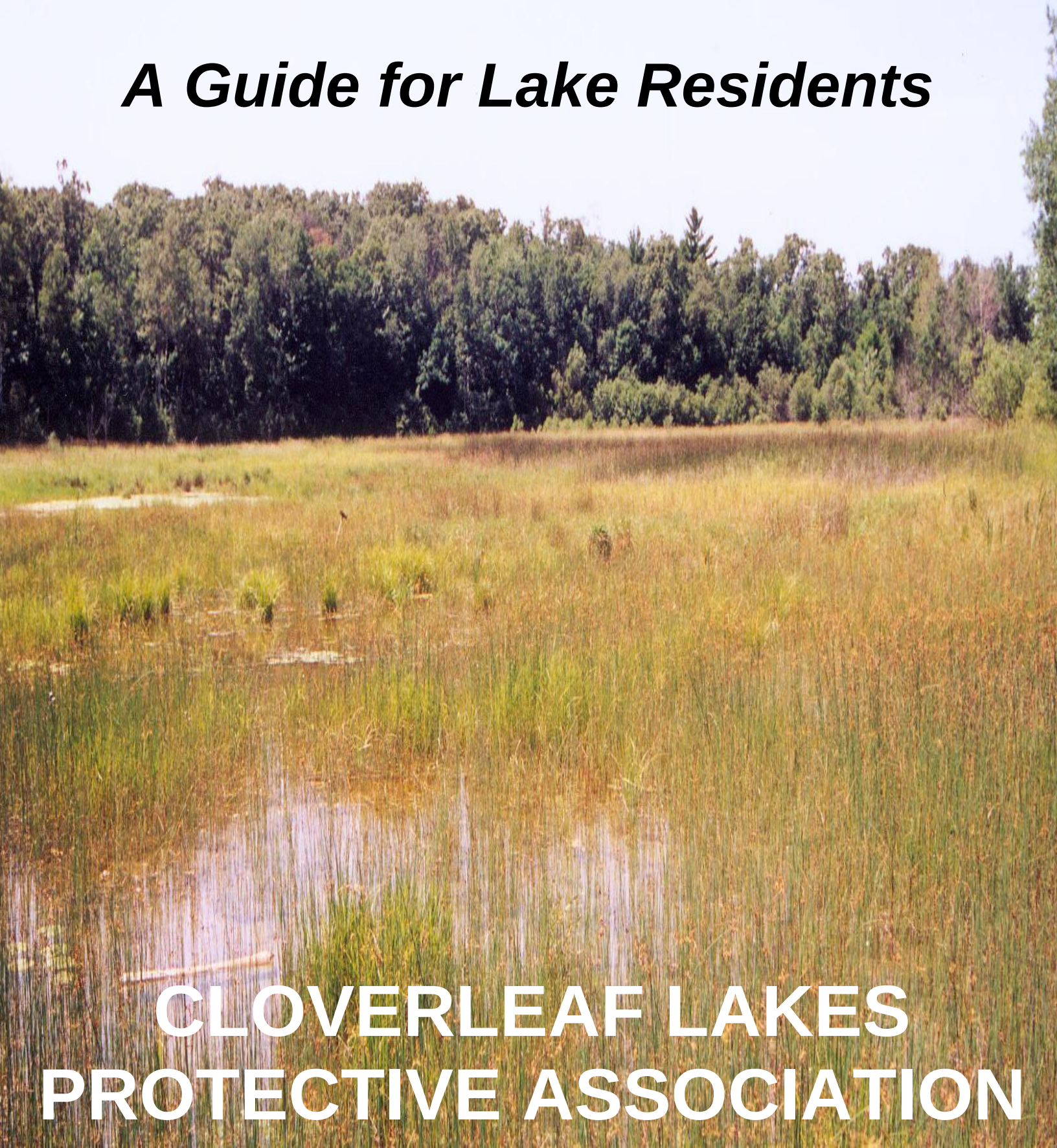
# Cloverleaf Lakes Shoreland Restoration

## *A Guide for Lake Residents*



**CLOVERLEAF LAKES PROTECTIVE ASSOCIATION**

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## PURPOSE

This report was prepared by NES Ecological Services (NES) on behalf of the Cloverleaf Lakes Protective Association (CLPA) to fulfill obligations related to two Lake Planning Grants awarded to CLPA by the Wisconsin Department of Natural Resources (WDNR). It is the hope of NES and CLPA that this report can be used to address the current and future land development pressures associated with the shorelines of the Cloverleaf Lakes. The ultimate goal of these grants was the production of two publications that: 1) educate the residents around the Cloverleaf Lakes about the important interactions that occur between a lake and its shoreline, 2) provide shoreland restoration options and guidance to those individuals that want to undertake their own project, and 3) supply descriptions and photographs of shoreland restoration projects implemented around the lake system. The first two objectives of the grant have been completed and are reported on in this document, while the third objective will be presented as a stand-alone report.

## INTRODUCTION

Development along the shorelines of Wisconsin's lakes and rivers has increased considerably over the last century resulting in the destruction and/or degradation of their associated *shorelands*. Shawano County's 134 named and unnamed lakes, including the three interconnected lakes (Pine, Grass and Round) that comprise the Cloverleaf Lakes chain, have not been immune. Much of the loss can be attributed to our society's desire for manicured landscapes. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting them to the "neat and clean" appearance of manicured lawns and flowerbeds; as a result, *ecological communities* and *biotic diversity* are drastically reduced or eliminated. What does this mean for waterfront residents and visitors? For most it results in a loss of something valuable - **time** spent working on a manicured landscape; **property** due to increased shoreline erosion; **wildlife** that provides leisure activities (e.g., fishing & bird watching) and insect control; **aesthetics**; **water activities** that are diminished due to excessive plant growth; and/or **money** to fix the erosion, weed, and insect problems.

Most people would agree that they live along or visit lakes and rivers to enjoy their scenic beauty, recreational opportunities, and to get away from their busy lifestyles. So why do we continue conducting activities that cost both us and our river and lake ecosystems? As with many issues, a lack of knowledge and education regarding the subject can be attributed to the problem. For this reason, agencies, lake organizations, environmental groups, and individuals around the state are working to provide the necessary materials such as this publication. The Cloverleaf Lakes Protective District Shoreline Restoration Steering Committee's idea to complete a how-to guide on shoreland restoration will provide them and others within Shawano County and surrounding counties with an educational tool that, in time, will help them work with property owners to improve the overall health of their lakes and rivers.

## SHORELANDS AND THEIR IMPORTANCE

Shorelands encompass two or more communities that extend from the *littoral zone* within a lake or river into a *terrestrial zone* found inland and adjacent to the water's edge. In many cases, a *wetland zone* will also be encountered between the terrestrial and littoral zones. When shoreland restoration activities are discussed, the terrestrial and wetland zones will often times be referred to as the *shoreland buffer zone*.

The diversity of native vegetation found within undisturbed, natural communities that comprise shoreland areas along lakes and rivers provides many benefits including: terrestrial and aquatic wildlife habitat; flood control; improved water quality; recreational and aesthetic value; and shoreline stability. Therefore, removal of native vegetation including the conversion of shoreland buffers into lawns immediately leads to the destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects. The maintenance of the newly created area also decreases water quality by considerably increasing inputs of

phosphorus and sediments into the lake. However, 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 habitat 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.

These negative impacts occur because native 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 and food for fish and wildlife; and stabilize soils found at the water's edge. 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 the restoration process, the ecological habitat and benefits lost during development or through traditional suburban landscaping are revitalized. In recent years, many Wisconsin counties have realized the importance of shoreland zones and have instituted incentives or adopted rules for lakefront property owners that agree to restore native vegetation on their property or that want to develop or improve structures on their lot. Due to these efforts, many waterfront property owners and visitors have seen increased aesthetics, wildlife habitat, property values, water quality, and recreational opportunities.

The sections that follow provide restoration methods and materials that can be used by the Cloverleaf Lakes landowners to restore their shoreland areas. 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, is a glossary of related terms and a list of relevant references.

## DESIGNING SHORELAND BUFFERS

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). Development of this step-by-step guide is intended to help landowners complete their own restoration projects, but there are certain situations such as bank stabilization and soil erosion caused by surface water runoff that may require additional assistance. A list of organizations, both public and private, that may be of help is included at the end of this document. Whether a landowner decides to conduct a shoreland restoration independently or to use a professional, the first step in the process is to determine a project goal.

### Restoration Goals

Landowners wanting to undertake a restoration project often times have an idea(s) of what they want to accomplish on their property based on their knowledge of the land or perhaps a hobby. Preventing further shoreline erosion, increasing wildlife viewing opportunities, reducing surface water runoff into the adjacent waterway, or improving fish habitat are all goals that can be achieved through restoration projects. In some cases, the project will not be voluntary; rather, the local municipality or County Zoning Office will require the development and implementation of a shoreland buffer "*mitigation*" plan prior to issuing a building permit for structural improvements. Whether the project is voluntary or required, the

following information can be utilized by waterfront property owners to achieve their goals and improve their shoreland communities.

## Existing Site Conditions

Prior to developing a *restoration plan*, site characteristics and features unique to the property need to be examined. Start with the creation of a base drawing depicting the location of the house, path(s), and any other structures (e.g., fire pit, boathouse, pier, etc.) that exist on the property. The map can be a simple sketch or a comprehensive survey of the features present; the amount of detail desired or required will depend on the complexity of the project and the landowner's budget. Regardless of how the drawing is prepared, it should be to scale so that distances, elevations, and areas can be determined when preparing the restoration plan. Once the map is prepared, the below site conditions can be recorded on the drawing. These features and conditions will affect how project goals are achieved and ultimately their success.

### Topography and Natural Land Features

Hills, swales, depressions, slopes and ice ridges are all found within the landscape around Cloverleaf Lakes and in Shawano County. These terrain features dictate where surface water will flow or remain ponded after rain events. Knowing how water moves through or over a site can assist a landowner with the placement of proposed paths or other man-made structures, and surface water control devices such as *rain gardens* that intercept and treat *run-off* prior to entering an adjacent waterbody. This information is particularly useful if property damage is to be avoided or the landowner's goal is to help improve water quality.

**Photo 1. Ice ridge along Pine Lake.**

The plan developer must also know where water may stand for periods of time on the property. Natural depressions or other areas that capture, hold and infiltrate water will need to be planted with the appropriate native species. One such area might be the landward side of an *ice ridge*. These natural barriers not only assist with surface water control, but they also help protect vegetation and structures from damaging ice shoves. Efforts should be taken to preserve these features; and were appropriate, native vegetation should be established. Since soils within and on the ridge may be periodically moved, the planting of trees and tall growing shrubs is not recommended.

**Photo 2. Steep slope – Grass Lake.**

If any of the on-site depressions or low spots are potentially *wetland*, the landowner should contact either the Wisconsin Department of Natural Resources Water Management Specialist (WDNR) and/or staff at the U.S. Army Corps of Engineers for proper identification prior to conducting any activities within the community. Certain activities within wetlands require permits from either one or both agencies.

A property owner can learn how water flows through their property by either looking for evidence of erosion (i.e., *rills* or *gullies*) caused by moving water, if present, or through direct observation during a large rain event. After the event, notes can be taken regarding the location of standing water and the length of time it remains. Assessing the steepness of a slope can also assist the plan developer with determining erosion control needs, *terracing* requirements and appropriate vegetation species during restoration activities.

## Erosion Issues

**Photo 3. Stormwater runoff outfall on steep slope – Grass Lake.**

Water flowing down steep slopes has the potential to erode soil especially if the landscape features direct it into narrow valleys; or water is collected, funneled and discharged to a specific area (e.g. rainwater from downspouts). If the water is not intercepted and its velocity slowed down or the surrounding vegetation is not well established, the outcome could be the creation of *rills* or *gullies* as discussed above. Water flowing toward an adjacent waterbody has the potential to deposit soil and/or erode the shoreline, resulting in reduced water quality and property damage. A review of the property and its landscape by the plan developer will reveal potential or real erosion problems that could be addressed.

**Photo 4. Shoreline erosion undercutting bank & exposed tree roots – Pine Lake.**

Although high velocity surface water runoff can damage shorelines, the cause often times is the water found within the adjacent lake or river. Waves created during storm events and windy days can crash relentlessly into the shoreline; however, weather events are not the only culprit. An increased use of personal watercraft are also responsible, which can be observed during a nice, summer day on the water; this is especially true on waterbodies that do not have slow no-wake regulations. Wave energy produced by watercraft may not be as significant as those caused by storm events, but they do act as an additional stressor. Most healthy shorelines will remain relatively unaffected during these events; the damage occurs when the aquatic and/or shoreline vegetation has been significantly altered or removed. Dense stands of emergent vegetation are able to diminish wave energy prior to reaching shore while roots from herbaceous and woody plants bind and hold soils found on the shoreline. Trees that have fallen into the water and ice ridges are also capable of reducing damage done by wave action.

**Photo 5. Shoreline erosion with minor undercutting – Pine Lake.**

**Photo 6. Shoreline erosion exposing timber and rock from previous stabilization efforts – Pine Lake.**

Slumping soils, exposed tree roots, undercut structures, and muddy waters can all be indicators of shoreline erosion. These conditions can be very obvious on some properties, but there are cases where the landowner will need to look more carefully or request professional assistance to determine if a problem exists. An example would be the loss of soil at the toe of the shoreline slope which can result in minor undercutting that is not very visible due to the existing vegetation. If you are still unsure whether or not the shoreline may be eroding, review conditions of the adjacent shorelines. Has *rip-rap* been placed or a man-made structure such as a sea wall been constructed? Talk to the neighbors about their shorelines. Often times these items were placed to prevent further erosion.

Once a problem has been identified, the plan developer should note the location of the property on the lake and determine the prevailing wind direction. Generally, winds from a westerly direction will be the most common. Knowing these conditions will help determine if wind generated waves are a potential issue for the property or are responsible for shoreline erosion. A shoreline that is located on the east side

**Photo 7. Wave action on shoreline.**

of a large lake will receive more frequent and stronger wave action due to the amount of open water over which the wind travels, referred to as the *fetch length*. Although the fetch length is similar for those properties located directly across the lake on the western shoreline, the wind is often pushing water away from the shoreline. These properties, however, are not immune to the impacts of watercraft generated waves. Often times, the same lakes that have longer fetch lengths are bigger waterbodies that are utilized more frequently by larger boats, jet skis and water-skiing activities. Even though these activities may occur on a lake, not all areas will be impacted equally. Properties located in secluded bays, channels, and near slow no-wake areas will be less susceptible to wave induced shoreline erosion. The same is true for shorelines around smaller waterbodies; therefore, an individual should note recreational use patterns when assessing erosion issues and their potential causes.

## Soil Properties

To learn about soils on a property, an individual can either utilize the United Stated Department of Agriculture (USDA) - Natural Resource Conservation Service (NRCS) Web Soil Survey site (http://websoilsurvey.nrcs.usda.gov/app/) or check out a copy of the Soil Survey of Shawano County (1982). These two references include soil maps that are labeled with symbols that refer to specific soil map units. Each unit is given a classification based on properties observed by soil scientists in the field including soil profiles and textures; and descriptions that include general soil facts along with hazards and limitations to be considered. This background information is very useful, but an investigation of the site's soils should also be conducted to verify existing conditions. Natural events, construction activities or other historic actions could have altered the soil profile.

Soil observations can be conducted by digging small pits that are roughly 18-24" in depth. In general, one or two soil pits per site should be enough to collect the required data; however, if there are unusual features or noticeable topographic and/or vegetation community changes, additional soil pits should be dug. Placement of these pits should occur primarily within those areas to be restored; although additional soils information for the site could prove to be valuable. If in-water soils data is desired, a different approach will be necessary. In these cases an individual should either utilize a soil probe or their hand to dig into the substrate to collect the soils information.

As the soil pits are being excavated, unusual or interesting observations about each soil layer should be noted. Does there appear to be *organic matter* or *humus* within the topsoil? Most native species do not need rich, fertile soils (i.e., garden soils) to grow successfully. In reality, most native species thrive in what would be considered less than suitable horticultural conditions, but some humus is required because it provides the following benefits: 1) humus stores and releases most of the nutrients utilized by plants; 2) organic matter is like a sponge and has great water holding capacity that is available to plants; and 3) humus provides good soil structure and improves water infiltration through the soil. If the topsoil has not been drastically altered or removed within the restoration area and the existing vegetation appears to be relatively healthy then there is likely enough organic matter present to support most native species without conducting soil amendments such as adding compost or fertilizers. In fact, adding amendments to the soil may be detrimental to the restoration as they could increase the presence and growth of unwanted weeds that thrive in more fertile soil conditions. Soil samples could be tested to determine fertility, but if the site appears to have normal soils then testing is unnecessary. If desired, your local University of Wisconsin – Extension office can assist with soil testing parameters.

Another item to note is whether or not the soil is compacted. Construction activities and even foot traffic can cause particles in some soils to become squeezed together reducing the number of pore spaces available for water and air movement. Does the soil sample area pond water? Was the soil rather difficult to dig through? Answering "yes" to both of these questions may indicate a soil compaction issue. Dealing with this issue will ideally involve a one-time incorporation of 2"-3" of compost into the topsoil to a depth of three to six inches. Tilling will help loosen the ground immediately and work the organic matter into the soil; and as mentioned above, the added organic matter will improve long-term water infiltration capabilities. Native plants chosen for the site will also assist with continued infiltration as their root systems extend deep into the soils.

Now that the soils can be observed, the plan preparer should determine the soil texture (Appendix A) for each layer or *horizon*. An individual could approach this task in one of two ways: 1) request assistance from a professional or 2) use the Guide to Texture by Feel included within Appendix A. There are many different textures so the task could be a little daunting, but the main goal is to group the soil into one of these main soil types - clay, silt, loam, sand or *muck*. Once the textures are determined, they can be compared to the profile(s) for the soil unit(s) identified on the property. If the textures appear similar to those described by the NRCS then specific properties of that soil unit are available for review, which will help establish restoration opportunities. Among other items, the type of soil(s) found on a property determines *permeability* and the *available water capacity*; both of which influence the overall vegetation community present on-site and the specific plant species chosen for restoration.

Another property determined for each soil map unit is the pH value. Like the amount of moisture available, pH values determine the plant species capable of growing within an area. Values are generally grouped into three ranges: acidic (0 to 6), neutral (6 to 8), and alkaline (8-14). Although important, knowing the exact pH level may not be necessary if the existing on-site vegetation appears to be relatively healthy. Turf grasses and many other species including most natives persist in the pH neutral category; therefore, soil amendments would not be necessary. If an individual wants to know the value, readings can be taken from the Shawano County soil survey; however, an on-site reading will provide more site specific data. The pH can be measured by either using a pH meter that can be purchased at many garden centers or by sending a soil sample into a laboratory for testing as mentioned above. If a reading indicates the presence of an acidic or alkaline soil, amendments such as lime and sulphate of ammonia, respectively, can be added to attain a more neutral soil; however, working these amendments into the soil will need to be conducted on a regular basis. For this reason, choosing native species suitable to the existing site conditions may prove to be less costly and more productive.

## Moisture Regime

In addition to noting areas of standing water on the site, the excavated soil pits should remain open for 24 hours to determine if groundwater is present on the property. Depending on topography and location to the adjacent waterbody, the pit(s) may fill completely or partially with water and saturate the surrounding soils, which can impact vegetation growth. The depth of water in the hole should be measured and recorded along with the depth of soil saturation. An individual can determine soil saturation by squeezing a sample of soil into a small ball and bouncing in the palm of their hand. If the outside of the soil is glistening or water is evident when the ball is broken apart, the soil is saturated. Spring or early summer is the best time of the year to determine if a high water table is present and the soils are saturated; however, the soil pit and measurements should not be done right before or after rain events as this may skew the results. As summer progresses into fall the water table will likely drop further below the ground surface making it difficult to assess its location during the early portion of the growing season without professional assistance. Information pertaining to water table levels and the length of time they remain can also be found in the description for each soil map unit, previously determined, in the Soil Survey of Shawano County (1982).

Installing emergent vegetation within the lake will require a slightly different assessment. Water will most likely be present throughout the year, but lake levels can fluctuate during the growing season. Planting when water levels are low or high is not recommended unless the plan developer is familiar with normal levels on the waterbody. Knowledge of water depths within the restoration area will result in proper species selection and placement. In addition to noting depths, water clarity should be recorded. If sunlight is unable to penetrate through the water column due to high levels of *tannin*, *phytoplankton*, or other suspended solids, plant growth will be diminished or non-existent. One of the best and most inexpensive tools used to measure light penetration within the water is a *secchi disk*. Ideally, the disk should be visible on or very near the lake bottom within planting areas.

## Sun Exposure

The amount of sunlight a site receives throughout the day during the *growing season* will dictate what plant species will be capable of growing within the area. There are devices that can be purchased to assist with determining the amount of light present, but a less costly approach is to take a series of digital photographs of the planting site. Pick a day in the early part of the growing season after tree leaf-out that is to be mostly sunny. Begin taking photos shortly after sunrise and thereafter every hour throughout the remainder of the day. The photos can then easily be downloaded onto a computer and reviewed to determine the length of time sunlight was present within the restoration area.

## Vegetation

**Photo 8. Lawn maintained to rip-rap shoreline – Grass/Pine Lakes.**

A quick survey of a site's existing plants should be undertaken prior to developing a restoration plan. The type of vegetation present on a site will most often times be determined by the extent of historic disturbance and current manipulation. In many cases the native, understory vegetation has been removed in favor of a more manicured landscape including a maintained lawn. For those areas that are left "natural", *exotic* and sometimes *invasive* species are often times present or dominant. Existing tree and shrub species along with any exotic and native plant populations on-site should be noted. Doing so will aid in choosing restoration methods for specific areas. 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. On the other hand, if a large number of exotic plants are growing in or around a site with native species, a planting and *maintenance plan* may need to be developed. In most cases a planting and/or 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.

Vegetation species including exotic species that occur within the water should also be recorded on the site survey. Observations or information pertaining to excessive plant and algae growth in the water should also be noted. Species such as duckweeds (*Lemna spp*.) curly-leaf pondweed (*Potamogeton crispus*), Eurasian water milfoil (*Myriophyllum spicatum*) and algae species can disrupt or eliminate growing conditions for other desirable species. If these are not controlled, establishment of submergent, emergent, and floating-leaved vegetation will be difficult.

**Photo 9. Reed canary grass growing on graveled shoreline – Grass Lake.**

The reference section found at the end of this document contains

several good books and websites that can assist an individual with plant species identification. Additional help could be sought from your local UW-Extension office, university, Land Conservation Department or private firms that staff ecologists.

### Wildlife

Knowing the species of wildlife and their general abundance within the area is important when conducting restoration activities. Certain species such as white-tailed deer (*Odocoileus virginianus*), muskrat (*Ondatra zibethicus*), Eastern cottontail rabbit (*Sylvilagus floridanus*), Canada geese (*Branta canadensis*) and carp (*Cyprinus carpio*) can quickly damage or destroy plantings. Daily observations, noting tracks during winter or talking with local fishers and/or trappers can help determine potential problem species. The information will help determine appropriate plant protection activities during installation.

Although wildlife can be detrimental to a restoration, the goal of some landowners is to attract more wildlife through the restoration process by providing additional food sources and/or habitat. Installing native species that provide nuts, berries, seeds, nectar or pollen can attract a variety of insects, birds and mammals. In all likelihood some of the above species will be attracted in the process, but if the planting is protected during establishment, it should persist for years to come. In addition to providing food, habitat features such as brush and rock piles, *snags*, and fallen woody debris, both in and out of the water, can provide shelter and reproductive habitat for many wildlife species. Unless they are considered unsafe, existing habitat features should remain on the property.

## Restoration Plan Development

After the above site condition data are collected and recorded on the base map a restoration plan can be developed. Typically the most important part of the plan is plant selection since native vegetation is often the foundation of many shoreland restorations conducted today. However, before the selection process can be finalized, site specific shoreline stabilization and erosion control methods must be designed.

### Shoreline Stabilization

The below options are not intended to be an all inclusive list; rather, they are provided as examples of common practices utilized to stop and prevent further shoreline erosion. Before any of these methods are designed and constructed, an individual should review information found on the following WDNR website: http://dnr.wi.gov/waterways/shoreline_habitat/lake_erosion.html. Since most shoreline stabilization projects will require some work below the *ordinary high water mark*, a permit(s) will be required from the State of Wisconsin and possibly the federal government, except for those activities that are exempt. An individual should consult with their local WDNR Water Management Specialist if they have questions about a project.

#### *Heavy armor*

Seawalls and rock rip-rap fall into the category of heavy armor as these are often treatments used on waterbodies that have moderate to high wave energy or ice shove. Energy for a particular lake and shoreline can be calculated using the "Erosion Energy Calculator" found on the above WDNR website. This information should then be used to determine the most suitable stabilization technique. An erosion energy review of several shoreline properties on the Cloverleaf Lakes indicates the chain of lakes is a low energy system, which means existing walls or rip-rapped shoreline can be repaired or replaced provided specific requirements are followed. New installation of these heavy armor techniques, however, will likely not be permitted. In contrast, most of Shawano Lake's shoreline has moderate to high erosion

potential; and therefore, these techniques are employed quite frequently. In cases where these techniques are used, an individual should work with a professional engineer and/or contractor to design and install the materials correctly to prevent failure.

## *Integrated Bank Treatment*

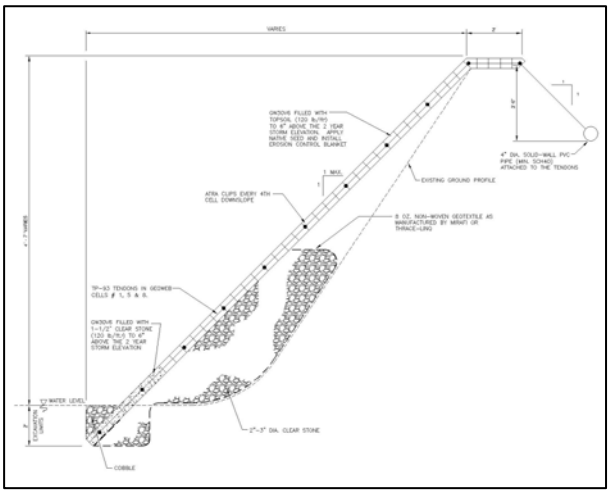

**Figure 1. Typical Geoweb® design.**

**Photo 10. Geoweb installation on streambank – SW Wisconsin.**

Manufactured materials (e.g. Geoweb®) filled with soil and fabric encapsulated soil lifts are two techniques that combine the use of protective armoring with the benefits of native vegetation establishment. The attached designs (Figures 1 & 2) and photographs (10 & 11) depict how the eroded banks are to be re-shaped and the materials installed including stone at the toe of the slope to protect the bank from further erosion and undercutting. There are two significant differences between the techniques: 1) encapsulated soil lifts are constructed of mostly biodegradable materials, while Geoweb® is manufactured plastic; and 2) Geoweb® can be installed on much steeper slopes, which is advantageous in applications where space is limited. As with the heavy armor techniques, the integrated bank treatments are usually reserved for moderate and high energy shorelines; although, the local WDNR Water Management Specialist may work with a landowner if the treatment appears necessary and beneficial for a specific location. In cases where these techniques are used, an individual should work with a professional engineer and/or contractor to design and install the materials correctly.

**Photo 11. Encapsulated soil lift installed on shoreline.**

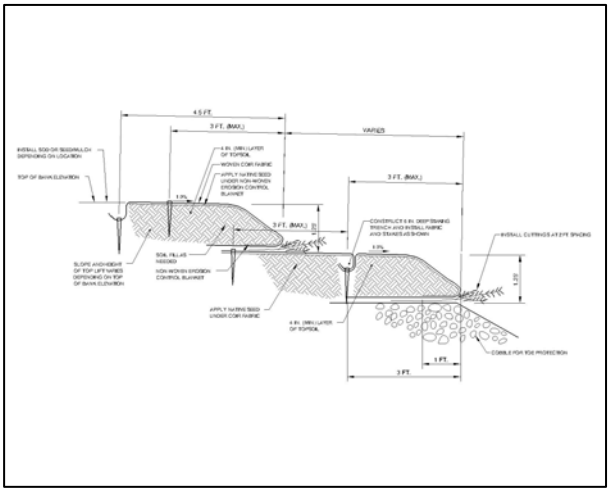

**Figure 2. Typical encapsulated soil lift design.**

## *Biostablization*

Native vegetation and biodegradable materials are the only materials utilized in biostabilization projects. They are installed along shorelines that have low to moderate wave energy and erosion potential. In many cases, cuttings taken from native shrubs including willow (*Salix spp*.) and dogwood (*Cornus spp*.) species are used to establish woody vegetation with extensive, dense root systems that help bind the soil. When live cuttings are to be used for a project, the stakes are harvested just prior to construction and when the shrub is dormant, making early spring or late fall the best time for installation.

Plant material can be harvested from a local source or purchased from a native plant nursery. If the material is to be harvested, cuttings should be 0.5" to 1.5" in diameter and 4-8' in length. The top of the stake should be cut flush so it is blunt, while the bottom should be cut at a 45 degree angle to help facilitate installation. Immediately after cutting, the stakes should be placed in a mix of water and rooting

hormone and installed. Although the material can be stored for longer periods, if necessary; success of the planting will likely be reduced. Live stakes or posts can be installed upright at the water's edge and on the slope by either pushing them into the soil or by drilling a hole; or they can be installed horizontally between soil layers (Figure 2 from above and Photo 11). Although the construction of soil lifts is included within the integrated bank treatments, they can also be a used as a biostabilization technique if the rock toe were replaced with a *biolog*. Shrub species used in these restoration techniques can grow 6-20 feet in height; therefore, the use of live cuttings is often times not preferred by landowners that want to retain views of the water, which was the case for the shorelines reviewed on Cloverleaf Lakes. Landowners instead chose installation of biologs along with select scattered, native shrubs, grasses, sedges, ferns and *forbs* as the preferred method of shoreline stabilization and restoration.

**Photo 12. Live willow stakes planted on riverbank – Wolf River.**

Biologs have become a popular material used to stabilize shorelines due to their ability to dissipate wave energy and provide a good growing medium for native plantings. Coir logs are made with coconut fibers held together with netting, usually a natural twine product (Photo 13). They are assembled in various densities, diameters and lengths, although there are standards for each. A denser biolog will be more expensive, but it will take longer to break down allowing planted vegetation more time to become established. Another advantage is these logs can have holes pre-drilled for easier plant installation. The diameter and length of the fiber logs to be utilized depends on the condition, size and accessibility of the shoreline. In some cases, the diameter of the biolog can be chosen so they can be installed directly against the eroded shoreline with little or no bank modifications. When shoreline re-shaping is required the biolog is installed at the existing toe of slope and the shoreline is graded or the area behind the log backfilled to provide a gentle slope to the biolog. Example designs for shorelines on Pine Lake in Shawano County can be found in Appendix B. The diameter of a biolog chosen in these cases will be determined by the desired slope. Length of the biologs will be determined by the chosen diameter and density, the length of shoreline to be protected, and its accessibility. As the diameter and density increase so to does the weight of the biolog. A 16" or 20" rather dense log that is 20 feet in length will require 4-6 people to carry the material, which could be difficult if access to the water's edge is not good.

**Photo 13. 16" biologs.**

In situations where grading and backfilling activities are conducted and water levels are high, a second biolog or encapsulated soil bag (i.e., Envirolok™) should be installed for additional protection from waves that are continually overtopping the first log (Photo 14 & Figure 3). Caution should be used, however, if a second biolog is installed. Although biologs provide a good growing medium, they must be in close contact with water in order to retain this condition. Coconut fibers absorb and retain moisture, but they can dry out very quickly, which could impact vegetation with limited root establishment.

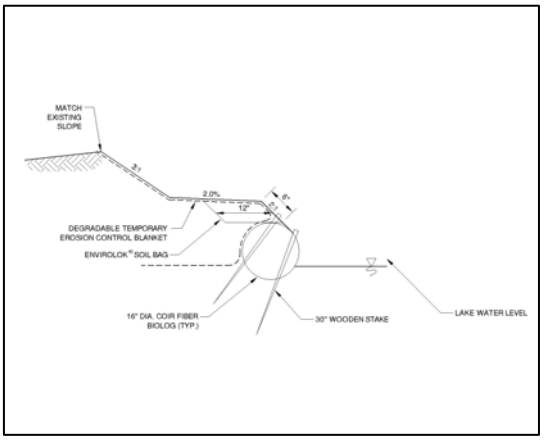


**Figure 3. Typical biolog installation design.**

**Photo 14. Planted double-level biologs and backfilled slope – Grass Lake.**

After the Envirolok™ and/or biologs are purchased, installed and secured, final grading and backfilling of the slope can occur. Steps should be taken to prevent soil erosion into the adjacent water during these activities. These could include the installation of *silt fence* above the biolog; use of *erosion control blanket;* seeding of a *cover crop* such as oats (*Avena sativa*) or annual rye (*Lolium multiflorum*); or a combination of the three methods. There are many types of erosion blanket available; therefore, determining the type to use may be a bit overwhelming. When ordering materials, talk to the company's representative about the site's conditions and they should be able to make product recommendations; otherwise, contact a firm experienced in shoreland restoration for assistance.

To complete restoration, the area on the slope above the biolog will need to be either seeded or planted with bare-root material and/or plugs. Live plants will also need to be installed within the biolog and Envirolok bags, if utilized. These materials could be *hydroseeded*, but this method cannot be done without the aid of a landscape firm; it can be rather expensive; and seeding success is lower than if live plants are installed.

## Surface Water Run-off Reduction

The reduction and treatment of stormwater water run-off prior to it discharging into surface waters (e.g., river, lakes, wetlands, etc.) has become a significant environmental issue in the last decade. Uncontrolled run-off has been responsible for flooding issues, pollution of surface waters, decreased *groundwater recharge*, and loss of wildlife habitat. To help curb impacts, many municipalities around the state are designing and constructing facilities to manage existing and future stormwater run-off. Entities conducting building and road construction activities that impact more than one acre or have a certain percentage of *impervious* surface are also required by local and state laws to capture and treat run-off from their construction area. Professional engineers are generally consulted during the site planning process and hired to design stormwater management facilities that will appropriately treat surface water run-off. These facilities include vegetated swales along with retention, detention, and infiltration basins. Most individual homeowners will not be responsible for constructing such facilities unless they plan on undertaking significant structural improvements that increase their overall impervious surface area. In these cases, local and/or county ordinances will likely require mitigation for environmental impacts, which could include the construction of a *rain garden*, a small version of an infiltration basin.

### *Rain Gardens*

Rain gardens are shallow depressions planted with native vegetation that are designed to capture and infiltrate surface water run-off. They are usually constructed near a known point of water discharge like a downspout or sump pump hose; however, they can also be placed adjacent to an impervious surface such as a driveway or road (Photos 15 & 16). In addition to assisting with erosion and water quality issues, native plants installed within the garden increase wildlife habitat and aesthetics within a homeowner's landscape.

**Photo 15. Area staked for rain garden installation – Grass Lake.**

There are technical, elaborate rain garden designs that include soil amendments, piping, etc.; and there are simple designs that are more easily constructed. Unless an individual has a unique site or

significant erosion problems that require an engineer's assistance, a homeowner should only be concerned about designing a garden that is appealing, affordable, and fits into their landscape plan. To help determine the location, size and shape of the garden, an individual should consider the following items:

**Photo 16. Installed and planted rain garden – Grass Lake.**

1) Constructing a rain garden over buried utilities can be done, but there is a risk the garden will be disturbed in the future if utility work is required. An individual will also want to know where the utilities are located when digging. Call Digger's Hotline at 800-242-8511 to have the underground utilities marked for free.
2) Locate the rain garden at least 10 feet from the house's foundation to avoid water seepage and damage.
3) Avoid large trees if possible. Additional water could cause damage and digging could be difficult with the roots.
4) Is there a natural, shallow depression or flat area that exists on the site where flow can be intercepted or directed? Placing a garden in these areas will require less digging and lower berms than a garden located on a slope. Rain gardens can be constructed on slopes, but they must be designed so water still infiltrates and does not cause erosion problems. In most cases the garden will need to either have a taller berm or be terraced in order to achieve proper surface water control. Steep slope designs may require the assistance of an engineer to ensure the rain garden is properly sized to handle the amount of surface water entering it.
5) To achieve good infiltration, rain gardens should not be located on soils that are compacted, unless soil amendments are going to be conducted, or in areas that pond water for long periods of time due to a high water table or very slow infiltration rates. These areas can be planted with suitable native vegetation, but additional water should not be directed to those locations unless standing water conditions are desirable.

Once these areas are identified on the base map an individual can locate the most ideal spot(s) to install a rain garden. Previously collected soils data, site features and the homeowner's desires can then be utilized to design the depth, size and shape of the garden.

**Depth**

Most rain gardens are between 4 and 8 inches in depth, which is determined by the landscape of the property. A sloping landscape will require more excavation unless soil material is added through the construction of a larger berm on the downslope side of the garden. Regardless of the final depth, the most important factor is to keep the bottom of the rain garden level throughout so that water is distributed evenly; therefore, digging and filling activities should be conducted accordingly.

**Size**

For a typical residential lot, a rain garden that is 100-300 $ft^2$ in size will be large enough to treat most if not all of the site's stormwater run-off; however, if a homeowner is interested in determining the exact size needed for their property they can refer to the publication "Rain Gardens – A How to Manual for Owners" (UWEX 2003). This document contains a formula that can be used to calculate the suggested size of a rain garden based on its depth, soil types present, and the amount of water entering the site. Otherwise, an individual can size the garden based on soils, existing site features, and homeowner preference. In general, gardens that have clay soils should be a little larger in size than those with sandy soils. Clay soils have slower infiltration rates; therefore, the more area available for infiltration the better. Trees, paths, property lines and other features can be worked around, but they may restrict the direction

and area available to construct the garden. Since a rain garden is like any other planted flowerbed, there will be some maintenance required to keep it looking nice. The amount of time an individual can dedicate to its upkeep can be a deciding factor in its size. Construction costs and time can also be a limiting factor. As an example, material costs to construct a 300 $ft^2$ rain garden are roughly double that of a 150 $ft^2$ basin and this does not factor in additional labor time. In the end, establishing any sized rain garden will provide all the benefits discussed above.

**Photo 17. Installation of a small rain garden – Pine Lake.**

**Shape**

There are recommendations regarding the shape (length x width) of rain gardens; but for the most part, the shape will be dictated by site features and most importantly homeowner preference. Working around trees, paths, etc. will help mold the garden's shape, but the homeowner must be happy with its appearance within the landscape. If the garden is unappealing or out of place, the homeowner will regret its installation. Adding an edge around the planting will help define the garden and increase its aesthetic appeal.

## Plant Selection

When implementing shoreline restoration projects, selecting the appropriate plant species is a critical and often times difficult step in the planning process. Choosing to plant non-native or exotic plants is strongly discouraged. Whether their introduction was on purpose or an accident, history has taught us that some of these species (e.g., purple loosestrife, reed canary grass, etc.) are able to out-compete native plants for two reasons: 1) there are no diseases or predators to control their populations, and 2) 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.

For these reasons the use of native plant species is recommended for all restoration projects. These species have evolved over thousands of years and are adapted to the local climate and environmental conditions. Maintenance activities are limited to occasional pruning, mowing and/or burning, which reduces ecological impacts. They provide nesting, shelter and food needs for wildlife; absorb and filter surface water; and prevent soil erosion with their deep, dense root systems. The term native, however, is relative. Certain plants that are native to the southern portion of Wisconsin may or may not be native to Shawano County. As an example, compass plant (*Silphium laciniatum*) is a common prairie plant in Wisconsin's southern counties, but there are no known historic observations of this plant in Shawano County. For the purposes of this document, native plants refer to those species that have a record of being observed in Shawano County or have been found in all the surrounding counties. A list of these species can be found by searching the following University of Wisconsin herbarium websites:

UW Madison - http://www.botany.wisc.edu/herb/Countysearch.html
UW Stevens Point - http://wisplants.uwsp.edu/Countysearch.html

Although these are the recommended species for use in restoration projects, other native species such as compass plant could be utilized if the site conditions are suitable.

So how do you choose the appropriate native species? The first step is to review all the below site condition data collected during the assessment and categorize it as follows:

| | |
|---|---|
| Soil Texture: | Clay, Silt/Loam, Sand or Muck |
| Water Regime: | Dry – No Soil Saturation or Water Present<br>Moist – Soils Saturated Below 6" and Water Table Present Below 12"<br>Wet – Soils Saturated to the Soil Surface or Standing Water Present (Depth) |
| Sun Exposure: | Shade - < 4 Hours of Sunlight<br>Partial Shade/Sun – 4 to 8 Hours of Sunlight<br>Sunny - > 8 Hours of Sunlight |

These three conditions can then be combined and the areas sketched on the base map to produce different planting zones (e.g., clay/dry/shade or muck/wet(12")/sunny, etc.) for the site. Natural shorelines typically have different zones of vegetation (Figures 4 and 5) growing along them based upon these differing conditions. Collectively, these zones are known as a *hydrosere*. The in-water zone directly adjacent to the shoreline is known as the littoral zone, which is dominated by emergent, submergent and floating leaf vegetation. Communities within this zone include open water, deep marsh and shallow marsh. As water depths decrease and soils become exposed, the littoral zone transitions into a wetland zone. Although the communities found within the littoral zone are considered wetland, water depth is the main factor that separates the two zones. Plant species found within the wetland zone are more often found growing in areas that have saturated soil conditions with little or no standing water present. Communities within this zone include tall shrub and forested swamps, meadows and wet to wet-mesic prairie. The final transition is to a terrestrial zone or upland, where the absence of a high water table dictates the species found growing there. Communities found within this zone include forest, prairie, grassland, and savanna. Information about specific plant community types and their associated native vegetation can be found by reading and studying "The Vegetation of Wisconsin – An Ordination of Plant Communities" (Curtis 1959).

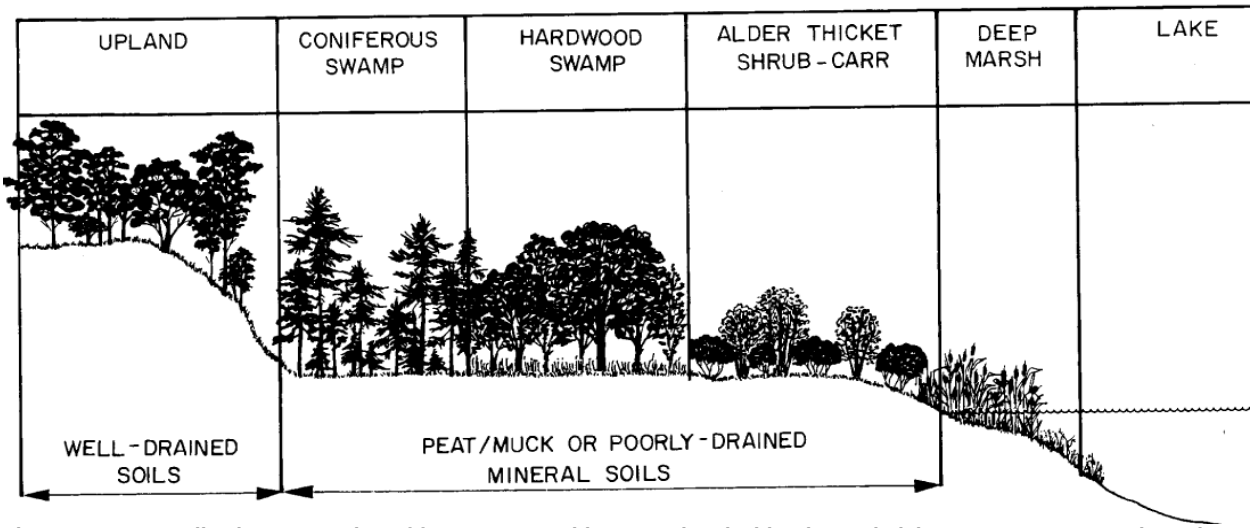


**Figure 4. A generalized cross section of forest communities associated with Wisconsin lakes. From Eggers and Reed, 1997.**

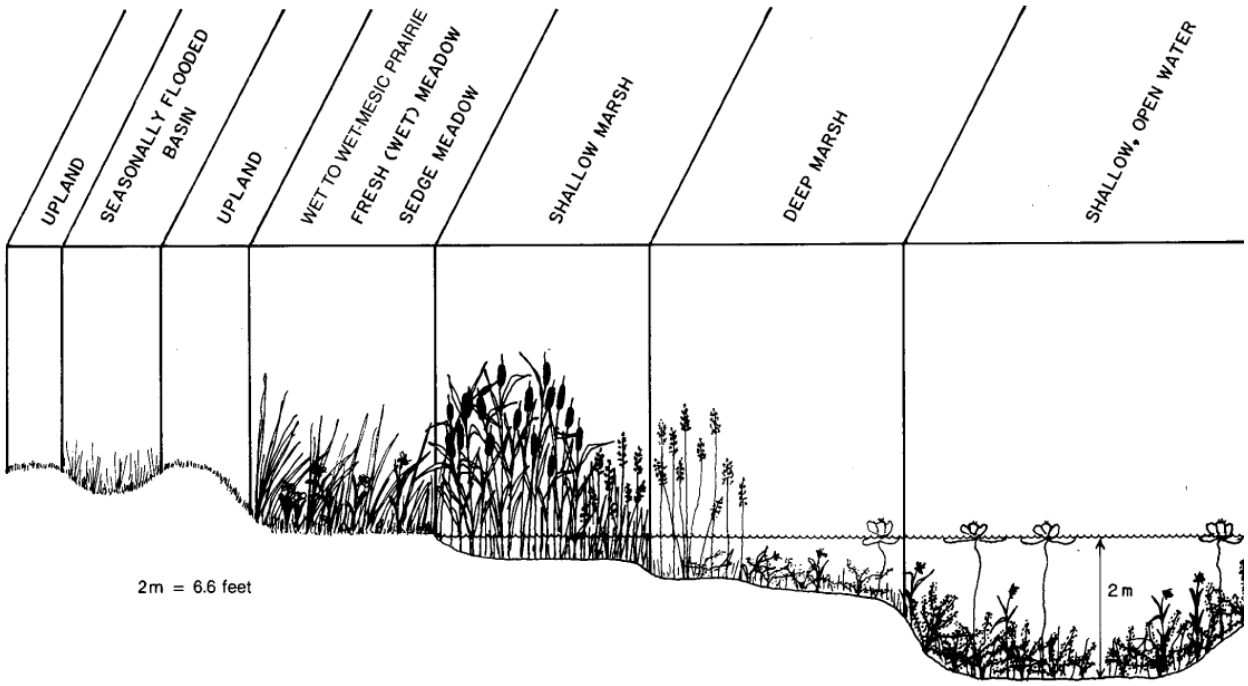


**Figure 5. A generalized cross section of open communities associated with Wisconsin lakes. From Eggers and Reed, 1997**

Since rain gardens are constructed, they do not fit into the above plant communities very well. If they had to be categorized, they would most closely resemble the seasonally flooded basin found in Figure 5. These communities receive overflow water from an adjacent waterbody where it is held and allowed to infiltrate into the soil. They may hold water for hours or days depending on the soil type found within the depression. The same is true of rain gardens. Most gardens, however, are designed to infiltrate water within a day, resulting in occasionally saturated soil conditions. Unless the constructed garden does not drain particularly well, the best plant species to use are those that tend to be found in moist water regimes.

Once the planting zones and their possible communities are determined, native plant species can be chosen. One way to approach the selection process is to observe plant species found on natural shorelands within the area and compare site conditions. In an effort to help in the development of planting plans, NES inventoried the shoreland plant communities of the three Cloverleaf Lakes. Results of the inventory are shown in Appendix C. Although the inventory is helpful, this list should by no means be the sole source used for developing shoreland planting plans in Shawano County; rather, it should be viewed as a guideline. Many species that were historically found within the area are no longer present due to past alterations or continued disturbance; and, some of the species found on this list are not commercially available. Unless an individual is going to transplant select native species, a restoration's species list will ultimately be determined by those that are available for purchase from local nurseries. A list of those species currently available can be found in Appendix D. Another approach would be to review native species already growing in the restoration area and find other species that grow in similar conditions utilizing the information found in Appendix D. If this is not an option, as would be the case for rain gardens, Appendix D can be used to generate a list of native species capable of growing in the planned restoration zones.

The above information will help chose species suitable for the site, but before the final species list can be generated for each planting zone, the plan developer must review the restoration goal(s) and consider the desired view of the adjacent waterbody. The vertical and in some cases horizontal growth of trees, shrubs

and some grasses and forbs could interfere with a homeowner's *viewshed* both immediately and further into the future; therefore, only those species that will fit into the overall landscape plan should be chosen.

Although there are a few native species that have exceptionally deep and extensive root systems, most have better developed roots than turf grasses; and therefore, any native species is a good choice for those interested in achieving increased erosion and surface water control. The native species list (Appendix D) also includes bloom color and period, which is helpful in designing a restoration that will provide varying colors throughout the year. An ever changing landscape will increase the site's appeal to wildlife, the homeowner and neighbors. Individuals interested in creating a more landscaped appearance can do so by clumping two to five individuals of one species together and interspersing them to create colorful patterns. More information regarding the use of native plants in landscaping can be found in "Landscaping with Native Plants of Wisconsin" (Steiner 2007). The other option is to evenly mix grasses/sedges with forbs to create a natural, wild design. Ferns, vines, shrubs and trees can be intermixed within the design to provide additional species diversity and wildlife value. Even though the species list does not include a section pertaining to wildlife importance, any native species incorporated into a restoration will provide some level of significance. If a homeowner wants to attract specific insects, birds or mammals additional research will be required as this document can not cover this topic in detail. A review of the book "Birdscaping in the Midwest: A Guide to Gardening with Native Plants to Attract Birds" (Nowak 2007), however, should help.

Several example planting lists and designs prepared for properties located on Grass and Pine Lakes can be found in Appendix B. Each plan includes a review of the existing site conditions and the homeowner's restoration goals.

# SHORELAND BUFFER ESTABLISHMENT

## 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 aggressive, non-native species from a site. An existing buffer that is dominated by native species will require the control or elimination of exotic species, which may be accomplished through pulling or spot herbicide treatment methods. If large amounts of exotic species are present, the easiest way to eliminate them is through multiple 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.

### Terrestrial Zones

Many of these restoration sites are currently maintained as lawn; therefore, the existing turf grass will need to be eliminated. There are a few different ways to approach this task. The quickest way to achieve this goal is through the application of a glyphosate herbicide such as "Round-up". This non-selective herbicide will effectively eliminate most or all vegetation after one or two applications. The best time to apply the herbicide is when the grass is healthy and actively growing. For optimal control, spraying should be avoided during periods of dormancy or stress, which can occur under extremely dry or wet conditions.

If a chemical free approach is preferred, materials such as layers of newspaper, cardboard, black plastic, tarps or mulch can be laid over the lawn to smother the vegetation. This method can be rather inexpensive, non-hazardous, and very effective, but often times it will take a whole growing season or more to be effective. Most woodland species prefer rich, organic soils. If these soils are already present then soil amendments are not necessary; however, if additional organic material is needed, shredded

hardwood bark mulch can help. Approximately 6-12" of bark mulch should be placed in the desired area and allowed to settle for one year. The mulch will smother the existing vegetation and decompose providing a good planting bed the following year. An added benefit of herbicide applications and smothering is the preservation of the sod layer, which results in added weed suppression and moisture retention.

A second chemical-free approach is tilling. Repeatedly (every two to three weeks depending on growth) working the soil can also eliminate the existing vegetation and any weeds that may begin to grow within the exposed seedbed. Although tilling may be feasible, it can be labor intensive, the process can take a whole growing season to achieve the desired results, and the end product is an exposed seedbed which could be open to future weed invasions and potential soil erosion. These problems could be reduced or eliminated if a cover crop is planted or mulch is used to suppress such growth and products like erosion blanket and silt fence are installed to stop soil movement into the adjacent waterbody. These problems are less likely to be encountered if the vegetation is eliminated without soil disturbance as discussed above.

A final chemical-free approach would be to strip the existing sod lay. The process will require the removal of the top 2-4" of soil along with the grass. The positive side of this method is the immediate removal of the non-native vegetation layer, but the negatives to sod removal include: 1) the process is very labor intensive; 2) like tilling, the soils will be exposed to possible erosion and weed seed invasions; and 3) a large percentage of the topsoil and organic matter is removed. Organic material and/or topsoil can be used to replace the lost material, but erosion and weed seed invasions could be an issue and the process will be more costly.

If soil amendments and pH alterations are required they would need to be conducted with either the tilling or sod removal methods so the material (compost, lime, etc.) can be worked into the topsoil layer. However, as discussed earlier, unless extreme conditions exist within the restoration area no soil alterations should be required with the installation of native plants. Most species are very hardy and will persist under the site's current conditions.

### Wetland and Littoral Zones

The presence of flowing/standing water and/or saturated soil conditions for long periods of time within these zones make it impractical to utilize smothering and tilling activities for seedbed preparation. It is also important to note that federal, state and local laws prevent tilling activities and the addition of mulch within wetlands without first obtaining a permit. Therefore, a non-selective herbicide such as "Rodeo" or "Habitat" will need to be the main tool utilized for vegetation suppression. These two products have proven successful in controlling aggressive, exotic species and are registered for use in aquatic environments. Prior to applying any herbicide, an individual will need to contact the WDNR to obtain an aquatic plant control permit if applications are to be conducted in areas containing standing water. Applications should be conducted when the plants are actively growing. Best results can be achieved and will likely be necessary through multiple applications during the growing season; however, one season of treatment may not be enough. An abundance of seeds in the seedbed could require aggressive treatment over several years to adequately eliminate certain species such as reed canary grass.

### Rain Garden Construction

After the location, size and shape of the rain garden has been added to the restoration map, the approximate perimeter can be field marked using flags or rope (Photo 15). Once established, digging to the desired and pre-determined depth may commence. For gardens located in relatively flat areas, the excess soil can be removed and used to create a low berm around the three sides not receiving direct water discharge. The berm, which only needs to be 2 or 3 inches in height, will be highest on the

downhill side and slowly taper as they wrap around the garden's side toward the uphill discharge point. These berms help capture and hold flowing water while increasing storage capacity within the garden.

Rain gardens that are to be constructed on a slope will require a little more measuring to determine the necessary berm height on the downhill side of the basin. The easiest way to accomplish this measurement is to pound two stakes into the ground, one on the uphill side and the other on the downhill side. Next, attach a rope to the bottom of the uphill stake and then using a string level (available at any hardware store) attach the rope at the appropriate height on the downhill stake so the string is relatively level. Soil dug from within the garden can then be used to construct the downhill berm. Depending on the slope, berms could be 6-8" in height. The Letven site plan found in Appendix B depicts a rain garden design on a moderate slope. If berms exceed this height due to steep slopes, an individual may want to consider constructing several interconnected rain gardens that step down the slope, similar to the Sorenson rain garden design (Appendix B). The booklet "Rain Gardens – A How to Manual for Owners" mentioned earlier contains good diagrams on this process.

As digging proceeds, the most important thing to remember is the bottom of the garden should be relatively level as shown on the Letven plan. An individual can achieve this goal one of three ways: 1) through survey methods, which are expensive and often time more technical than needed; 2) via level checks throughout the basin by using a 2"X4" board and carpenters level; or 3) by running water from a hose into the basin and observing standing water locations. If water pools in areas unevenly, the bottom can be further leveled by adding or removing soils. Adding water to the garden prior to final completion will also help gauge infiltration rates if an individual had questions regarding the moisture regime.

**Photo 18. Landscape timbers bordering a terraced rain garden – Grass Lake.**

After construction is completed, soils within the rain garden and on the berms will need to be protected to prevent possible erosion and allow vegetation establishment. Accomplishing this task will depend on how the area is to be planted. If the rain garden and berms are to be seeded, the native seed including a cover crop should be installed and the area covered with either erosion blanket or straw mulch. Do not use marsh hay as this is reed canary grass. Another option is to place shredded hardwood bark mulch on these areas and install live plants. Wood chips are not recommended since they are buoyant and will be move by water entering the garden. Seeding into the bark mulch is not recommended because it is difficult to get good seed to soil contact required for germination. Bark mulch is beneficial because the material allows for greater water retention, suppresses weed growth and adds a little more organic material to planting area. A combination of these two options can also be implemented (Photo 16). In most cases bark mulch is added within the garden and planted with plugs, while the berms are seeded with grass seed and protected with either straw mulch or erosion blanket. Seeding the berms with grass allows the rain garden to gradually transition into the surrounding landscape. Some homeowners, however, may want to establish the garden as a distinct landscape feature. In these cases an abrupt border such as rock or landscape timbers can be used to create an edge (Photos 17 and 18).

## Material/Plant Installation

### Biologs

Once a fiber log is in place it must be anchored securely to prevent movement. In low energy areas that have little concern for ice damage, 2" wooden stakes are installed at angles in front and behind the biolog to prevent them from being lifted by the water. For areas that have more wave action and potential issues with ice shove, duckbill anchors with steel cabling or similar should be used to ensure secure placement. Manufacturer's installation directions should be followed for anchor spacing requirements. Log segments should also be tied together at their ends to provide more stability between each unit.

### Live Stakes

Live stakes or posts can be installed upright at the water's edge and on the slope (Photo 12) by either pushing them into the soil or by drilling a hole with an auger; or they can be installed horizontally between soil layers as they are in an encapsulated soil lift (Figure 2 and Photo 11).

### Native Herbaceous and Woody Plants

#### *Terrestrial Zones*

Once the existing vegetation has been adequately suppressed, planting activities can begin; however, the progression of the planting will be dictated by factors including: the chosen seedbed preparation method, the desired look of the planting, and installation timing. Sod removal and replacement with topsoil will allow an individual to conduct plant installation immediately; however, if herbicide is used to prepare the site, vegetation installation should be delayed at least one week after the last herbicide treatment. Plants can be installed directly into the topsoil or through the sod layer utilizing a planting trowel or power auger. Once the holes are created, the plug or plant's roots shall be inserted to a depth equal to the height of the topsoil around the plant's roots. To achieve a manicured appearance, selected species should be randomly placed in "clumps" of two to five individuals each; and unless designated otherwise, all plants should be planted one-foot on center. Most plant nursery catalogs include plant spacing recommendations. When planting adjacent to shrubs or trees, a two-foot spacing should be retained to allow for their growth.

As mentioned above, the dead sod layer will assist with weed suppression and moisture retention; however, if the dead grass understory is not aesthetically appealing, a 1-2" layer of shredded hardwood bark mulch or weed-free straw can be added. To reduce plant damage, mulch should be placed prior to installation; however, the mulch should not be in direct contact with the plants to ensure they have adequate growing room. For the best results, herbaceous live plants should be installed in either the spring/early summer (mid-May through June) or early fall (mid-September to mid-October). Planting during the middle and later portion of the summer can be done, but precautions must be taken to ensure the plants have an adequate and frequent water supply. If plants are installed in the fall, three to four inches (3-4") of straw mulch should be placed on the plants after they have gone dormant to ensure winter survival. The straw should then be removed in the spring.

To reduce transplant shock, bare-root shrubs and trees should be installed in their dormant state during the early spring (mid-April to late May) or late fall (mid-October to late November). Trees and shrubs should be scatter planted within the designated planting zone. Trees can be planted as close together as six feet for dense plantings, but a ten-foot spacing provides more room for growth, especially in a residential setting. Shrubs can be planted individually, but are often times clustered in groups of three or

more and are planted on three to five-foot centers depending on the desired density. Installation of the woody vegetation should start with the excavation of an adequately sized hole for the bare-root plant material. Once the hole is made, the plant's roots should be inserted into the hole and spread out evenly. The trees shall be planted at a soil depth equal to the environment from which it was removed prior to being shipped. Backfill approximately 2/3 of the hole with the native soil removed earlier making sure to remove any large rocks and debris, if present. Soil placed in the hole should not be compacted; rather, the water should be poured over the soil to promote natural settling around the roots. Once settled, fill the remaining hole to bring up to grade.

The same planting procedures discussed above should also be implemented if seedbed preparation is accomplished through smothering with cardboard, black plastic or tarps, once the materials are removed. If newspaper is utilized, the plants can be installed directly through the paper without removal. Since smothering will likely result in a late season installation, the planting procedures for fall should be followed; however, the materials could remain in place throughout the winter and planting conducted the following spring.

Woodland species can be installed directly into areas where bark mulch is used to smother the existing vegetation and amend the soils. However this should only be done if the mulch has been allowed to settle and further decompose. Installing plants into a newly placed, thick mulch bed will result in settling around the plant's roots, which could leave them exposed and growing in a less than ideal condition. The result could be unhealthy plant growth and/or loss.

If tilling is chosen as the preferred method of seedbed preparation, live plant installation in the fall should include the placement of straw or shredded hardwood bark mulch not only to assist with plant survival, but also with erosion control. If planting is to be conducted the following spring then either mulch should be placed to protect the exposed soil or a cover crop of winter wheat should be seeded at a rate of 5 lbs/acre prior to October 15th. The wheat will ensure site stabilization during winter and reduce weed growth the following spring. Prior to plant installation the wheat should be mowed to prevent seed head development. If mulch is to be added, the wheat cover crop should be cut to 1-2" in height. Either cutting and mulching or cutting alone will result in the elimination of the winter wheat by the following spring. Planting activities can then proceed as discussed above.

### *Wetland and Littoral Zones*

Unless there are exotic species growing within the littoral zone that need to be eradicated emergent, submergent, and floating-leaved plants can be installed without any site preparation. For the best results, live plants should be installed between June 1 and July 15th. Under good growing conditions, these plants will spread quickly so they do not need to be planted as close together. Emergent vegetation should be planted on approximate two or three-foot centers throughout the community. Planting of the live material should be done by making a slit in the substrate with either the installer's hand or an instrument such as a tree planting bar. Once the hole is made, the plug or plant's roots should be inserted into the hole. The entire root mass of live plants must be inserted in the soil to prevent plants from dislodging. Periodic inspections should be conducted during the two weeks following the planting to re-install vegetation that has become dislodged.

On wet shorelines or in wetlands with existing vegetation, the process will begin with vegetation suppression through herbicide applications. Once these are completed planting activities can begin; however, to make plant installation easier, the existing dead vegetation may need to be mowed with either a brush mower or string trimmer to a height of 1-2". Vegetation installation procedures in these areas will be similar to those discussed in the terrestrial zone except for the addition of mulch. Unless a permit is

obtained from the regulatory agencies, no materials (e.g., topsoil, mulch, etc.) can be placed within a wetland community.

## Native Seed

### *Terrestrial Zones*

For those areas that will be tilled and seeded, the topsoil should be worked with a tiller to a depth of 2-3". The topsoil should be free of heavy clay, refuse, stumps, large roots, rocks over 2 inches in diameter, weeds, or other extraneous material which would be detrimental to good seed-to-soil contact, and therefore seed establishment. The surface should then be dragged or raked to provide a smooth, fine textured soil throughout the planting area. A cover crop of annual rye and common oats, along with the selected native mix can then be sown at rates of 1, 12 and 6 ounces per 1,000 square feet, respectively.

Since most sites will be relatively small, the areas should be seeded by hand. The hand and push seeders that are typically used for lawn seeding should not be used for sowing native seed. Native seed tends to either be too small so it falls through the seeder unevenly; or, the seed is too large and will not pass through the openings easily. Native grass seed also tends to be fluffy and can stick together causing additional issues. Prior to seeding, the cover crop and native seed should be mixed together with a carrier (e.g., sawdust, vermiculite, moist sand, etc.) to ensure even distribution of the seed. The seed quantity could be relatively small so the applicator may want to split the mixture in half and conservatively sow the entire area with only half of the mixture. The second half of the mixture can then be utilized to cover those areas not previously seeded or to provide better coverage within the restoration area. Seeding should be done perpendicular to the first pass when going over the site a second time. Conducting the seeding in this manner will prevent the need to order additional seed, which can be expensive. Hand seeding should not be conducted when wind conditions exceed 10 mph (miles per hour). After the seed has been installed, the area should be lightly raked so the seed is covered by ¼ to ½ " of soil and rolled to ensure good seed to soil contact. Seed should not be sown or rolled on soils that are too wet for conditions or are frozen. Once the areas are seeded, the site should either be mulched with straw or covered with erosion blanket to ensure seed protection and no soil loss into the adjacent waterbody.

Areas that are too large to hand seed will need to be installed with either a broadcast or no-till drill type seeder capable of handling native seed. The seeders should be properly calibrated to ensure an even seed distribution is achieved within the planting area.

### *Wetland and Littoral Zones*

Since tilling is not normally conducted within wetland areas, live planting would be the primary choice for vegetation establishment; however, seeding can be done. For small areas, an individual could use a hand rake to lightly scratch the surface and then sow the seeds by hand, as described above. Seed can also be sown directly on the soil surface without any preparation, but this must be done in late fall so the seed can work its way into the ground during the freeze-thaw cycle of winter and spring. If water flow is possible, surface seeding is not recommended. Seeding success rates in these conditions will vary.

Although seeding could be conducted within the littoral zone it is not recommended. Live plant installation will have a much higher success rate.

For the best results, seeding should be conducted in either the spring/early summer (mid-April through June) or fall (October through mid-November). Seeding during the middle and later portion of the summer can be done, but precautions must be taken to ensure the seeds and young plants have an adequate and frequent water supply.

## Herbivore protection

In order to prevent damage or loss of planted woody vegetation, a protective tube or wrap could be placed around the plant (Photo 19). The material should be installed when the tree or shrub is being planted by inserting it into the hole such that 2-3" of the tube or wrap is buried below the surface. Placing the structure below the surface will prevent rodents such as meadow voles and rabbits from getting inside and damaging the woody plant's trunk. Soil around the protector will help anchor it in place, but they should be further secured by fastening the tubes to two or three wooden stakes. After the trees or shrubs are protected, mulch can be added inside and around each to assist with moisture retention and weed suppression. Mulch within the protectors should not be placed in direct contact with the woody vegetation to prevent potential moisture issues.

**Photo 19. Foreground – Protective tree tube Background – Wave break structures.**

If the protective tubes are undesirable, there are granular and liquid products on the market that will repel most mammals and birds. An assortment can be found at most hardware stores. The major drawback to using these products is they need to be continually applied in order to ensure maximum protection.

Another option is to install fencing around the planting area to keep species like deer, rabbits and geese out. Depending on the type of fencing materials chosen, the cost could be relatively inexpensive. Photo 20 depicts a fencing system that is constructed of green plastic snow fencing that is zip-tied to steel t-posts. In this case it was used to keep geese out. The outer fence should be two or three feet in height and installed so it is flush with the ground to prevent geese from going under. Fencing within the water should be three to four feet in height and should be installed so that at least twelve inches of the fence is below the water line. If muskrats are a problem, the lower portion of the fencing system will need to go down to the bottom of the lake and be reinforced with a metal fencing such as chicken wire. The fencing should be maintained throughout the first full growing season. Provided the plantings are successfully established, the fencing system can be removed in fall and will not be necessary in subsequent years, unless muskrat populations are high. However, continually installing fencing to prevent muskrat browse would be labor intensive; therefore, it would be in a homeowner's best interest to work with a local trapper to ease future damage.

**Photo 20. Fencing used to exclude geese from an emergent planting.**

## Wave Brakes

The establishment of aquatic vegetation can be difficult due to wave action. Vegetation species need time to grow and establish their root mass before they can withstand the energy produced by wind and boat generated waves. If plants are not afforded this protection, they could be uprooted before they even have a chance to become established. Property location will determine the amount of protection required, but in almost all cases some form of barrier will need to be installed to ensure success. For those areas that receive limited wave action, a simple structure such as the above mentioned snow fencing system could be utilized (Photo 20). Although the fencing is not solid, it would break up and absorb most of the wave energy prior to reaching the plantings. For moderate to high wave energy situations, a more solid and stable system will be needed. These can vary in expense and complexity. In addition to assisting with shoreline stabilization, biologs can also be anchored in the water to assist with wave energy reduction. Another option is the assembly and installation of a system using plywood securely anchored to stakes (Photo 19). These items can be very successful, but they can also be rather expensive. A cost effective alternative is the use of brush bundles (Photo 21 – insert Clintonville photo), which often times can be secured for free from family, friends, neighbors or municipal compost sites. Branches are interwoven and tied together to create a rather solid structure when properly anchored in the water; however, constructing the brush bundles in this fashion can be time consuming. One way to reduce the time commitment would be to use Christmas trees that are discarded in January of each year. Because the branches are already connected, there will be less time required to interconnect and fasten the trees together to create the structure. These same trees are sometimes tied together and sunk in lakes to create fish habitat. Although this may be the case, a WDNR permit is required to install any structure in the water that will remain for an extended period of time.

**Photo 21. Installation of brush bundles – Pigeon Lake.**

## Suppliers

The easiest way of acquiring native seeds and 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 300 miles or less 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. A list of a few nurseries within 300 miles that grow native plants is shown below. A more extensive list can be found on the WDNR website.

Although most reputable nurseries sell "*Pure Live Seed (PLS)*", an individual should check to ensure they are purchasing quality seed. Another note to remember when ordering seeds is all *legume* species should be inoculated with a *rhizobium*. The nursery can do this prior to shipping, but an individual will most likely need to request the inoculation.

## ***Plants & Seeds***

**Marshland Transplant Nursery**
P.O. Box 1
Berlin, WI 54923
(920) 361-4200

**Agrecol**
2918 Agriculture Drive
Madison, WI 53718
(608) 223-3571

**JF New**
1402 Pankratz Street, Suite 302
Madison, WI 53704
(608) 240-1453

**Prairie Nursery**
P.O. Box 306
Westfield, WI 53964
(608) 296-3346

**Stone Silo Prairie Gardens**
4500 Oak Ridge Circle
DePere, WI 54115
(920) 336-1662

**Dragonfly Gardens**
P.O. Box 192
Amery, WI 54001
(715) 268-4666

## ***Shrubs & Trees***

**Reeseville Ridge Nursery**
512 South Main Street
Reeseville, WI 53579
(920) 927-3291

**Alpha Nurseries**
3737 65th Street
Holland, MI 49423
(269) 857-7804

**Outback Nursery**
15280 110th Street South
Hastings, MN 55033
(651) 438-2771

**Cascade Forest Nursery**
22033 Fillmore Road
Cascade, IA 52033
(319) 852-3042

## ***Erosion Blanket & Biologs***

**ERO-TEX**
N94W14330 Garwin Mace Drive
Menomonee Falls, WI 53051
(866) 437-6839

**CFM – Construction Fabrics & Materials Corp.**
2525 Peiper Road
Cottage Grove, WI 53527
(608) 839-8031

**Brock White**
1425 South Ashland Avenue
Green Bay, WI 54304
(920) 432-6438

**Earth & Road**
101 Skyline Drive
Arlington, WI 53911
(608) 635-7755

## Maintenance

In general, maintenance can be divided into two time periods – short term (the first two years) and long term (following the second year). Short term maintenance tasks are those activities required to establish the landowner's desired garden, ecological community, etc., while long term maintenance tasks are those activities required to sustain the desired planting. The following section outlines and discusses tasks to be conducted during these periods.

### Short Term

#### *Watering*

Shortly after native seeds and plants are installed they should be watered to assist with germination and reduce transplant shock. Sufficient water will be required to ensure seed/plant establishment and survival; therefore, if at any point the soil or mulch becomes dry, the planting should be watered. Regular precipitation events, especially with the presence of mulch, should alleviate the need for watering, but if sufficient rainfall is absent the planting should be watered. For areas containing live plants and mulch, apply approximately 0.5" to 1" of water via a sprinkler system during a watering event to provide a deep soil soaking, rather than conducting several short watering events. An individual can measure the amount of water applied to the restoration site by placing a rain gauge in the planting. Seeded areas should be watered once every two or three days to keep the soil moist. These watering events should continue for the first six to eight weeks after installation for seeded areas, or until the plants appear well established. For live plantings, watering for the first two to three weeks should suffice. Once the plants appear to be fully established, watering is unnecessary except during extended drought periods.

Planting bare-root trees and shrubs in the spring and/or fall often times eliminates the need to conduct watering activities; however, newly planted trees and shrubs could struggle during extended periods with little rainfall. If woody vegetation appears to be stressed due to climatic conditions, watering activities should be conducted. The placement of five gallons of water per tree or shrub each week will help the plants survive droughty conditions. With trees and shrubs, the old adage "more is better" is not true when discussing watering; therefore, caution must be taken to ensure the woody plants are not over-watered, which could cause additional stress.

#### *Weed Control*

**Live Planting**

Other than watering, the main activity that must take place during the short term maintenance period is preventing the establishment of exotic plants or *weeds* within the shoreland buffer. For many individuals, the installation of live plants versus seeding will make weeding a simpler task. Plants can be marked with identification labels, if desired, and any plant not marked can be removed periodically throughout the growing season, to aid in identifying weeds versus non-weeds. As the native plants begin to spread in the second year, unknown plants can be compared quickly to those that were planted and a decision made regarding its status as a desirable or undesirable plant. Weeding in this fashion eliminates the need for specific species identification by a homeowner, which can be problematic. For those individuals wanting to learn more about common weeds and their identification or specific maintenance practices recommended for particular species, the reference section at the end of this document contains several good books that can be of assistance.

The use of mulch with live plantings, at least initially, further eases maintenance requirements. As mentioned earlier, a layer of mulch will suppress weed growth; and often times, when unwanted plants do

appear they are growing in the mulch, which makes for easier removal. If unwanted plants are to be pulled, the best time is when soil and mulch conditions are moist so the weeds pull out easily. During drier times of the year (late summer), the plant community may need to be thoroughly watered to achieve these conditions.

Weeding within the terrestrial and aquatic zones should not be real labor intensive, but an hour or two, depending on the restoration size, may be required every two weeks during the first growing season to ensure they are kept under control. Weeds should be removed prior to seed development to prevent further infestations. Very aggressive and invasive species that are removed should not be composted; rather, they should be properly disposed of in a landfill facility. Unless a very aggressive species appears within the planting, herbicide should not be utilized to control unwanted plants. If herbicide is utilized, extreme caution must be used to ensure the desired native species are not impacted. An individual should either apply the herbicide solution directly to a cut stem with a sponge type applicator so that it can be absorbed into the root system or apply herbicide to the plant using the "Glove of Death" technique. The technique involves spraying the solution onto a cotton glove that is worn by the applicator over chemically resistant gloves; the applicator then takes hold of the plant near the base and runs the cotton glove up the plant stem. These two techniques reduce potential herbicide contact with desirable native species. Always be sure to follow label directions and utilize safe, responsible application methods.

*Prairie and Rain Garden*

Starting the spring after the first full growing season, the dead material from the previous year's growth could be cut approximately 2-4" above the ground by hand or with a string mower. The material should then be removed and composted so new plant growth is not smothered. Although this task can done in fall after the plants go dormant, conducting this activity at this time of the year removes a seed source for wildlife and increases the potential for plant damage, especially those species that have hollow stems. Cutting and removing old vegetation every year is often done for aesthetic reasons. New growth will appear even if the community is not mowed and the old material will breakdown during the growing season.

*Woodland*

If a neatly kept garden is preferred, the old plant material can be cut and removed each spring, but this eliminates organic material for future plants. Many of the suggested woodland species thrive in organic rich forests that are supplied with an annual crop of leaves and old plant material every fall. These materials are broken down by organisms throughout the following growing season and continually enrich the community's soil; therefore, some debris is desired.

The success of shrubs and trees within the fallow field and other communities will be achieved provided the planted material has: 1) adequate protection from herbivores, 2) enough water, and 3) competing weeds suppressed. As discussed earlier, the installation and maintenance of a protector around woody plants is suggested until they are well established. Protection from voles and rabbits in the early years will eliminate continued damage and replacement. If maintenance activities are to be conducted, 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.

*Wetland and Aquatic*

Except for the removal of undesirable species, these communities should not require the removal of dead vegetation on an annual basis.

**Seeding**

*Prairie*

Restoration through seed installation requires a slightly different approach to maintenance activities. Although vegetation will be eliminated during seedbed preparation, disturbance of the site during these activities provides weed species an opportunity to colonize the area more easily. Since young native plants will be growing with weed species and distinguishing the two can initially be difficult, removal of most unwanted species will need to be conducted through mowing activities. Weed species often grow more quickly than native species; therefore, regular mowing activities throughout the first growing season will have little or no impact on desirable species while controlling weeds. The amount of mowing will depend on precipitation events and the density of weeds present. In mid-May to early June when vegetation reaches a height of 12", the planting should be mowed to a height of approximately six inches. This process should be repeated throughout the growing season. Make sure to avoid mowing too frequently, which can encourage weed growth in a "ground cover" type fashion, and smother the desirable seedlings. During the second growing season, the seeded area should be mowed as low as possible without scarifying the soil to encourage additional seed germination and seedling growth in mid-spring (i.e., mid-April to early May). Depending on weed density a second mowing may then be necessary in June. The cutting should occur when vegetation reaches 12", and it should be mowed to a height of 6-8". Conducting mowing activities prior to weed seed development is important to ensure the species are adequately controlled. Most areas will be small enough that a string mower can be used to cut the top portion of the vegetation. Caution should be taken to ensure the cut vegetation is not so dense that it smothers the young seedlings. Excess material should be removed if necessary.

Throughout the growing season the status of invasive species coverage should be assessed, focusing on the threat of aggressive perennial species such as fescue (*Festuca spp.*), smooth brome (*Bromus inermis*), quack grass (*Elytrigia repens*), sweet clover (*Melilotus spp*.), thistle, (*Cirsium spp*.), and reed canary grass. Spot herbicide treatment and hand cutting of these undesirable species may also be required during the first two years of establishment. Pulling undesirable species is an option, but this method is not suggested because it can uproot small native seedlings and cause soil disturbance, which can lead to additional weed invasions. As mentioned above, herbicides should be used cautiously and only if necessary. The two techniques discussed earlier should be employed. These methods should be conducted at a time that will maximize the damage to exotic plants while minimizing effects to the native plantings.

*Woodland and Wetland*

Although mowing activities could occur within these communities as described above, most often times, weed species are removed through selective cutting, spot herbicide applications and pulling. Many of these species grow more quickly than prairie species and compete well with undesirable species, therefore, reducing weed pressure. Untimely mowing activities could result in long-term damage to desired native species.

*Aquatic and Rain Garden*

Seeding can occur within these communities, but it is not recommended. If seeding is conducted, activities within the aquatic community should be similar to those performed in the woodland and wetland communities, while the rain garden activities should mimic a prairie planting maintenance regime.

Long Term

### *Watering*

Once plants are fully established, watering is unnecessary except during extended drought periods. Wilted leaves on the plants will provide an indicator as to when watering may be necessary. If the desirable species show little or no signs of stress, watering is not necessary.

### *Weed Control*

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 to achieve a desired appearance. 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 and maintenance activities should be conducted to ensure exotic species are not becoming established within the plantings. A well established native plant community can be sustainable, but the ever growing number of invasive species requires some limited annual maintenance to achieve this goal.

#### Prairie Seeding

Unlike most other communities, once a prairie community becomes established, a timely disturbance is required to maintain its diversity and vigor. Historically fire was the disturbance that renewed these communities. Fire is still utilized today in the form of prescribed burns, which are conducted in either mid-spring (i.e, late March through early May) or late fall (i.e., mid-late October into early December). A well-timed fire will set back undesirable cool season grasses and forbs, while providing optimal growing conditions for prairie species. Restorations conducted within urban settings cannot, however, always be managed with fire. In these cases, the community should be mowed low to the ground, without disturbing the soil, and the cut vegetation removed from the site. Although mowing does not blacken the ground and enhance soil warming to promote prairie plant growth, the activity does remove competition by setting back cool season weeds. The periodic mowing or burning events should be conducted every two or three years depending on weed density and thatch accumulation.

## GLOSSARY

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

**Available Water Capacity:** the amount of water stored in the soil that is available for plant use

**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)

**Cover Crop:** a temporary crop, (commonly oats or annual rye) planted to keep nutrients and soil from eroding and greatly reduces the amount of weed growth.

**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 Control Blanket:** a blanket of plastic fibers, straw or other plant residue designed to protect soil from rainfall and runoff, and helps hold moisture in the soil for plant use.

**Erosion Fabric:** a mat-like material constructed of staw, coir, aspen fibers, etc. that is placed over exposed substrates to prevent 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

**Fetch Length:** the distance wind travels across open water

**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.

**Forbs:** a non-woody flowering plant that is not a grass

**Groundwater Recharge:** the process by which the groundwater is replenished

**Growing Season:** the period of the year when native plants and crops grow. Approximately April - October

**Gullies:** large channels formed from concentrated surface water runoff

**Horizon:** each soil layer in the soil profile. There are usually multiple horizon's (layers) in each profile

**Humus:** partially decomposed organic matter

**Hydroseed:** the seeding process consisting of spraying a mixture of seed, mulch and water

**Hydrosere:** adjacent plant communities growing along a wetness gradient

**Ice Ridge: a** land feature caused by the natural pushing action against the shore from the expansion and contraction of ice that forms the shore into a ridge

**Impervious:** a surface that does not allow water to infiltrate (e.g. parking lots, roads and etc.)

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

**Landscape:** a continuum of adjacent habitats and communities

**Legume:** A nitrogen-fixing plant that produces pods containing seeds

**Littoral Zone:** an area within a lake or river that receives enough light to allow vegetation growth

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

**Mitigation:** replacement of an ecological function through the creation or restoration of another function or community

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

**Native Plant/Vegetation:** a plant or species that evolved and originally occurred in a region

**Ordinary High Water Mark:** a line on the shore established by the fluctuating water level that indicates by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas

**Organic:** the fraction of the soil comprised of the decomposed plant and animal matter

**Permeability:** a substance's ability to allow liquids to pass through

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

**Photoperiod:** the duration and timing of sunlight occurrences

**Phytoplankton:** very tiny organisms in aquatic systems

**Pure Live Seed (PLS):** a measure used by the seed industry to describe the percentage of a quantity of seed that will germinate. PLS is obtained by multiplying the purity percentage by the percentage of total viable seed, then dividing by 100

**Rain Garden:** a planted depression that collects concentrated runoff from impervious areas and allows them to be absorbed into the ground

**Restoration Plan:** a plan consisting of a current site map, site condition data, planting and maintenance list and schedule, along with steps to follow and any other pertinent information that may help successfully achieve the landowner's goal

**Rhizobium:** soil bacteria that fix nitrogen becoming established inside root nodules of legumes

**Rills:** small channels formed where surface water runoff is spread out and less concentrated.

**Runoff:** rainwater that flows over the ground surface

**Secci Disk:** a circular disk used to measure water transparency

**Shoreland:** an area encompassing the littoral, wetland and terrestrial communities around a lake or river

**Shoreland Buffer Zone:** an area from the ordinary high water mark inland that is left in or restored to a natural state around a lake or river and provides specific ecological functions

**Silt Fence:** a temporary erosion control devices made of woven synthetic fabric supported be either wood or steel posts

**Snag:** a tree or branch in the lake bed protruding above the water surface

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

**Tannin:** natural organic material that can cause the water to be slightly discolored

**Terracing:** the practice of creating nearly level layers on a slope to reduce erosion potential by reducing runoff velocity

**Terrestrial Zone:** an area dominated by upland vegetation species that has a water table >12" below the ground surface

**Viewshed:** the desired view from a specific vantage point

**Wetland:** an area that is saturated either permanently or seasonally and is defined by soils, hydrology and vegetation. Often occurs in depressions and has either standing water or a water table between 0 – 12" below the ground surface

**Wetland Zone:** an area dominated by hydrophytic (water loving) vegetation species with a water table between 0 – 12" below the ground surface

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## Organizations that can Provide Guidance with Shoreland Restorations

Cofrin Center for Biodiversity - University of Wisconsin Green Bay - http://www.uwgb.edu/biodiversity/

Shawano County Land Conservation Department - http://www.co.shawano.wi.us

University of Wisconsin Extension - Shawano County - http://shawano.uwex.edu/

Wisconsin Department of Natural Resources - http://dnr.wi.gov/

Wisconsin Association of Lakes - http://www.wisconsinlakes.org/index.htm

Wisconsin River Alliance - http://www.wisconsinrivers.org/

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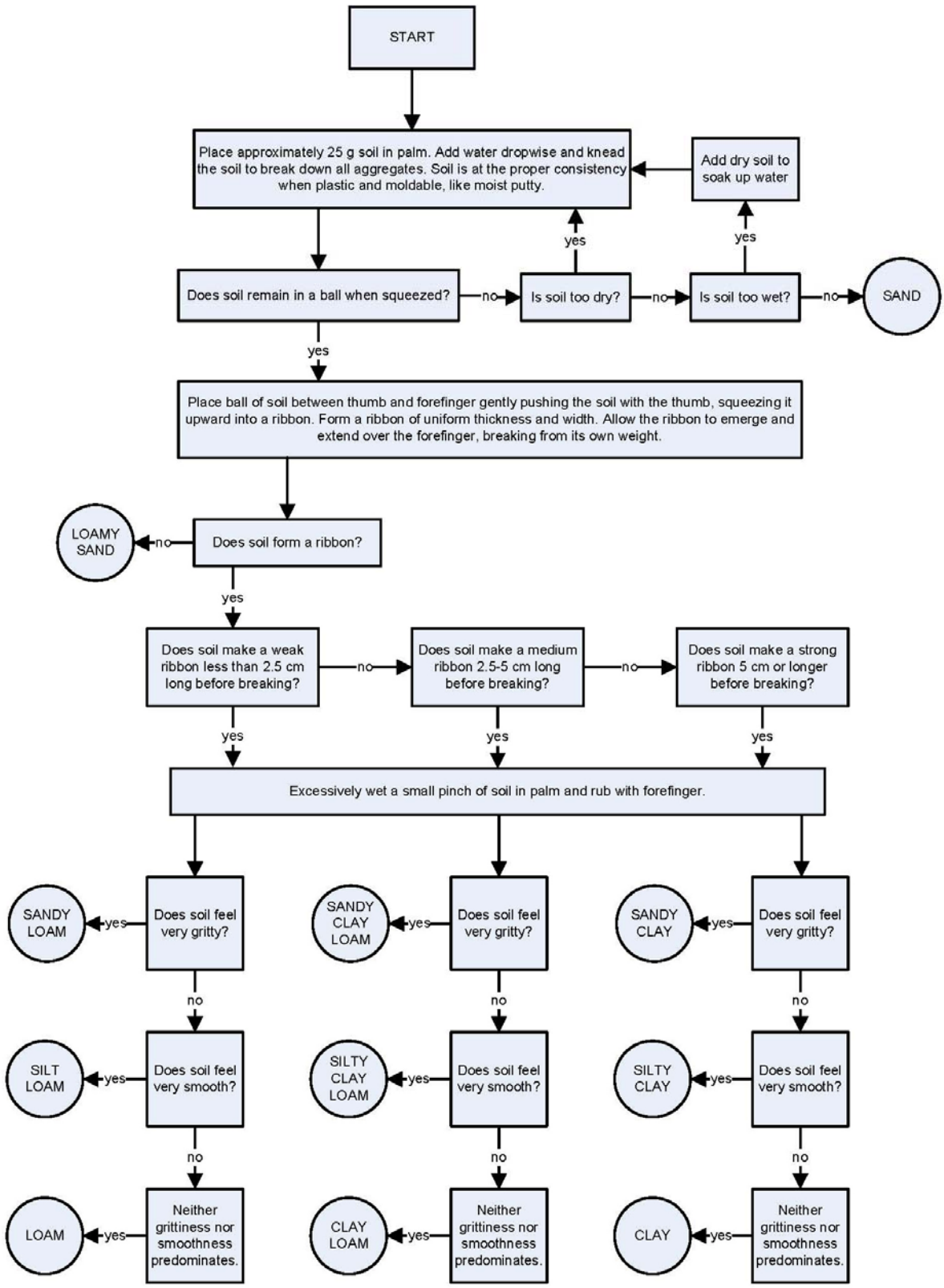
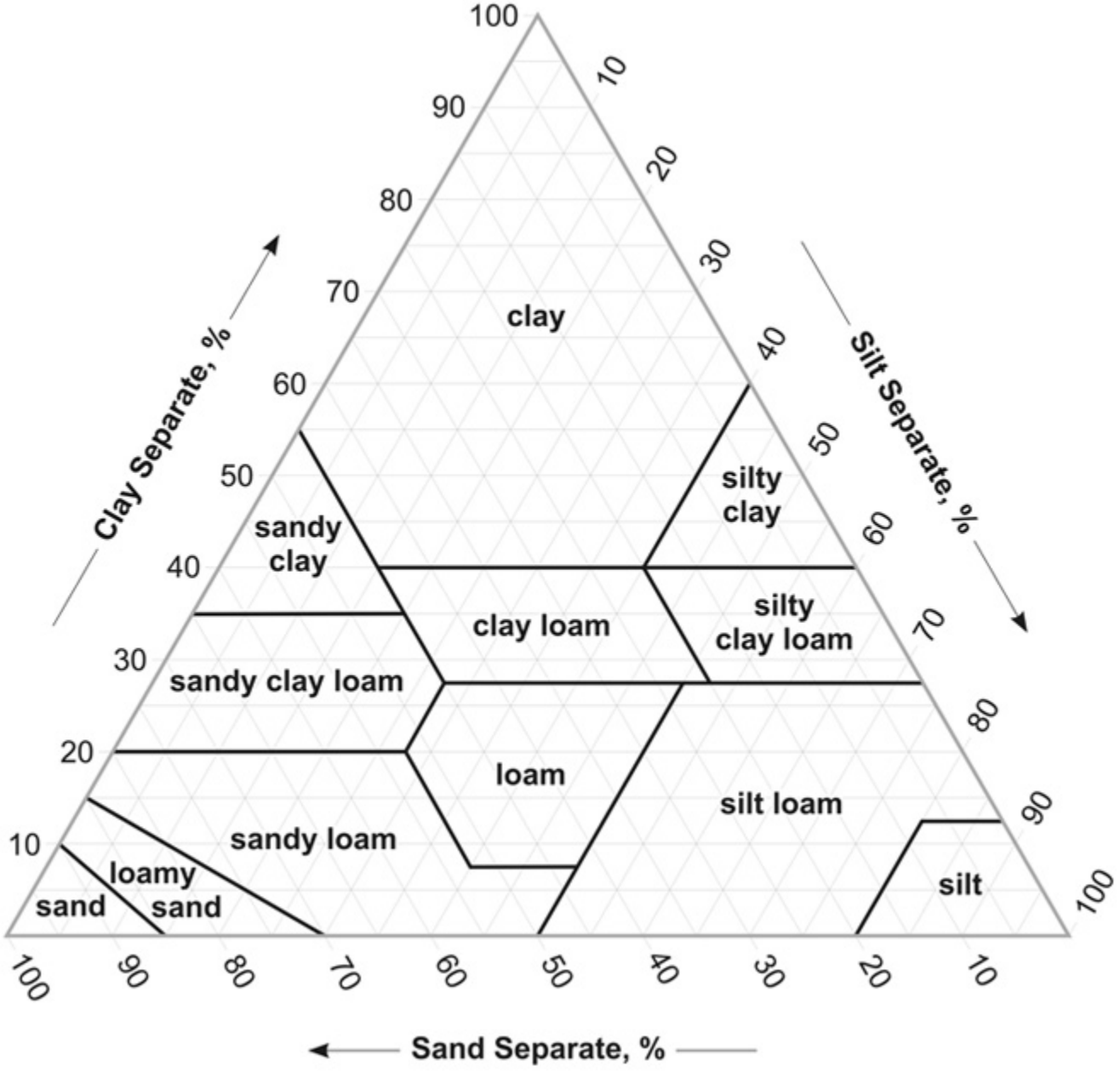
# A

# APPENDIX A

**USDA/NRCS Guide to Texture by Feel**
**Soil Texture Triangle**

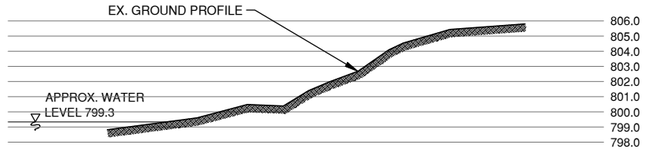

START
Place approximately 25 g soil in palm. Add water dropwise and knead the soil to break down all aggregates. Soil is at the proper consistency when plastic and moldable, like moist putty.
Add dry soil to soak up water
yes
yes
Does soil remain in a ball when squeezed?
no
Is soil too dry?
no
Is soil too wet?
no
SAND
yes
Place ball of soil between thumb and forefinger gently pushing the soil with the thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over the forefinger, breaking from its own weight.
LOAMY SAND
no
Does soil form a ribbon?
yes
Does soil make a weak ribbon less than 2.5 cm long before breaking?
no
Does soil make a medium ribbon 2.5-5 cm long before breaking?
no
Does soil make a strong ribbon 5 cm or longer before breaking?
yes
yes
yes
Excessively wet a small pinch of soil in palm and rub with forefinger.
SANDY LOAM
yes
Does soil feel very gritty?
SANDY CLAY LOAM
yes
Does soil feel very gritty?
SANDY CLAY
yes
Does soil feel very gritty?
no
no
no
SILT LOAM
yes
Does soil feel very smooth?
SILTY CLAY LOAM
yes
Does soil feel very smooth?
SILTY CLAY
yes
Does soil feel very smooth?
no
no
no
LOAM
yes
Neither grittiness nor smoothness predominates.
CLAY LOAM
yes
Neither grittiness nor smoothness predominates.
CLAY
yes
Neither grittiness nor smoothness predominates.


100
90
80
70
60
50
40
30
20
10
Clay Separate, %
Silt Separate, %
Sand Separate, %
clay
silty clay
sandy clay
clay loam
silty clay loam
sandy clay loam
loam
silt loam
sandy loam
loamy sand
sand
silt

# B

# APPENDIX B

**Example Designs for Shorelines on Pine & Grass Lakes in Shawano County, WI**




EXISTING CONDITIONS

## SECTION A - A1

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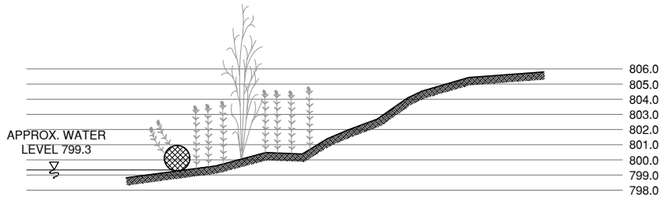
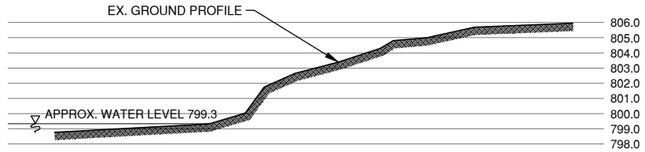
VERT. SCALE: 1" = 5'




PROPOSED CONDITIONS *




EXISTING CONDITIONS

## SECTION B - B1

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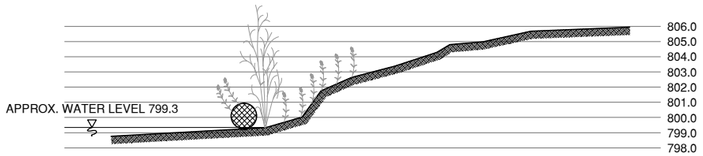
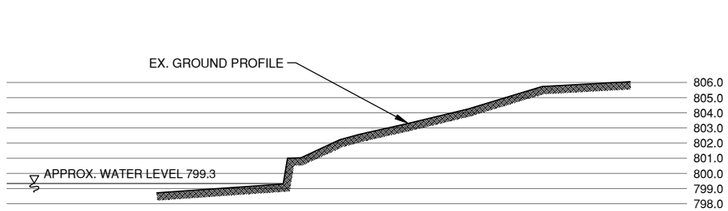
VERT. SCALE: 1" = 5'




PROPOSED CONDITIONS *




EXISTING CONDITIONS

## SECTION C - C1

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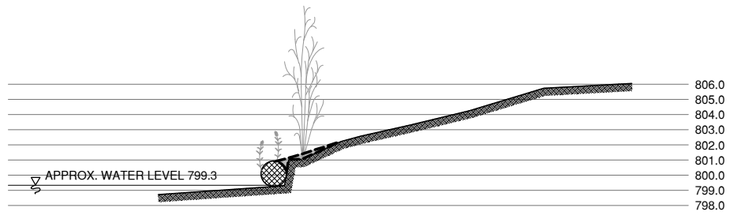
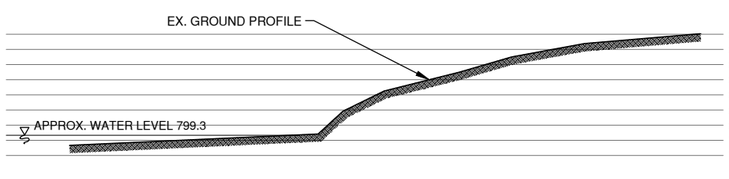
VERT. SCALE: 1" = 5'




PROPOSED CONDITIONS




EXISTING CONDITIONS

## SECTION D - D1

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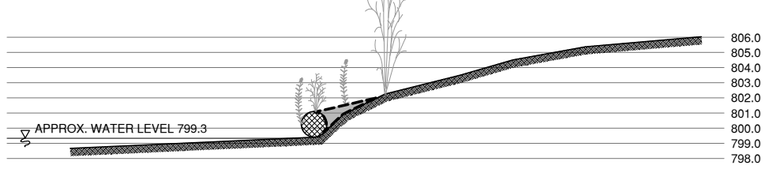
VERT. SCALE: 1" = 5'




PROPOSED CONDITIONS

LEGEND

- 20" BIOLOG (SECURED W/DUCK BILL ANCHORS AND CABLES)
- EROSION BLANKET
- NATIVE SHRUB
- NATIVE HERBACEOUS VEGETATION (PLANTED 1 FOOT ON CENTER)
- TOPSOIL
- PLANTING ZONE #1

*NOTE: BIOLOGS IN THESE TWO AREAS WILL ACT AS WAVE-BREAKS WHILE WETLAND VEGETATION BECOMES ESTABLISHED BEHIND THEM

AFTER




PROPOSED PLANTING PLAN

BEFORE




EXISTING SITE CONDITIONS

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION | DRAWN RLR-LLP-KLJ / CHECKED JRH / DESIGNED JRH | CLOVERLEAF LAKES PROTECTION ASSOCIATION<br>TOWN OF BELLE PLAINE<br>SHAWANO COUNTY, WISCONSIN | ANUNSON SITE PLAN | DATE 07/2009 / FILE 4747002 SITE / JOB NO. 4747002 | Robert E. Lee & Associates, Inc.<br>ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES<br>4664 GOLDEN POND PARK COURT<br>HOBART, WI 54155 PHONE:(920) 662-9641<br>INTERNET: www.releeinc.com FAX:(920) 662-9141 | SHEET NO. 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |

File: G:\4700\4747\4747002\cad\4747002 SITE PHOTOS.dwg
Plot Date: Jan 05, 2011 - 11:51am
LAYOUT: ANUNSON
PLAN VIEW: ANUNSON PLAN, ANUNSON "Aa-10" "Etx-Pit"

## Anunson Property

Planting Zone: Biolog and Shoreline Buffer – Zone 1
Soil: Loamy Sand-Sand
Sun: Full-Partial Sun
Moisture: Wet
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Acorus calamus* | Sweet Flag |
| *Asclepias incarnata* | Swamp Milkweed |
| *Aster lanceolatus* | Panicled Aster |
| *Aster umbellatus* | Flat-Top Aster |
| *Calamagrostis canadensis* | Canada Bluejoint |
| *Carex crinita* | Fringed Sedge |
| *Carex hystericina* | Porcupine Sedge |
| *Carex lacustris* | Lake Sedge |
| *Cephalanthus occidentalis** | Buttonbush |
| *Chelone glabra* | Turtlehead |
| *Cornus amomum** | Silky Dogwood |
| *Eupatorium maculatum* | Spotted Joe Pye Weed |
| *Eupatorium perfoliatum* | Boneset |
| *Gentiana andrewsii* | Bottle Gentian |
| *Glyceria striata* | Fowl Manna Grass |
| *Helenium autumnale* | Sneezeweed |
| *Ilex verticillata** | Winterberry |
| *Iris versicolor* | Blue Flag Iris |
| *Lobelia cardinalis* | Cardinal Flower |
| *Lobelia siphilitica* | Great Blue Lobelia |
| *Lycopus americanus* | Water Horehound |
| *Mimulus ringens* | Monkey Flower |
| *Rosa palustris** | Swamp Rose |
| *Sambucus canadensis** | Elderberry |
| *Solidago patula* | Swamp Goldenrod |
| *Thalictrum dasycarpum* | Purple Meadow Rue |

* shrub

## Anunson Property

Planting Zone: Shoreline Buffer – Zone 2
Soil: Loamy Sand-Sand
Sun: Full-Partial Sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

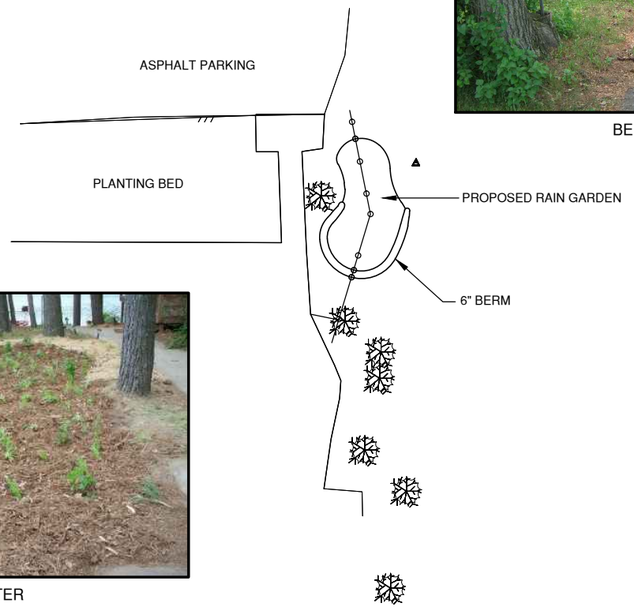
| Scientific Name | Common Name |
|---|---|
| *Anemone canadensis* | Canada Anemone |
| *Aster lateriflorus* | Calico Aster |
| *Aster novae-angliae* | New England Aster |
| *Carex stricta* | Tussock Sedge |
| *Carex vulpinoidea* | Brown Fox Sedge |
| *Elymus hystrix* | Bottlebrush Grass |
| *Elymus virginicus* | Virginia Wild Rye |
| *Eupatorium purpureum* | Purple Joe Pye Weed |
| *Eupatorium rugosum* | White Snakeroot |
| *Geranium maculatum* | Wild Geranium |
| *Physocarpus opulifolius** | Ninebark |
| *Pycnanthemum virginianum* | Common Mountain Mint |
| *Solidago flexicaulis* | Zig-zag Goldenrod |
| *Veronicastrum virginicum* | Culver's Root |
| *Viburnum lentago** | Nannyberry |
| *Zizia aurea* | Golden Alexander |

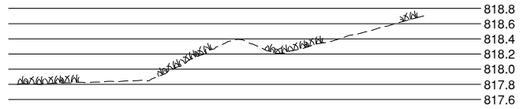
* shrub

CLOVERLEAF LAKES ROAD

BEFORE

AFTER




EXISTING PROFILE
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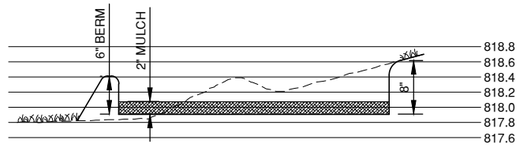
VERT. SCALE: 1" = 1'




PROPOSED PROFILE
HOR. SCALE: 1" = 5'
VERT. SCALE: 1" = 1'

BEFORE

AFTER

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Plot Date: Jan 05, 2011 - 11:53am
LAYOUT: LETVEN SITE
PLAN VIEW: LETVEN SITE

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
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DRAWN LLP
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

LETVEN SITE PLAN

DATE 6/18/2009
FILE 4747002 SITE PHOTOS
JOB NO. 4747002

Robert E. Lee & Associates, Inc.
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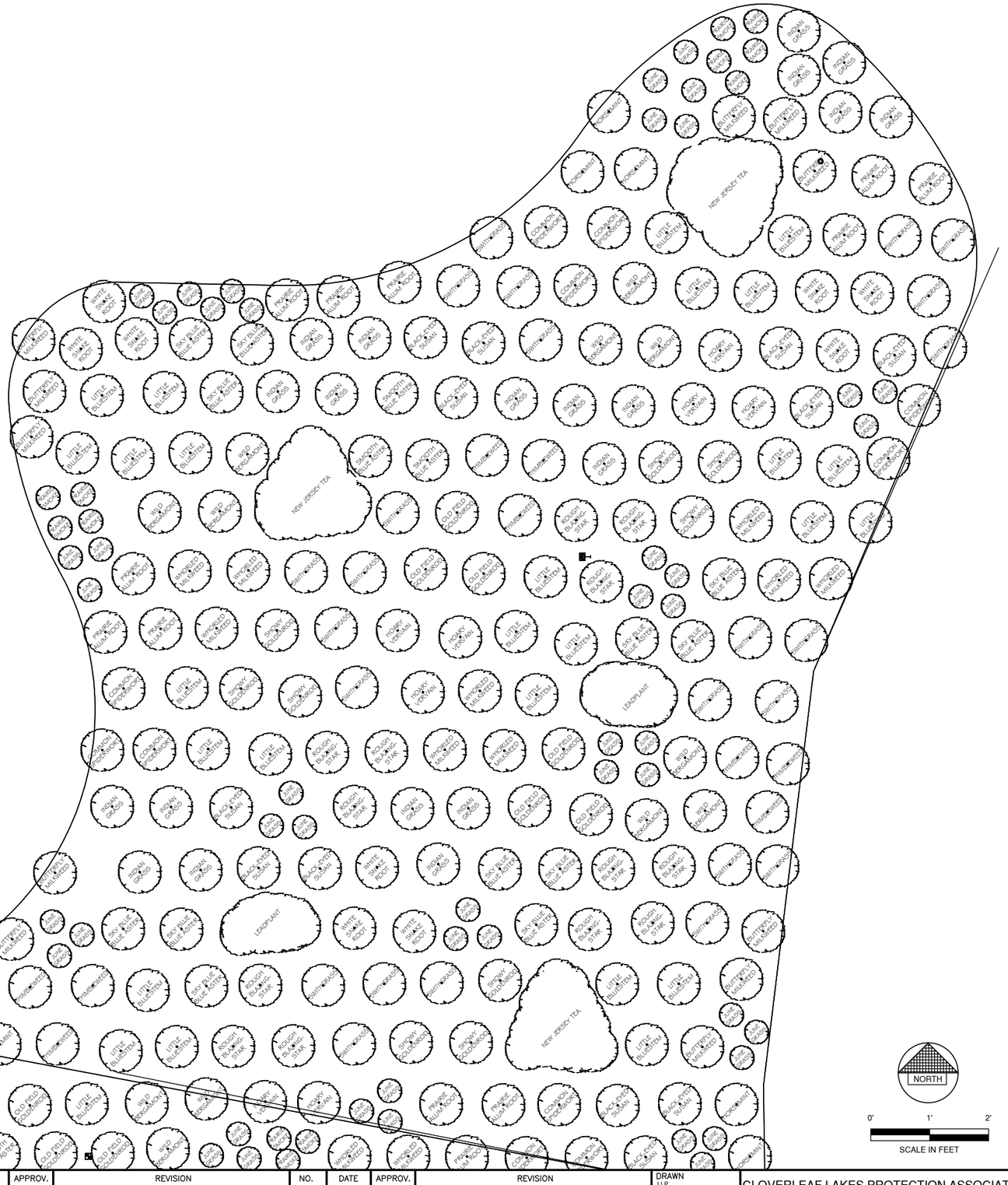
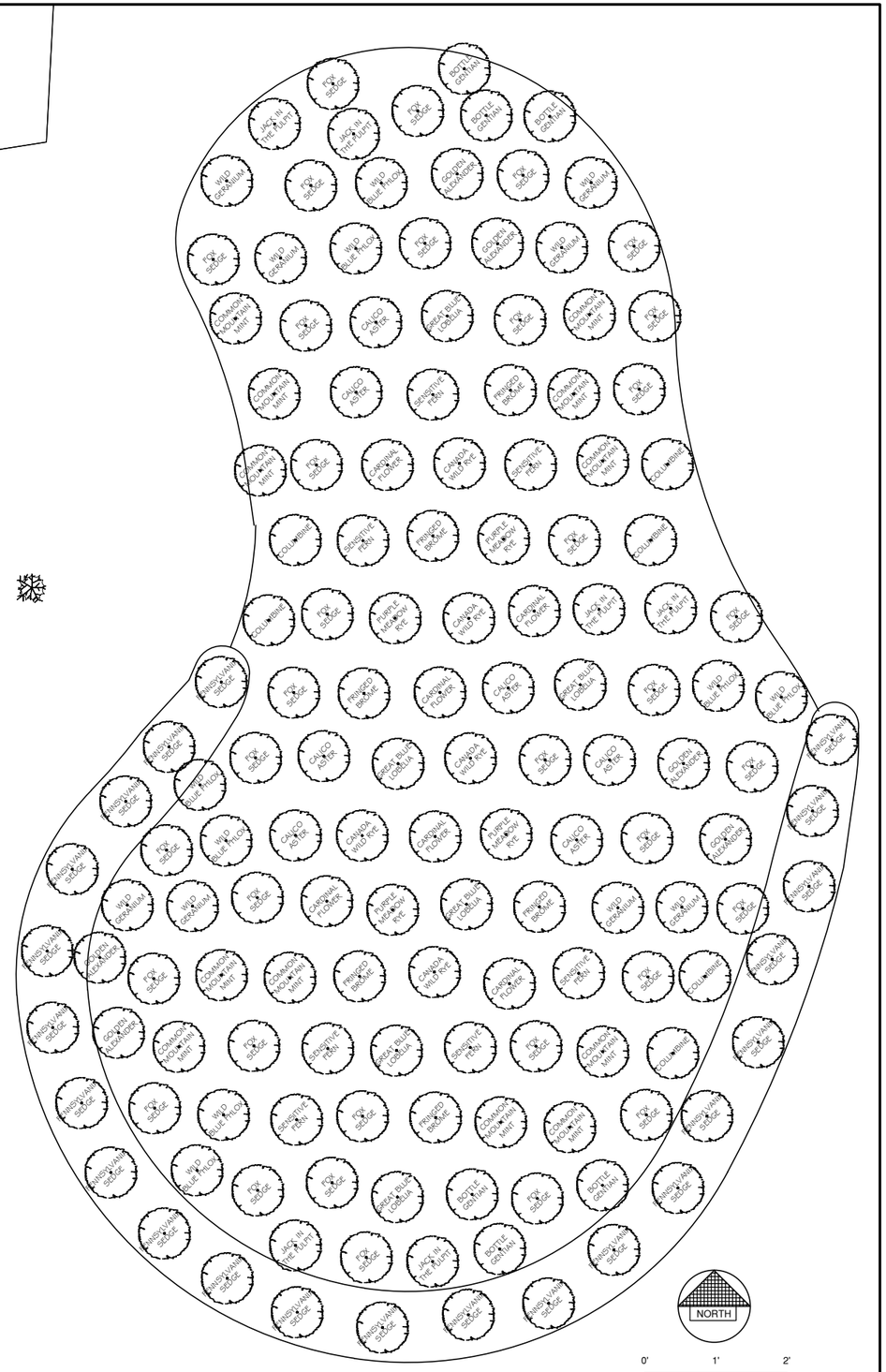
SHEET NO. 1

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Plot Date: Jan 05, 2017 - 11:35am

LAYOUT: LETVEN PLANTING

PLAN VIEW: PLANTING DETAIL 1 & 2

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION |
|---|---|---|---|---|---|---|---|
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DRAWN LLP
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

LETVEN PLANTING DETAIL

DATE 09/2009
FILE 4747002 SITE
JOB NO. 4747002

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SHEET NO. 2

# Letven Property

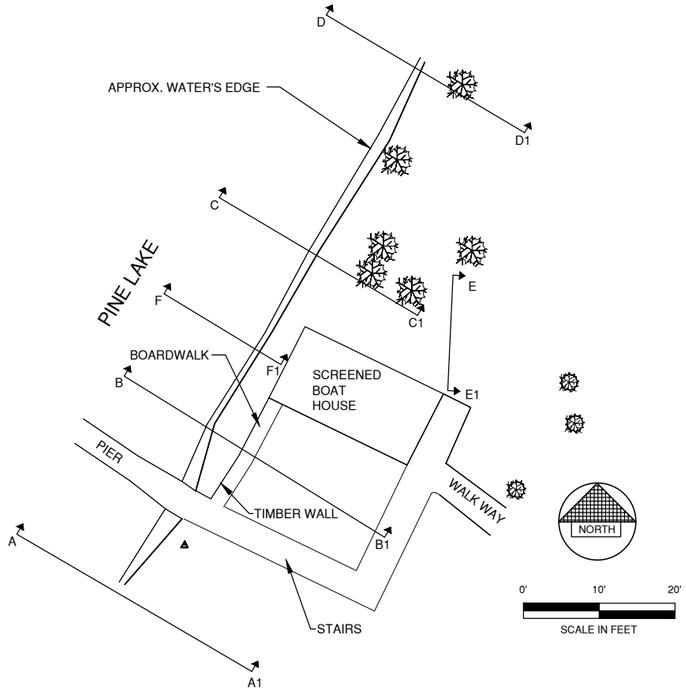
Planting Zone: Rain Garden
Soil: Sand
Sun: Partial Shade
Moisture: Medium
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Aquilegia canadensis* | Columbine |
| *Arisaema triphyllum* | Jack-in-the-Pulpit |
| *Aster lateriflorus* | Calico Aster |
| *Bromus ciliatus* | Fringed Brome |
| *Carex vulpinoidea* | Brown Fox Sedge |
| *Elymus virginicus* | Virginia Wild Rye |
| *Gentian andrewsii* | Bottle Gentian |
| *Geranium maculatum* | Wild Geranium |
| *Lobelia cardinalis* | Cardinal Flower |
| *Lobelia siphilitica* | Great Blue Lobelia |
| *Onoclea sensibilis* | Sensitive Fern |
| *Phlox divaricatus* | Wild Blue Phlox |
| *Pycnanthemum virginianum* | Common Mountain Mint |
| *Thalictrum dasycarpum* | Purple Meadow Rue |
| *Zizia aurea* | Golden Alexander |

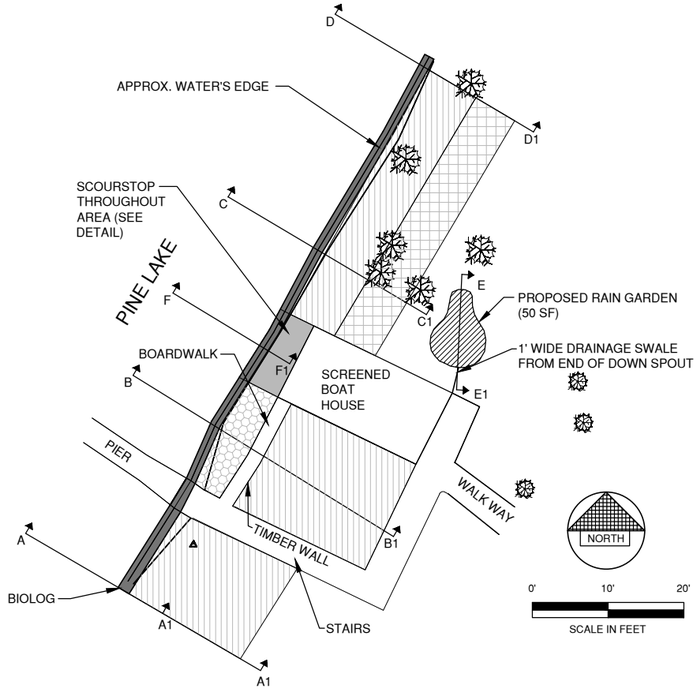
Planting Zone: Shoreline Garden
Soil: Sandy loam-fine sand
Sun: Full sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Amorpha canescens** | Leadplant |
| *Anemone cylindrica* | Thimbleweed |
| *Asclepias tuberosa* | Butterfly Milkweed |
| *Asclepias verticillata* | Whorled Milkweed |
| *Aster laevis* | Smooth Blue Aster |
| *Aster oolentangiensis* | Sky-blue Aster |
| *Ceanothus americanus** | New Jersey Tea |
| *Eupatorium rugosum* | White Snakeroot |
| *Geum triflorum* | Prairie Smoke |
| *Heuchera richardsonii* | Prairie Alum Root |
| *Koeleria macrantha* | June Grass |
| *Liatris aspera* | Rough Blazing Star |
| *Monarda fistulosa* | Wild Bergamont |
| *Monarda punctata* | Horsemint |
| *Panicum virgatum* | Switchgrass |
| *Rudbeckia hirta* | Black-eyed Susan |
| *Schizachyrium scoparium* | Little Blue Stem |
| *Solidago nemoralis* | Old Field Goldenrod |
| *Solidago speciosa* | Showy Goldenrod |
| *Sorghastrum nutans* | Indian Grass |
| *Tradescantia ohiensis* | Common Spiderwort |
| *Verbena stricta* | Hoary Vervain |

* shrub




EXISTING CONDITIONS

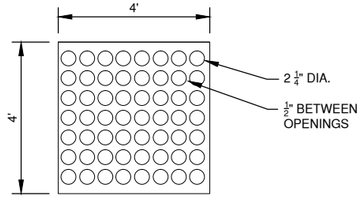



PROPOSED CONDITIONS

BEFORE

PLANTING AREAS

- PLANTING ZONE #1 (768 SF)
- PLANTING ZONE #2 (217 SF)
- PLANTING ZONE #3 (69 SF)
- PLANTING ZONE #4 (55 SF)
- RAIN GARDEN




SCOURSTOP DETAIL

AFTER

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

DRAWN RLR-llp
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ODDER SITE PLAN

DATE 07/2009
FILE 4747002 SITE
JOB NO. 4747002

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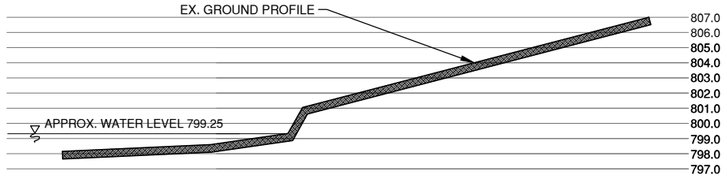
SHEET NO. 1

File: R:\4700\47477\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jun 05, 2017 - 11:34am
PLAN VIEW: ODDER PLAN, ODDER "AA-DD" "CC-PP", RAIN GARDEN LAYOUT: LETVEN SITE




EXISTING CONDITIONS

## SECTION A - A1

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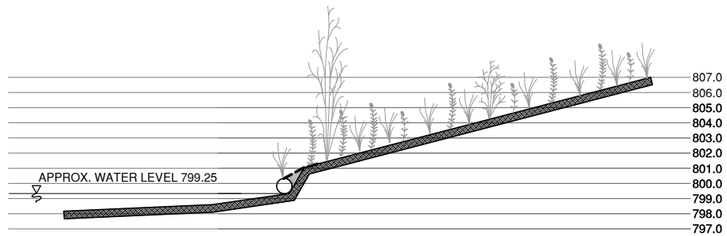
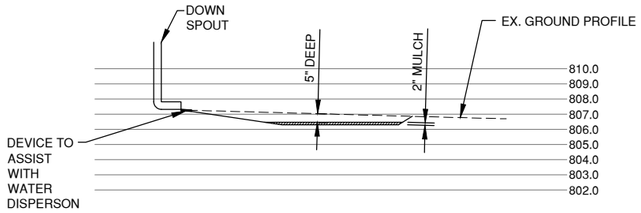
VERT. SCALE: 1" = 5'




PROPOSED CONDITIONS




PROPOSED RAIN GARDEN

## SECTION E - E1

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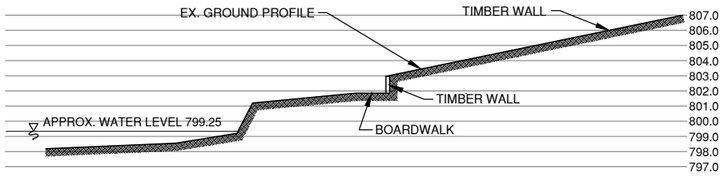
VERT. SCALE: 1" = 5'




EXISTING CONDITIONS

## SECTION B - B1

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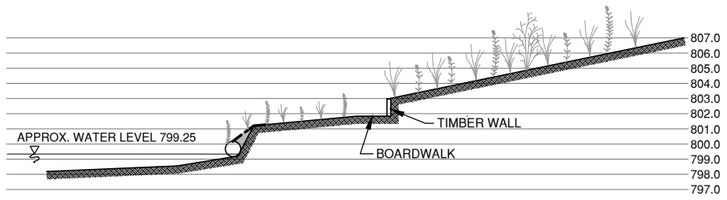
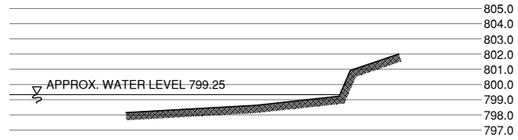
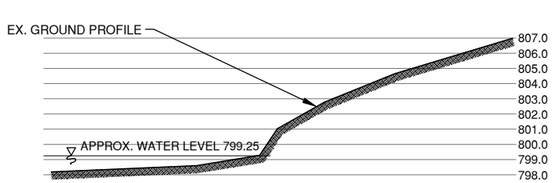



PROPOSED CONDITIONS




## SECTION F - F1

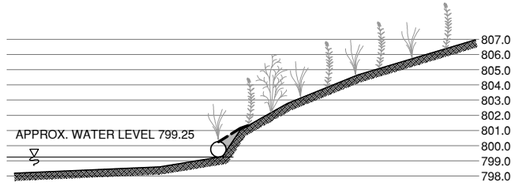
HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'



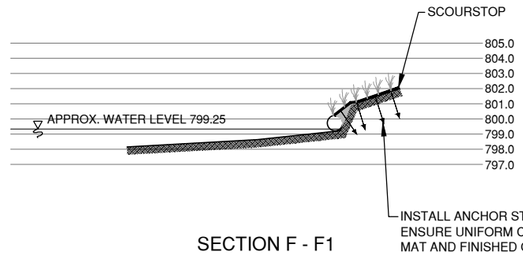

EXISTING CONDITIONS

## SECTION C - C1

HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'

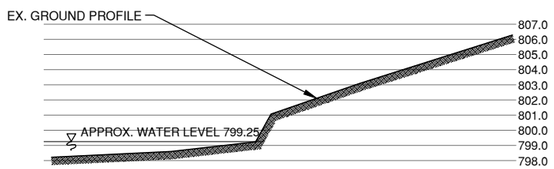



PROPOSED CONDITIONS




## SECTION F - F1

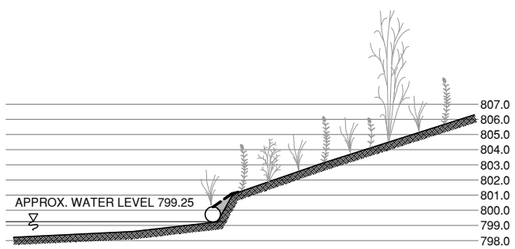
HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'




EXISTING CONDITIONS

## SECTION D - D1

HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'




PROPOSED CONDITIONS

## LEGEND

- TOPSOIL
- NATIVE SHRUB
- NATIVE WILD FLOWERS (PLANTED 1 FOOT ON CENTER)
- NATIVE GRASSES/SEDGES (PLANTED 1 FOOT ON CENTER)
- 16" BIOLOG (SECURED W/DUCK BILL ANCHORS AND CABLES)
- EROSION BLANKET

File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jan 05, 2011 - 11:45am

PLAN VIEW: ODDER PLAN, ODDER "XA-05" "CY-PR", RAIN GARDEN(OUT), LETVEN SITE

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

DRAWN: RLR-llp
CHECKED: JH
DESIGNED: JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ODDER SITE PROFILE

DATE: 07/2009
FILE: 4747002 SITE
JOB NO.: 4747002

Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
4664 GOLDEN POND PARK COURT
HOBART, WI 54155
PHONE:(920) 662-9641
INTERNET: www.releeinc.com
FAX:(920) 662-9141

# Odders Property

Planting Zone: Rain Garden
Soil: Sandy loam-sand
Sun: Partial Shade
Moisture: Medium
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Aquilegia canadensis* | Columbine |
| *Arisaema triphyllum* | Jack-in-the-Pulpit |
| *Aster lateriflorus* | Calico Aster |
| *Bromus ciliatus* | Fringed Brome |
| *Carex hystericina* | Porcupine Sedge |
| *Carex radiata* | Wood Sedge |
| *Carex stipata* | Common Fox Sedge |
| *Chelone glabra* | Turtlehead |
| *Elymus hystrix* | Bottlebrush Grass |
| *Eupatorium purpureum* | Purple Joe Pye Weed |
| *Geranium maculatum* | Wild Geranium |
| *Lobelia cardinalis* | Cardinal Flower |
| *Lobelia siphilitica* | Great Blue Lobelia |
| *Onoclea sensibilis* | Sensitive Fern |
| *Polemonium reptans* | Jacob’s Ladder |
| *Pycnanthemum virginianum* | Common Mountain Mint |
| *Thalictrum dasycarpum* | Purple Meadow Rue |
| *Veronicastrum virginicum* | Culver's Root |
| *Zizia aurea* | Golden Alexander |

Planting Zone: Biolog
Soil: -
Sun: Full-Partial Sun
Moisture: Wet
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Anemone canadensis* | Canada Anemone |
| *Asclepias incarnata* | Swamp Milkweed |
| *Calamagrostis canadensis* | Bluejoint Grass |
| *Carex bebbi* | Bebb’s Sedge |
| *Carex comosa* | Bristly Sedge |
| *Chelone glabra* | Turtlehead |
| *Eupatorium maculatum* | Spotted Joe Pye Weed |
| *Eupatorium perfoliatum* | Boneset |
| *Glyceria striata* | Fowl Manna Grass |
| *Helenium autumnale* | Sneezeweed |
| *Iris versicolor* | Blue Flag Iris |
| *Leersia oryzoides* | Rice Cut Grass |
| *Lobelia cardinalis* | Cardinal Flower |
| *Lobelia siphilitica* | Great Blue Lobelia |
| *Mimulus ringens* | Monkey Flower |
| *Pycnanthemum virginianum* | Common Mountain Mint |
| *Scirpus cyperinus* | Wool Grass |
| *Verbena hastata* | Blue Vervain |

## Odders Property

Planting Zone: Shoreline Buffer – Zone 1
Soil: Sandy loam-sand
Sun: Full-Partial Sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Allium cernuum* | Nodding Pink Onion |
| *Amorpha canescens** | Leadplant |
| *Andropogon gerardi* | Big Bluestem |
| *Asclepias syriaca* | Common Milkweed |
| *Asclepias tuberosa* | Butterfly Milkweed |
| *Asclepias verticillata* | Whorled Milkweed |
| *Aster laevis* | Smooth Blue Aster |
| *Aster novae-angliae* | New England Aster |
| *Aster oolentangiensis* | Sky-blue Aster |
| *Bouteloua curtipendula* | Side-Oats-Grama |
| *Ceanothus americanus** | New Jersey Tea |
| *Corylus americana** | American Hazelnut |
| *Desmodium canadense* | Canada Tick Trefoil |
| *Echinacea pallida* | Pale Purple Coneflower |
| *Geum triflorum* | Prairie Smoke |
| *Heuchera richardsonii* | Prairie Alum Root |
| *Koeleria macrantha* | June Grass |
| *Liatris aspera* | Rough Blazing Star |
| *Lupinus perennis* | Lupine |
| *Monarda fistulosa* | Wild Bergamont |
| *Monarda punctata* | Horsemint |
| *Parthenium integrifolium* | Wild Quinine |
| *Ratibida pinnata* | Yellow Coneflower |
| *Rudbeckia hirta* | Black-eyed Susan |
| *Schizachyrium scoparium* | Little Blue Stem |
| *Solidago nemoralis* | Old Field Goldenrod |
| *Solidago speciosa* | Showy Goldenrod |
| *Sorghastrum nutans* | Indian Grass |
| *Spirea alba** | Meadowsweet |
| *Spirea tomentosa** | Steeplebush |
| *Tradescantia ohiensis* | Common Spiderwort |
| *Verbena stricta* | Hoary Vervain |
| *Veronicastrum virginicum* | Culver’s Root |

* shrub

# Odders Property

Planting Zone: Shoreline Buffer – Zone 2
Soil: Sandy loam-sand
Sun: Partial Sun
Moisture: Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Amelanchier arborea** | Serviceberry |
| *Anemone cylindrica* | Thimbleweed |
| *Aquilegia canadensis* | Columbine |
| *Aster cordifolius* | Heart-leaved Aster |
| *Aster lateriflorus* | Calico Aster |
| *Aster macrophyllus* | Large-leaf Aster |
| *Bromus pubescens* | Hairy Woodland Brome |
| *Carex pennsylvanica* | Pennsylvania Sedge |
| *Elymus hystrix* | Bottlebrush Grass |
| *Elymus virginicus* | Virginia Wild Rye |
| *Eupatorium rugosum* | White Snakeroot |
| *Geranium maculatum* | Wild Geranium |
| *Maianthemum racemosum* | False Solomon's Seal |
| *Maianthemum stellatum* | Starry Solomon's Seal |
| *Phlox divaricata* | Woodland Phlox |
| *Solidgao flexicaulis* | Zig-zag Goldenrod |
| *Thalictrum dioicum* | Early Meadow Rue |
| *Vaccinium angustifolium** | Early Low Blueberry |
| *Zizia aurea* | Golden Alexander |

* shrub

Planting Zone: Shoreline Buffer – Zone 3
Soil: Sandy loam-sand
Sun: Full-Partial Sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

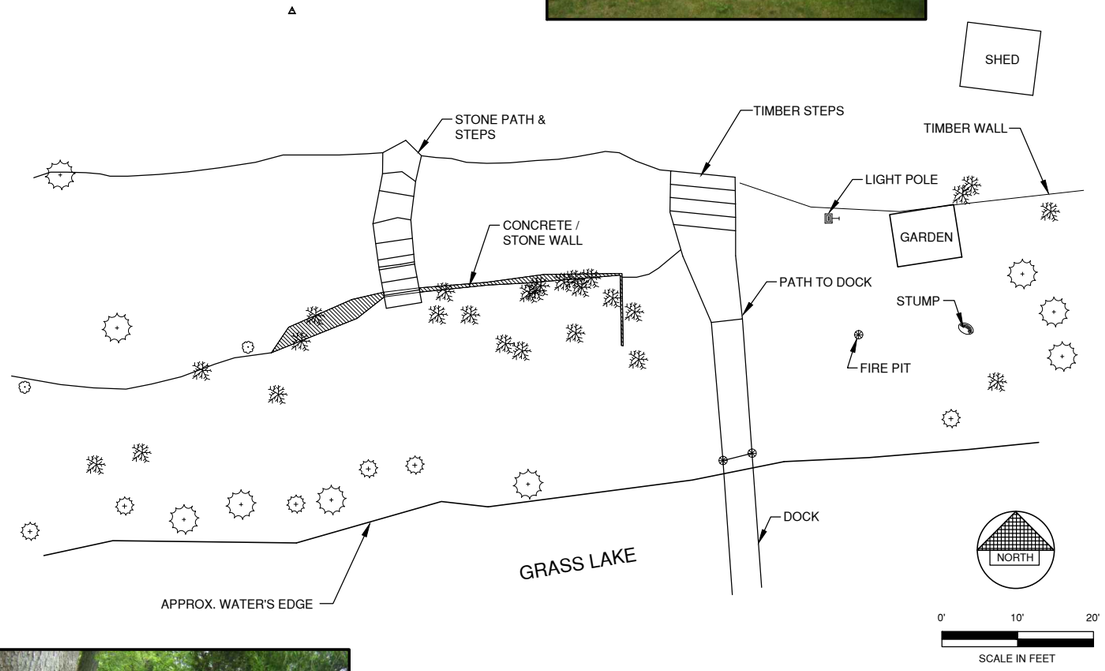
| Scientific Name | Common Name |
|---|---|
| *Allium cernuum* | Nodding Pink Onion |
| *Aquilegia canadensis* | Columbine |
| *Asclepias verticillata* | Whorled Milkweed |
| *Dalea purpurea* | Purple Prairie Clover |
| *Dodecatheon meadia* | Shooting Star |
| *Gentian andrewsii* | Bottle Gentian |
| *Geum triflorum* | Prairie Smoke |
| *Hierochloe odorata* | Vanilla Sweet Grass |
| *Koeleria macrantha* | June Grass |
| *Lupinus perennis* | Lupine |
| *Monarda punctata* | Horsemint |
| *Potentilla arguta* | Prairie Cinquefoil |
| *Schizachyrium scoparium* | Little Blue Stem |
| *Sisyrinchium atlanticum* | Eastern Blue-Eyed Grass |
| *Solidago nemoralis* | Old Field Goldenrod |
| *Solidago speciosa* | Showy Goldenrod |
| *Sporobolus heterolepis* | Prairie Dropseed |
| *Zizia aurea* | Golden Alexander |

## Odders Property

Planting Zone: Shoreline Buffer – Zone 4
Soil: Sandy loam-sand
Sun: Full-Partial Sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

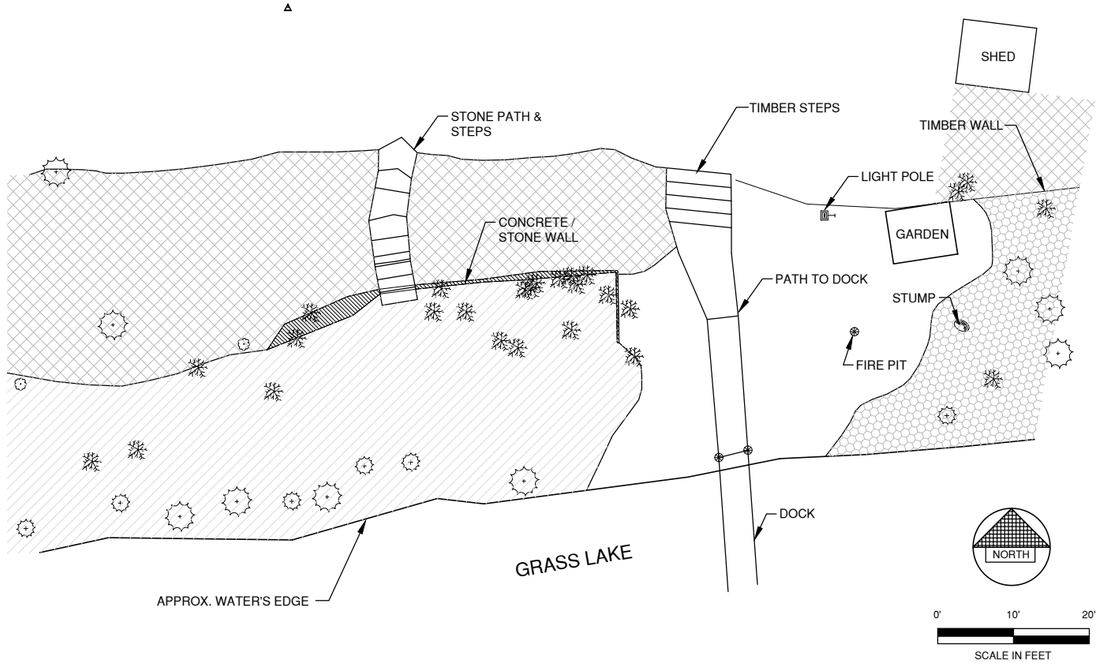
| Scientific Name | Common Name |
|---|---|
| *Carex pensylvanica* | Pennsylvania Sedge |
| *Carex vulpinoidea (Biolog)* | Brown Fox Sedge |

BEFORE




EXISTING CONDITIONS

BEFORE




PROPOSED CONDITIONS

## PLANTING AREAS

- PLANTING ZONE #1 (2063 SF) - MESIC / WET-MESIC FOREST UNDERSTORY
- PLANTING ZONE #2 (2008 SF) - MESIC FOREST UNDERSTORY
- PLANTING ZONE #3 (550 SF) - MESIC / WET-MESIC PRAIRIE

File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jun 05, 2017 - 12:00pm
LAYOUT: ROSENFELDT
PLAN VIEW: ROSEN-EX, ROSEN-PR

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

DRAWN LLP
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ROSENFELDT SITE PLAN

DATE 09/2009
FILE 4747002 SITE
JOB NO. 4747002

Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
4664 GOLDEN POND PARK COURT
HOBART, WI 54155 PHONE:(920) 662-9641
INTERNET: www.releeinc.com FAX:(920) 662-9141

SHEET NO. 1

## Rosenfeldt Property

Planting Zone: Mesic\Wet Mesic Prairie
Soil: Loamy sand-sand-sandy loam
Sun: Full Sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Allium cernuum* | Nodding Pink Onion |
| *Amorpha canescens** | Leadplant |
| *Andropogon gerardi* | Big Bluestem |
| *Anemone canadensis* | Canada Anemone |
| *Asclepias syriaca* | Common Milkweed |
| *Asclepias tuberosa* | Butterfly Milkweed |
| *Asclepias verticillata* | Whorled Milkweed |
| *Aster laevis* | Smooth Blue Aster |
| *Aster novae-angliae* | New England Aster |
| *Aster oolentangiensis* | Sky-blue Aster |
| *Ceanothus americanus** | New Jersey Tea |
| *Dalea purpurea* | Purple Prairie Clover |
| *Dodecatheon meadia* | Shooting Star |
| *Echinacea pallida* | Pale Purple Coneflower |
| *Elymus canadensis* | Canada Wild Rye |
| *Filipendula rubra* | Queen of the Prairie |
| *Gentian andrewsii* | Bottle Gentian |
| *Helenium autumnale* | Sneezeweed |
| *Heleopsis helianthoides* | False Sunflower |
| *Heuchera richardsonii* | Prairie Alum Root |
| *Hierochloe odorata* | Vanilla Sweet Grass |
| *Liatris aspera* | Rough Blazing Star |
| *Liatris pycnostachya* | Prairie Blazing Star |
| *Monarda fistulosa* | Wild Bergamont |
| *Panicum virgatum* | Switchgrass |
| *Parthenium integrifolium* | Wild Quinine |
| *Pycnanthemum virginianum* | Common Mountain Mint |
| *Ratibida pinnata* | Yellow Coneflower |
| *Rudbeckia hirta* | Black-eyed Susan |
| *Schizachyrium scoparium* | Little Blue Stem |
| *Sisyrinchium atlanticum* | Eastern Blue-Eyed Grass |
| *Solidago nemoralis* | Old Field Goldenrod |
| *Solidago rigida* | Stiff Goldenrod |
| *Sorghastrum nutans* | Indian Grass |
| *Sporobolus heterolepis* | Prairie Dropseed |
| *Tradescantia ohiensis* | Common Spiderwort |
| *Veronicastrum virginicum* | Culver's Root |

* shrub

## Rosenfeldt Property

Planting Zone: Mesic\Wet Mesic Forest Understory
Soil: Loamy sand-sand
Sun: Partial Shade
Moisture: Medium-Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Anemone virginiana* | Tall Anemone |
| *Arisaema triphyllum* | Jack-in-the-Pulpit |
| *Aster lanceolatus* | Panicled Aster |
| *Aster lateriflorus* | Calico Aster |
| *Athyrium felix-femina* | Lady Fern |
| *Bromus pubescens* | Hairy Woodland Brome |
| *Campanula americana* | Tall Bellflower |
| *Carex normalis* | Spreading Oval Sedge |
| *Carex radiata* | Wood Sedge |
| *Carex stipata* | Common Fox Sedge |
| *Cephalanthus occidentalis** | Buttonbush |
| *Chelone glabra* | Turtlehead |
| *Cornus amomum** | Silky Dogwood |
| *Elymus virginicus* | Virginia Wild Rye |
| *Eupatorium purpureum* | Purple Joe Pye Weed |
| *Geranium maculatum* | Wild Geranium |
| *Glyceria striata* | Fowl Manna Grass |
| *Helianthus strumosus* | Pale-leaved Sunflower |
| *Ilex verticillata** | Common Winterberry |
| *Iris versicolor* | Blue Flag Iris |
| *Lobelia cardinalis* | Cardinal Flower |
| *Lobelia siphilitica* | Great Blue Lobelia |
| *Mertensia virginica* | Virginia Bluebells |
| *Onoclea sensibilis* | Sensitive Fern |
| *Osmunda regalis* | Royal Fern |
| *Parthenocissus quinquefolia** | Virgina Creeper |
| *Sambucus canadensis** | Common Elderberry |
| *Solidago patula* | Swamp Goldenrod |
| *Thalictrum dasycarpum* | Purple Meadow Rue |
| *Thalictrum thalictroides* | Rue Anemone |
| *Zizia aurea* | Golden Alexander |

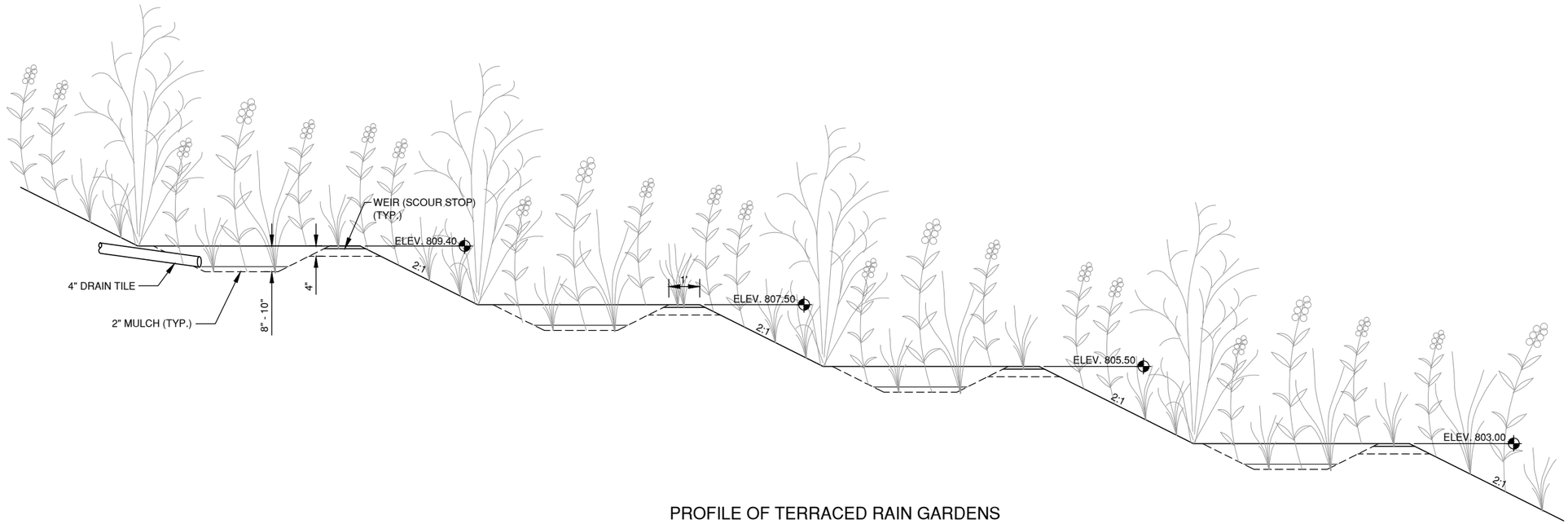
* shrub

## Rosenfeldt Property

Planting Zone: Mesic Forest Understory
Soil: Loamy sand-sand-sandy loam
Sun: Partial Shade
Moisture: Medium-Dry
pH: Neutral (no amendments)

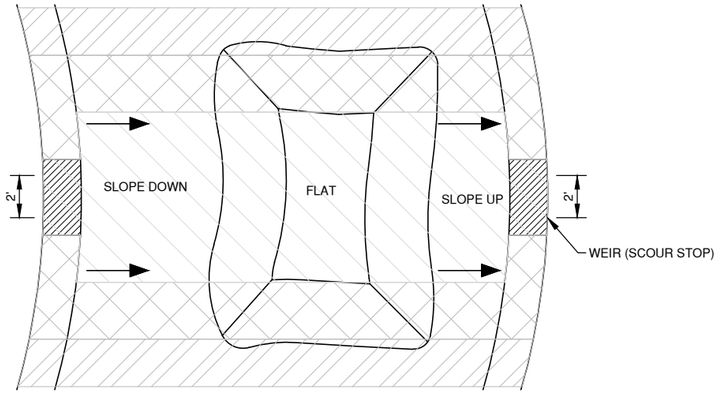
| Scientific Name | Common Name |
|---|---|
| *Actaea pachypoda* | White Baneberry |
| *Actaea rubra* | Red Baneberry |
| *Adiantum pedatum* | Maidenhair Fern |
| *Amelanchier arborea** | Serviceberry |
| *Anemone cylindrica* | Thimbleweed |
| *Aquilegia canadensis* | Columbine |
| *Asarum canadense* | Wild Ginger |
| *Aster cordifolius* | Heart-leaved Aster |
| *Aster macrophyllus* | Large-leaf Aster |
| *Aster sagittifolius* | Arrow-leaved Aster |
| *Carex pennsylvanica* | Pennsylvania Sedge |
| *Caulophyllum thalictroides* | Blue Cohosh |
| *Cornus alternifolia** | Alternate-leaf Dogwood |
| *Corylus americana** | American Hazelnut |
| *Dirca palustris** | Leatherwood |
| *Elymus hystrix* | Bottlebrush Grass |
| *Elymus villosus* | Silky Wild Rye |
| *Eupatorium rugosum* | White Snakeroot |
| *Geranium maculatum* | Wild Geranium |
| *Hamamelis virginiana** | Witch-hazel |
| *Maianthemum racemosum* | False Solomon's Seal |
| *Maianthemum stellatum* | Starry Solomon's Seal |
| *Mitella diphylla* | Bishop’s Cap |
| *Osmorhiza claytonii* | Hairy Sweet Cicely |
| *Phlox divaricata* | Woodland Phlox |
| *Podophyllum peltatum* | Mayapple |
| *Polemonium reptans* | Jacob’s Ladder |
| *Polygonatum biflorum* | Smooth Solomon’s Seal |
| *Solidgao flexicaulis* | Zig-zag Goldenrod |
| *Taxus canadensis*** | Canada Yew |
| *Thalictrum dioicum* | Early Meadow Rue |
| *Trillium grandiflorum* | Large White Trillium |
| *Uvularia grandiflorum* | Large-flowered Bellwort |
| *Viburnum lentago** | Nannyberry |
| *Viburnum trilobum** | Highbush Cranberry |

* shrub
** shrub that must be protected from deer browse



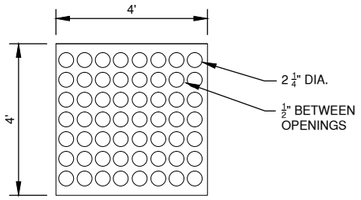

PROFILE OF TERRACED RAIN GARDENS

SCALE: 1" = 2'




PLAN OF TERRACED RAIN GARDENS

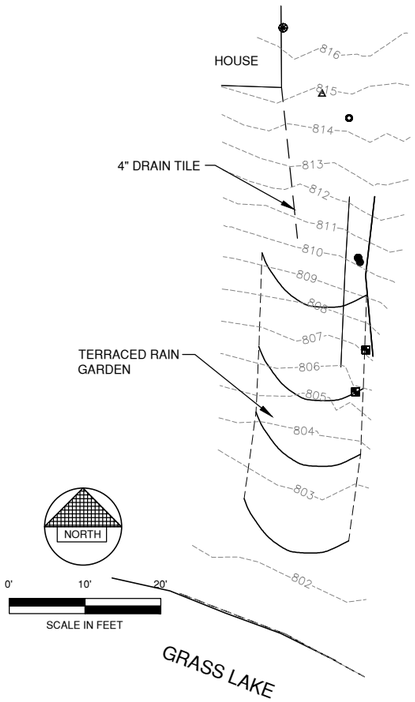
SCALE: 1" = 2'




SCOUR STOP DETAIL

BEFORE

AFTER




RAIN GARDEN PLANTING LEGEND

- PLANTING ZONE #1
- PLANTING ZONE #2
- PLANTING ZONE #3
- NATIVE SHRUB
- NATIVE WILD FLOWERS (PLANTED 1 FOOT ON CENTER)
- NATIVE GRASSES/SEDGES (PLANTED 1 FOOT ON CENTER)

| NO. | DATE | APPROV. | REVISION | NO. | DATE | APPROV. | REVISION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

DRAWN: RLR
CHECKED: JH
DESIGNED: JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

SORENSON SITE PLAN

DATE: 07/2009
FILE: 4747002 SITE
JOB NO.: 4747002

Robert E. Lee & Associates, Inc.
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4664 GOLDEN POND PARK COURT
HOBART, WI 54155
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INTERNET: www.releeinc.com
FAX:(920) 662-9141

SHEET NO. 1

File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jan 06, 2011 - 8:23am

LAYOUT: LETVEN_SITE

PLAN_VIEW

# Sorenson Property

Planting Zone: Rain Garden – Zone 1
Soil: Sandy Loam-Sand
Sun: Partial Sun
Moisture: Medium-Wet
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Allium cernuum* | Nodding Onion |
| *Anemone canadensis* | Canada Anemone |
| *Arisaema triphyllum* | Jack-in-the-Pulpit |
| *Aster lanceolatus* | Panicled Aster |
| *Aster novae-angliae* | New England Aster |
| *Bromus ciliatus* | Fringed Brome |
| *Carex normalis* | Spreading Oval Sedge |
| *Carex rosea* | Rosy Sedge |
| *Calamagrostis canadensis* | Bluejoint Grass |
| *Chelone glabra* | Turtlehead |
| *Eupatorium purpureum* | Purple Joe Pye Weed |
| *Gentian andrewsii* | Bottle Gentian |
| *Lobelia cardinalis* | Cardinal Flower |
| *Lobelia siphilitica* | Great Blue Lobelia |
| *Onoclea sensibilis* | Sensitive Fern |
| *Osmunda regalis* | Royal Fern |
| *Pycnanthemum virginianum* | Common Mountain Mint |
| *Veronicastrum virginicum* | Culver's Root |
| *Zizia aurea* | Golden Alexander |

Planting Zone: Rain Garden – Zone 2
Soil: Sandy Loam-Sand
Sun: Partial Sun
Moisture: Medium-Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Adiantum pedatum* | Maidenhair Fern |
| *Anemone cylindrica* | Thimbleweed |
| *Aster lateriflorus* | Calico Aster |
| *Athyrium filix-femina* | Lady Fern |
| *Bromus pubescens* | Hairy Woodland Brome |
| *Carex radiata* | Wood Sedge |
| *Carex scoparia* | Broom Sedge |
| *Elymus virginicus* | Virginia Wild Rye |
| *Eupatorium rugosum* | White Snakeroot |
| *Geranium maculatum* | Wild Geranium |
| *Liatris aspera* | Rough Blazingstar |
| *Maianthemum racemosum* | False Solomon's Seal |
| *Maianthemum stellatum* | Starry Solomon's Seal |
| *Monarda fistulosa* | Wild Bergamont |
| *Zizia aurea* | Golden Alexander |

## Sorenson Property

Planting Zone: Rain Garden – Zone 3
Soil: Sandy Loam-Sand
Sun: Partial Sun
Moisture: Dry
pH: Neutral (no amendments)

| Scientific Name | Common Name |
|---|---|
| *Amelanchier arborea** | Serviceberry |
| *Aquilegia canadensis* | Columbine |
| *Aster cordifolius* | Heart-leaved Aster |
| *Aster macrophyllus* | Large-leaf Aster |
| *Carex pennsylvanica* | Pennsylvania Sedge |
| *Cornus alternifolia** | Alternate-leaf Dogwood |
| *Dodecatheon meadia* | Shooting Star |
| *Elymus hystrix* | Bottlebrush Grass |
| *Phlox divaricata* | Woodland Phlox |
| *Rudbeckia hirta* | Black-eyed Susan |
| *Sambucus canadensis** | Common Elderberry |
| *Solidgao flexicaulis* | Zig-zag Goldenrod |
| *Thalictrum dioicum* | Early Meadow Rue |
| *Viburnum acerifolium** | Mapleleaf Viburnum |
| *Viburnum lentago** | Nannyberry |

* shrub

# C

# APPENDIX C

## Cloverleaf Lakes Shoreland Plant Communities Inventory

Dominant Species
Invasive/Potentially Invasive Species
* Surveyed in Emergent Stands

# CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
## COMPREHENSIVE SPECIES LIST



| Scientific Name | Common Name | Height | Color | Bloom Period | Moisture | Soil | Sun | Avail |
|---|---|---|---|---|---|---|---|---|
| *Acer rubrum* | red maple | 20-40 | | Mar-May | D,W,M | | | x |
| *Acer saccharinum* | silver maple | 40-60 | | Feb-May | M,W | | | x |
| *Achillea millefolium* | yarrow | 1-3 | white | May-Jun | D,M | | F | x |
| *Agrostis alba* | redtop | | | | | | | |
| *Alimsa triviale* | northern water-plantain | 1-3 | white | Jul-Sep | W | C,L | F | x |
| *Alnus rugosa* | speckled alder | 3-15 | green/brown | Apr-Jun | W,M | | F,P,S | x |
| *Amphicarpaea bracteata* | hog-peanut | <1 | white/pink | Aug-Sep | M,W | | | |
| *Apocynum androsaemifolium* | spreading dogbane | 1-3 | pink | Jun-Aug | D,M | | F,P | x |
| *Asclepias incarnata* | swamp milkweed | 3-5 | red/pink | Jun-Jul | W | S,L,C | F | x |
| *Asclepias syriaca* | common milkweed | 3-4 | purple | Jun-Aug | D,W,M | S,L,C | F,P | x |
| *Aster lanceolatus* | white panicle aster | 2-5 | white | Aug-Oct | M,W | | P,S | x |
| *Aster lateriflorus* | calico aster | 2-3 | white | Sep-Oct | D,M | S,L,C | P,S | x |
| *Aster puniceus* | swamp aster | 1-7 | white | Aug-Oct | W | C,L | F,P | x |
| *Betula papyrifera* | paper birch | <65 | | | D,M | | F,P | x |
| *Boehmeria cylindrica* | false nettle | 1-4 | green | Aug-Sep | W | | | |
| *Brasenia schreberi** | water shield | <1 | purple | Jun-Sep | W | | F | |
| *Bromus inermis* | smooth brome | 3-4 | | | | | | |
| *Calamagrostis canadensis** | blue joint grass | 3-5 | purplish | Jun-Aug | M,W | C,L | F,P | x |
| *Caltha palustris* | marsh-marigold | 1-3 | yellow | May-Aug | W | C,L | F,P,S | x |
| *Campanula rapunculoides* | creeping bellflower | 1-3 | blue | | | | | |
| *Campanula rotundifolia* | harebell | 1-2 | blue | Jun-Sep | D,M | S,G | F,P | x |
| *Carex aquatilis** | long-bracted tussock sedge | 2-3 | green | May-Jun | M,W | C,L | F | x |
| *Carex bromoides* | brome-like sedge | 1-3 | greenish/brown | May-Jun | W | | | |
| *Carex comosa** | bristly sedge | 2-4 | green | May-Jun | W | S,L,C | F | x |
| *Carex crawfordii* | Crawford's sedge | 1-3 | green | June | M,W | S | | |
| *Carex crinita* | fringed sedge | 1-4 | green | May-Jun | W | C,L | F,P,S | x |
| *Carex pensylvanica* | Pennsylvania sedge | 1-2 | green/brown | April | D | S | F,P,S | x |
| *Carex projecta* | necklace sedge | 1-3 | golden-brown | May-Jun | M,W | S,L,C | F,P,S | x |
| *Carex stipata* | common fox sedge | 3-6 | golden-brown | May-Jun | W | Wet S,L,C | F,P | x |
| *Carex trisperma* | three-fruited sedge | 1-2 | green | May-Jun | W | | | |
| *Carex viridula* | green yellow sedge | 1-2 | green | May-Jun | W | S | | |
| *Carex vulpinoidea* | brown fox sedge | 1-3 | golden-brown | May-Jun | W | Wet S,L,C | F | x |
| *Carpinus caroliniana* | American hornbeam | <40 | | | M,W | | F,P,S | x |
| *Cicuta bulbifera* | bulbet water-hemlock | 1-3 | white | Aug-Sep | W | | | |
| *Cornus canadensis* | bunchberry | <1 | white | May-Jul | M,W | | P,S | x |
| *Cornus foemina* | gray dogwood | 3-10 | white | Jun-Jul | M,W | S,L,C | P,S | x |
| *Cornus stolonifera* | red-osier dogwood | 3-10 | white | May-Aug | W,M | | P,S | x |
| *Drosera rotundifolia* | sundew | <1 | white/pink | Jul-Aug | W | | F,P | |

Dominant Species
Invasive/Potentially Invasive Species
* Surveyed in Emergent Stands

# CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
## COMPREHENSIVE SPECIES LIST

| Scientific Name | Common Name | Height | Color | Bloom Period | Moisture | Soil | Sun | Avail |
|---|---|---|---|---|---|---|---|---|
| *Dryopteris cristata* | crested shieldfern | 1-3 | green | | W | | P,S | |
| *Dryopteris carthusiana* | spinulose shieldfern | <1 | green | | M,W | | P,S | x |
| *Eleocharis erythropoda** | bald spikerush | 1-2 | brown/red | May-Aug | W | | | |
| *Equisetum hyemale* | scouring horsetail | 1-4 | green | | W | | | |
| *Eupatorium maculatum* | joe-pye weed | 4-6 | pink | Aug-Sep | W | S,L,C | F | x |
| *Eupatorium perfoliatum* | boneset | 3-4 | white | Jun-Oct | M,W | C,L | F,P | x |
| *Euphorbia corollata* | flowering spurge | 1-4 | white | Jun-Sep | D,M | C,L | S | x |
| *Euthamia graminifolia* | grass-leaved goldenrod | 1-4 | yellow | Jul-Oct | D,M | S,L | F,P | x |
| *Fagus grandifolia* | American beech | 66-115 | | | D,M | | P,S | x |
| *Fraxinus pennsylvanica* | green ash | 40-55 | | | M | | F,P | x |
| *Galium asprellum* | rough bedstraw | <1 | white | May-Aug | W | | | |
| *Glyceria grandis* | reed manna grass | 3-5 | purple | Jun-Sep | W | C,L | F | x |
| *Ilex verticillata* | winterberry | 6-16 | white | May-Jun | W,M,D | | F,P | x |
| *Impatiens capensis** | orange jewelweed | 2-6 | orange | Jul-Sep | W | | | |
| *Iris pseudacorus* | yellow flag | 2-3 | yellow | May-Jun | W | | | |
| *Iris versicolor* | wild blue flag | 2-3 | blue | Jun-Jul | W | S,L,C | F,P | x |
| *Juncus effusus* | soft rush | 1-4 | green/brown | Jun-Jul | M,W | C,L | F | x |
| *Lilium philadelphicum* | orange-cup lily | 1-3 | orange | Jun-Aug | M,W | L | F,P | |
| *Linaria vulgaris* | butter and eggs | 1-3 | orange/yellow | May-Sep | D,M | S | | |
| *Lycopodium obscurum* | flat-branched ground-pine | <1 | green | | M,W | | | |
| *Lycopus americanus* | American water-horehound | 1-2 | white | Jul-Sep | W | C | F | x |
| *Lysimachia nummularia* | creeping jennie | <1 | yellow | Jun-Aug | M,W | | | |
| *Maianthemum canadense* | wild-lily-of-the-valley | <1 | white | May-Jun | M | | P,S | |
| *Malus pumila* | cultivated apple | | | | | | | |
| *Matteuccia struthiopteris* | ostrich fern | 1-3 | green | | M | | P,S | x |
| *Myosotis scorpioides* | water scorpion grass | 1-2 | blue | May-Sep | W | | | |
| *Myrica gale* | meadow fern | 3-6 | | Apr-May | W | | F,P | x |
| *Nuphar variegata** | bull-head pond-lily | <1 | yellow | Jun-Aug | W | | F | |
| *Nymphaea odorata** | white water-lily | <1 | white | Jul-Sep | W | | F | x |
| *Oenothera biennis* | bastard evening-primrose | 2-6 | yellow | Jun-Oct | D,M,W | S,C | F,P | x |
| *Onoclea sensibilis* | sensitive fern | <1 | green | | M,W | S,L,C | F,P | x |
| *Osmunda regalis* | royal fern | 3-6 | green | | W | S,L,C | F,P,S | x |
| *Parthenocissus quinquifolia* | Virginia creeper | varies | green | May-Jun | D,M | | F,P,S | x |
| *Pedicularis canadensis* | Canadian lousewort | 1 | yellow | May-Jun | D,M,W | S,C | F,P | |
| *Phalaris arundinacea* | reed canary grass | 2-6 | green | | M,W | | F,P | |
| *Physocarpus opulifolius* | common ninebark | 6-9 | white | Jun-Jul | W | | | x |
| *Pilea pumila* | clearweed | 1-2 | green | Jul-Sep | M,W | | S | |
| *Pinus resinosa* | red pine | 50-80 | | | D,M | | F,P | x |

# CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
## COMPREHENSIVE SPECIES LIST



| Scientific Name | Common Name | Height | Color | Bloom Period | Moisture | Soil | Sun | Avail |
|---|---|---|---|---|---|---|---|---|
| *Pinus strobus* | white pine | 80-110 | | | D,M | | F,P | x |
| *Poa palustris* | fowl bluegrass | 1-5 | green/purple | Jun-Sep | W | | | |
| *Poa pratensis* | Kentucky bluegrass | 1-1.5 | | | | | | |
| *Polygonum hydropiper* | smartweed | 1-2 | greenish/pink | Jul-Sep | W | | | |
| *Pontederia cordata** | pickerel-weed | 1-3 | blue | Jun-Aug | W | S,L,C | F,P | x |
| *Populus deltoides* | eastern cottonwood | <100 | | | M,W | | F,P | x |
| *Populus grandidentata* | big-tooth aspen | 60-80 | | | D,M | | F,P | x |
| *Prenanthes alba* | lion's-foot | 1-5 | pink/white | Aug-Sep | D | | S | x |
| *Pteridium aquilinum* | bracken fern | 2-5 | white | Aug-Oct | D,M | S,L | P,S | x |
| *Pycnantheum virginianum* | Virginia mountain mint | 1-3 | white | Jul-Sep | M,W | C,L | F,P | x |
| *Quercus alba* | white oak | <80 | | | D,M | S,L | F,P | x |
| *Quercus rubra* | red oak | <100 | | | D,M | S,L | F,P | x |
| *Rhus typhina* | staghorn sumac | 4-15 | | Jun-Jul | D | S,L | F | x |
| *Robinia pseudoacacia* | black locust | | | | | | | |
| *Rosa palustris** | swamp rose | 1-7 | pink | Jul-Aug | W | | F,P | x |
| *Rubus flagellaris* | northern dewberry | <1 | white | May-Jun | D,M,W | S,G | | |
| *Rubus strigosus* | American red raspberry | 1-7 | white/greenish | May-Aug | D,M | | | |
| *Rudbeckia hirta* | black-eyed susan | 1-3 | yellow | Jun-Sep | D,M | S,L,C | F,P | x |
| *Sagittaria latifolia** | common arrowhead | 1-3 | white | Jul-Sep | W | C,L | F,P | x |
| *Salix babylonica* | weeping willow | <40 | | | W | | | |
| *Salix bebbiana* | Bebb's willow | 8-20 | | | M,W | | F,P | x |
| *Salix exigua* | sandbar willow | 3-12 | yellow | May-Jun | W | | F | |
| *Salix nigra* | black willow | <65 | | | | | | |
| *Saponaria officinalis* | bouncing-bet | 1-3 | white/pink | Jul-Oct | | S | | |
| *Schoenoplectus acutus** | hardstem bulrush | 3-9 | grey/brown | May-Sep | W | C,L | F | x |
| *Schoenoplectus pungens** | three-square bulrush | 1-5 | red/brown | Jun-Aug | W | | F | x |
| *Schoenoplectus tabernaemontani* | softstem bulrush | 3-6 | red/brown | May-Aug | W | C,L | F | x |
| *Scirpus atrovirens* | green bulrush | 3-6 | greenish/brown | Jun-Aug | W | S,C,Peat,Muck | F | x |
| *Scuttelaria lateriflora* | maddog skullcap | 1-2 | blue | Jun-Sep | M,W | | P,S | x |
| *Silene latifolia* | bladder campion | 1-4 | white | Jun-Oct | D,M | | | |
| *Solanum dulcamara* | climbing nightshade | 1-8 | purple/blue | Jun-Sep | M | | | |
| *Solidago gigantea* | giant goldenrod | 1-7 | yellow | Jul-Oct | D,M,W | | | x |
| *Spartina pectinata* | prairie cord grass | 2-7 | green | Aug-Sep | M,W | C,L | F,P | x |
| *Sphagnum spp.* | Sphagnum moss | <1 | green | | W | | F,P,S | |
| *Thalictrum thalictroides* | rue-anemone | <1 | pink/white | Apr-May | D,M | | | |
| *Thelyptris palustris* | marsh fern | 1-2 | green | | W | | S | |

# CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
## COMPREHENSIVE SPECIES LIST



| Scientific Name | Common Name | Height | Color | Bloom Period | Moisture | Soil | Sun | Avail |
|---|---|---|---|---|---|---|---|---|
| *Toxicodendron rydbergii* | poison ivy | 1-3 | white | Jun-Aug | D,M,W | | F,P | |
| *Toxicodendron vernix* | poison sumac | <20 | | | W | | | |
| *Trientalis borealis* | starflower | <1 | white | May-Jun | M | | | |
| *Typha latifolia** | broad-leaved cattail | 3-9 | brown | May-Jul | W | | S | |
| *Ulmus rubra* | red elm | 60-110 | | | M | | F,P | x |
| *Urtica dioica* | stinging nettle | 1-6 | white | Jun-Sep | D,M,W | | | |
| *Vaccinium angustifolium* | low bush blueberry | 1-2 | white | May-Jun | D,M | S,G | F,P,S | x |
| *Verbena hastata* | blue vervain | 3-6 | blue | Jul-Sep | M,W | S,L,C | F | x |
| *Veronica americana* | American speedwell | <1 | blue | Jun-Oct | W | | | |
| *Vitis riparia* | riverbank grape | 1-15 | green/white | May-Jul | M,W | S | P,S | |

# D

# APPENDIX D

## Native Plant Availability at Local Nurseries

# Commercially Available Vegetation
# Native to Shawano County, Wisconsin

| Common Name | Scientific Name | Type | Color | Bloom | Height | Sun | Moisture | Soil |
|---|---|---|---|---|---|---|---|---|
| Balsam Fir | *Abies balsamea* | Tree | | | <80' | F,P | W,M | |
| Red Maple | *Acer rubrum* | Tree | | | 20'-40' | F,P | W,M,D | |
| Silver Maple | *Acer saccharinum* | Tree | | | 40'-60' | F,P | W,M | |
| Sugar Maple | *Acer saccharum* | Tree | | | 40'-60' | F,P | D | Clay-Loam |
| Mountain Maple | *Acer spicatum* | Tree | | | <20' | P | M | |
| Common Yarrow | *Achillea millefolium* | Forb | White/Pink | July-Oct | 8"-20" | F | W,M | |
| Sweet Flag | *Acorus americanus* | Aquatic | Yellow | June-July | 3' | F,P | W | |
| Sweet-flag | *Acorus calamus* | Aquatic | Yellow | June-July | 3' | F,P | W | |
| White Baneberry | *Actaea pachypoda* | Forb | White Berries | May-June | 1'-2' | S | M,D | Loam-Sandy |
| Red Baneberry | *Actaea rubra* | Forb | Red Berries | May-June | 1'-2' | S | M,D | Clay-Loam-Sandy |
| Maidenhair Fern | *Adiantum pedatum* | Fern | | | 1'-2' | P,S | M | |
| Purple Giant Hyssop | *Agastache scrophulariaefolia* | Forb | Pink/Purple | Aug-Sept | 3'-5' | F,P | D | |
| Common Water Plantain | *Alisma subcordatum* | Aquatic | White | July-Sept | 1'-3' | F | W | Clay-Loam |
| Wild Leek | *Allium tricoccum* | Forb | White | June-July | 4"-12" | P,S | | |
| Speckled Alder | *Alnus rugosa* | Shrub | | | <30' | F,P,S | W,M | |
| Juneberry | *Amelanchier laevis* | Shrub | White | April-May | 15'-25' | F,P | W | |
| Running Serviceberry | *Amelanchier spicata* | Shrub | White | April-June | | F,P | | Rock-Sand-Gravel |
| Leadplant | *Amorpha canescens* | Shrub | Purple | June-Sept | 2'-4' | F,P | M,D | Loam-Sandy |
| Pearly Everlasting | *Anaphalis margaritacea* | Forb | White | June-Aug | 1.5'-2' | F,P | D | |
| Bog Rosemary | *Andromeda glaucophylla* | Shrub | Pink | May-June | 8"-20" | F,P | W | Acidic |
| Big Bluestem | *Andropogon gerardi* | Grass | Bronze | Aug-Oct | 3'-8' | F,P | M,D | Loam-Sandy |
| Canada Anemone | *Anemone canadensis* | Forb | White | May-Aug | 8"-36" | F,P | W,M | Loam-Sandy |
| Thimbleweed | *Anemone cylindrica* | Forb | White | June-Aug | 1'-3' | F,P | M,D | Loam-Sandy |
| Tall Thimbleweed | *Anemone virginiana* | Forb | White | May-July | 1.5'-2.5' | F,P | W,M,D | |
| Plantain Pussy-toes | *Antennaria plantaginifolia* | Forb | White | May-July | 0.5'-1' | F,P | M,D | |
| Spreading Dogbane | *Apocynum androsaemifolium* | Forb | Pink | June-Aug | 8"-32" | F,P | | |
| Columbine | *Aquilegia canadensis* | Forb | Red/Yellow | May-July | 1'-3' | F,P,S | M,D | Loam-Sandy |
| Jack-in-the-Pulpit | *Arisaema triphyllum* | Forb | Purple/Green | May-June | 1.5'-2.5' | P,S | W,M | |
| Purple Chokeberry | *Aronia prunifolia* | Shrub | White | | 8'-12' | F,P | M | |
| Prairie Sage | *Artemisia ludoviciana* | Forb | Yellow | July-Oct | 1.5'-2.5' | F,P | D | |
| Wild Ginger | *Asarum canadense* | Forb | Red/Brown | April-May | 2"-8" | P,S | | |
| Marsh Milkweed | *Asclepias incarnata* | Forb | Red | June-Sept | 3'-5' | F | W,M | Clay-Loam |
| Common Milkweed | *Asclepias syriaca* | Forb | Purple | June-Aug | 3'-4' | F,P | W,M,D | Clay-Loam-Sandy |
| Butterfly Milkweed | *Asclepias tuberosa* | Forb | Orange | June-Aug | 1'-3' | F,P | M,D | Loam-Sandy |
| Whorled Milkweed | *Asclepias verticillata* | Forb | White | July-Sept | 1'-2' | F,P | M,D | Loam-Sandy |
| Heart-leaved Aster | *Aster cordifolius* | Forb | Blue/Purple | Aug-Nov | 1.5'-4' | F,P | M,D | |
| Smooth Blue Aster | *Aster laevis* | Forb | Blue | Aug-Oct | 1'-3' | F,P | M | Loam |
| White Panicled Aster | *Aster lanceolatus* | Forb | White | July-Nov | 2'-5' | P,S | W,M | |
| Calico Aster | *Aster lateriflorus* | Forb | White | Aug-Oct | 1'-4' | F,P,S | M | Loam |
| Large-leaf Aster | *Aster macrophyllus* | Forb | White | July-Oct | 1'-3.5' | F,P | W,M,D | Loam-Sandy |
| New England Aster | *Aster novae-angliae* | Forb | Purple | Aug-Oct | 1'-7' | F,P | W,M | Clay-Loam |
| Sky-blue Aster | *Aster oolentangiensis* | Forb | Blue | Aug-Oct | 1'-4' | F,P | M,D | Loam-Sandy |
| Frost Aster | *Aster pilosus* | Forb | White | Aug-Nov | 1'-5' | F | D | Sandy-Gravelly |
| Swamp Aster | *Aster puniceus* | Forb | White | Aug-Oct | 1'-7' | F,P | W | Clay-Loam |
| Arrow Leaf Aster | *Aster sagittifolius* | Forb | Light Blue | Aug-Oct | 1'-4' | F,P,S | M,D | Loam-Sandy |
| Flat-topped Aster | *Aster umbellatus* | Forb | Cream | July-Sept | 1'-6' | F,P | W,M | Clay-Loam |
| Lady Fern | *Athyrium filix-femina* | Fern | | | 1'-2' | P,S | M | |
| Yellow Birch | *Betula alleghaniensis* | Tree | | | <100' | F,P | W,M,D | Clay-Loam |
| Paper Birch | *Betula papyrifera* | Tree | | | <65' | F,P | M,D | Clay-Loam-Sandy |
| Nodding Bur Marigold | *Bidens cernuus* | Forb | Yellow | Aug-Oct | 4"-40" | F,P | W | |
| Purple-Stemmed Tickseed | *Bidens connata* | Forb | Yellow/Orange | Aug-Oct | 4"-80" | F,P | W | |
| Common Beggars Tick | *Bidens frondosa* | Forb | Orange | June-Oct | 8"-48" | F,P | W,M | |
| Fringed Brome | *Bromus ciliatus* | Grass | Straw | June-July | 2'-4' | F,P | W | Clay-Loam |

F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

W - Wet
M - Medium/moist
D - Dry

# Commercially Available Vegetation
# Native to Shawano County, Wisconsin

| Common Name | Scientific Name | Type | Color | Bloom | Height | Sun | Moisture | Soil |
|---|---|---|---|---|---|---|---|---|
| Prairie Brome | *Bromus kalmii* | Grass | | | 1'-3' | F,P | M | Loam |
| Hairy Woodland Brome | *Bromus pubescens* | Grass | Straw | | 2'-5' | P,S | M | Loam |
| Bluejoint | *Calamagrostis canadensis* | Grass | Straw | July-Aug | 3'-5' | F,P | W,M | Clay-Loam |
| Water Arum | *Calla palustris* | Aquatic | White | June | 5"-10" | P,S | W | Muck |
| Marsh Marigold | *Caltha palustris* | Forb | Yellow | April-May | 8"-24" | F,P,S | W | Clay-Loam |
| Water Sedge | *Carex aquatilis* | Sedge | Green | May-June | 2'-3' | F | W,M | Clay-Loam |
| Bebb's Sedge | *Carex bebbii* | Sedge | Green | May-June | 2'-3' | F | M | Loam |
| Common Wood Sedge | *Carex blanda* | Sedge | Green/Brown | May-July | <1' | F, PS, S | D,M,W | Clay, Sand, Loam |
| Bristly Sedge | *Carex comosa* | Sedge | Green | May-June | 1'-2' | F | W | Clay-Loam |
| Fringed Sedge | *Carex crinita* | Sedge | Green | May-June | 2'-5' | F,P,S | W,M | Clay-Loam |
| Crested Oval Sedge | *Carex cristatella* | Sedge | Green | May-June | 2'-3' | F,P | W,M | Clay-Loam |
| Graceful Sedge | *Carex gracillima* | Sedge | Green | April-May | 1'-3' | P | M,D | |
| Pale Sedge | *Carex granularis* | Sedge | Green | May | <1.5' | P,S | W,M | Limey |
| Porcupine Sedge | *Carex hystericina* | Sedge | Green | May-June | 1'-3' | F | W | Clay-Loam |
| Prairie Star Sedge | *Carex interior* | Sedge | Green | May | 1'-3' | F,P | W | |
| Shining Bur Sedge | *Carex intumescens* | Sedge | Green | May-June | 1'-3' | P,S | W.M | Clay-Loam |
| Common Lake Sedge | *Carex lacustris* | Sedge | Green | May-June | 2'-4' | F,P,S | W,M | Clay-Loam |
| Common Hop Sedge | *Carex lupulina* | Sedge | Green | May-June | 2'-3' | F,P,S | M | Clay-Loam |
| Sand-bracted Sedge | *Carex muhlenbergii* | Sedge | Green | May-June | 1'-3' | F,P | D | Sandy |
| Swamp Oval Sedge | *Carex muskingumensis* | Sedge | Green | June | 1'-3' | P,S | W | |
| Spreading Oval Sedge | *Carex normalis* | Sedge | Green | June | 2'-4' | P | W | |
| Pennsylvania Sedge | *Carex pensylvanica* | Sedge | Green | May | 6"-12" | F,P,S | M,D | |
| Loose-Headed Oval Sedge | *Carex projecta* | Sedge | Green | June-July | 1'-3' | F,P,S | M | Clay-Loam-Sandy |
| Straight-Styled Wood Sedge | *Carex radiata* | Sedge | Green | May | 1'-3' | P | W,M | |
| Deflexed Bottlebrush Sedge | *Carex retrorsa* | Sedge | Green | May-June | 1'-3' | P | W | |
| Curly-Styled Wood Sedge | *Carex rosea* | Sedge | Green | May | 1'-3' | P,S | M,D | |
| Lance-fruit Oval Sedge | *Carex scoparia* | Sedge | Green | May-June | 1'-3' | F,P | W,M | Loam-Sandy |
| Long-beaked Sedge | *Carex sprengelii* | Sedge | Green | June-July | 1'-3' | F,P | W,M | |
| Common Fox Sedge | *Carex stipata* | Sedge | Green | May-June | 1'-4' | F,P,S | W,M | Clay-Loam |
| Common Tussock Sedge | *Carex stricta* | Sedge | Green | May-June | 1'-3' | F,P,S | W,M | |
| Brown Fox Sedge | *Carex vulpinoidea* | Sedge | Green | May-June | 1'-3' | F,P | W,M | Clay-Loam |
| Blue Beech | *Carpinus caroliniana* | Tree | | | <40' | F,P | W,M | |
| Yellowbud Hickory | *Carya cordiformis* | Tree | | | <110' | F,P | W,M,D | |
| Blue Cohosh | *Caulophyllum thalictroides* | Forb | Green | April-May | 1'-3' | F,P | W,M | Loam |
| New Jersey Tea | *Ceanothus americanus* | Shrub | White | June-Aug | 1'-3' | F,P | M,D | Loam-Sandy |
| Prairie Red-root | *Ceanothus herbaceus* | Shrub | White | April-July | <3' | F,P | M,D | |
| American Bittersweet | *Celastrus scandens* | Vine | Orange fruit | May-June | Climbing | F,P | M,D | Loam-Sandy |
| Buttonbrush | *Cephalanthus occidentalis* | Shrub | White/Yellow | | 3'-10' | F,P | W | |
| Leatherleaf | *Chamaedaphne calyculata* | Shrub | White | April-June | 1'-3' | F,P | W | Acidic |
| Turtlehead | *Chelone glabra* | Forb | Cream | July-Sept | 2'-3' | F | W | Clay-Loam |
| Wood Reed Grass | *Cinna arundinacea* | Grass | Tan | Aug-Oct | 3'-5' | P | W.M | Loam |
| Virgin's Bower | *Clematis virginiana* | Vine | White | July-Aug | Climbing | F,P | W,M | |
| Sweetfern | *Comptonia peregrina* | Shrub | | | <4.5' | F,P | D | Sandy |
| Pagoda Dogwood | *Cornus alternifolia* | Shrub | White | May-June | <30' | F,P | M,D | |
| Silky Dogwood | *Cornus ammomum* | Shrub | White | May-June | 3'-10' | F,P | W,M | |
| Bunch-berry | *Cornus canadensis* | Forb | White | May-June | 4"-10" | P,S | W,M | |
| Gray dogwood | *Cornus racemosa* | Shrub | White | May-June | 6'-15' | F,P | W,M | Clay-Loam-Sandy |
| Red-osier Dogwood | *Cornus stolonifera* | Shrub | White | June-July | 3'-10' | F,P | W.M | |
| Hazelnut | *Corylus americana* | Shrub | | | <11' | F,P | M,D | |
| Beaked Hazelnut | *Corylus cornuta* | Shrub | | | <16' | F,P | M,D | Loam-Sandy |
| Poverty Oat-grass | *Danthonia spicata* | Grass | Straw | June | 12" | F,P | D | Sand-Gravel |
| Swamp Loosestrife | *Decodon verticillatus* | Forb | Pink | Aug-Sept | 1'-9' | F,P | W | Muck |
| Showy Tick Trefoil | *Desmodium canadense* | Forb | Purple | June-Sept | 3'-6' | F,P | M | Loam |

F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

W - Wet
M - Medium/moist
D - Dry

# Commercially Available Vegetation
# Native to Shawano County, Wisconsin

| Common Name | Scientific Name | Type | Color | Bloom | Height | Sun | Moisture | Soil |
|---|---|---|---|---|---|---|---|---|
| Dutchman's Breeches | *Dicentra cucullaria* | Forb | White | May-June | 1 | F,P | D,M | |
| Dwarf Bush Honeysuckle | *Diervilla lonicera* | Shrub | Yellow/Red | June-July | 6"-36" | F,P | M,D | Rocky |
| Leatherwood | *Dirca palustris* | Shrub | Yellow | | <10' | P | M | |
| Spinulose Shield Fern | *Dryopteris carthusiana* | Fern | | | 1"-6" | P,S | W,M | |
| Needle Spike Rush | *Eleocharis acicularis* | Rush | Green | July-Sept | <1' | F | W | Clay-Loam |
| Blunt Spike Rush | *Eleocharis ovata* | Rush | Green | June-Aug | 2"-10" | F | W | Sand-Gravel-Muck |
| Common Spike Rush | *Eleocharis palustris* | Rush | Green | June-Aug | 1'-2' | F | W | Clay-Loam |
| Canada Wild Rye | *Elymus canadensis* | Grass | Straw | July-Aug | 3'-6' | F,P | M,D | Loam-Sandy |
| Bottlebrush Grass | *Elymus hystrix* | Grass | Straw | June-Aug | 3' | P,S | M,D | Loam-Sandy |
| Virginia Wild Rye | *Elymus virginicus* | Grass | Straw | July-Aug | 2'-4' | F,P,S | W,M | Clay-Loam |
| Trailing-arbutus | *Epigaea repens* | Forb | White | April-May | 6" | P,S | W,M | |
| Fireweed | *Epilobium angustifolium* | Forb | Purple | June-Aug | 3'-4' | F,P | M | |
| Cinnamon Willow Herb | *Epilobium coloratum* | Forb | Pink | June-Sept | 2'-6' | F,P | W,M,D | Loam-Sandy |
| Trout-lily | *Erythronium americanum* | Forb | Yellow | May-June | 8" | F,P | M | |
| Eastern Wahoo | *Euonymus atropurpurea* | Shrub | | | <25' | F,P | M | |
| Spotted Joe-Pye Weed | *Eupatorium maculatum* | Forb | Pink | July-Oct | 2'-7' | F,P | W | Clay |
| Boneset | *Eupatorium perfoliatum* | Forb | White | June-Oct | 3'-4' | F,P | W,M | Clay-Loam |
| White Snakeroot | *Eupatorium rugosum* | Forb | White | July-Oct | 1'-5' | F,P | M | Rocky |
| Flowering Spurge | *Euphorbia collorata* | Forb | White | June-Sept | 12"-40" | F | M,D | Loam-Sandy |
| Grass-leaved Goldenrod | *Euthamia graminifolia* | Forb | Yellow | July-Oct | 1'-4' | F,P | M,D | Loam-Sandy |
| American Beech | *Fagus grandifolia* | Tree | | | 66'-115' | P,S | M,D | |
| Woodland Strawberry | *Fragaria vesca* | Forb | White | May-June | 6"-10" | F,S | M,D | |
| Wild Strawberry | *Fragaria virginiana* | Forb | White | May-June | 6" | F,S | D | |
| White Ash | *Fraxinus americana* | Tree | | | 50'-80' | P,S | M,D | Loam |
| Black Ash | *Fraxinus nigra* | Tree | | | 40'-60' | P,S | W,M | |
| Green Ash | *Fraxinus pennyslvanica* | Tree | | | 40'-55' | F,P | M | |
| Northern Bedstraw | *Galium boreale* | Forb | White | June-July | 16"-2' | F,S | W,M,D | |
| Creeping Snowberry | *Gaultheria hispidula* | Forb | White | April-May | 8"-16" | P,S | W | |
| Wintergreen | *Gaultheria procumbens* | Forb | Pink | May-June | 6" | P,S | D,M | |
| Black Huckleberry | *Gaylussacia baccata* | Shrub | | | 1'-3' | F,P,S | W,M | |
| Bottle Gentian | *Gentian andrewsii* | Forb | Blue | Aug-Oct | 1'-3' | F,P | M | Loam |
| Wild Geranium | *Geranium maculatum* | Forb | Lavender | April-June | 1'-2' | F,P,S | M | Loam |
| Prairie Smoke | *Geum triflorum* | Forb | Red | April-June | 1' | F,P | M,D | Loam-Sandy |
| Rattlesnake Grass | *Glyceria canadensis* | Grass | Straw | June | 2'-3' | F,P | W | Clay-Loam |
| Reed Manna Grass | *Glyceria grandis* | Grass | Straw | June-July | 3'-5' | F | W | Clay-Loam |
| Fowl-manna Grass | *Glyceria striata* | Grass | Straw | June-July | 1'-5' | F,P | W,M | Clay-Loam |
| Witch Hazel | *Hamemalis virginiana* | Shrub | Yellow | | <20' | P,S | M | |
| Sneezeweed | *Helenium autumnale* | Forb | Yellow | Aug-Oct | 2'-5' | F,P | W,M | Clay-Loam |
| Tall Sunflower | *Helianthus giganteus* | Forb | Yellow | Jul-Oct | 3'-10' | F,P | M | |
| Western Sunflower | *Helianthus occidentalis* | Forb | Yellow | July-Sept | 2'-3' | F,P | M,D | |
| Pale-leaved Sunflower | *Helianthus strumosus* | Forb | Yellow | July-Oct | 2'-6' | F,P | M | Loam |
| False Sunflower | *Heliopsis helianthoides* | Forb | Yellow | July-Sept | 2'-5' | F,P | M | Loam |
| Rounded Hepatica | *Hepatica americana* | Forb | White/Lavender | April-May | 6" | P,S | M,D | |
| Cow Parsnip | *Heracleum lanatum* | Forb | White | June-July | 3'-7' | F,P,S | W,M | Clay-Loam |
| Prairie Alum Root | *Heuchera richardsonii* | Forb | White | May-July | 1'-3' | F,P | M,D | Loam-Sandy |
| Sweetgrass | *Hierochloe odorata* | Grass | Straw | May-June | 1'-2' | F,P | W,M | Clay-Loam-Sandy |
| Great St. John's Wort | *Hypericum pyramidatum* | Forb | Yellow | July-Aug | 2'-5' | F,P | W,M | Clay-Loam |
| Mountain Holly | *Ilex mucronata* | Shrub | Yellow | April-June | <10' | F,P | W,M | |
| Winterberry | *Ilex verticillata* | Shrub | White | May-June | 6'-16' | F,P | W,M,D | |
| Wild Iris | *Iris shrevei* | Forb | Blue | May-July | 2'-3' | F,P | W | Clay-Loam-Sandy |
| Blue Flag Iris | *Iris versicolor* | Forb | Light Blue | May-July | 1'-3' | F,P | W | Clay-Loam-Sandy |
| Southern Blue-flag | *Iris virginica* | Forb | Blue | June-July | 2'-3' | F,P | W | |
| Bitternut | *Juglans cinerea* | Tree | | | <60' | P | M | |

F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

W - Wet
M - Medium/moist
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# Commercially Available Vegetation
# Native to Shawano County, Wisconsin

| Common Name | Scientific Name | Type | Color | Bloom | Height | Sun | Moisture | Soil |
|---|---|---|---|---|---|---|---|---|
| Canadian Rush | *Juncus canadensis* | Rush | Green | July-Oct | 1'-3' | F | W,M | |
| Common Rush | *Juncus effusus* | Rush | Green | June-July | 1'-4' | F | W,M | Clay-Loam |
| Path Rush | *Juncus tenuis* | Rush | Green | June-July | <1' | F,P | M,D | Loam |
| Eastern Redcedar | *Juniperus virginiana* | Tree | | | 40'-50' | F,P | D | Sand-gravelly |
| Bog-laurel | *Kalmia polifolia* | Shrub | Pink/Purple | May-June | 1'-2' | F | W | Bog |
| June Grass | *Koeleria macrantha* | Grass | Green | May-June | 2' | F | D | Sandy |
| Tamarack | *Larix laricina* | Tree | | | 40'-80' | F,P | W,M | Loamy-muck |
| Marsh Pea | *Lathyrus palustris* | Forb | Purple/White | June-July | 1'-4' | F,P | W,M | |
| Labrador-tea | *Ledum groenlandicum* | Shrub | White | May-June | 1.5'-3' | F,P | W | |
| Rice Cut Grass | *Leersia oryzoides* | Grass | Straw | | 3'-4' | F,P | W | Clay-Loam |
| Round-headed Bush Clover | *Lespedeza capitata* | Forb | Green | July-Oct | 2'-4' | F,P | M,D | Loam-Sandy |
| Rough Blazing Star | *Liatris aspera* | Forb | Purple | July-Oct | 2'-3' | F,P | M,D | Loam-Sandy |
| Cardinal Flower | *Lobelia cardinalis* | Forb | Red | July-Sept | 2'-5' | F,P | W,M | Clay-Loam |
| Great Blue Lobelia | *Lobelia siphilitica* | Forb | Blue | July-Sept | 1'-4' | F,P | W,M | Clay-Loam |
| Fly Honeysuckle | *Lonicera canadensis* | Shrub | White | April-May | 3'-6' | P | M,D | |
| Red-vine Honeysuckle | *Lonicera dioica* | Shrub | Yellow/Orange | May-June | Climbing | F,P | M | |
| Mountain Fly Honeysuckle | *Lonicera villosa* | Shrub | White/Yellow | June | <3' | P | W | |
| Lupine | *Lupinus perennis* | Forb | Blue | May-Aug | 1'-2' | F,P | D | Sandy |
| American Water Horehound | *Lycopus americana* | Forb | White | July-Sept | 1'-2' | F | W | Clay |
| False Solomon's Seal | *Maianthemum racemosum* | Forb | White | May-June | 1'-3' | F,P | M,D | Loam-Sandy |
| Starry Solomon's Seal | *Maianthemum stellatum* | Forb | White | May-June | 1'-2' | F,P | M,D | Loam-Sandy |
| Ostrich Fern | *Matteuccia struthiopteris* | Fern | Green | | 1'-3' | P,S | M | Loamy-muck |
| Wild Mint | *Mentha arvensis* | Forb | Pink | July-Sept | 6"-36" | F | W,M | |
| Monkey Flower | *Mimulus ringens* | Forb | Purple | July-Sept | 1'-3' | F,P | W | Clay-Loam |
| Partridgeberry | *Mitchella repens* | Forb | White | May-June | 4" | P,S | M,D | |
| Bishop's Cap | *Mitella diphylla* | Forb | White | May-June | 1'-2' | P,S | M,D | |
| Wild Bergamont | *Monarda fistulosa* | Forb | Lavender | July-Sept | 2'-4' | F,P | D | Sandy |
| Horsemint | *Monarda punctata* | Forb | Lavender | July-Sept | 1'-2' | F,P | D | Sandy |
| Sweetgale | *Myrica gale* | Shrub | | | 3'-6' | F,P | W | Sandy |
| White Water Lily | *Nymphaea odorata subsp.tuberosa* | Aquatic | White | July-Sept | | F | W | |
| Evening Primrose | *Oenothera biennis* | Forb | Yellow | June-Oct | 2'-6' | F,P | W,M,D | Clay-Sandy |
| Sensitive Fern | *Onoclea sensibilis* | Fern | Green | | 6"-12" | P,S | M | Loamy-muck |
| Hairy Sweet Cicely | *Osmorhiza claytonii* | Forb | White | May-June | 1'-3' | P,S | M | Loam-Sandy |
| Cinnamon Fern | *Osmunda cinnamomea* | Fern | Green/Brown | | 1'-4' | P,S | M | Loamy-muck |
| Interrupted Fern | *Osmunda claytoniana* | Fern | Green | | 1'-3' | P,S | M | Loamy-muck |
| Royal Fern | *Osmunda regalis* | Fern | Green | | 1'-2' | F,P,S | M | |
| Hop-hornbeam | *Ostrya virginiana* | Shrub | | | <55' | F,P | M | Loam |
| Switchgrass | *Panicum virgatum* | Grass | Straw | Aug-Sept | 3'-6' | F,P | M,D | Loam-Sandy |
| Virginia Creeper | *Parthenocissus quinquefolia* | Vine | Green | May-June | Climbing | F,P,S | M,D | |
| Fen Bentony | *Pedicularis lanceolata* | Forb | Yellow | May-June | 1' | F,P | W,M,D | Clay-Sandy |
| Smooth Penstemon | *Penstemon digitalis* | Forb | White | June-July | 2'-2.5' | F,P | M | |
| Ditch Stonecrop | *Penthorum sedoides* | Forb | Green | July-Sept | 1'-3' | F,P | W,M | Clay-Loam |
| Wild Blue Phlox | *Phlox divaricatus* | Forb | Blue | May-June | 1'-2' | P,S | M | Clay-Loam-Sandy |
| Prairie Phlox | *Phlox pilosa* | Forb | Pink | May-June | 1.5'-2' | F,P | D | |
| Ninebark | *Physocarpus opulifolius* | Shrub | White/Pink | June | 6'-10' | F,P | M,D | |
| Obedient Plant | *Physostegia virginiana* | Forb | Pink | Aug-Oct | 2'-3' | F | W,M | Clay-Loam |
| White Spruce | *Picea glauca* | Tree | | | 50'-60' | F,P | D | Clay-Loam |
| Red Pine | *Pinus resinosa* | Tree | | | 50'-80' | F,P | M,D | Loam-Sandy |
| White Pine | *Pinus strobus* | Tree | | | 80'-110' | F,P | M,D | Loam-Sandy |
| May-apple | *Podophyllum peltatum* | Forb | White | May-June | 2'-3' | P | M | |
| Jacob's Ladder | *Polemonium reptans* | Forb | Blue | May-June | 1'-2' | F,P,S | M | Loam |
| Great Solomons-seal | *Polygonatum canaliculatum* | Forb | White/Yellow | May-July | 1"-5" | F,P | M,D | Loam-Sandy |
| Pennsylvania Smartweed | *Polygonum pensylvanicum* | Forb | White/Pink | July-Sept | 2'-6' | F,P | W,M | |

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P - Partial sun/shade (4-8 hours)
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W - Wet
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# Commercially Available Vegetation
## Native to Shawano County, Wisconsin

| Common Name | Scientific Name | Type | Color | Bloom | Height | Sun | Moisture | Soil |
|---|---|---|---|---|---|---|---|---|
| Pickerel-Weed | *Pontederia cordata* | Aquatic | Purple | June-Sept | 1'-3' | F,P | M | Clay-Loam-Sandy |
| Balsam Poplar | *Populus balsamifera* | Tree | | | <80' | F,P | W | |
| Eastern Cottonwood | *Populus deltoides* | Tree | | | <100' | F,P | W,M | |
| Bigtooth Aspen | *Populus grandidentata* | Tree | | | 60'-80' | F,P | M,D | |
| Quaking Aspen | *Populus tremuloides* | Tree | | | 30'-40' | F,P | M | |
| Prairie Cinquefoil | *Potentilla arguta* | Forb | White/Yellow | June-July | 1'-3' | F | M,D | |
| Lionsfoot | *Prenanthes alba* | Forb | White | Aug-Oct | 2'-5' | P,S | M,D | Clay-Loam-Sandy |
| Wild Plum | *Prunus americana* | Shrub | White | April | 12'-25' | F,P | M | |
| Pin Cherry | *Prunus pensylvanica* | Tree | White | | 15'-50' | F,P | D | Loam-Sandy |
| Sand Cherry | *Prunus pumila* | Shrub | White | April-May | 1'-3' | F,P | D | Sandy-Rocky |
| Black Cherry | *Prunus serotina* | Tree | | | 40'-65' | F,P | M,D | Loam-Sandy |
| Chokecherry | *Prunus virginiana* | Tree | | | 15'-30' | F,P | M,D | Loam-Sandy |
| Common Mountain Mint | *Pycnanthemum virginianum* | Forb | White | July-Sept | 1'-3' | F,P | W,M | Clay-Loam |
| White Oak | *Quercus alba* | Tree | | | <80' | F,P | M,D | Loam-Sandy |
| Swamp White Oak | *Quercus bicolor* | Tree | | | 50'-70' | F,P | M | Clay-Loam-Sandy |
| Northern Pin Oak | *Quercus ellipsoidalis* | Tree | | | <65' | F,P | D | Sandy |
| Bur Oak | *Quercus macrocarpa* | Tree | | | <100' | F,P | M,D | Loam-Sandy |
| Northern Red Oak | *Quercus rubra* | Tree | | | <100' | F,P | M,D | Loam-Sandy |
| Yellow Coneflower | *Ratibida pinnata* | Forb | Yellow | June-Aug | 3'-6' | F,P | M | Loam |
| Staghorn Sumac | *Rhus typhina* | Shrub | | | 4'-15' | F,P | M,D | Loam-Sandy |
| American Black Currant | *Ribes americanum* | Shrub | Yellow | May-June | 3'-4' | F,P | M | |
| Swamp Skunk Currant | *Ribes glandulosum* | Shrub | White | June | <3' | F,P | M | |
| Smooth Rose | *Rosa blanda* | Shrub | Pink | June-July | 1'-3' | F,P | M,D | Loam-Sandy |
| Pasture Rose | *Rosa carolina* | Shrub | Pink | June-July | 1'-3' | F,P | M,D | Loam-Sandy |
| Swamp Rose | *Rosa palustris* | Shrub | Pink | June-July | <7' | F,P | W | |
| Blackberry | *Rubus alleghaniensis* | Shrub | White | May-July | 2'-7' | F,P | | |
| Dewberry | *Rubus hispidus* | Shrub | White | June-Aug | Trailing | F,P | W | |
| Northern Raspberry | *Rubus idaeus canadensis* | Shrub | White | May-June | <7' | F,P | M,D | |
| Black Raspberry | *Rubus occidentalis* | Shrub | White | May-June | 3'-9' | F,P | M,D | |
| Black-eyed Susan | *Rudbeckia hirta* | Forb | Yellow | June-Oct | 1'-3' | F,P | M,D | Loam-Sandy |
| Wild Golden Glow | *Rudbeckia laciniata* | Forb | Yellow | July-Sept | 2'-10' | F,P,S | W,M | Clay-Loam |
| Brown-eyed Susan | *Rudbeckia triloba* | Forb | Yellow | July-Oct | 1'-5' | F,P | M | Loam |
| Common Arrowhead | *Sagittaria latifolia* | Forb | White | July-Sept | 1'-3' | F,P | W | Clay-Loam |
| Peach-leaved Willow | *Salix amygdaloides* | Shrub | | | 10'-65' | F,P | W,M | |
| Bebb's Willow | *Salix bebbiana* | Shrub | | | 8'-20' | F,P | W,M | |
| Pussy Willow | *Salix discolor* | Shrub | | | 8'-27' | F,P | W | |
| Coyote Willow | *Salix humilis* | Shrub | | | 3.5'-10' | F,P | W,M,D | |
| Shining Willow | *Salix lucida* | Shrub | | | <25' | F,P | W,M | |
| Black Willow | *Salix nigra* | Tree | | | <65' | F,P | W,M | |
| Slender Willow | *Salix petiolaris* | Shrub | | | 5'-23' | F,P | W,M | |
| Autumn Willow | *Salix serissima* | Shrub | | | 3.5'-13' | F,P | W | Bog |
| Wild Elderberry | *Sambucus canadensis* | Shrub | | | <15' | F,P | W,M | Clay-Loam |
| Red Elderberry | *Sambucus racemosa var. pubens* | Shrub | | | <20' | F,P,S | M | |
| Bloodroot | *Sanguinaria canadensis* | Forb | White | April-May | 3"-6" | F,P,S | M | |
| Little Blue Stem | *Schizachyrium scoparium* | Grass | Red | Aug-Oct | 2'-3' | F,P | M,D | Loam-Sandy |
| Hard-stem Bulrush | *Schoenoplectus acutus* | Aquatic | Green | May-Sept | 3'-9' | F | W | Clay-Loam |
| Chairmakers Rush | *Schoenoplectus pungens* | Aquatic | Green | June-Sept | 2'-5' | F | W | |
| Soft-stem Bulrush | *Schoenoplectus tabernaemontani* | Aquatic | green | May-Aug | 3'-6' | F | W | Clay-Loam |
| Dark-green Bulrush | *Scirpus atrovirens* | Aquatic | Green | June-Aug | 3'-5' | F | W | Clay-Loam |
| Wool Grass | *Scirpus cyperinus* | Aquatic | Green | June-Sept | 3'-5' | F | W | Clay-Loam |
| Red Bulrush | *Scirpus pendulus* | Aquatic | Green | May-July | 2'-4' | F | W,M | |
| Mad-dog Skullcap | *Scutellaria lateriflora* | Forb | Purple | June-Sept | 1'-2' | P,S | W,M | |
| Tall Water Parsnip | *Sium suave* | Forb | White | July-Aug | 2'-6' | F | W | Muck |

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P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

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# Commercially Available Vegetation
# Native to Shawano County, Wisconsin

| Common Name | Scientific Name | Type | Color | Bloom | Height | Sun | Moisture | Soil |
|---|---|---|---|---|---|---|---|---|
| Old Field Goldenrod | *Solidago nemoralis* | Forb | Yellow | June-Oct | 1'-3' | F,P | D | Sandy |
| Swamp Goldenrod | *Solidago patula* | Forb | Yellow | Aug-Sept | 1'-7' | F,P | W | Limey |
| Stiff Goldenrod | *Solidago rigida* | Forb | Yellow | July-Sept | 1'-5' | F,P | M,D | Loam-Sandy |
| Showy Goldenrod | *Solidago speciosa* | Forb | Yellow | July-Oct | 1'-4' | F,P | M,D | Loam-Sandy |
| Elm-leaved Goldenrod | *Solidago ulmifolia* | Forb | Yellow | July-Oct | 1'-5' | P,S | D | |
| Zig-zag Goldenrod | *Solidgao flexicaulis* | Forb | Yellow | Aug-Sept | 8"-48" | F,P | M,D | |
| Indian Grass | *Sorghastrum nutans* | Grass | Green | Aug-Sept | 3'-6' | F,P | M,D | Loam-Sandy |
| American Bur-reed | *Sparganium americanum* | Aquatic | Green | June-Aug | 2'-5' | F,P | W | |
| Giant Bur-reed | *Sparganium eurycarpum* | Aquatic | Green | May-Aug | 3'-5' | F | W | Clay-Loam |
| Prairie Cordgrass | *Spartina pectinata* | Grass | Straw | July-Aug | 2'-3' | F,P | W,M | Clay-Loam |
| Meadowsweet | *Spiraea alba* | Shrub | White | June-Aug | 3'-6' | F,P | W,M | |
| Steeplebush | *Spiraea tomentosa* | Shrub | Pink | July-Sept | 2'-3.5' | F,P | M | |
| Porcupine Grass | *Stipa spartea* | Grass | Green | June | 1'-4' | F,P | D | Sandy |
| Snowberry | *Symphoricarpos albus* | Shrub | White | April-May | 3'-6' | F,P | M | |
| Wolfberry | *Symphoricarpos occidentalis* | Shrub | White | June-Aug | 1'-3' | F,P | W,M | |
| Skunk Cabbage | *Symplocarpus foetidus* | Forb | Green | April-May | 1'-3' | P,S | M | |
| Canada Yew | *Taxus canadensis* | Shrub | Red Berries | | 3'-6' | P,S | M | |
| Germander | *Teucrium canadense* | Forb | Pink | July-Aug | 1'-3' | F,P | M | Loam |
| Purple Meadow Rue | *Thalictrum dasycarpum* | Forb | Cream | May-July | 3'-5' | F,P | M | Loam |
| Early Meadow Rue | *Thalictrum dioicum* | Forb | White | May-June | 2'-4' | P,S | M,D | |
| Eastern White Cedar | *Thuja occidentalis* | Tree | | | 40'-50' | F,P | W,M | |
| Basswood | *Tilia americana* | Tree | | | <130' | F,P | M,D | Clay-Loam |
| Common Spiderwort | *Tradescantia ohiensis* | Forb | Blue/Pink | April-July | 16"-40" | F,P | W,M,D | Loam-Sandy |
| Large Flowered Trillium | *Trillium grandiflorum* | Forb | White | May-June | 8"-16" | P,S | M,D | Loam-Sandy |
| Eastern Hemlock | *Tsuga canadensis* | Tree | | | 65'-100' | P | M | Loam-Sandy |
| American Elm | *Ulmus americana* | Tree | | | 70'-110' | F,P | M | |
| Red Elm | *Ulmus rubra* | Tree | | | 60'-110' | F,P | M | |
| Large Flowered Bellwort | *Uvularia grandflora* | Forb | Yellow | April-May | 8"-20" | P | D | |
| Lowbush Blueberry | *Vaccinium angustifolium* | Shrub | White | May-June | 2"-14" | F,P,S | M,D | Sand-Gravel |
| Large Cranberry | *Vaccinium macrocarpon* | Shrub | White | June-Aug | Trailing | F,P | W | Bog |
| Velvetleaf Blueberry | *Vaccinium myrtilloides* | Shrub | White | May-July | 8"-20" | F,P,S | W,M | Bog |
| Small Cranberry | *Vaccinium oxycoccus* | Shrub | Pink | June-July | 2"-6" | F,P | W | Bog-Sandy |
| Water Celery | *Vallisneria americana* | Aquatic | White | | | F | W | |
| Blue Vervain | *Verbena hastata* | Forb | Blue | July-Oct | 2'-6' | F,P | W,M | Clay-Loam |
| Hoary Vervain | *Verbena stricta* | Forb | Blue | July-Sept | 2'-3' | F,P | D | Sandy |
| Common Ironweed | *Vernonia fasciculata* | Forb | Purple | July-Sept | 2'-6' | F,P | W,M | Loam-Sandy |
| Culver's Root | *Veronicastrum virginicum* | Forb | White | June-Sept | 3'-6' | F,P | M | Loam |
| Maple-leaf Viburnum | *Viburnum acerifolium* | Shrub | | | <8' | P,S | M,D | Loam-Sandy |
| Nannyberry | *Viburnum lentago* | Shrub | | | 12'-25' | F,P | W,M | Clay-Loam |
| Highbush Cranberry | *Viburnum opulus* | Shrub | | | <25' | F,P | W,M | |
| Rafinesque Viburnum | *Viburnum rafinesquianum* | Shrub | White | April | <6' | F,P,S | M | |
| Prickly-ash | *Zanthoxylum americanum* | Shrub | Yellow | April-May | <33' | F,P | M | |
| Wild Rice | *Zizania aquatica* | Grass | Green | July-Sept | <9' | F | W | |
| Golden Alexander | *Zizia aurea* | Forb | Yellow | May-July | 1'-3' | F,P | M | Loam |

F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

W - Wet
M - Medium/moist
D - Dry