protection and Classification Grants" NR **191.01 Purpose**. The purpose of this chapter is to establish procedures for implementing a lake management and classification grant program as provided for in s. 281.69 stats. Grants made under this program will assist management units in conducting activities that will protect or improve the quality of water in lakes, the natural ecosystem of lakes or the uses of lakes.

Wisconsin Statues, Section.281.69 Lake management and classification grants and contracts.

1(m) Types of projects: The department shall develop and administer a financial assistance program to provide grants for the following 2 types of projects:

(a) Lake management projects that will improve or protect the quality of water in lakes or the quality of natural lake ecosystems.

(b) Lake classification projects that will classify lakes by use and implement protection activities for the lakes based on their classification.

Waters Team Members

The waters team was put together on suggestion of the DNR as a result of reorganization into basin teams. This reorganization caused countywide teams with an invested interest in surface water quality to form the waters team. The waters team members and the agencies in which they belong are listed in table 1-1.

Table 1-1. Waters Teams Members and the Agencies in Which They Belong.

Member	**Organization**	**Position**
Pat Blashka	Manitowoc County Fish & Game	President
Chris Zigmunt	Manitowoc Lakes Association	
Jessica Ford	Community Resource Development Agent – UW-Extension	
Steve Hogler	Dept of Natural Resources	Fisheries Biologist
Steve Surendonk	Dept of Natural Resources	Fisheries Technician
Liz Heinen	Dept of Natural Resources	Water Supply Specialist
Tim Rasman	Dept of Natural Resources	Water Quality Biologist
Mike Demske	Planning & Parks Commission	
George Gottier	Natural Resources Conservation Service	
Mike Dresen	College of Natural Resources, U.W. Stevens Point	U.W. Ext. Land Management Specialist
Dan Niquette	Aquatic Solutions, LLC	
Mark Walter	Bay-Lake Regional Planning Commission	
Michelle Yanda	Manitowoc Soil & Water Conservation Dept.	GIS Coordinator
Tom Ward	Manitowoc Soil & Water Conservation Dept.	Department Director

The function of the waters team was the concern with the water quality issues in the county. Serving as sounding boards for different projects, the waters team was to communicate teamwork between agencies, county departments, and private organizations. Over a period of about two years, 1998 and 1999, the waters team worked on classifying the lakes of Manitowoc County.

Waters Team Criteria for Lakes Classification

On October 21st, 1998, the waters team looked at a two different classification systems, shoreland classification and use pressure classification. In regards to shoreland classification, there was currently a bluff setback formula for Lake Michigan but none for streams. It was decided that one could be applied to stream bluffs. Use classification pressure would be a valuable tool to help townships flag lakes poised for more development and anticipating future problems.

The waters team looked at many other different aspects before classifying the lakes and streams. The waters team looked at existing lake ordinances and how other organizations handled use pressure. GIS maps were used to determine soil types, soil to bedrock, and to map what may be causing some of the water quality problems such as bad wells and sink holes.

The idea of fisheries/water quality classification was mentioned at the October 21st meeting. It appeared that fisheries should be considered as a classification system. Water quality was one of the four criteria under fisheries classification to be looked at. The other three criteria were habitat, over harvest, and desirable species.

After reviewing the aspects that needed to be part of the lakes classification, Tom Ward and Michelle Yanda meet on December 18th 1998 to determine what steps needed to be taken in the classification process. So starting on January 26, 1999, the waters team met to review all the different aspects, which needed to be taken into consideration when classifying the lakes of Manitowoc County.

Shoreline classification was on of the topics discussed at the meeting. Shoreline was categorized as developed, buildable, or non-buildable. Developed was defined as 100 feet of frontage with a livable structure/residence. Buildable was at least 100 feet of frontage that was not a wetland or land that was not owned by the County, State, or the Fish & Game. Non-buildable consisted of wetland, preserved land, or land that did not meet current zoning requirements. Criteria used to classify buildable land were septic suitability, building potential, & zoning. Clarification was needed on zoning and the density factor of development.

A second topic discussed at this meeting was GIS and 2nd tier development on lakes. An excellent presentation on the mapping of lake development highlighted the scoring criteria for buildable shoreline. Criteria presented included septic suitability, building potential, and zoning classification. The lakes watershed and the 1000-foot shoreland zone were also mapped. There was also discussion on home setback and near shore impact of development. Some

recommendations were to include a development potential value (# homes) if land were to be rezoned and to make that value a range.

On the topic of 2nd tier development, the main question seemed to be how to zone land in the 1000' shoreland zone to protect water quality. It was suggested that is might be more useful to look at the whole watershed and call it Watershed Development instead of 2nd tier development. Potential criteria for the watershed could be land use, cover type, and zoning. It was noted that some lakes could have a greater number of lots in the lake watershed such as Harpts Lake. One would expect a lower density of homes the further from the lake but the development of a density factor (such as the # of homes per average parcel size) for the whole watershed was suggested. As far as what may affect water quality in the watershed; buffers, impervious material, land practices, and easement incentives were mentioned. It may also be useful to look at trends and compare watersheds.

Fisheries in regards to water quality were also discussed at this meeting. Desirable species makeup was emphasized as a good way to classify lakes.

It was decided at this meeting to concentrate on the lakes with public access (17) for the shore land classification with 13 other lakes possible if time permits. The majority of the lakes would then be 10 acres or larger in size with none of the 30 lakes smaller than 6 acres.

Lastly at this meeting, a list of possible organizations to supply candidates for the Lake & River Shoreline Protection Advisory Committee was supplied

Public guidance on goals and citizen concerns which waters team follow through:

MANITOWOC COUNTY CLASSIFICATION OF LAKES AND ASSOCIATED WATER RESOURCES

	Water Resource Classification Criteria																	
							Potential for recreational overuse			Fish & wildlife populations					Potential for Nor			
Classification Systems	Size, Depth, Shape of the Lake	Watershed Size	Water Quality	Zoning Density	Suitability for Septic	Availability of Sewers	Parking Space	Quality Ordinances	Proximity to Urbanization	Environmentally Sensitive Area	Undeveloped Shoreline	Total Phosphorus	Sechi Disc	Chlorophyl l A	Livestock Density	% Cropland	% Wetland	% W
I. Shoreline Development Density	X			X		X			X		X						X	
II. Watershed Classification of 10 River Basins		X	X												X	X	X	X
III. Phosphorous Sensitivity	X	X	X		X	X			X			X				X		
IV. Trophic Classification	X											X	X	X				
V. Potential Development		X		X	X	X	X	X	X	X	X							
VI. Use Pressure				X	X	X	X	X	X									
VII. Groundwater					X											X	X	

WORK PLAN

Classification Systems	How it Will Be Conducted	By Whom
I. Shoreland Development Density	• Aerial Photos • Tax Parcels • Onsite Verification	• College Intern • Planning & Parks • Lake Association
II. Watershed Classification	• GIS Layers	• Intern • Soil & Water Dept.
III. Phosporus Sensitivity	• Storet Files • Hard Files • Self Help • Lake Mgt. Plans	• Consultant
IV. Trophic Classification	• Storet Files • Hard Files • Self Help • Lake Mgt. Plans	• Consultant
V. Potential Development	• Survey • Parks Information • State Access Guide	• Planning & Parks Dept. • DNR • Project Manager
VI. Classificaiton by Use Pressure	• Survey • Parks Information • State Access Guide	• Planning & Parks Dept. • DNR • Project Manager
VII. Identification of Groundwater Sensitive Area	• Soil & Water GIS	• Intern
VIII. Education: Demo, Publication "Surface Water Resources"	• Existing Publications • Planning & Parks • Consultants Data • GIS Layers	• Project Manager • Lakes Association • Planning & Parks Dept.
IX. Resource Management Objectives	• Consultant Data • Classification Data	• Project Manager • Waters Team

BUDGET

Who	Function	Cost
1. Consultant	• Phosphorous Sensitivity • Trophic Classification	$15,000
2. College Interns (2)	• Conduct Shoreland Density Survey • Watershed Classification Layers • Groundwater Sensitive Areas	$10,000
3. Project Manager	• Draft RFP for Consultants • Potential Development • Classification of Use Pressure • Establish Demo Sites • Draft "Publication" • Draft Final Report • Coordinate with Team	$35,000
4. Water Resources of Manitowoc County	• Publication, Layout, and Appendixes	$ 6,000
	Total	$66,000

RESOLUTION

No. 97/98-142

RESOLUTION REQUESTING A LAKE PROTECTION GRANT

TO THE CHAIRPERSON AND BOARD OF SUPERVISORS
OF MANITOWOC COUNTY, WISCONSIN

Supervisors:

WHEREAS, concerned citizens and landowners met on December 2, 1997 to identify water issues in Manitowoc County; and

WHEREAS, staff from the Department of Natural Resources (DNR), USDA Natural Resources Conservation Service (NRCS), Planning and Parks Commission, Soil and Water Conservation Department (SWCD), Manitowoc County Fish and Game Protective Association, and the County Lakes Association have formed a County Waters Team to address these public water issues; and

WHEREAS, the County Waters Team has proposed a project to identify groundwater sensitive areas of the County; analyze land use impacts on streams; and classify the Lakes in the County on their state of water quality, land use pressure and levels and types of recreational pressures; and

WHEREAS, the results of this project will be used to update the "1968 Surface Water Resources of Manitowoc County" publication, prioritize agency staff and programs, prioritize lake needs, provide information to towns and County for land use planning and zoning, and serve as a tool in making natural resource decisions; and

WHEREAS, the Manitowoc County Fish and Game Protective Association at their January 1998 meeting has budgeted $10,000 to help meet the local 25% grant match,

NOW, THEREFORE BE IT RESOLVED that the Manitowoc County Board, through the Manitowoc County Soil and Water Conservation Department, requests $64,000 in funds and assistance available from the Wisconsin Department of Natural Resources under the "Lake Protection Project Grant Program", and

HEREBY AUTHORIZES the Soil and Water Conservation Department Director to act on behalf of Manitowoc county to: submit an application to the State of Wisconsin for financial aid for lake planning purposes; sign documents; and take necessary action to undertake, direct, and complete the approved planning grant.

BE IT FURTHER RESOLVED that Manitowoc County will meet the obligations of the planning project, including timely publication of the results, and meet the obligations of the grant, including the 25% match, with a Fish & Game Association match of $10,000 and a County match of $6,000 of donated in-kind labor, services, or dollars.

Dated this 17th day of February, 1998

Respectfully submitted by the Natural Resources and Education Committee:

Robert L. Wenzel — Jane Wallander — Marie B. Kohlbeck

Robert Rasmussen — Ted Zigmunt

Adopted this 17th day of Feb., 1998.
24 Ayes 0 Noes 1 Absent
ATTEST: Dan Fischer, County Clerk

Fiscal Impact:

Requires the County to provide $6,000 of in kind services for this grant.
1998 funds are avialable in the Soil and Water Conservation Department budget
Two-thirds vote required; amends 1998 budget for $64,000 in grant funds if received.

Discussion of Lakes Classification Methodology

Consultants Report - 'Aquatic Solutions' on Lakes and Rivers

MANITOWOC COUNTY LAKE & RIVER CLASSIFICATION
Section I - Shoreline and Shoreland Watershed Management (Lakes)

OBJECTIVE:
Inventory the degree of development as well as potential development on County lakes in order to group lakes into similar management strategies thus providing County Planning and Parks Department and Town Government with the tools to develop effective zoning regulation and land use protection.

INTRODUCTION:
In formulating the strategy on how to classify the lakes in Manitowoc County it was noted that most of the lakes in the County are very similar. Other counties used criteria such as lake surface area, lake depth, shoreline shape, hydrologic type, trophic state, flushing index, and stratification factor to classify their lakes. These criteria were briefly analyzed to see if they would apply to lakes in Manitowoc County. It was found that 83% of the lakes surveyed were less than 50 acres, 95% were less than 50 feet deep, 84 % had a shoreline shape of 1.5 or less, 80% were seepage lakes, and all but two were eutrophic. A quick score based on the previously mentioned criteria using a system developed for other counties confirmed little separation/classification of Manitowoc Counties lakes.

Therefore a unique classification system was needed for Manitowoc County. It was decided by the Waters Team (a group of professionals from various agencies formed to work on the Lake Classification) to classify the lakes by four categories: Shoreland & Watershed Management, Use Pressure, Fisheries & Water Quality, and Ground Water Management.

METHODS:
Since most of the lakes in Manitowoc County are very similar in shape and size, the amount of development on the shoreline was used to classify them into groups. Only named lakes appearing on USGS Quadrant Maps (54 lakes) were chosen for the initial sample size (*Table 1*). It was later decided that lakes less than 5 acres in size would not be included in the sample unless they had public access (includes roadside access). This eliminated 15 lakes as shown in Table 1. It was also decided that lakes less than 6 feet in depth would not be included because these waters are considered wetlands by the State of Wisconsin. This eliminated one lake from the sample. Shoto Lake was eliminated because it is a flowage and Boot Lake because it is mainly in

Calumet County. Three unnamed lakes were added to the sample because they met the size & depth criteria of 5 acres and greater than 6 feet of depth (*Table 1*). The remaining 39 lakes used in the Lake Classification along with their location are shown in Table 2. Some definitions of terms that are used in the classification process follow:

Shoreland = the land surrounding the lake out to 1000 feet from the shoreline as defined by the State of Wisconsin Shoreland Zoning Ordinance.
Shoreline = the actual land that borders the lakes edge. We considered lots out to 250 feet from the actual shoreline as shoreline lots.

Developed Shoreline = Shoreline lot with a livable (year-round or seasonal) structure on it.

% Developed Shoreline = % of the whole lakes shoreline that is developed.

Non-Buildable Shoreline = Shoreline lot that is currently protected from development such as County land (boat access), State land, or land owned by the County Fish & Game Association.

% Non-Buildable Shoreline = % of the whole lakes shoreline that is non-buildable.

While analyzing the amount of development on the lakes and developing a classification matrix to group lakes with similar development patterns, two scoring system categories emerged. These categories are "Habitat & Aesthetics" which takes into consideration current development and "Potential Development."

A) Habitat and Aesthetics

The Habitat and Aesthetics Scoring System looked at current development on the lakes by analyzing and scoring two main components: the amount of developed shoreline on each lake and the density of the homes within that developed shoreline. It is generally accepted by lake owners that the more homes there are on the lake and the closer the homes are together the less aesthetically pleasing it is to live on the lake. Likewise the more homes there are on a lake and the closer the homes are together the less natural habitat there is for native wildlife due to habitat destruction. A scoring system was devised for the lakes based on the % developed shoreline and the number of homes per one hundred feet of developed shoreline. More points were given to lakes with more development and higher density homes. The scoring system is shown below:

% DEVELOPED SHORELINE

No buildable shoreline	0 Points
0 - 25 %	0 points
26 - 50 %	1 Point
51 - 75 %	2 Points
76 - 100 %	3 Points

HOMES PER 100 FEET

No buildable shoreline	0 Points

0 - .25	0 Points
.26 - .50	1 Point
.51 - .75	2 Points
.76 - 1	3 Points
> 1	4 Points

B) Potential Development

The Potential Development Scoring System looked at potential development on the lakes by analyzing and scoring three main components: **1)** % of undeveloped shoreline on the lake **2)** how much of the undeveloped shoreline was buildable or % buildable shoreline (see definition of non-buildable shoreline above) and **3)** building potential of the buildable shoreline. Component # 3, building potential, was further divided into three sections: construction potential, septic suitability, and zoning. This component thus qualifies the buildable shoreline. Construction potential and septic suitabilty were rated according to LESA (Land Evaluation Site Assessment) and took into consideration factors such as soil type, slope of the land, drainage, and flood potential. The scoring system for shoreline zoning was based on zoning districts as defined by the Manitowoc County Planning and Parks Commission. The different districts were rated on a point basis depending on the minimum required lot width and area in square feet. Shoreline districts with smaller required lot widths such as C-1 (Conservancy) and R-3 (Residential) which only require 100 feet of shoreline were given more points than A-3 (Strictly Agricultural) which can only have farm homes with 35 acres or more or A-2 (Agricultural) which requires 330 feet of shoreline. The Potential Development Scoring System is as follows with lakes that have more undeveloped buildable shoreline and zoned for residences scoring higher.

Component 1) **% UNDEVELOPED SHORELINE**

Non-Buildable	0 Points
0 - 25 %	0 Points
26 - 50 %	1 Point
51 - 75 %	2 Points
76 - 100 %	3 Points

Component 2) **% BUILDABLE SHORELINE**

Non-Buildable	0 Points
0 - 25 %	0 Points
26 - 50 %	1 Point
51 - 75 %	2 Points
76 - 100 %	3 Points

Component 3)	**CONSTRUCTION POTENTIAL**	
	Low	1 Point
	Medium	2 Points
	High	3 Points
	SEPTIC SUITABILITY	
	Poor	1 Point
	Fair	2 Points
	Good	3 Points
	ZONING	
	A-3 (35 acres)	0 Points
	A-2 (330 feet)	1 Point
	A-1 (150 feet)	2 Points
	R-1 (150 feet)	2 Points
	R-2 (120 feet)	3 Points
	R-3 (100 feet)	3 Points
	C-1 (100 feet)	3 Points

Although there can be many factors affecting development on a lake, the presence of good buildable shoreline seemed to be the main contributing factor. Everything else being equal, size of the lake could be a major factor but in Manitowoc County the larger lakes are all semi to highly developed with little buildable land remaining.

RESULTS:

A) Habitat and Aesthetics

In order to classify lakes by development, shoreline home density and developed shoreline were determined for a number of lakes. Using aerial photos of the lakes from 1991, current parcel maps, and computer based GIS maps from 1992; we determined the density of homes per 100 feet of developed shoreline, the % developed shoreline, and the % buildable shoreline for the 39 lakes.

The developed shoreline, non-buildable shoreline, and the home density (homes/100 feet of developed shoreline) for all the lakes are shown in Table 3. A development type or class was used to further describe the lakes under the category Aesthetics and Habitat.

The degree of development and the home density placed the lakes into three distinct classes: 1) Natural Lakes, 2) Semi-Developed Lakes, and 3) Highly Developed Lakes.

1) Natural Lakes

Natural Lakes have a range of 0 - 25% of the shoreline developed with low home density (Table 3). Low home density was generally from 0 through .6 homes/100 feet of developed shoreline. Many of the natural lakes are smaller lakes (< 10 acres) or if they are larger they are shallow such as Mud Lake (62 acres, 3 feet deep). Natural lakes are often surrounded by large areas of wetlands, which discouraged them from being developed in the past although development is now beginning to take place behind and right up to the borders of these wetlands (Table 4-notes). Other larger natural lakes have been protected from development by more restrictive zoning e.g. Harpt Lake or by landowners e.g. the Convent on Silver Lake.

2) Semi-Developed Lakes

Semi-Developed lakes have a combination of either high development and low home density or low development and high home density. Development ranged from 0 to 100% developed and

home density from high (> 1 home/100 feet) to low. Thus in order to fit in this class the lake either had low development and a higher home density, higher development and a lower home density, or a medium level of both development and home density. Two examples of lakes in the semi-developed class on opposite ends of the spectrum would be Grossheusch Lake and Little Pigeon Lake. Grossheusch Lake is 100 % developed due to the surrounding area being zoned A-3(strictly agriculture) with a home density of .2 homes/100 feet(Table 3) while Little Pigeon is only 25% developed due to areas of wetlands but has a home density of 1.3 homes/100 feet.

3) Highly Developed Lakes

The highly developed class of lakes had from 60 - 100% development and high home density. Only four lakes fell into this class: Cedar, Wilke, English, and Pigeon. These are four of the largest lakes in Manitowoc County that *had* the greatest potential for development.

The scoring for Habitat and Aesthetics (% developed and homes per 100 feet) is shown in Table 4.

B) Potential Development

In order to classify lakes by potential development; the % undeveloped, % buildable(Table 3), and building potential of the buildable shoreline(Table 5) were analyzed.

GIS maps with shoreline building potential and septic suitability were analyzed out to 250 feet from shore. A weighted mean for the amount of shoreline in each of the categories above was determined to the nearest quarter of a point and used in the Potential Development scoring table (Table 5). The scores for % undeveloped, % buildable, building potential, septic potential, and zoning were added together to get a total score for each lake in the Potential Development category of the scoring system (Table 5). The minimum total score possible is 0 points and the maximum 15 points. The range of scores for low potential was 5 - 9 points, moderate potential 7 - 12 points, and high potential lakes all scored 13 points. The overlap of scores is due to some unique factors for certain lakes that must be considered when looking at potential development, but are too lake specific to include in the broad classification process. These factors include but are not limited to: the width of wetland surrounding the lake, parcel size, the number of land owners, the type of landowner (e.g. the Convent on Silver Lake, the Sportsman's Club on Hartlaub Lake), and current development patterns on the lake (e.g. Wilke Lake).

C) Final Matrix

The two scoring categories, Aesthetics & Habitat and Potential Development, were then combined to place each lake in a matrix group as shown in table 6. Natural lakes were assigned to column 1, semi-developed lakes column 2, and highly developed lakes were assigned to column 3. Non-buildable lakes were assigned to row (a), lakes with low potential development to row (b), moderate potential development row (c), and high potential development row (d). The actual matrix is shown in table 7. It should be noted that potential development could change drastically with changes in zoning and this would change a lakes classification. Obviously as lakes become more developed this would change their classification also. The general lake characteristics for each matrix group are shown in Table 8. Lakes with high potential for development need more protection than lakes that are currently non-buildable. Therefore as one goes down the columns the lakes have a greater need for protection. Lakes that

are highly developed need more restoration. Therefore as one goes across the rows the lakes have a greater need for restoration. Lakes in the lower left hand box would then need the most protection while lakes in upper right the most restoration with a combination of varying degrees of the need for protection and restoration in the boxes in-between.
The lake matrix was analyzed by a group of professionals from various disciplines organized to work with the Lakes Classification Project (The Waters Team). The goal was to use the matrix to recommend management strategies for the newly grouped lakes based on the need for protection and restoration.

Section II - Shoreline and Shoreland Watershed Management (Rivers)

OBJECTIVE:
Inventory the degree of development as well as potential development on County rivers and streams in order to group rivers and streams into similar management strategies thus providing County Planning and Parks Department and Town Government with the tools to develop effective zoning regulation and land use protection.
INTRODUCTION:

The Lake Classification System was presented to the Lake and River Shoreline Protection Advisory Committee, which after several meetings made recommendations for shoreland zoning changes in order protect and restore the lakes in Manitowoc County. The committee's role was to also make recommendations concerning Lake Michigan and the County's rivers and streams. Therefore development on the main rivers and streams was analyzed in order to place them into a classification.

METHODS
The rivers and streams in Manitowoc County are not as highly developed as the highly developed lakes. Determining shoreline density on the rivers using the techniques used on the lakes would have been beyond the scope of this project due to the vast number of miles of river and streamline shoreline. Therefore shoreline development was determined using the new Manitowoc County Plat Book that was published in 1999. The Lake and River Shoreline Protection Advisory Committee had previously decided that the smaller tributaries would be classified the same as the main river and stream channels. The main rivers and streams that were analyzed are the: East and West Twin Rivers, Manitowoc River, Branch River, Sheboygan River (in Manitowoc County), Pigeon River, Silver Creek, Pine Creek, Point Creek, Fischer Creek, and Centerville Creek. Areas of development were located as small tracts (tr) in the plat book. No sections of highly developed shoreline were located within the unincorporated areas of the County. Since shoreline zoning's jurisdiction only applies to the unincorporated areas of Manitowoc County, the corporated areas were not analyzed.

RESULTS
The committee's recommendation for home density in the new zoning ordinance was .5 homes/100 feet for semi-developed shoreline and .25 homes/100 feet for natural shoreline.
Based on these levels of development, only Natural and Semi-Developed shoreline was identified on the main river and stream channels and dividing lines between the two levels of

development were recommended based on the area (small tracts) of semi-developed shoreline furthest out from the mouth of the river or stream. The data was presented to the Lake and River Shoreline Protection Advisory Committee and their recommendations are as follows:
All small tributaries including Pine, Point, Fischer, and Centerville Creeks as well as the shoreline of Lake Michigan should be classified as Natural.
As shown in table 10.

East Twin River
The East Twin River should be classified as Semi-Developed from Lake Michigan out to where it crosses East Hillcrest Road bordering Section 22 of Township 19-20 North Range 24 East Two Rivers West Plat and Section 15 of Township 20 North Range 24 East Mishicot South Plat. The portion of the East Twin River to the north of East Hillcrest Road (not including any incorporated area) shall be classified as Natural.

West Twin River
The West Twin River should be classified as Semi-Developed from Lake Michigan out to where it crosses Highway V East of Highway Q, Section 19 in T-20 N, R-23-24-E Kossuth Plat (not including any incorporated area). The portion of the West Twin River to the north and west of Highway B shall be classified as Natural.

Manitowoc River
The Manitowoc River should be classified as Semi-Developed from Lake Michigan out to where it crosses Highway J in the town of Clarksmills, Section 28 in T-19- N, R-22-E Cato Plat (not including any incorporated area). The portion of the Manitowoc River to the west of Highway J shall be classified as Natural.

Branch River
The Branch River should be classified as Semi-Developed from the Manitowoc River out to where it crosses Highway 10 near the town of Branch, Section 5 in T-19- N, R-23-E Manitowoc Rapids Plat (not including any incorporated area). The portion of the Branch River to the north of Highway 10 shall be classified as Natural.

Sheboygan River
All of the Sheboygan River in Manitowoc County should be classified as Semi-Developed.

Pigeon River
All of the Pigeon River in Manitowoc County should be classified as Natural.

Silver Creek
Silver Creek should be classified as Semi-Developed from Lake Michigan out to where it crosses Highway 151 west of Silver Lake, Section 32 in T-19- N, R-23-E Manitowoc Rapids Plat (not including any incorporated area). The portion of Silver creek to the south and west of Highway 151 shall be classified as Natural.

Appendices of tables from findings on classification

Table 1 – Original Named Lakes and 39 Classified Lakes:

Lake Name	Size (acres)	Max. Depth (feet)	Reason Dropped/ Kept	Lake Name	Size (acres)	Max. Depth (feet)	Reason Dropped/ Kept
Cedar	**142**	**21**		**Little Pigeon**	**7**	**15**	
Long	**120**	**38**		**Meeme-8**	**7**	**14**	**added**
Wilke	**95**	**21**		**Eaton Twin-S**	**7**	**21**	
Pigeon	**86**	**67**		**Weyers**	**6**	**32**	
Silver	**69**	**43**		**Gass**	**6**	**24**	
Bullhead	**67**	**40**		**Eaton Twin-N**	**6**	**24**	
Mud North	**62**	**3**		**West**	**6**	**38**	
Mud South				**Schleswig- 4**	**6**	**17**	**added**
Shoto	*55*	*11*	*flowage*	**Hidden**	**6**	**?**	
English	**51**	**80**		**Teek**	**5**	**36**	
Hartlaub	**34**	**59**					
Harpt	**31**	**54**		Scout	7	3	depth
Horseshoe	**22**	**54**		*Inch*	4	16	size
Carstens	**21**	**28**		*Little Sy*	4	20	size
Sy	**17**	**31**		*Fenske*	4	19	size
Tuma	**15**	**33**		*Peterson*	4	30	size
Schleswig-23	**15**	**10**	**added**	*Ranger*	4	3	size
Kellners	**15**	**5**		*Karsteadt*	4	26	size
Schisel	**14**	**32**		*Vetting*	4	34	size
Boot	*11*	*16*	*Calumet Cty.*	**Grosshuesch**	**3**	**33**	**access**
Hempton	**10**	**10**		*Lutzke-S*	*3*	*3*	size
Glomski	**9**	**43**		*Neumeyer*	*3*	*6*	size
Praeder	**9**	**17**		*Lutzke-N*	*2*	24	size
Kasbaum	**9**	**68**		*Bergene*	*2*	*16*	size
Shoe	**9**	**34**		*Lindeman*	*2*	*30*	size
Graf	**8**	**17**		*Steinthal*	*2*	*7*	size
Spring	**8**	**23**		**Waack**	**1**	**18**	**access**
Oschwald	**8**	**13**		*Quarry*	*1*	*6*	size
Mott	**7**	**9**		*Spring Pond*	*1*	*11*	size
BOLD = KEPT							
LIGHT = DROPPED							

Table 2 – Location of 39 Classified Lakes Used in Grouping Matrix:

	LAKE	Township	Section	USGS Quadrant
1	Schisel	Cato	13	Clarks Mills
2	Hempton	Cato	3	Whitelaw
3	Hidden	Cooperstown	8	Denmark
4	Eaton-Twin-N	Eaton	36	School Hill
5	Eaton-Twin-S	Eaton	36	School Hill
6	Oschwald	Eaton	25	Valders
7	Kellners	Franklin	3	Whitelaw
8	Harpt	Gibson	17	Larrabee
9	Mott	Gibson	17	Larrabee
10	Tuma	Gibson	17	Larrabee
11	Little Pigeon	Liberty	33	School Hill
12	Pigeon	Liberty	33	School Hill
13	Teek	Manitowoc Rapids	28	Clarks Mills
14	Silver	Manitowoc Rapids	33,34	Manitowoc
15	Horseshoe	Meeme	20	School Hill
16	Spring	Meeme	5	School Hill
17	Unnamed	Meeme	8	School Hill
18	West	Meeme	17	School Hill
19	Carstens	Newton	17	Clarks Mills
20	English	Newton	7	Clarks Mills
21	Grosshuesch	Newton	21	Clarks Mills
22	Waack	Newton	16	Clarks Mills
23	Gass	Newton	3	Manitowoc
24	Glomski	Newton	4	Manitowoc
25	Hartlaub	Newton	10	Manitowoc
26	Kasbaum	Newton	3	Manitowoc
27	Weyers	Newton	10	Manitowoc
28	Long	Rockland	6,7	Brillion
29	Bullhead	Rockland	19	Potter
30	Cedar	Schleswig	24	School Hill
31	Graf	Schleswig	15	School Hill
32	Mud - N	Schleswig	9	School Hill / Kiel
33	Mud - S	Schleswig	9	School Hill / Kiel
34	Praeder	Schleswig	15	School Hill
35	Shoe	Schleswig	16	School Hill
36	Sy	Schleswig	12	School Hill
37	Unnamed	Schleswig	23,26	School Hill
38	Unnamed	Schleswig	4	School Hill
39	Wilke	Schleswig	2	School Hill

Table 3 – Number of Shoreline Homes, Developed Shoreline, and Buildable Shoreline:

AESTHETICS AND HABITAT						BUILDING POTENTIAL					
LAKE	Perimeter(ft)	Developed(ft)	%	# Homes	#/100 ft.	Undeveloped(ft)	%	Non-Buildable(ft)	% Undev.	Buildable(ft)	% Undev.
Bullhead	6980	1114	16	10	0.9	5866	84	4071	58	1795	26
Carstens	4444	1537	35	10	0.7	2907	65	2033	46	874	20
Cedar	18184	13579	75	122	0.9	4605	25	1865	10	2741	15
Eaton Twin N	1889	0	0	0	0.0	1889	100	180	10	1708	90
Eaton Twin S	1977	598	30	6	1.0	1379	70	327	17	1054	53
English	6192	5045	81	59	1.2	1148	19	495	8	653	11
Gass	2297	225	10	2	0.9	2072	90	642	28	1430	62
Glomski	2279	100	4	1	1.0	2179	96	0	0	2179	96
Graf	2989	200	7	2	1.0	2789	93	2219	74	570	19
Grosshuesch	1333	1333	100	3	0.2	0	0	0	0	0	0
Harpt	5109	1211	24	5	0.4	3898	76	2696	53	1202	24
Hartlaub	6671	1430	21	6	0.4	5241	79	2374	36	2867	43
Hempton	3110	0	0	0	0	3110	100	3110	100	0	0
Hidden	4297	3710	86	8	0.2	587	14	0	0	587	14
Horseshoe	6231	2010	32	18	0.9	4221	68	3057	49	1164	19
Kasbaum	2285	540	24	4	0.7	1745	76	1491	65	254	11
Kellners	3698	0	0	0	0	3698	100	3698	100	0	0
Little Pigeon	2487	626	25	8	1.3	1861	75	1861	75	0	0
Long	17839	5548	31	66	1.2	12291	69	5945	33	6347	36
Meeme-8-1	1186	330	28	1	0.3	856	72	474	40	387	33
Mott	2245	0	0	0	0	2245	100	2245	100	0	0
Mud North	3356	0	0	0	0	3356	100	3356	100	0	0
Mud South	2031	0	0	0	0	2031	100	2031	100	0	0
Oschwald	2907	0	0	0	0	2907	100	0	0	2907	100
Pigeon	8653	5882	68	52	0.9	2771	32	475	5	2296	27
Prueder	2341	299	13	3	1.0	2043	87	1627	69	416	18
Schleswig-23,26	3144	0	0	0	0.0	3144	100	806	26	2338	74
Schleswig-4-11	1690	0	0	0	0.0	1690	100	401	24	1295	77
Schisel	3719	807	22	6	0.7	2912	78	1982	53	931	25
Shoe	3180	0	0	0	0.0	3180	100	1340	42	1840	58
Silver	11954	2486	21	9	0.4	9468	79	6853	57	2614	22
Spring	3251	1200	37	13	1.1	2051	63	966	30	1085	33
Sy	4326	935	22	11	1.2	3390	78	3287	76	104	2
Teek	1960	0	0	0	0.0	1960	100	1231	63	729	37
Tuma	3359	251	7	3	1.2	3108	93	1023	30	2085	62
Waack	818	0	0	0	0	818	100	0	0	818	100
West	1900	0	0	0	0	1900	100	736	39	1163	61
Weyers	1936	0	0	0	0	1936	100	1081	56	855	44
Wilke	9183	7371	80	90	1.2	1812	20	1117	12	695	8

Table 4 – Scoring for Habitat and Aesthetics:

Lake	% Developed	Score		Homes/ 100'	Score		TOTAL SCORE	CLASS	Notes
Bullhead	16	0		0.9	3		3	Semi-Developed	
Carstens	35	1		0.7	2		3	Semi-Developed	
Cedar	75	2		0.9	3		5	Highly Developed	
Eaton Twin -N	0	0		0	0		0	Natural	develop behind wetland
Eaton Twin -S	30	1		1	3		4	Semi-Developed	
English	81	3		1.2	4		7	Highly Developed	
Gass	10	0		0.9	3		3	Semi-Developed	develop behind wetland
Glomski	4	0		0.1	0		0	Natural	
Graf	7	0		1	3		3	Natural	develop behind wetland
Grossheusch	100	3		0.2	0		3	Semi-Developed	
Harpt	24	0		0.4	1		1	Natural	
Hartlaub	21	0		0.4	1		1	Natural	
Hempton	0	0		0	0		0	Natural	wetland to 250'
Hidden	86	3		0.2	0		3	Semi-Developed	
Horseshoe	32	1		0.9	3		4	Semi-Developed	
Kasbaum	24	0		0.7	2		2	Natural	
Kellners	0	0		0	0		0	Natural	wetland to 250'
Little Pigeon	25	1		1.3	4		5	Semi-Developed	develop behind wetland
Long	31	1		1.2	4		5	Semi-Developed	
Meeme-8-1	28	1		0.3	1		2	Natural	
Mott	0	0		0	0		0	Natural	wetland to 250'
Mud North	0	0		0	0		0	Natural	wetland to 250'
Mud South	0	0		0	0		0	Natural	wetland to 250'
Oschwald	0	0		0	0		0	Natural	
Pigeon	68	2		0.9	3		5	Highly Developed	
Prueder	13	0		0.1	0		0	Natural	
Schisel	22	0		0.7	2		2	Natural	
Schleswig-23,26	0	0		0	0		0	Natural	
Schleswig-4-11	0	0		0	0		0	Natural	develop behind wetland
Shoe	0	0		0	0		0	Natural	develop behind wetland
Silver	21	0		0.4	1		1	Natural	
Spring	37	1		1.1	4		5	Semi-Developed	
Sy	22	0		1.2	4		4	Semi-Developed	
Teek	0	0		0	0		0	Natural	develop behind wetland
Tuma	7	0		1.2	4		4	Semi-Developed	develop behind wetland
Waack	0	0		0	0		0	Natural	
West	0	0		0	0		0	Natural	develop behind wetland
Weyers	0	0		0	0		0	Natural	develop behind wetland
Wilke	80	3		1.2	4		7	Highly Developed	

	(whole lake)			Undevel.			Potent.	Potent.			
Grossheusch	0	0	**Grossheusch**	0	0	**Grossheusch**	-	-	-	0	**Grossheusch**
Hempton	100	0	**Hempton**	0	0	**Hempton**	-	-	-	0	**Hempton**
Kellners	100	0	**Kellners**	0	0	**Kellners**	-	-	-	0	**Kellners**
Mott	100	0	**Mott**	0	0	**Mott**	-	-	-	0	**Mott**
Mud North	100	0	**Mud North**	0	0	**Mud North**	-	-	-	0	**Mud North**
Mud South	100	0	**Mud South**	0	0	**Mud South**	-	-	-	0	**Mud South**
Hidden	14	0	**Sy**	2	0	**Waack**	1	1	0	2	**Hidden**
English	19	0	**Wilke**	8	0	**Teek**	2	2	0	4	**Harpt**
Wilke	20	0	**English**	11	0	**Carstens**	1.5	1.5	1.5	4.5	**Silver**
Cedar	25	0	**Kasbaum**	11	0	**Gass**	1.5	1.5	2	5	**Waack**
Pigeon	32	1	**Hidden**	14	0	**Graf**	1	1	3	5	**Schisel**
Spring	63	2	**Cedar**	15	0	**Harpt**	2	2	1	5	**Prueder**
Carstens	65	2	**Prueder**	18	0	**Hidden**	2	2	1	5	**Graf**
Horseshoe	68	2	**Graf**	19	0	**Kasbaum**	2	2	1	5	**Carstens**
Long	69	2	**Silver**	22	0	**Schisel**	2	2	1	5	**Cedar**
Eaton Twin -S	70	2	**Harpt**	24	0	**Silver**	1.5	1.5	2	5	**English**
Meeme-8-1	72	2	**Schisel**	25	0	**Sy**	1	1	3	5	**Kasbaum**
Little Pigeon	75	2	**Bullhead**	26	1	**Tuma**	2	2	1	5	**Sy**
Tuma	93	2	**Carstens**	26	1	**Glomski**	1.25	1.25	2.75	5.25	**Teek**
Harpt	76	3	**Pigeon**	27	1	**Horseshoe**	1.5	2	2	5.5	**Horseshoe**
Kasbaum	76	3	**Horseshoe**	28	1	**Meeme-8-1**	2	2.5	1	5.5	**Long**
Schisel	78	3	**Meeme-8-1**	33	1	**Spring**	1.25	1.25	3	5.5	**Meeme-8-1**
Sy	78	3	**Spring**	33	1	**Bullhead**	2	1.75	2	5.75	**Pigeon**
Hartlaub	79	3	**Long**	36	1	**Hartlaub**	2	2	2	6	**Spring**
Silver	79	3	**Teek**	37	1	**Prueder**	1.5	2	2.5	6	**Tuma**
Bullhead	84	3	**Little Pigeon**	38	1	**West**	3	3	0	6	**Bullhead**
Prueder	87	3	**Hartlaub**	43	1	**Long**	1.75	2	2.5	6.25	**Gass**
Gass	90	3	**Weyers**	44	1	**Eaton Twin -N**	2.75	2.75	1	6.5	**Hartlaub**
Graf	93	3	**Eaton Twin -S**	53	2	**Pigeon**	1.75	1.75	3	6.5	**Little Pigeon**
Glomski	96	3	**Shoe**	58	2	**Eaton Twin -S**	2.5	2.5	2	7	**Eaton Twin -S**
Eaton Twin -N	100	3	**West**	61	2	**Little Pigeon**	2	2	3	7	**Glomski**
Oschwald	100	3	**Gass**	62	2	**Schleswig-4**	2	3	2	7	**West**
Schleswig-23	100	3	**Tuma**	62	2	**Shoe**	2	2	3	7	**Weyers**
Schleswig-4	100	3	**Schleswig-23**	74	2	**Weyers**	2	2	3	7	**Shoe**
Shoe	100	3	**Schleswig-4**	77	3	**Wilke**	2	2	3	7	**Wilke**
Teek	100	3	**Eaton Twin -N**	90	3	**Oschwald**	2.25	3	2	7.25	**Eaton Twin -N**
Waack	100	3	**Glomski**	96	3	**Cedar**	1.75	2.75	3	7.5	**Oschwald**
West	100	3	**Oschwald**	100	3	**English**	2	3	3	8	**Schleswig-23,26**
Weyers	100	3	**Waack**	100	3	**Schleswig-23**	2	3	3	8	**Schleswig-4-11**

Table 6 – Lake Total Score and Matrix Position:

AESTHETICS & HABITAT	CLASS	Score	Matrix Column	DEVELOPMENT POTENTIAL	CLASS	Score	Matrix Row	MATRIX BOX	TOTAL SCORE
Hempton	NATURAL	0	1	Hempton	Non-Buildable	0	a	Hempton	0
Kellners	NATURAL	0	1	Kellners	Non-Buildable	0	a	Kellners	0
Mott	NATURAL	0	1	Mott	Non-Buildable	0	a	Mott	0
Mud North	NATURAL	0	1	Mud North	Non-Buildable	0	a	Mud North	0
Mud South	NATURAL	0	1	Mud South	Non-Buildable	0	a	Mud South	0
Graf	NATURAL	3	1	Grossheusch	Non-Buildable	0	a	Waack	8
Harpt	NATURAL	1	1	Graf	Low	10	b	Harpt	9
Hartlaub	NATURAL	1	1	Harpt	Low	8	b	Silver	9
Prueder	NATURAL	0	1	Prueder	Low	10	b	Prueder	10

Oschwald	NATURAL	0	1		Hartlaub	Moderate	10	c		Meeme-8-1	10
Shoe	NATURAL	0	1		Glomski	Moderate	11	c		Hartlaub	11
Weyers	NATURAL	0	1		Shoe	Moderate	12	c		West	11
Kasbaum	NATURAL	2	1		Weyers	Moderate	11	c		Glomski	11
Eaton Twin -N	NATURAL	0	1		Bullhead	Moderate	10	c		Weyers	11
Teek	NATURAL	0	1		Carstens	Moderate	6	c		Shoe	12
West	NATURAL	0	1		Gass	Moderate	10	c		Eaton Twin -N	13
Schleswig-4	NATURAL	0	1		Horseshoe	Moderate	9	c		Schleswig-4	13
Schleswig-23	NATURAL	0	1		Kasbaum	Moderate	8	c		Oschwald	13
Meeme-8-1	NATURAL	2	1		Little Pigeon	Moderate	10	c		Schleswig-23	13
Grossheusch	SEMI-DEVELOPED	3	2		Long	Moderate	9	c		Grossheusch	3
Hidden	SEMI-DEVELOPED	3	2		Spring	Moderate	9	c		Hidden	8
Bullhead	SEMI-DEVELOPED	3	2		Sy	Moderate	8	c		Carstens	9
Carstens	SEMI-DEVELOPED	3	2		Tuma	Moderate	9	c		Sy	12
Gass	SEMI-DEVELOPED	3	2		Cedar	Moderate	8	c		Gass	13
Horseshoe	SEMI-DEVELOPED	4	2		English	Moderate	8	c		Horseshoe	13
Little Pigeon	SEMI-DEVELOPED	5	2		Pigeon	Moderate	9	c		Tuma	13
Long	SEMI-DEVELOPED	5	2		Wilke	Moderate	7	c		Bullhead	13
Spring	SEMI-DEVELOPED	5	2		Eaton Twin -S	Moderate	11	c		Spring	14
Sy	SEMI-DEVELOPED	4	2		Teek	Moderate	8	c		Long	14
Tuma	SEMI-DEVELOPED	4	2		West	Moderate	11	c		Little Pigeon	15
Eaton Twin -S	SEMI-DEVELOPED	4	2		Meeme-8-1	Moderate	8	c		Eaton Twin -S	15
Cedar	HIGHLY DEVELOPED	5	3		Oschwald	High	13	d		Cedar	13
English	HIGHLY DEVELOPED	7	3		Eaton Twin -N	High	13	d		Pigeon	14
Pigeon	HIGHLY DEVELOPED	5	3		Schleswig-4	High	13	d		Wilke	14
Wilke	HIGHLY DEVELOPED	7	3		Schleswig-23	High	13	d		English	15

Table 7 - Lake Classification Grouping Matrix Box:

	Aesthetics & Habitat			
		Column 1	Column 2	Column 3
	Building Potential	**Natural Lakes 0-25 % Developed Low Home Density**	**Semi-Developed Lakes 0-100 % Developed Low/High Home Density**	**Highly Developed Lakes 60-100 % Developed**
Row A	**NON BUILDABLE**	Hemton Mott Kellners Mud North Mud South	Grossheusch	
Row B	**Low Potential Development**	Waack Schisel Harpt Graf Prueder Silver	Hidden	
Row C	**Moderate Potential Development**	Glomski West Weyers Teek Shoe Meem-8 Hartlaub Kasbaum	Carstens Horseshoe Tuma Sy Bullhead Gas Spring Little Pigeon	Cedar Wilke English Pigeon

Row D	**Development**	Schleswig-4 Schleswig-23		

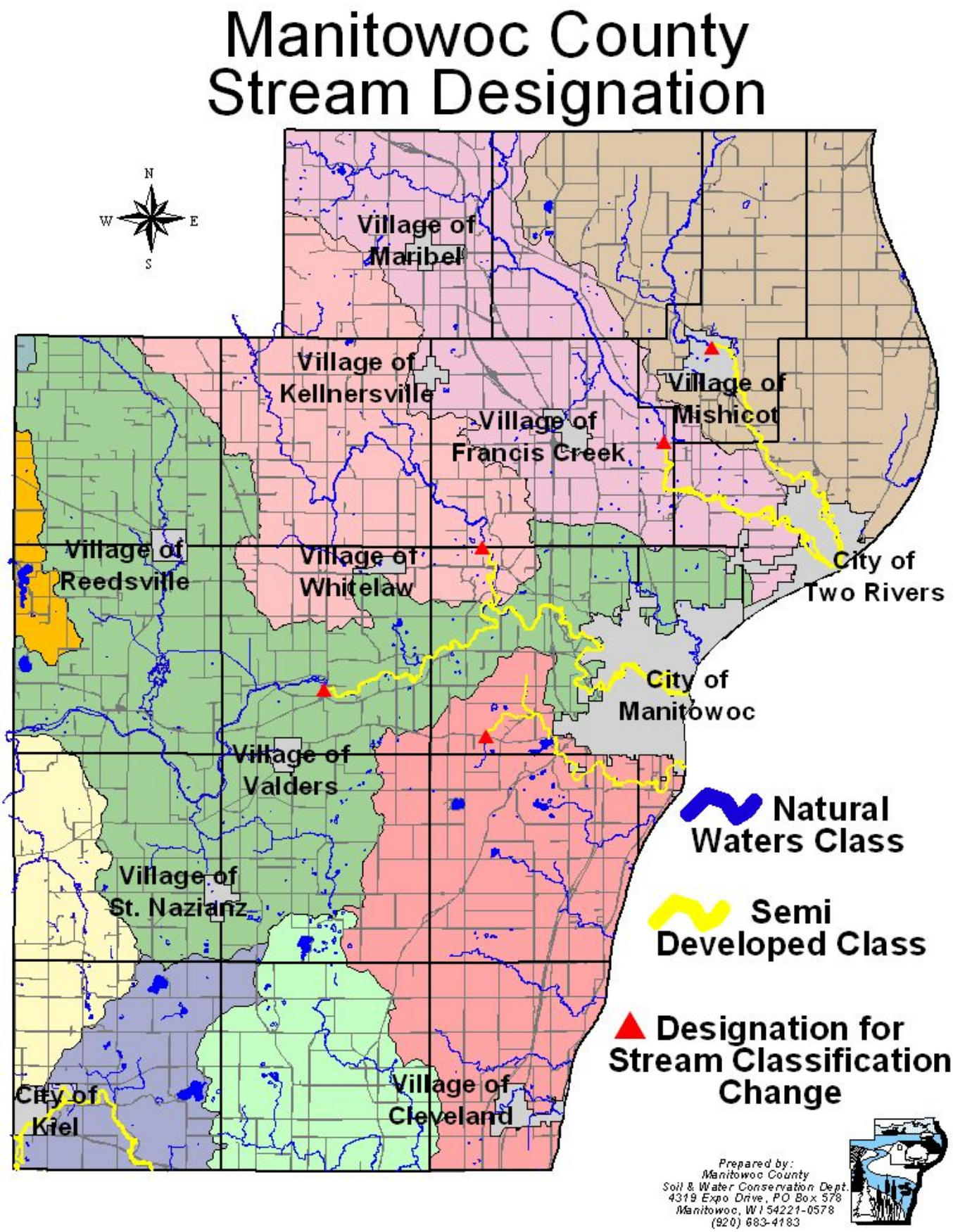
	Natural Lakes 0-25 % Developed Low Home Density	Semi-Developed Lakes 0-100 % Developed Low/High Home Density	Highly Developed Lakes 60-100 % Developed
NON BUILDABLE	▪ Undeveloped ▪ Wetland lakes ▪ Limited Potential ▪ Vulnerable behind wetland ▪ Protected to 250’	▪ 90-100% developed ▪ Low home density ▪ Protected by zoning ▪ Need protection	▪ 100% developed ▪ **NEED MOST RESTORATION**
Low Potential Development	▪ Mostly undeveloped ▪ Some slightly developed ▪ Vulnerable behind wetland ▪ Some vulnerable shoreline ▪ Need some protection	▪ 50-90% developed ▪ Low home density ▪ Protected by zoning ▪ Need protection	▪ 80-90% developed ▪ Need restoration ▪ Some protection
Moderate Potential Development	▪ Most slightly developed ▪ Some undeveloped ▪ Vulnerabel shoreline ▪ Some behind wetland ▪ Need protection	▪ 0-50% developed ▪ High home density ▪ Protection & restoration	▪ 70-80% developed ▪ Need restoration ▪ Some protection
High Potential Development	▪ Mostly undeveloped ▪ Some slightly developed ▪ Most vulnerable shoreline ▪ **NEED MOST PROTECTION**	▪ 0-50% developed ▪ High home density ▪ Protection & restoration	▪ 60-70% developed ▪ Need protection ▪ Some restoration

Table 9 – Size, Depth, and Watershed Size Classified Lake:

CLASS	Lake	Size (acres)	Max. Depth (feet)	Watershed (acres)
Natural Non-Buildable	Mud	62	3	1180
	Kellners	15	5	230
	Hempton	10	10	1680
	Mott	7	9	131
Natural Low Potential Development	Silver	69	43	11076
	Harpt	31	54	641
	Schisel	14	32	256
	Prueder	9	17	136
	Graf	8	17	220
	Waack	1	18	507
Natural Moderate Potential Development	Hartlaub	34	59	666
	Glomski	9	43	170
	Shoe	9	34	718
	Kasbaum	9	68	120
	Meeme-8-1	7	14	
	Weyers	6	32	196
	West	6	38	46
	Teek	5	36	740
Natural High Potential Development	Schleswig-23	15	10	
	Oschwald	8	13	146
	Eaton Twin -N	6	24	241
	Schleswig-4	6	17	
Semi-Developed Non-Buildable	Grossheusch	3	33	82
Semi-Developed Low Potential Development	Hidden	6	?	72
Semi-Developed Moderate Potential Development	Long	120	38	663
	Bullhead	67	40	649
	Horseshoe	22	54	1176
	Carstens	21	28	708
	Sy	17	31	2556
	Tuma	15	33	67
	Spring	8	23	49
	Little Pigeon	7	15	57
	Eaton Twin -S	7	21	241
	Gass	6	24	355
Highly Developed	Cedar	142	21	522

Moderate Potential Development	Wilke	95	21	546
	Pigeon	86	67	1270
	English	51	80	275

Table 10 – Rivers Classification:



Rivers Report & Tables - Classification of West Twin River

According to the proposed Lake & River Classification, "The West Twin River should be classified as Semi-Developed from Lake Michigan out to where it crosses Highway V East of Highway Q, Section 19 in T 20 N, R 23-24 E Kossuth Plat (not including any incorporated area). The portion of the West Twin River to the north and west of Highway B shall be classified as Natural."

The proposed semi-developed section of the West Twin was studied again to determine whether this classification is accurate.

Methods

A method other than that used for the lakes classification is necessary to measure density on the rivers and streams for several reasons.

Since streams do not have a set perimeter as lakes do, calculations related to percentage of shoreline (% Developed Shoreline and % Non-Buildable Shoreline) used in the lakes classification cannot be applied to the rivers and streams classifications.

It is also necessary to have start and end points, though somewhat arbitrary, for sections of the same stream that may be classified differently. Roads are used for dividing such sections.

The following equation is a result of methods discussion on 6/14/01.

(# of Lots / Length of Developed Shoreline in feet) * 100

Developed Shoreline is defined in this case as shoreline divided into lots. Lot lines are derived from Planning & Parks Department's plats.

Lots counted do not necessarily have structures built on them. This is in contrast to the proposed Lake Classification method, which considers Developed Shoreline to be "Shoreline lot with a livable (year-round or seasonal) structure on it." Lots are counted instead of homes because some lots do not have structures but are potential sites for future development.

RESULTS

The result of applying the above equation to the area in question on the West Twin was an average of **0.68 Lots per 100 feet of Developed Shoreline**.

The committee's recommendation:
Natural shoreline = 0.25 homes per 100 ft of shoreline
Semi-developed shoreline = 0.5 homes per 100 ft of shoreline

According to interpretation of this data, the West Twin River has been accurately classified as Semi-Developed from Lake Michigan to Highway V.

RECOMMENDATIONS

A few changes could be made in the wording and techniques used in the proposal in order to take into account potential development and the differences between lakes and streams or rivers.

Although the committee did not find any highly developed shoreline, the proposal would be more understandable if there was a limit to the semi-developed shoreline classification, thereby giving a range for each class rather than one number, as given in the Results part of Section II in the Classification document.

As discussed earlier, lots per 100 feet of Developed Shoreline rather than homes per 100 feet of Shoreline were used in calculating the level of development for the West Twin River. This method considers the possibility of those lots being built on in the future. It also calls for redefining "Developed Shoreline" or creating a separate definition in relation to streams and rivers. The new definition would describe Developed Shoreline as shoreline that is divided into lots, whereas the current definition requires that a "livable structure" be currently on the lot for it to be developed.

Discussion of Advisory Committee

Advisory Committee Members

In March of 1999, 26 individuals were asked to serve on the Lake and River Shoreline Protection Advisory Committee. Individuals were selected from certain stake-holding organizations with an invested interest in the water quality of Manitowoc County. Each stakeholder was asked to suggest a representative to serve on the Advisory Committee. Committee members represented all of the County lakes associations, farmers adjacent to the lakes, realtors, sportsman's clubs, river riparian landowners, town and city government, and two committee members of the County Board. The Advisory Committee members and the organizations they represented are listed in table 3-1.

Table 3-1. Lake and River Shoreline Protection Advisory Committee Members

MEMBER	ORGANIZATION
Scott Krueger	Long Lake Association
Eric Barlament	Long Lake Association
Carol Entringer	English Lake Association
Wilfred Gries	Bullhead Lake Association
Bill Seibold	Wilke Lake Association
Peggy Lenz	Pigeon Lake Association
Robert W. Christian	Horseshoe Lake Water Improv. Assoc
Brian Robley	County Lake Association
Al Meyer	County Lake Association
Diana Johnston	Realtor
Jay Brindle	Realtor
Jim Koeppel	Fish & Game Association
Terry Busse	Fish & Game Association
Chad Johnson	Fish Organization
Randy Junk	Fish Organization
George Herrmann	Towns Association
Randy Brandes	Towns Association
Edward Spurney	Planning & Park Commission

Robert Rasmussen	Natural Resource & Ed Committee
Leroy Waack, Jr.	Landowner – Agriculture
Clyde Satori	Landowner – Agriculture
Mrs. Charles Spring	Riparian Landowner – River System
Hans Pearson	Silver Lake College
John Schueler	Newton Township
Nic Levendusky	City of Manitowoc - Planning

After these individuals agreed to serve on the Advisory Committee, they attended a number of meetings at which they studied data presented from the Lake and River Classification Project to formulate criteria for Shoreland Zoning Ordinance changes and Shoreland Protection. There were a total of six meetings, all of which were held in 1999. The first meeting was March 22, followed by April 7, May 19, May 22, October 12, October 13, and the last meeting was on December 9.

Summary of Committee Meetings and Decisions

March 22, 1999 was the start of the planning process for the Lake and River Shoreland Protection Advisory Committee. The first meeting was designed to introduce the Committee to the Lake and River Classification Project. At this meeting the Committee members were informed of their goal in relation to the project.

The overall goal of the Committee was to "develop a Shoreland Protection Plan and recommendations for amending the Shoreland Zoning Ordinance". Upon completion, the Plan was to be presented to the following: Waters Team, Planning and Parks Commission, lake associations and the public at large. With this goal in mind, the Committee was given conditions of the charge:

- *The Plan will NOT be the development of individual lake protection plans*
- *Consider the impacts of existing development*
- *Plan must be administratively efficient and enforceable*
- *Rational and objectives of the plan must be clear to the public*
- *Plan must address technical assistance, informational programming, fiscal support and incentives for beneficial shoreland practices.*

Realizing the need for the Advisory Committee to fully understand natural shoreline, they were given an informative presentation. Tim Rasman, WDNR biologist, spoke to the Committee about the shallow water zone (littoral zone) and the benefits of the lake's edge for wildlife. Dan Niquette, a consulting biologist, presented information about the vegetated buffer zone. Mr. Niquette also presented the Committee with an introduction to the County Shoreline Zoning.

During the next two educational meetings (April 7 & May 19), the Committee spent time studying a variety of data. The Committee was presented with the results from the citizens' concerns for water resources. These results helped the Committee to better understand what the citizens would like to see happen with the Lakes Classification Project. Current zoning information that included the Shoreland Zoning (NR115), Flood Plain

Zoning (NR116), and other issues of zoning concern were presented to the Committee. An overview of DNR, Corp of Engineers, and town regulations was introduced to the Committee. Mike Dresen, U.W. Extension Land Management Specialist, presented tools the Committee could use for outlining shoreland management.

The following Advisory Committee meeting, which took place on Saturday, May 22nd was an extremely important and productive meeting for the Committee. The goal of this meeting was for the Committee to identify issues and concerns for the three lake classes. The Committee started by identifying large group issues and concerns:

- Current shoreland ordinances
- Relationship of Shoreland Ordinance and recommendations to town zoning
- Goal/mission statement for project
- Final product to include site design diagram and summary
- Education regarding rationale for regulations
- Education for both regarding variances
- Consistent application of regulations and enforcement
- Education and incentives for buffer restoration
- KISS – Keep it simple…..
- Get recommendations from Planning and Zoning Department
- Town and public review of recommendations
- Appropriate level of detail for this group
- Need information regarding impacts of development
- In-water restoration
- Intensity of lot development
- Water use conflicts
- Enforcement capacity
- Incentives for protection and restoration
- Compliance as a goal of enforcement
- Need a public education strategy and resources (based on good science)
- Regulations must have protection or restoration impact

Summarized and combined, the large group issues and concerns were then condensed into five categories: 1) clear goals 2) education 3) enforcement 4) simple/clear rules 5) public review.

With UW-Extension Community Resource Development Agent Jessica Ford serving as a facilitator, the Committee worked in groups to classify shoreline/shoreland hopes and fears of each lake category—natural, semi-developed, and highly developed lakes. The hopes and fears of each of these lakes classification groups are listed in tables 3-2, 3-3, and 3-4.

Table 3-2. Natural Classified Shoreline/Shoreland Hopes and Fears

	Hopes	Fears
Natural	• To keep the natural lakes as undeveloped as possible to preserve aesthetics and water quality • Lake quality and natural state are kept • To limit development of outside natural wetlands, which could contaminate such wetlands and ultimately degrade water quality in the lake	• No fishing • No hunting • Water quality and fisheries will go down hill • Development would occur on natural lakes and the process of water degradation would begin to occur • The non-enforcement of violations • Destruction of existing natural buffers during and after development • Not strong enough zoning requirements • Lot sizes are not big enough

Table 3-3. Semi-Developed Classified Shoreline/Shoreland Hopes and Fears

	Hopes	Fears
Semi-Developed	• Uniformity in zoning • Clean water forever • Protect area by zoning • That our Committee will take the lead in building a framework which upholds new approaches to maintain a healthy aquatic environment • Only single dwelling homes, no condominiums or apartments • Large lot sizes for new development • A set percent of impermeable surface • Incentives for restoration, keeping natural water frontage	• Breakdown will occur in the courage to promulgate a strong goal in the face of obstacles such as lack of enforcement, politics, lack of funds, etc. • Increased pollution • Pollution by over development • Poor water quality • Loss of fish and wildlife habitat • Developers put up condominiums/marina • Keyhole water access

Table 3-4. Highly Developed Classified Shoreline/Shoreland Hopes and Fears

	Hopes	Fears
Highly Developed	• Classification • Growth freeze • Sensitive area protection (purchase, easements, regulations) • New enforceable ordinances • I&E for public support • Restoration – habitat and water • Highly developed lakes • Erosion control • Rule enforcement • Education • Reduce runoff to lake • Restoration of lakeshore • Prevent deterioration of surface and groundwater and work toward restoration	• Lack of enforcement • Resistance to change • Demonstrate mutual interests • Ordinance adopted but not enforced • Variances undermine ordinance • Lack of town support • Existing owners and users of lakes and streams will not change attitudes or behavior • Land buyers, sellers (developers), and zoning agencies will not recognize their mutual interests

Using the information gathered from the groups, the Committee identified concerns or threats to Manitowoc County's lakes and streams. The primary concerns identified by the group to be addressed in the recommendations were:

1. Diminished water quality from over development and nonpoint pollution in the watershed,
2. Need for improved zoning criteria around lakes and streams and adequate enforcement,
3. Loss of fish and wildlife habitat,
4. Noise and light pollution, and
5. Lack of education about living on a lake and resistance of property owners to change.

Next the group went on to look at issues and solutions for dealing with restoration on lakes. **The Committee identified the three prime issues of water quality, zoning, and enforcement that needed to be addressed.**

Water quality issues:

- Chemical application to lawns and gardens
- Restriction on impervious surfaces
- Septic system maintenance
- Lawn maintenance
- Runoff regulation and construction site erosion
- Shoreline buffering
- Develop plant management – plan and site plan

Zoning issues:

- Create zoning lake district
- Incentives to encourage compliance when not subject to zoning
- Ordinances for all vegetation management
- Enforcement of non-conforming uses
- Design review prior to construction
- Raised light pollution
- Chemical application
- Mitigation to obtain compliance on grand fathered lots
- Setback regulations
- Runoff ordinances

Enforcement issues were not completed at this meeting.

After identifying the prime issues to be addressed, the Committee began studying solutions to protect these issues:

- A person or lake association acting as a liaison or clearing house for building permits
    - Variances and zoning changes
    - Require zoning authority to notice this group
- Site planning
    - Erosion control
    - Buffer zone
- Size of lots
- Setback
    - Minimum twice the current setback
    - Trees remain, shrub removal okay
    - No terracing
- Buffer zone – no cut
    - Uses half of setback
    - Activities permitted: walkway, view corridor, storage shed (size)
- Permitted uses
    - No commercial
    - No boat houses
    - Storage shed (size) okay
    - No high density livestock concentration
- Conditional uses
    - Home business
- Education
    - Publications to realtors, developers, "Living on the Edge"
    - Natural land
- Incentives – financial
- Road setback

All the information gathered at the May 22 meeting was then given to the Waters Team, a group of agency and organization representatives, to review and analyze in an effort to develop a matrix. The Waters Team also spent time reviewing other counties'

lakes classification systems in search of a helpful direction for classifying Manitowoc County's lakes.

The Waters Team held its first meeting on June 29,1999, followed by meetings on August 8, 10, 18 and October 8 to draft a vision for natural waters, semi-developed waters, and highly developed waters. As a result of the May 22 meeting, with Advisory Committee guidance, the following visions were developed for each of the lake classes

Water Visions

Natural Waters Vision

Protection Strategy

Vision: Protect the quality of water, habitat, aesthetics and tranquility of natural waters by maintaining low-density development through the use of restrictive standards for new shoreland development

Semi-Developed Waters Vision

Protection & Restoration Strategy

Vision: Protect the remaining natural shoreline area and restore the developed shoreline by establishing zoning standards for moderate density, single-family residential development, controls on runoff, and incentives and motivational initiatives.

Developed Waters Vision

Restoration Strategy

Vision: Restore the functional aspects of the shoreline buffer to provide habitat, aesthetics, and water quality protection via educational methods, incentives, and ordinances. Designate sensitive areas throughout the watershed for protection from deteriorating factors. Limit further growth of second and third tier development by establishing enforceable zoning ordinances.

The Team then developed a matrix of recommendations to accomplish each of the issues identified by the AdvisoryCommittee for May 22. This matrix of criteria was to be reviewed by the Lakes and River Shoreline Protection Advisory Committee on October 12 and 13. From this criteria list, changes for the Shoreland Zoning Ordinance will be developed.

The Lakes and River Shoreline Protection Advisory Committee reviewed the matrix developed by the Waters Team at the October 12 and 13 meetings. The Committee made the following decisions:

AGENDA ISSUES	DECISIONS MADE 10/13/99
Lake Michigan	**Placed in Natural Waters category**
River and streams	Breakdown of municipalities/dams of water classes
Storage sheds	Mail out with ideas with impervious surface
Impervious surface limitations	Mail out an option choice sheet, with one standard across the board, with setback – 2 tier approach %
Unclassified lakes	Will be placed in Natural Waters category
Non-conforming lots	

The matrix was then adjusted with the decisions from the October 12 and 13 meeting.

The final meeting of the Lakes and River Shoreline Protection Advisory Committee was held on December 9, 1999. At this meeting, the Committee completed the final recommendations of criteria for amending the Shoreline Zoning Ordinance. A final matrix was put together. The Committee also put together a table comparing the current Zoning Standards to the new proposed standards, table 3-5.

The proposed standards were finalized in February 2000 prior to the public introduction of these new standards.

There were few major changes to the matrix during the 1999 Advisory Committee meetings. The addition of boathouses was one of the changes. Due to the proposed increased setback, a compromise was made by allowing landowners to have boathouses along the shoreline. Impervious surface limitations were also changed with the matrix revisions. A total impervious surface was limited for each lot.

Table 3-5. Current Zoning Standards vs. Proposed Standards

	Current Shoreline Standards – Adopted in 1969	**NEW PROPOSAL** For Highly Developed Waters
Min. Waterfront Lot Area	R-1 43,560 sq. ft. R-2 21,780 sq. ft. R-3 15,000 sq. ft. S-1 20,000 sq. ft.	30,000 sq. ft.
Min. Lot width	R-1 150 ft. R-2 120 ft. R-3 100 ft. S-1 100 ft.	150 ft.
Shoreline Setback	75 ft.	75 ft.
Boat Houses & Storage Sheds	Boat Houses are allowed for boat storage only. Storage sheds with 75 ft. setback from OHWM*.	Boat Houses and Storage sheds permitted if greater than 25 ft. from OHWM*, smaller than 50 sq. ft. and screened by vegetation.
Vegetative Protection Area	35 ft. from waters edge	50 ft. from waters edge
View Corridor	30 ft.	30 ft. wide selective pruning and removal
Erosion Control	None	Required to submit a plan
Storm Water Management	None	Required to submit a plan
Mitigation for Non-Conforming Structures *OHWM = Ordinary High Water Mark	**None, by variance only**	**Mitigation:** TAllow reduced setback to the road TAllow reduced shoreline setback to create a 30ft. building site no closer than 25 ft. to OHWM* TAllow expansion on landward side of structure. TAllow expansion up to 1500 sq. ft. TAbandon 50 % life time valuation cap for expansion TTreat nearly non-conforming structures less restrictively than most non-compliant

Proposed Standards

The following matrix and tables are a summary of the final decisions made by the Advisory Committee. All this information was presented to the public at the open houses.

Summary of
MITIGATION REQUIREMENTS

AN APPROVED PLAN AND IMPLEMENTATION SCHEDULE, WHICH INCLUDE THE FOLLOWING, ARE REQUIRED:

Mandatory Practices:

1) Evaluate and upgrade septic.
2) Implement standard erosion and storm water runoff control measures.

Choose at least 4 points of proposed or current practices from the following:

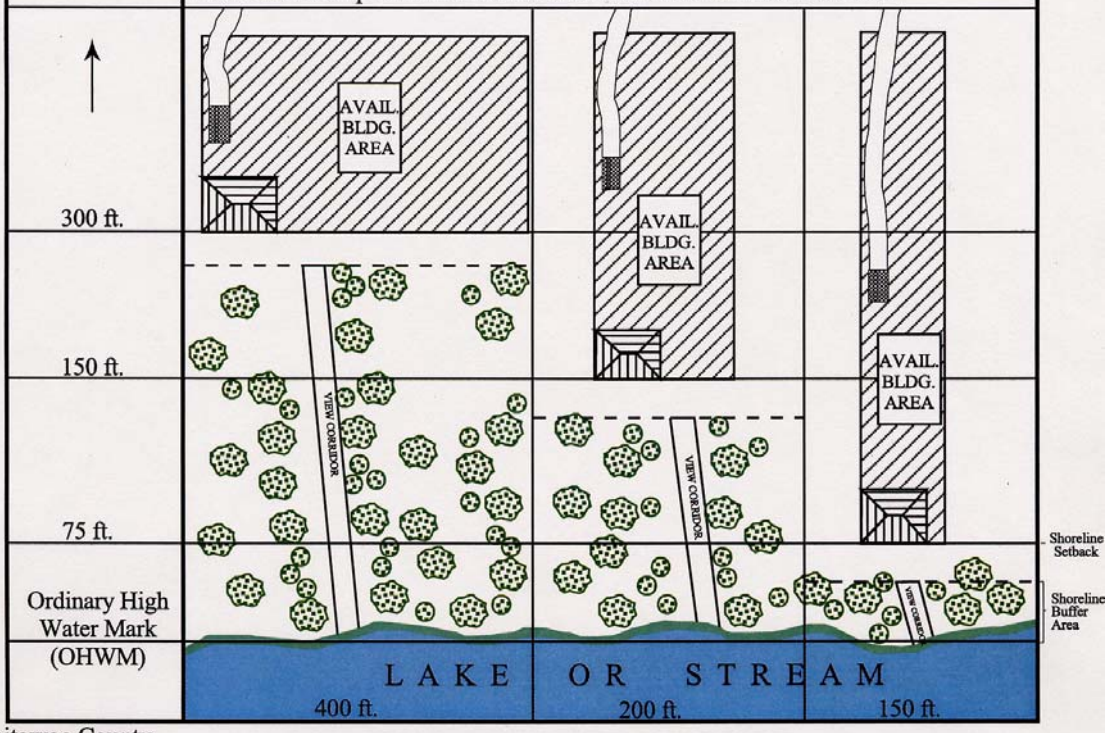
1) Restore buffer area within 25 ft. of OHWM or within the first 50% of the distance between principle structure and OHWM, whichever is less [1point/2 points on highly-developed waters].
2) Restore buffer area within 50 ft. of OHWM [2 points/3 points on highly developed waters].
3) Restore buffer area within 75 ft. of OHWM [3 points].
4) Restore native vegetation in both side yards [1 point].
5) Remove non-conforming accessory buildings from shore setback area [1 point per building].
6) Conform to exterior lighting provisions [1/2 point].
7) Use exterior building materials that blend with natural vegetation [1/2 point].
8) Other practices agreed upon by Zoning Department (seawall removal, limited dockage and mooring, etc.) [Points determined by the Zoning Department].

FOR DETAILED INFORMATION, CONSULT THE SPECIFIC PROVISIONS OF THE ORDINANCE.

WATER CLASS DEVELOPMENT STANDARDS

(FOR ALL NEW LOTS AND ACTIVITIES AFTER THE EFFECTIVE DATE OF THE ORDINANCE)

(% of shoreline developed / at X home density)	NATURAL WATERS (0 - 25% / low)	SEMI - DEVELOPED WATERS (0 - 100% / low to high)	HIGHLY DEVELOPED WATERS (60 - 100% / high)
Management Strategy	Protection	Protection & Restoration	Restoration & Watershed Mgmt.
Min. lot area Waterfront Back Lot	5 acres 35 acres	2 acres 5 acres or cluster	30,000 sq. ft. 5 acres or cluster
Min. lot width (OHWM & setback)	400 ft.	200 ft.	150 ft.
Shoreline setback (from OHWM)	300 ft.	150 ft.	75 ft.
	Applies to all structures except piers & boat hoists		
Boathouses	Prohibited	May be placed within shoreline setback area (see matrix for details)	
Vegetation Protection Area	OHWM - 275 ft.	OHWM - 125 ft.	OHWM - 50 ft.
	No vegatation removal or land distrubance with these exceptions: pedestrian access, selectively cut view corridor, erosion control, pier where permitted & within view corridor, exotic & noxious species removal, removal of dead & dying trees which are a safety hazard, roadway crossings		
View Corridor	- 30 ft. wide selective pruning & removal - Structures exempted from shoreline setback must be confined to corridor		



Manitowoc County Proposed Shoreland Zoning Requirements

SEE THE REVERSE SIDE FOR SHORELINE VEGETATION PROTECTION REQUIREMENTS

MANITOWOC COUNTY
PROPOSED WATER RESOURCE PROTECTION INITIATIVES
(02/18/00 draft)

Shoreland Development Standards

(land use regulations that apply within 1,000 ft. of a lake, pond or flowage & within 300 ft. or the floodplain of a river or stream)

Waters Classification	**Natural Waters**	**Semi-Developed Waters**	
Lot size			
Waterfront	5 acres	2 acres	30,000 s 5 acres c
Back lot	35 acres or cluster	5 acres or cluster	Min. area
Multiunit attached	Prohibited	Min. area and frontage + 50%/unit as a **C**onditional **U**se **P**ermit (CUP)	CUP
Multiunit detached	Prohibited		
Campground	Prohibited		
Cluster development (planned residential development)	1) 20 acre minimum parcel size 2) 50% open space dedication required 3) Open space ownership options 4) 50% density bonus incentive 5) Design approval criteria for open space, infrastructure and building site location 6) No waterfront clusters		
Lot width (at ordinary highwater mark [OHWM] and setback line)	400 ft.	200 ft.	150 ft.
Back lot water access *(keyhole development)*	No new keyhole access. The minimum water frontage & area requirements must be unit.		

Shoreline setback for structures (from OHWM)	300 ft.	150 ft.	75 ft.
	No setback averaging. Substitute roadway and shoreline setback reduction formula (see attached diagr		
Boathouses	A boathouse may be placed within the shoreline setback area on class 2 & 3 lakes pro 1. There are no other structures except for a pier or pedestrian walkway within the s 2. It is <50 sq. ft. in area (impervious footprint); 3. It is no closer than 25 ft. to the OHWM; 4. It is completely screened from view from the water by vegetation; and 5. The vegetation protection area (25 ft. less than required setback) is maintained as shoreline buffer with a full compliment of water quality, habitat and aesthetic fun		
Shore bluff setback and construction (define bluff line)	1) 2.5 x bluff height + 100 ft. from OHWM for Lake Michigan (current ordinance) 2) 50 or 75 ft. from bluff line on inland waters 3) Require CUP for construction activities on slopes >12% (need standards) 4) Prohibit recontouring of bluffs		
Wetland drainage way and **non-navigable stream setback**	25 ft.		
Shoreline buffer areas	Buffer = an area extending from the shoreline (OHWM) to a line that is 25 ft. less setback where no vegetation removal, land disturbance or new structures (including with these exceptions: 1) 30 ft. wide (max.) selectively pruned view corridor, 2) pedestrian access, 3) piers, 4) permitted shoreline protection where significant ongoing erosion is demonstrated, 5) approved habitat restoration projects, 6) exotic/noxious species removal, 7) public water access consistent with class objectives, 8) required mitigation practices, 9) permitted public roadway crossings, 10) maintenance of existing lawn/landscaping practices.		

Shoreline protection	Bioengineered only with DNR permit & where significant ongoing erosion demonstrated.	Any with DNR permit only where sig demonstrated.
Impervious surface limitation	Total impervious surface is limited for each lot. No lot may include more than 15% ft., which ever is less, as impervious surface that is located between OHWM and a lin of the shoreline setback.	
	Impervious surface = any construction that substantially prevents infiltration of sto roof, patio, paving, etc.)	
Stormwater management and erosion control	Require approved plan for any land disturbing activities >10,000 sq. ft. (must conform to standardized forestry BMP's, and others]).	
Design review	1) Exterior lighting on waterfront properties should be down-focused & for safety/se 2) Signage in areas zoned single family residential use should be limited to property real estate for sale & public agency informational signs. Restrictions on size, ligh features should be developed.	
Site plan review	1) Required for new construction and additions >200 sq. ft. 2) Surveyed site plan required where required to confirm compliance (on approved f a) Drainage (contour map) b) Location of well c) Location of buffer & view corridor d) Erosion control plan e) All structures	
Non-conforming structures	1) Abandon 50% lifetime valuation cap for expansion. 2) Treat nearly conforming structures less restrictively than the most noncompliant. 3) Treat principle structures (homes) less restrictively than accessory structures (too 4) Substitute an impervious surface cap for the current valuation cap. 5) Require mitigation (environmental compensation) where improvement or expansi structures is permitted [see attached diagram]. 6) Record mitigation plan with deed to property (recorded by Zoning Office with co	

Enforcement of Land Use Regulations	
Insufficient monitoring of projects in progress	1) Planning and Parks Dept. should provide a list of approved zoning permits and pe amendments, conditional uses and variances to Lake & River Associations (the la to town clerks). 2) Planning and Parks Dept. should develop a system to track permits, mitigation & parcel (shoreland tag in current records or GIS parcel map). 3) Staffing of the Zoning Office should be increased by at least 1 position. The posi permit fees (currently no fees are charged for a number of activities requiring Cou supplemented by State grant programs. The Planning and Parks Dept. should con position to administration, monitoring and enforcement of shoreland and similar l related educational and incentive programs.
Insufficient penalties for violation	1) The Zoning Office and County Corporation Counsel should seek compliance with and site restoration where technically feasible in all enforcement cases. This poli formal objective of enforcement actions in the ordinance. 2) The forfeiture schedule should be revised to increase the penalty for violations es violations (daily penalty) and repeat offenders. Contractors should be jointly liab violations including construction without permits.
EDUCATION	1) Materials describing ordinance objectives, permit requirements and standards sho provided to property owners and contractors. 2) A Waterfront Property Stewardship Manual should be developed (include a list o agency contacts). 3) Application and decision forms for variances, appeals, CUP's and amendments sh current ordinance and legal standards and made readily available. 4) Workshops for building contractors, realtors, landscapers and similar professiona acquaint them with ordinance objectives and requirements.

Watershed Issues		
Issue	**Watershed Management and Zoning**	**Education, technical assis**

BUFFER AREA MANAGEMENT	1) Recommend designation and protection of an environmental corridor district. 2) Authorize new or expanded feedlots in shoreland zone only as a CUP with an approved waste management plan. 3) Encourage lake groups to identify sensitive aquatic areas through DNR planning grants (NR107).	1) Provide education on co species. 2) Provide shoreline & in- demonstration projects 3) Provide low/no-cost ma assistance for buffer res 4) Encourage lake groups areas through DNR plan
Land division review (subdivision ordinance)	1) Require certified survey or subdivision plat approval for all land splits of <20 acres. 2) Review for stormwater management and erosion control (under authority of land development plan requirements in current ordinance).	
Permitted uses in comprehensive zoning ordinance (shared County/town authority)	1) Single family residential 2) Conservancy 3) Forestry 4) Non-structural agriculture 5) Appropriate public access 6) Multi-unit and campground	
Well and septic compliance (sanitary code)	Require inspection and compliance at time of sale. (Also amend County code when/if uniform plumbing code revised)	
Nutrient/chemical management	Amend current County Ordinance to require immediate incorporation of animal waste within 300 ft. of waterways	1) Make low/no phosphoru groups?). 2) Encourage non-chemica 3) Provide education on lo for landscapers and pro
Storm water management and erosion control	Must comply with standard practices (current provision in County ordinance [no permit or plan required])	

Watershed Issues cont.		
Noise & Light Pollution (most issues moved to shoreland category)		
WATERCRAFT ORDINANCES		Provide model ordinances a town development of watercr
Loss of Edge, Fish and Wildlife (issues addressed under other categories)		
Resistance of Property Owners to Change (issues addressed under other issues)		
PUBLIC EDUCATION PLAN	(see Chippewa plan)	
DECISION MAKER EDUCATION PLAN		
INCENTIVES		1) Provide tax incentives fo 2) Recognize water steward 3) Provide recognition, spec group that implements a s restoration plan.
Sensitive areas acquisition/easements		1) Establish a Manitowoc C 2) Encourage use of Stewar Protection grants for prio
LAKE GROUP ACTIVITIES	Encourage lake management districts to investigate forming boating law enforcement patrols.	1) Plan and provide educati water users and others rel programs. 2) Distribute Waterfront Pro 3) Provide a workshop for la regarding new ordinances and related issues. 4) Sponsor stewardship reco 5) Sponsor, fund and constr 6) Maintain list of property purposes). 7) Monitor compliance with water/shoreland construc
Education (issues addressed under other categories)		
Publications/fact sheets	Yes	
Workshops	Yes	
Demonstration projects	Yes	
Technical Assistance	Yes	
Lake Fair	Yes	
Workshops/Seminars	Yes	
Newsletter	Yes. Monthly. Support County and State regulations/enforcement.	

Public Meetings and Open Houses

Taking a step forward, the Committee was now ready to go public with all the data and information put together throughout the year. In an effort to gain pubic input, the Manitowoc County Soil and Water Conservation Department scheduled two open houses to present the recommendations for the new Shoreland Zoning proposal created by the Lakes and River Shoreline Protection Advisory Committee with guidance from the Waters Team. The first open house was held on February 28, 2000, 5:00 - 9:00 p.m. at the Rockland Town Hall/Fire Station. The second was held on Monday, March 20, 2000 from 5:00- 9:00 p.m. at the Schleswig Town Hall.

These open houses consisted of several stations which featured a specific section of the proposal. These stations included: 1)Why Shoreland Protection? 2)Grouping Our Waters to Categorize Their Similarities 3) Shoreline Buffers 4) New Lot Size and Development Patterns 5) Nonconformities 6) Erosion, Runoff and Agricultural Management. After individuals had a chance to stop at each station and hopefully had a better understanding of the proposed Shoreland Zoning, they were asked to answer some questions and give their comments regarding the proposed zoning. The questions and results from the public meetings are in table 3-8.

Summary of Survey Results

Table 3-8. Public Comments Sheet Tally, April 18, 2000.

Question	*Favor*	**Do not favor, but would accept**	**Need more info.**	**Do not accept**	**Comments**
1) SHORELAND PROTECTION					
a) Do you favor grouping of County waters and managing them differently rather than the current one-size-fits all approach?	44	7	8	7	• Need to be educated • There is a difference between northern WI and southern WI in terms of population growth • Lakes and rivers should be managed separately • Favors County grouping of waters

2) GROUPING WATERS					
a) Do you favor the criteria and resulting grouping of lakes and streams?	5	8	15	4	• Do not believe Lake Michigan should be considered a natural body of water • Highly developed and semi-developed should be combined to make on class of waters • Long Lake should be classified as highly developed and not semi-developed
b) Do you favor the strategies for each class of waters?	34	7	12	9	• Would agree if Long Lake was classified differently • River frontage needs more definition • Leave setback at 75 feet, less variances and tax breaks for adding a buffer
3) SHORELINE BUFFERS					
a) Do you favor the proposed greater shoreline setbacks for new structures on less developed waters?	38	7	15	3	• Do not favor and would not accept any alternative • Why should those who conserve the land be penalized? • Too restrictive, 75 ft. is plenty, many lots are only 190' deep and 150' setback is unreasonable when a holding tank and road setbacks are considered • Only on less developed waters, not Long Lake • Rivers need more definition • Buffers should be reduced to 35' on existing cottages • Leave as is, new proposal destroys view and that is why people buy lakefront property
b) Do you favor the proposal to limit shoreline vegetation removal and land disturbing activities within shoreline buffer areas?	37	5	14	7	• Depends on the area • Allow for additional clearing for view, not

					complete clearing as to avoid erosion • Current 35’ is reasonable, need more control over my forested land, regardless of proximity of water • Need more information on pulling weeds along shoreline, can any weeds be pulled
c) Do you favor the proposal limiting new boathouses to the semi-developed and developed waters?	41	7	9	5	• Should not be limited if development is not affecting water quality • Who determines semi-developed and developed waters?
d) Do you favor the proposal to require a setback for new structures from wetlands, nonnavigable streams, drainage ways and bluffs?	37	9	9	8	• Depends on land structure and availability of land • A 75’ setback is reasonable • Leave as is • Too inflexible for river front property owners • If landowner already owns a structure, they should be able to build on the same site • Setback from the river should be 200’ • Wetlands, drainage ways, and bluffs are to inclusive

4) NEW LOT SIZE AND DEVELOPMENT PATTERNS					
a) Do you favor the larger minimum lot sizes proposed for less developed water classes?	39	10	10	4	• Too large, 100' frontage is reasonable • 200' frontage on natural waters provides adequate size lots, 400' is prohibitive and unnecessary • Law should apply to any new lot, not just existing lots
b) Do you favor the proposal limiting private water access (keyholing) for new lots without water frontage?	47	5	7	4	• We do not favor key holing • Very important concept to promote • We do not want this • Ok if setback is 500'
c) Do you favor the proposal to encourage clustered residential development requiring dedicated open space and compact lots?	25	8	18	9	
5) NONCONFORMITIES					
a) Do you favor the proposal to allow improvement and limited expansion of buildings within shoreline setback areas based on how close a structure is to the water and what proportion of the lot is occupied by structures?	37	6	15	5	• Too restrictive, a 75' setback is more reasonable • These properties should be deed restrictive
b) Do you favor the proposal to require new structures to be set back from the shoreline as close to the required setback as the lot allows?	44	4	10	4	• Too restrictive, a 75' setback is more reasonable • This should affect existing structures • Cottages or fulltime home should make a difference • On many lakes, cottages are located 10-20' from lake. These owners should be given some leeway

c) Do you favor the proposal to require environmental compensation for improvement or limited expansion of buildings within shoreline setback areas	27	10	17	7	• What is environmental compensation? • Should be based on impact of design, not a predetermined point system • Grandfather in houses and give tax breaks for any environmental compensation • Do favor unless a buffer zone is required
d) Do you favor requiring environmental compensation for expansion of buildings that are at least 75 feet from the water but less than the proposed shoreline setbacks?	20	11	24	7	• 75' is a fair distance, no compensation for over 75', setback only if under 75' • Do favor unless a buffer zone is required
6) EROSION AND RUNOFF MANAGEMENT					
a) Do you favor the proposal that limits the amount of impervious surface to manage the amount of runoff that flows into lakes, rivers, and streams?	41	6	14	1	• Proposal does not permit adequate space for home, driveway, etc. • Do favor unless a buffer zone is required • Do you want to control lands other than wetlands • 15% seems conservative, what about 10% pitches away from the water front • 15% is too small, 25% is better
b) Do you favor erosion control plans for additions and new construction and a storm water management plan for large areas of land disturbance?	48	3	5	6	• Believe erosion control measures are currently in effect
c) Do you favor a proposal requiring that manure spread within 300' of the waters edge be incorporated immediately?	52	3	4	2	• Strongly favor • Animals kept within 200' needs to be addressed • Need regulations to benefit farmers and nonfarmers

d) Do you favor a proposal requiring a conditional use permit and approved waste management plan for new or expanded feedlots in the shoreland area?	47	5	7	2	• We cannot be too restrictive or we will lose agriculture all together

OVERALL GENERAL COMMENTS:

The proposal is not bad; everyone wants to improve water quality. Property rights should also be an issue especially seeing lake quality continue to improve. Owners should have the right to build and make improvement even on natural lakes.

Cedar Lake-By not allowing an owner to build a new basement on an old cottage, you force a person to build a house, leaving a larger footprint.

We do not favor any proposal that will allow government to put more restrictions on its citizens. We have enough restrictions to deal with already.

Leave zoning as is, we do not need new changes.

I believe our lakes and wetlands need all the protection they can get.

I have a real problem with 25' natural habitat in front of our property line and a bigger problem with being hassled to build a second story to our property. There should be a 25' variance not a 50' variance.

Make sure this ordinance treats all landowners equally, regardless of income. As proposed landowners giving up development rights for no compensation.

All the information gathered from the open houses would be taken into account when finalizing the zoning regulations.

Second Work Group from Wilke and Cedar Lakes

Also as a result of the open houses, a group of concerned lake lot owners on Cedar and Wilke Lakes formed a work group to discuss their concerns with the Shoreland Zoning proposal. In an effort to accommodate the concerns of this work group, the Manitowoc Soil and Water Conservation Department held two public information meetings for lot owners. The first one was held on Sunday, August 27th 2000 at 10:00 a.m. on Cedar Lake and a second one at 12:30 p.m. on Wilke Lake. The intent of the meetings was to offer a one-on-one interpretation of the Shoreland Proposal to property owners and offer the out-of-town residents an opportunity to be involved.

The work group reviewed the details of the zoning proposal for highly developed lakes and identified the issues and concerns for non-compliance structures on their lakes. The work group developed the following changes to the proposal:

1. Permit basements on existing homes located within the 35' to 50' for nonconforming homes.
2. Permit foundations of the permanent footprint on homes within the 35' to 50' nonconformity zone.
3. Increase the allowable impervious area from 15% to 20% on small lots with proper storm management practices.

4. Develop a side lot setback formula creating an accrued 20’ set back from side lot lines of no less than 5 feet.
5. The closest allowable structure for rebuilding would be 35’ for existing non-conforming residents.

General Lakes Inventory of Manitowoc County

Lake & Rivers Statistics of Manitowoc County

Source: Wisconsin Department of Natural Resources "Wisconsin Lakes" 1995

Total Number of Lakes in the County:

101 lakes in County

Acres of Lakes in the County:

1492 acres

Named Lakes in the County:

56 named lakes

Unnamed Lakes in the County:

45 unnamed lakes

Lakes that are Classified in the County:

39 lakes classified (3 are unnamed lakes)

Length of Streams

(according to the WDNR 1:24K hydrology GIS layer)

- Total Length of streams: 927 miles
- Perennial: 355 miles
- Intermittent: 572 miles

What lakes have boat ramp or public access?

19 lakes have boat ramp or public access of those 7 have handicap access.

Lake Name	Pulbic Access	Handicap Access
Boot Lake	boat ramp	
Bullhead Lake	boat ramp	
Carstens Lake	boat ramp	
Cedar Lake	boat ramp	X
English Lake	boat ramp	X
Gass Lake	boat ramp	
Harpt Lake	boat ramp	
Hartlaub Lake	boat ramp	
Horseshoe Lake	boat ramp	X
Long Lake	boat ramp	
Pigeon Lake	boat ramp	X
Shoe Lake	boat ramp	
Silver Lake	boat ramp	X
Spring Lake	boat ramp	X
Tuma Lake	boat ramp	
Weyers Lake	boat ramp	
Wilke Lake	boat ramp	X
Grosshuesch Lake	roadside	
Waack Lake	roadside	

Table of Lakes by Township

Township	Section	Lake Name	USGS Quadrant
Cato	3	Hempton	Whitelaw
Cato	13	Schisel	Clarks Mills
Cooperstown	8	Hidden	Denmark
Eaton	36	Eaton-Twin-N	School Hill
Eaton	36	Eaton-Twin-S	School Hill
Eaton	25	Oschwald	Valders
Franklin	3	Kellners	Whitelaw
Gibson	17	Harpt	Larrabee
Gibson	17	Mott	Larrabee
Gibson	17	Tuma	Larrabee
Liberty	33	Little Pigeon	School Hill
Liberty	33	Pigeon	School Hill
Manitowoc Rapids	33,34	Silver	Manitowoc
Manitowoc Rapids	28	Teek	Clarks Mills
Meeme	20	Horseshoe	School Hill
Meeme	5	Spring	School Hill
Meeme	8	Unnamed	School Hill
Meeme	17	West	School Hill
Newton	17	Carstens	Clarks Mills
Newton	7	English	Clarks Mills
Newton	3	Gass	Manitowoc
Newton	4	Glomski	Manitowoc
Newton	21	Grosshuesch	Clarks Mills
Newton	10	Hartlaub	Manitowoc
Newton	3	Kasbaum	Manitowoc
Newton	16	Waack	Clarks Mills
Newton	10	Weyers	Manitowoc
Rockland	19	Bullhead	Potter
Rockland	6,7	Long	Brillion
Schleswig	24	Cedar	School Hill
Schleswig	15	Graf	School Hill
Schleswig	9	Mud - N	School Hill / Kiel
Schleswig	9	Mud - S	School Hill / Kiel
Schleswig	15	Praeder	School Hill
Schleswig	16	Shoe	School Hill
Schleswig	12	Sy	School Hill
Schleswig	23,26	Unnamed	School Hill
Schleswig	4	Unnamed	School Hill
Schleswig	2	Wilke	School Hill

County Map of Lakes and Locations