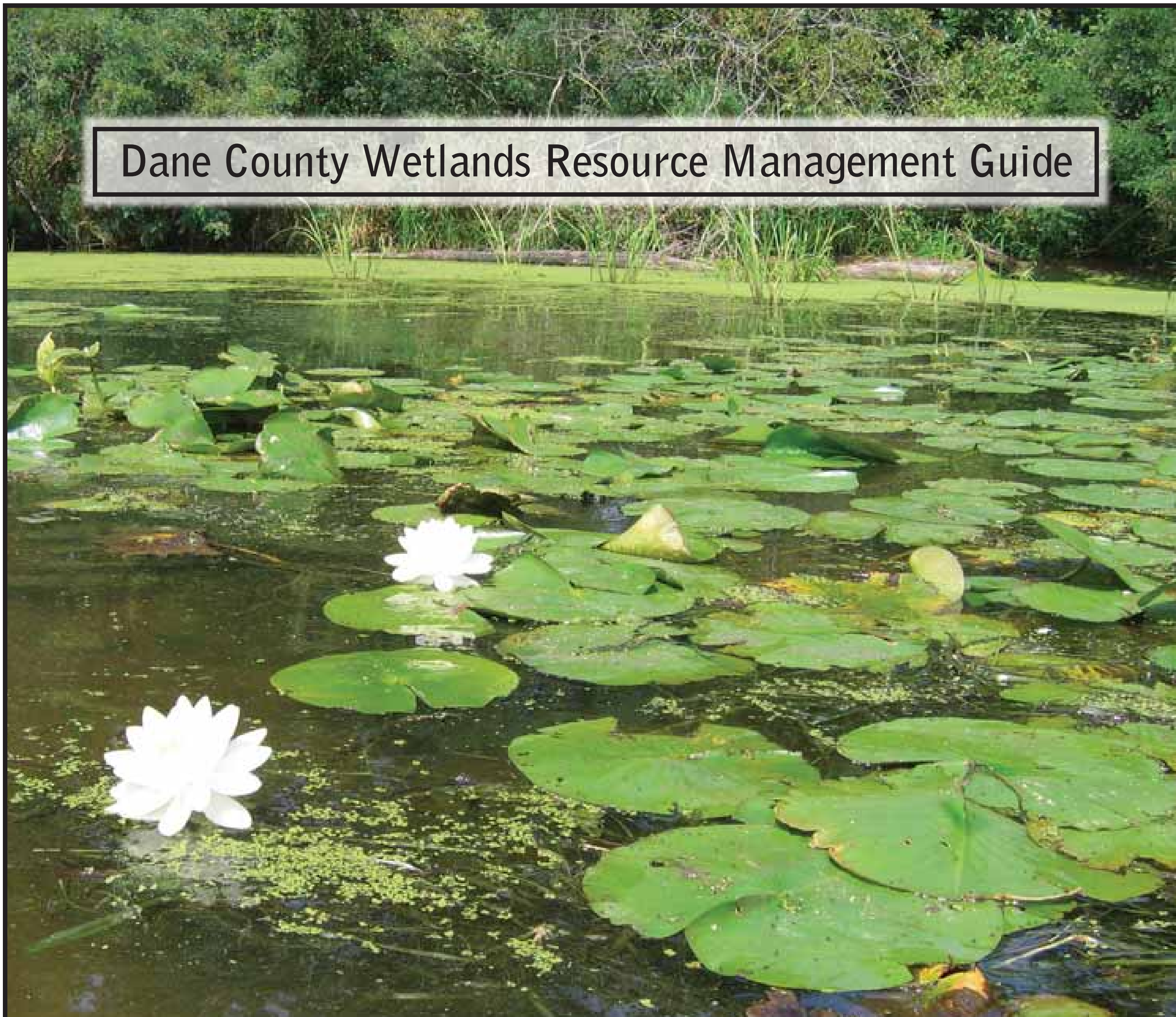
Dane County Wetlands Resource Management Guide



May 2008

Dane County
Wetlands Resource Management Guide

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I. EXECUTIVE SUMMARY

Wetland Losses

Over half of the wetlands in Dane County have been lost over the last century. Many of those that remain have been degraded. This has resulted in the loss of important wetland functions and benefits. Wetlands reduce the rate and volume of stormwater runoff and reduce flooding; they treat and remove pollutants; and provide important wildlife habitat and natural corridors for wildlife movement, scenic beauty, among other functions. There are also significant economic as well as ecological costs associated with the loss of these wetland functions.

Wetland Impacts

The primary disturbance to wetlands has been through artificial ditching, draining, and filling. In rural areas, ditching and buried drain tiles remove water close to the ground surface so the land can be cultivated. This alters the hydrology of the wetland, causing significant long-term negative impacts. Filling for urban development has also reduced the overall extent of wetland acreage and fragmented many large wetland areas. Stormwater runoff from streets and driveways, parking lots and yards can degrade a wetland by discharging excess water, fertilizers, chemicals, and other hazardous substances. Agricultural runoff from barnyards, feedlots, and croplands also contribute damaging substances into wetlands. Degraded wetlands become susceptible to aggressive invasive plant species that can become established and force out beneficial native wetland plants and animals. Their presence indicates that some disturbance has allowed the plants to gain entry and to dominate.

Reversing the loss

Wetland resource management has become a top conservation priority in Dane County, as well as throughout Wisconsin and the United States. Various federal, state and local programs have been developed in cooperation with landowners to protect existing wetlands from harm, to enhance the functions and values of degraded wetlands, and to restore prior-converted wetlands back to their natural state. These programs are becoming increasingly popular with landowners because they offer incentives, including payments, to restore or protect wetlands.

Previously ditched and tiled wetlands offer important restoration opportunities since it is relatively easy to restore their natural hydrology. This can often be accomplished by plugging or filling ditches and breaking tile lines. Natural vegetated buffer strips are also important for protecting wetlands from sediment and other pollutants running off adjacent lands. Wetlands can also be enhanced through management activities such as selective burning and re-introduction of native vegetation. Through restoration, protection, and enhancement activities, Dane County wetlands could provide many of the original benefits that have been lost or diminished over the last century.

Landowner participation and community support will be essential for accomplishing this. Most land in the county is in private ownership. Significant increases in wetland quality and quantity could be achieved if private landowners restore or improve wetlands on their properties. This can be aided through partnerships with developers, watershed associations and conservation groups; along with financial and technical assistance provided by federal, state, and local resource management agencies.

The *Dane County Wetlands Resource Management Guide* is intended to support and encourage landowner and community-based wetland improvement projects. The information, strategies, and activities presented in this guide provide the overall framework and various options for land acquisition, conservation easements, cooperative agreements, and management projects by individuals and groups in the community. Everyone brings their own set of skills, resources, and support base. The guide is meant to reflect how you or your organization can participate and cooperate in the efforts needed to reverse the loss of wetlands in Dane County, promote water quality improvements in its surface waters, and reduce damages and costs associated with flooding, erosion, and loss of habitat and wildlife.

Wetland Management Strategy and Tool Development

It is important to understand that each wetland is unique and, depending on the physical setting and characteristics, some wetland functions may be more important than others. How high a wetland is rated for certain functions and the number of functional categories in which it rates can help determine the best wetland management strategy to be taken as well as the appropriate tools to be used.

A wetland resource management process is presented in this guide which involves:

- Assessing the existing and potential wetland functions
- Evaluating surrounding land use and policy implications
- Developing a management strategy
- Choosing the appropriate management tool(s)
- Selecting among various actions and targeting them to a specific site

Wetland Resource Management Projects

Improving a wetland can be seen as lying along a continuum or spectrum, from the simplest and least costly projects on the one end to the most complicated and expensive on the other. It is generally easier to conserve or improve a wetland than it is to restore one. The project selected will largely depend on the resources available. Simple conservation projects can significantly improve a wetland's health. It may be simply a matter of removing the factors causing the impact in the first place. Examples include fencing out livestock, preserving a buffer area, controlling sources of pollution and excess runoff, controlling invasive plants, planting native species, etc. On some sites improvement is a long term process; for instance, invasive plants often require repeated efforts at control.

Restoration projects, on the other hand, usually require considerable planning, financing, and may also need federal, state, and local permits. Outside sources of funding may be available to help finance a project. There are also various government agencies and private organizations available to provide technical advice and support.

Tackling a Project

Good planning is a critical, but often overlooked stage of the restoration process. Inadequate planning is often cited as a major reason projects fail. Each plan should have a goal or "vision map" of what the site could look like, supporting objectives to reach that goal, and target criteria to measure progress and success.

General steps in the planning process include:

- Choosing a site
- Collecting past and present information on the local landscape
- Collecting past and present information on the project site
- Collecting data on reference sites
- Formulating goals, objectives and target criteria based on watershed, project site, and reference site information
- Deciding on methods for implementing changes designed to repair the damage and meet planning goals and objectives
- Selecting among available restoration tools
- Implementation
- Publicizing the project
- Monitoring
- Adaptive management (changing the approach based on what is learned from monitoring)
- Long-term management
- Long-term protection options for landowners

There are a variety of public and private agencies and organizations dedicated to wetland resource management. They can provide the necessary technical, financial, and volunteer assistance to help complete a successful project.

Wetland Resource Management Opportunities

Wetland resource management opportunities exist throughout Dane County. It is largely an issue of priority and finding the necessary resources to tackle a project.

As part of the natural resource inventory for the *Dane County Water Quality Plan*, a study of wetlands in Dane County was conducted by Bedford and Zimmerman in 1974. The purpose of the study was to provide the basis for planning, and decision-making, and to explore strategies for managing wetland resources in the county.

The study was conducted on the belief that the information necessary to determine the type of wetland, its condition, and its value can be read from indicators seen in the field. The wetlands covered in the study included all of those known or suspected at the time to be of particular value. The most valuable of these were studied in detail. This is a particularly useful reference for individuals in the early stages of designing their own wetland project.

Although the Bedford and Zimmerman study is dated, it is the only systematic qualitative evaluation of the wetlands of Dane County available. The information in that study was used to group wetlands into five categories. Wetlands are grouped based on their present or potential biological condition, scientific value, public use, extent of degradation, and immediate or long-range threats. While all wetlands have value, decisions must sometimes be made as to where specific approaches and efforts are best targeted.

The wetland groups are particularly helpful in decision-making and promoting better project planning and design.

Group I Wetlands
Wetlands in this group are the best in the county and, in some cases, among the most valuable in southern Wisconsin. A few function substantially as they did at the time of early settlement, so far as can be told. Although showing signs of disturbance, they remain virtually intact. Because of the scarcity of wetlands which approximate original ecosystems in their functioning, these wetlands have been included in Group I. Every effort should be made to protect them.

Group II Wetlands
This group contains the rest of the large peat deposits (those not in Group I) which are particularly valuable for protecting the Yahara River and chain of lakes. Most of the wetlands in this group fall into the so-called "undrainable" category and, therefore, are large or deep enough to have resilience. Alterations which have been made have not had a profound effect. These wetlands should get the same protection as those in Group I. It is important to point out that the wetlands in this group can benefit from carefully planned enhancement to their original function and value.

Group III Wetlands
While the wetlands in this group do not currently have outstanding values, they serve as support systems for those which do. Furthermore, they enhance the environment as a whole. Although substantially altered, these wetlands support wildlife and provide open space. While all reasonable efforts should be made to ensure their protection, enhancement may be an especially important consideration; improving one or more degraded functions such as flood protection, water quality, or wildlife habitat. When planning enhancement projects, one must be sure to consider possible effects on other functions beyond the targeted function.

Group IV Wetlands
Although severely degraded, they still function as a wetland in some way or for temporary periods of time. Some of them have value for watershed protection, wildlife use, or open space. Their best use appears to be enhancement or restoration for one or more of these purposes, rather than continued attempts at drainage. Further degradation of these wetlands should be discouraged.

Relatively few wetlands are listed as being in Group IV as compared to the actual number that exist in Dane County. Many wetlands which would have been placed in Group IV could not be visited during the 1974 study because of project limitations. Wetlands that could not be visited are included in the areas labeled as being "Not Inventoried." More investigation is needed to evaluate and group these wetlands. Ephemeral or temporary ponds have also not been listed, even though they may provide critical life cycle habitat for some species, especially amphibians.

Group V Potentially Restorable Wetlands
These areas no longer exist or function as wetlands. Drainage, filling, dredging, or a combination thereof, have converted these areas to non-wetland. In many cases, however, these alterations can be reversed through restoration efforts. In watersheds that have been adversely affected by drainage, flooding, and deteriorated water quality, restoration projects should be considered. Potential restoration sites should also be considered for improving or expanding existing wetlands.

The *Wetlands Resources Management Guide* can help in determining where the best opportunities exist.

Conclusion

It has become increasingly recognized that all wetlands have value – particularly since there are fewer of them remaining. Significant advances have also been made in the art and science of wetland restoration, as well as public opinion and policies for protecting wetland resources. Efforts focused on Group I wetlands should be directed at protecting the existing wetland resources – keeping them from becoming degraded. This would rely heavily on regulation and resource conservation activities. On the other end of the spectrum, efforts focused on Group V wetlands should be directed at restoring former wetlands. This would rely more heavily on acquisition and resource restoration activities.

Intermediate Group II, III, and IV wetlands will likely be the focus of combinations of strategies for preventing wetlands from becoming more degraded on the one hand, and improving them to generally higher quality on the other. Management activities should be generally focused on keeping wetlands from falling into a more impacted group, while restoring and improving wetlands that have been previously degraded. Usually, this can be accomplished by examining the communities of plants that live in these areas as indicators of their overall quality and health. In addition, landowner and community education is needed on all aspects of wetland resources management.

The 1974 Bedford and Zimmerman study was quite visionary in its effort to assess wetlands throughout Dane County, as well as suggesting management priorities and strategies. This was done at a time when the general public did not fully understand, appreciate, or particularly value the idea of protecting or restoring these wetlands. Today, this work can be renewed and advanced by individuals and groups picking up where these early pioneers left off, following the process outlined in this guide, thereby reversing the loss of wetlands that have occurred over the last century. Only recently has this loss begun to slow. More effort will be needed to reverse the course. Landowner participation and community support will be essential for accomplishing this.

Summary

Wetlands are among the most complex and least understood of natural community types. Most wetlands also serve multiple functions. One of the greatest threats to wetlands has been the incremental and piecemeal destruction often described as “death by a thousand cuts.” Efforts are needed at the local level to protect, restore, and enhance the wetlands that remain, preserving the many benefits which they provide.

The selection and cost of specific management tools and targeted activities depend on a number of factors. These factors should be based on an assessment of site characteristics, an evaluation of the land use, policy and financial constraints, and focused on a desired management strategy. Each management opportunity (e.g., willingness of the landowner, availability of funding, etc.) should be considered on a site-specific basis, using the process outlined in this guide as an overall framework in cooperation with federal, state and local resource management agencies, resource conservation organizations, and private property owners.

In the end, the management strategy for each wetland will be as unique as the wetland itself. The most appropriate management efforts will be determined by considering all the natural resource elements, as well as the partnerships and cooperation that may be developed among the various interests. The *Dane County Wetlands Resource Management Guide* has been developed to provide an overall framework for forming the needed partnerships to take the needed actions for protecting, restoring and enhancing the wetlands of Dane County, and promoting water quality improvements in its ground and surface waters.

II. BACKGROUND

A. Wetland Losses

Wetlands are ecosystems typically found where land and water meet on the landscape. They are transitional areas between dry upland and wet aquatic environments. Wetlands may form along the edge of lakes, rivers and streams, in low isolated spots on the landscape, or where groundwater bubbles to the surface through springs and seeps.[1]

Over the past 200 years, more than half of the wetlands in the lower U.S. have been lost and many of the remaining wetlands have been degraded.[2] Most of the drainage activity took place because it was widely believed that wetlands served no useful purpose and that the land would be more productive if put to agricultural or urban use. It has since been recognized, however, that wetlands, like all other parts of the natural environment, are an integral part of a complex ecological system. The concept of an ecological system is about linkages: everything in the ecosystem is connected directly or indirectly to everything else. It is impossible to alter one element without affecting the ecosystem itself or its other component parts.[3]

There has been a great deal of research over the years on wetlands and how they affect both flooding and water quality, in addition to other important aspects such as waterfowl and wildlife habitat. Research shows watersheds with fewer wetlands have flashier stream flows and water quality tends to be poorer. Wetlands are important for storing large amounts of water as well as stabilizing sediment, nutrients and other pollutants, keeping them from impacting areas located farther downstream.[4] It is almost always more effective and economical to control pollution at the source, rather than trying to address the problem after it has affected area lakes or streams. Wetlands provide a critical buffer in this chain of events between cause and effect.

Wetland areas that have been lost in Dane County are presented on Map 1, showing the distribution of present and former wetlands. Over 50% of the county's wetlands have been drained and are no longer a component part of the natural ecosystem. Approximately 36,000 acres were reported lost between 1901 and 1936.[5] Between 1939 and 1961 the Wisconsin Conservation Department listed 22,678 wetland acres lost.[6] Recent estimates using GIS indicate a total loss of 66,728 acres, or 56% of the original wetland acreage.[†]

According to the U.S. Fish and Wildlife Service, historic losses in wetlands have resulted in increased flooding and habitat loss. These losses and alterations compromise the important benefits provided by wetlands including water quality protection, providing habitat for a wide variety of plants and animals, and reducing flood damage, among others.[2] While *protecting* the remaining wetland resources is critical to the overall environmental health and well-being of

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† Map 1 shows WDNR wetlands in the county mapped over hydric soils. Hydric soils possess unique characteristics attributed to being formed under saturated soil conditions. These soils were formed over thousands of years and maintain their hydric characteristics, such as mottled or gray coloring, even after they have been altered by ditching, draining or cropping. Hydric soils that are not mapped as DNR wetlands are assumed to have been altered in some manner and are no longer functioning as wetlands. While being a good approximation, this *underestimates* wetland acreages and losses since it does not account for wetland inclusions which may be present in some non-hydric soil groups. Wetland inclusions are patches of hydric soil too small to be mapped.

Dane County and the nation, *restoring* and *enhancing* wetlands are also essential to ensure the quality of the aquatic ecosystems we have enjoyed historically.

Therefore, while we are fortunate that we still have about half of our historical wetland acreage, we should also be concerned about the condition of the remaining wetlands. Invasive species such as reed canary grass and purple loosestrife are extremely widespread and often dominant. The expansion of exotic species has caused the decline of many native species and their associated habitats. How can we halt and reverse such losses? Three positive actions can be taken:[1]

- Protect the remaining wetlands and manage them to sustain their natural diversity.
- Enhance or improve conditions at wetlands that are losing diversity.
- Restore former wetlands to expand acreage and regain the benefits for habitat, flood control, and water quality.

While Map 1 illustrates the significant extent of wetland conversion that has occurred throughout Dane County, it can also be used to help target these areas for restoration, protection and enhancement activities by government agencies working with private landowners and citizen groups. Prior-converted and farmed wetlands often provide the best opportunities to restore or enhance wetlands that have been lost or degraded over the last century.

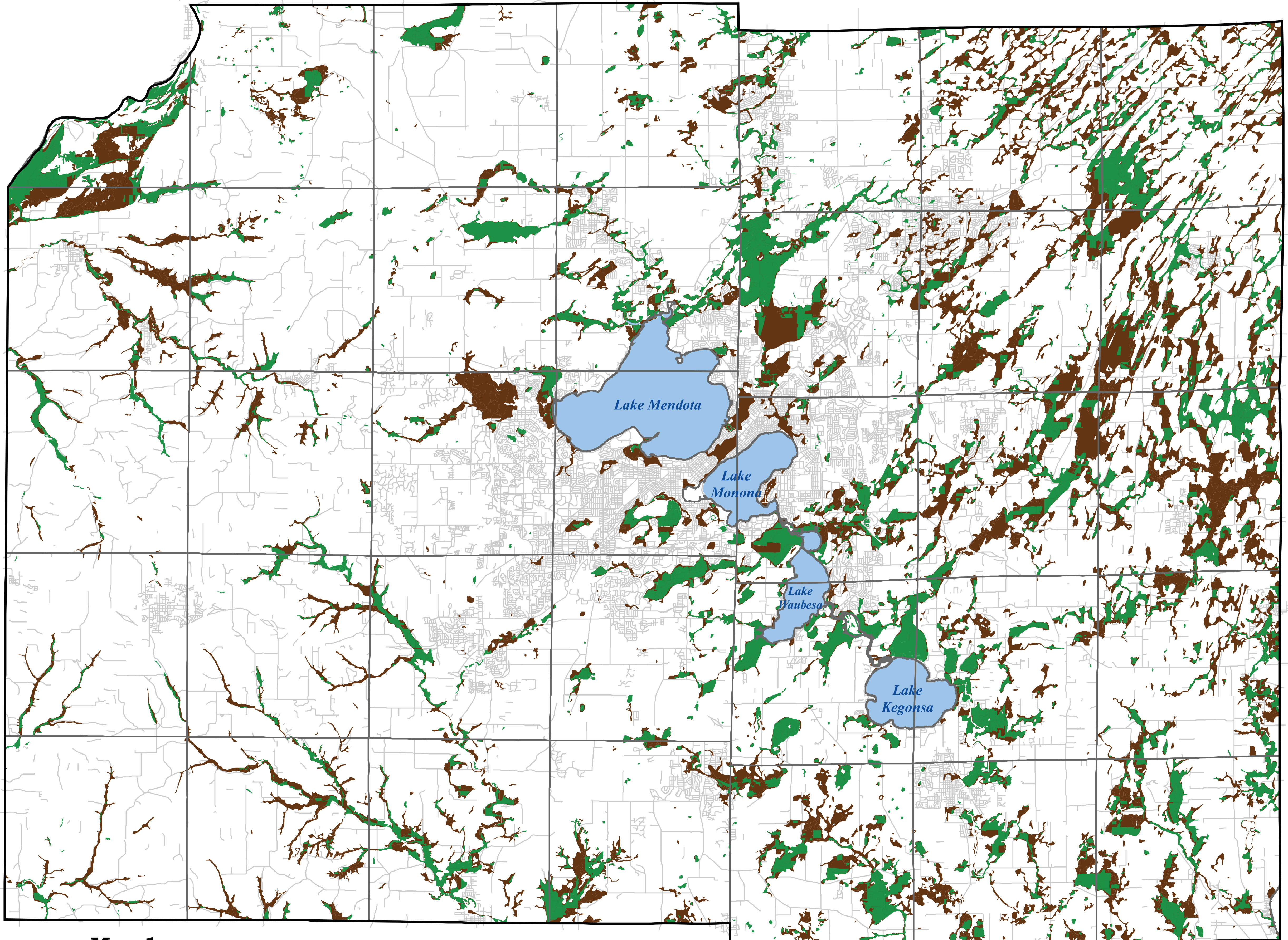
B. Geology and the Formation of Wetlands in Dane County [3]

The sizes, shapes and distribution of wetlands are affected by geologic history. Map 2 shows Dane County divided into five physiographic regions according to topography and glacial geology.

1. Wisconsin River Valley

The Wisconsin River Valley is an important and extensive wildlife corridor, only a small portion of which is located in Dane County. This region is dominated by floodplain topography, with the county's only sizeable floodplain forest on alluvial deposits. The flat topography and slow drainage causes wetlands such as sedge meadows to occur a short distance from the river's edge. River floodplain forest, sedge meadow, and shrub carr are the most prominent wetland types. Though much of the floodplain has been grazed or cultivated, it is important to maintain the integrity of the river and the bordering wetlands that remain.

Floodplain forest along the Wisconsin River



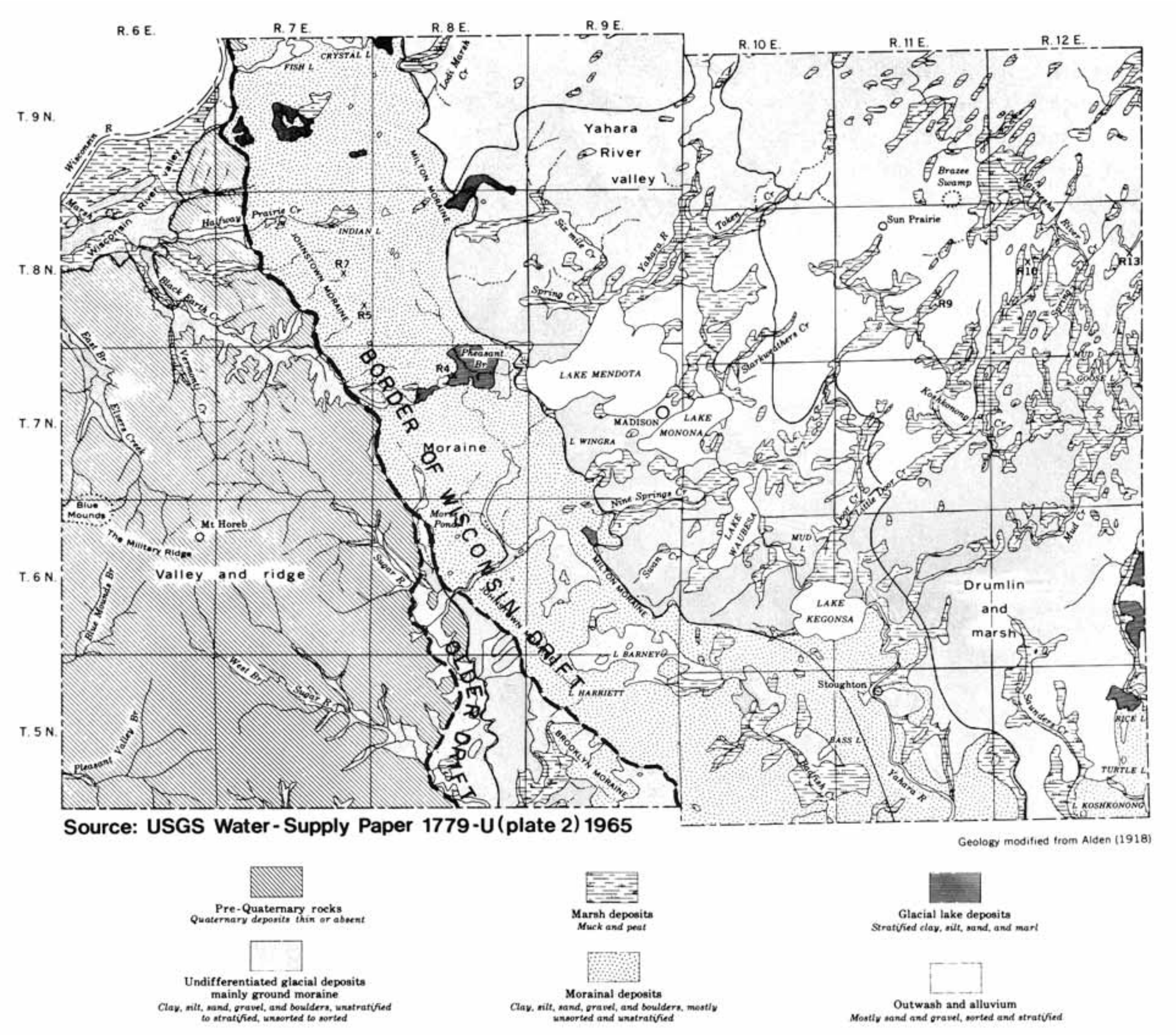
Map 1
Existing & Former Wetlands
Dane County, WI.

Existing Wetlands * Former Wetlands **

Jan. 2008

* Derived from 1986 Wisconsin DNR Mapped Wetland Inventory. ** Potentially restorable wetlands derived from hydric soils contained in the NRCS Dane County Soil Survey, revised 1998, and excluding DNR mapped wetlands.

Map 2. Physiographic areas and deposits of Quaternary age



2. Valley and Ridge

This is the stream valley topography typical of erosion of bedrock, and is the part of the "Driftless" or non-glaciated area of the state that extends into Dane County. This region exhibits older, dendritic drainage patterns, and its topography is such that wetlands are not abundant. Those wetlands that do occur are located along narrow stream valleys. Since they are often abundantly spring-fed and well-oxygenated, the streams of the Driftless Area offer the county's best trout fishing opportunities.

Black Earth Creek Wetlands

The stream valley wetlands in Dane County are of the same form as elsewhere along the southern part of the Wisconsin River watershed. However, alluvial deposits along these small narrow valleys are not extensive enough to allow development of floodplain forests. Small deposits are found along the stream banks with sedge meadows and shallow marshes a short distance from the stream. These wetland areas are necessarily narrow and restricted to the flatter locations in their watershed.

With the cessation of fire and a history of grazing and possible sedimentation, some of the sedge meadows have been altered to shrub dominated communities. In many cases, cottonwoods, box elder, and willows have become more abundant along the streambanks and spoil piles along stream ditches. In such narrow valleys where the competition for land is stiff, economic necessity has often forced the farmer into using marginal pasture for his cattle, to the advantage of neither the cattle nor the wetlands. Many of the valleys are still being grazed, thus reducing the value of the wetlands as ecological communities. The most obvious value of these wetlands is probably for flood control and water quality treatment.

Sugar River Wetlands

3. Moraine

Mud and Fish Lakes among other Kettle Ponds

A broad strip of terminal and recessional glacial moraine deposit characterizes this region. The thickness of the sand and gravelly material varies considerably so that much of the terrain is filled with small steep hills and kettle holes, or ice-formed depressions. Consequently, the wetlands of this region are characteristically of the depression type, rather than stream valley. Wetlands here tend to be small, isolated, and often steep-sided. They often occur in groups with gravelly deposits between them. Several deep marshes occur in small, isolated lakes. The steeper-sided kettle holes are frequently too steep to support wetland vegetation.

When these occur in proximity to other wetland areas, however, the combination provides valuable waterfowl habitat.

The major stream system of wetlands which did exist in this region, the Badfish Creek system, has been extensively altered by drainage efforts, channelization, and cultivation. Badfish Creek also receives effluent from the Madison Metropolitan Sewerage District's Nine Springs Treatment Plant. A few isolated pockets of spring-fed tributary streams and relatively undisturbed wetland still exist.

4. Yahara River Valley


Lower Mud Lake Among the Yahara Chain of Lakes

The Yahara River Valley and its major tributary valleys existed before the recent Wisconsin Glaciation and can be seen on a bedrock topographic map. Much of this valley system is now filled with glacial till, which preserved the drainage pattern but made it shallower and slowed the flow of water. Thus, the size, shape, and distribution of the wetlands in this area are controlled by both the bedrock and glacial deposit patterns. In addition, the riverbed is in contact with the groundwater through permeable glacial till. If during a flood the level of the river should rise above that of the surrounding water table, there will be a percolation of water away from the river bed to groundwater. Conversely, during a dry period the riverbed will receive groundwater. This, along with a fairly constant discharge from springs and seepages, helps stabilize the river. The combination of shallow gradient, stable water levels, and constantly moist conditions has led to the formation of the large peat deposits which are typical of the Yahara watershed. Wetlands here tend to be large, interconnected, and surrounded by low hills. Generally, groundwater is supplied by rainwater infiltrating in the hills and other "recharge" areas. Springs and seeps in "discharge" areas often promote the buildup of peat in these constantly waterlogged areas.

Since the discharge from the springs and seepages is made alkaline and calcium-rich by both the glacial till and the limestone bedrock, many of these peat meadows are characterized as calcareous "fens" or have portions of fen along the shallow edges. Fens are distinctive in this respect, along with the community of plants and animals they support. There do not appear to be another group of fens in North America as extensive as those in Dane County before drainage and filling began, although calcareous fens do occur throughout other limestone regions of the Midwest.

Some wetlands provide critical nursery habitat for fish. For example, northern pike deposit eggs on mats of aquatic vegetation that occurs along lake fringes and steam headwaters – Cherokee Marsh and Door Creek Wetlands are good examples of this. After hatching, the fry attach themselves to wetland vegetation that provides protection and food. Other species such as walleye, muskellunge, bass, perch, bluegill, and various minnow species also use quality wetlands as nursery habitats. When lake-edge wetlands are destroyed and shorelines become heavily developed, fish populations suffer. Therefore, wetland restoration is vital to the maintenance and improvement of fish habitat.[1]

The wetlands of the Yahara system, along with the waterfowl habitat and fishery values, depend on wise water management. Ditching in the tributary streams and river-edge wetlands has been partially successful in increasing the land area available for agriculture, but at a cost to the river. Increased surface runoff adds sediment, nutrients, and flood waters to the river. Ditching peat, as at Cherokee Marsh, also increases the nutrient load as the peat oxidizes and releases stored nutrients. Aquatic plant and animal communities are set out of balance, wildlife habitat is lost, and the natural qualities of the system deteriorate.

Table 1 shows the wetland area and losses between 1835 and 1974.[7] These wetland areas were undoubtedly very important for providing habitat for unique plant and animal communities, maintaining water quality, and preventing or reducing the risk of floods. For these reasons and more, restoration of as many wetlands as possible is needed here as well as in other areas of the county.

Table 1 – Wetland area and losses in the watersheds of the Yahara Lakes between 1835 and 1974, with percentage lost since 1835 shown in parentheses.*

	Wetland Area (acres)			
Year	**Mendota**	**Monona**	**Waubesa**	**Kegonsa**
1835	10,181	4,893	6,202	5,832
1938	7,882 (-23%)	1,829 (-63%)	4,794 (-23%)	4,250 (-27%)
1974	5,090 (-50%)	371 (-92%)	1,680 (-73%)	1,754 (70%)

* Sources of data:
1835 – Township survey maps (published by the U.S. Surveyor General's Office in 1851 and 1855)
1938 – Wisconsin Conservation Department (1961)
1974 – U.S. Geological Survey topographic maps (printed in 1976).

5. Drumlin and Marsh

This area is similar to the Yahara River Valley except that glacial deposit filled flatter watersheds in the smaller streams and created complex inter-related wetland networks. A field of northeast-southwest oriented drumlins separate wetlands into parallel lobes. The topography is low and rolling, and has lent itself to extensive drainage. Map 1 depicts the pre-settlement extent of these wetlands.

Once the area of the county richest in peatlands, the Drumlin and Marsh Region has suffered the greatest loss of wetlands. The numerous marshes lying between drumlins could be drained easily by interconnecting networks of ditches, and this was done in blocks of up to 5,000 acres at a time in the years between 1900 and 1926. Most of the networks drain west to Door Creek or east to Koshkonong Creek.

Downstream waters and wetlands have borne the cost in degraded water quality.

Old wetland areas, formed by sedge meadow, fen, or bog can still be identified and located by the presence of peat deposits. A few isolated remnants in fair condition still exist. Many other remnants are ditched, nearly drained, and full of nuisance plants such as nettle, giant ragweed, and reed canary grass.

Drainage attempts have drastically altered the character of the wetlands, but have often left the land still too wet to farm. Thus, the wetlands that remain suffer from lack of water and peat oxidation due to ditching, a history of cultivation in dry years, and invasion of exotic grasses and weeds. Some native wetland vegetation persists in wet “pockets,” but wildlife deficient acreages of reed canary grass, giant ragweed, and nettle are more typical. It should be noted, however, that some of Dane County’s best pheasant habitat is found where this vegetation occurs in combination with dense shrubs.

Other wetland functions that can remain after drainage attempts include spring waterfowl use and some degree of watershed protection from runoff. Some of the shallow areas, when flooded in the spring, come alive with snails and frogs which attract dozens of migrating shorebirds, herons, and waterfowl. These same areas provide flood storage and serve as sediment traps for farm runoff, although ditches counteract these functions and contribute directly to watershed problems. Because of their value for pheasant habitat, these areas have received much attention from the wildlife management section of the DNR.

C. Wetland Characteristics Defined

Wetlands are unique ecosystems that often occur at the transition between aquatic and terrestrial environments. They may be wet year-round or wet only during certain seasons. Some wetland types may not always appear to be wetlands.[2]

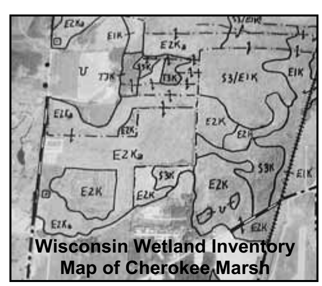
U.S. Army Corps of Engineers regulations for implementing the Clean Water Act define wetlands as follows:

> *Those areas that are inundated or saturated by surface or groundwater at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.*

The State of Wisconsin defines a wetland in the following manner:

> *An area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.*

Wetlands that are 2 acres and larger are outlined and classified on DNR Wisconsin Wetland Inventory Maps. Smaller wetlands are identified by point symbols (↓). The Inventory classifies wetlands according to vegetation, type, hydrology, human influence, and other characteristics.



Wisconsin Wetland Inventory Map of Cherokee Marsh

Although a cattail marsh is among the most recognizable wetlands, many different kinds of wetlands exist in Dane County such as wet prairies, sedge meadows, sphagnum bogs, tamarack swamps, floodplain forests, and alder thickets. Despite the wide variety of wetlands types, three features are common to all:[1]

- **Wetland hydrology** – the presence of water at or just below the surface of the land for at least a portion of the year;
- **Wetland soils** – specific types of soils that developed under saturated (wet) conditions;
- **Wetland vegetation** – distinctive plants adapted to wet conditions.

1. Wetland Hydrology [2]

The hydrology of a particular site is determined by the amount, flow, frequency, duration, and depth of water. It is typically the primary factor driving the other elements of a wetland ecosystem. Wetland hydrology generally exists when an area is wet enough to result in soils that are anaerobic (depleted of oxygen) and support hydrophytic vegetation (plants that are specifically adapted to anaerobic or waterlogged conditions).


Lodi Marsh

Wetland hydrology may exist at sites that are obviously flooded or at sites that are never flooded but have soils that are saturated near the surface. *A site's hydrologic characteristics are the most important factors in determining what kind of wetland will exist and what functions it will perform*. Wetland hydrology can generally be determined by visual observation or other evidence of standing water or saturated soil conditions. In more subtle or difficult situations, measuring ground and surface water elevations may be needed over the course of the year.

Unfortunately, many if not most of Wisconsin's wetlands have been harmed by some form of human activity over the past 100 to 150 years. In general, if the amount and flow of water – at the surface or underground – and the duration of soil saturation in a wetland are changed, the wetland plant and animal communities will likely change as well. Once wetland hydrology is altered, the factors that influence a wetland's plant and animal makeup will also be changed. Knowing how, and to what extent, a wetland is degraded is critical for determining how best to restore it to its original condition.[1]

If wetland hydrology can be established at a site, there is a good chance that other wetland characteristics will develop over time. When a project does not develop as planned, or does not develop into a wetland at all, it is most often because the hydrologic characteristics of the site have not been reproduced. Two critical aspects with regard to restoration projects are: 1) the soil elevation in relationship to water levels, and 2) the networks of channels to move water in and out. Incorrect elevations and topographies are some of the most common reasons wetland restoration projects fail to achieve their goals. Therefore, the first step in trouble-shooting wetland projects is to check the hydrologic characteristics of the site.

Water *quality* is equally important to the health of a wetland. Water *quality* usually refers to how "healthy" the water is for plants, animals, and humans. It can contain a number of dissolved and suspended materials including nutrients (e.g., nitrogen, phosphorus), contaminants (e.g., pesticides, oils) and other constituents (e.g., dissolved oxygen, salts, metals, suspended sediments, trash, etc.). Some chemicals (e.g., nutrients) can be either beneficial or toxic depending on the quantity present. An aquatic area with "good" water quality has the water chemistry that result in healthy populations of native plants and animals. Reference wetlands in relatively undisturbed and pristine condition are used to establish water quality standards for each wetland type. For example, development can upset the natural balance between the ground and surface water inputs to a wetland, along with their different water quality and chemistry, resulting in a shift in plant species and community structure. Fens are wetlands that are particularly vulnerable to stormwater runoff.

2. Wetland Soils

Wetland or "hydric" soils are saturated or waterlogged for all or part of the year. In hydric soils, water fills the air spaces between soil particles and forces the oxygen out causing soils to become anaerobic in the zones closest to the surface. Waterlogged, anaerobic conditions are very hostile to terrestrial plants and these conditions will quickly kill most upland species. As a result, wetlands are dominated by plants that are specifically adapted to these waterlogged soil conditions.[2]

When soils lose their oxygen, they change significantly in structure and chemistry which, in turn, influences the plant and animal species able to survive there. They also display unique "signature" characteristics which can be identified in the field. Wetland soils may be either organic or mineral. Organic soils are made up primarily of plant material, either decomposed ("muck") or partially decomposed ("peat"). Mineral soils are composed primarily of non-plant materials including sand, silt, and clay. Hydric soils can be identified by their color and structure.

Often organic, anaerobic soils are dark gray to nearly black. In more mineral soils, the chemistry and lack of oxygen affects minerals such as iron and manganese causing distinctive gray color variations. This is opposed to the brighter yellows and oranges typically associated with upland soils. This has much to do with the oxidized form of iron in the soil or ferric oxides, commonly known as rust. So, upland sub-soils (those located below the organic "A horizon") are generally rust-colored, whereas

hydric sub-soils are typically dull gray or black. Color comparisons using Munsell color charts are typically used to help determine whether a soil is hydric. Soil maps produced by the USDA Natural Resources Conservation Service are a good place to begin for local soil information.

3. Wetland Vegetation [2]


Water Celery or eelgrass

Wetland or "hydrophytic" plants are uniquely adapted to seasonal or year-round saturated soils, with specialized root and stem structures designed to capture and transport oxygen, which is limited in a wet environment. How much water is present for how long, and the specific soil conditions, determine which plants are suited. Saturated conditions also slow the decomposition of organic material such as dead leaves and plants, thereby tying up nutrients and creating organic soils such as muck and peat.[1]

Nutrient, turbidity, and chemical levels such as pH are key parameters determining the composition of a wetland plant community. Another critical element is the relationship of water levels to the ground elevation. If water is too deep, submergent and emergent vegetation will establish. If the ground elevation is too high, then an upland habitat will form. The types of wetland plants found in a particular area can provide a good indication of the characteristics and quality of the site.

Wetland plants which grow exclusively in wetlands are called "obligate" wetland species; others are "faculative" species as they may be found in both wetlands and drier areas. There are many types and various categories of wetland plants. Plants that grow in the water are called "submergents." Submergent plants are so well adapted to water that they live completely beneath the surface. Some plants like pondweed and eelgrass have roots that anchor them to the bottom. Others like the coontail are submerged but not rooted. Some aquatic plants have adapted to the water so that their leaves float on top of the water. Floating plants, like water lilies and duckweed, tend to occur in ponds and in places along streams and rivers where there is little or no current.


Water Lilly amid Duckweed


American Lotus

Common "emergent" plants are the broadleaf arrowhead, named for the arrowhead shape of its leaf, sedges, common cattail, and american lotus. Wetland plants also include shrubs (red osier dogwood, willow) and trees (silver maple, river birch).

Some wetlands may be degraded because they are dominated by invasive non-native species, that is, plants from other regions or countries. These invasive species can completely replace the natural wetland plant community, either because of their aggressiveness or lack of natural enemies. This alters the ecological functioning of the site.

Purple loosestrife, reed canary grass, and common reed grass are examples of non-native invasive wetland plants. The spread of non-native species is a huge ecological problem in the U.S. For many restoration and enhancement projects, significant effort is devoted to removing the invaders so that the native species can be re-established.


Purple Loosestrife

Since each species has certain environmental requirements and tolerances, it is possible to use species as indicators of a wetland's condition. Some indicator species are various shrubs and trees (especially when occurring in dense stands), uncommon or rare plant species, and exotic plant and animal species. For example, shrubs or trees in sedge meadows are disturbance indicators. One can go out on a soil deposit, such as a power line or sewer berm, age the cottonwoods and willows, and estimate closely the date of disturbance. Some wetland species may be rare now because the conditions they need, such as undisturbed fen or bog, are also rare. This may not have been the case a century ago.[3]


Mating Pair of Sandhill Cranes

Animal communities also vary with wetland type but, in general, healthy wetlands are rich in wildlife and biologically very productive. Because wetlands exist where land and water meet, they are often used by animals from both wet and dry environments. Many species depend on wetlands for all or part of their lives. Wetlands are also very important in maintaining biodiversity – they are used by over 43 percent of the species listed as endangered or threatened under the Endangered Species Act.[2]

Some of the smallest wetland animals are invertebrates (animals without backbones) such as beetles, water fleas, crayfish, dragonflies, snails, and clams. Invertebrates are an important food source for other animals, both as adults and in their egg and larval forms. They are especially important for supporting much of the wetland food chain. Amphibians, and to a lesser extent reptiles, are very strongly tied to wetlands because many salamanders, frogs, and turtles need both water and drier environments to complete their life cycles. Therefore, undisturbed upland buffers and corridors connecting to adjacent habitats are critical to these species.


Dragonfly

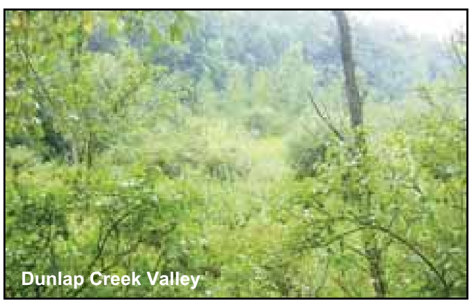
Fish are not found in all wetlands, but wherever there is permanent water fish are likely to occur. Fish may move in and out of wetlands as water depths fluctuate. Even wetlands with only seasonal flooding may be temporary habitat for fish from adjacent permanent water bodies. Many fish spawn in wetlands, and wetlands are particularly valuable as nursery areas where young fish can hide from hungry predators until they are big enough or fast enough to survive in open water. Some fish can provide insect control. Other bottom-feeding fish such as carp, however, can destroy submerged plant communities and reduce light levels by stirring up sediment.

Birds are some of the best-known inhabitants of wetlands. Birds occupy a variety of habitats in and around wetlands and are important indicators of wetland functioning. A common wetland dweller, ducks are particularly valuable to people who enjoy hunting or birding. Wetlands are also important to shorebirds (plovers, sandpipers) that feed on mudflats, wading birds (herons, egrets, bitterns) that feed in shallow water, songbirds (red-winged blackbirds, swamp sparrows, marsh wrens) that perch on or nest in tall grasses or shrubs, and other birds such as terns and marsh hawks are all common inhabitants of wetlands.

MMSD Lagoon Restoration Project

Finally, mammals such as beavers, raccoons, foxes, minks, shrews, and mice are common residents of wetlands as well, although their tracks are usually seen more often than the animals themselves. Mammals generally need adjacent uplands or upland islands for escape during high water periods. Therefore, undisturbed upland buffers and corridors connecting to adjacent habitats are critical to these species.

D. Wetland Communities and Diversity [3]



Dunlap Creek Valley

The concept of natural community is an important one, generally used for plant groupings. In general, plant communities do not exhibit definite or abrupt boundaries. Plant and animal species tend to overlap and respond to the environment in their own way. Although plant communities do not possess distinct boundaries (animals even less so), they can be broken into groupings for purposes of study and discussion.

One of the factors that makes for a rich *species diversity* in a natural ecosystem (and at the same time makes the ecosystem hard to understand, protect, and restore) is that the various species each have their own functional position in the environment, or niche. A niche is the interaction and relationships a species has with the rest of the ecosystem: what it eats, how, and when; what temperature it prefers; whether it is active by day or night; what plants it uses for cover; nesting; and more. The theory is that species avoid direct competition by avoiding the use of the same resources in the same way at the same time and place. These niches might overlap partly, but not completely. From the standpoint of the ecosystem, the different species complement each other, and resources are utilized more efficiently than they could be by a single species.

Another type of diversity is *structural diversity*. Different emergent species grow at different depths, have different heights, shapes, and rigidity. Shrubs and trees add to this diversity, so if they are not found in large monotypic stands, they have value for promoting animal species diversity. The relationship here is through the niche; for example, swamp sparrows nest in shrubs, coots in emergent

Typical Wetland Profile

vegetation at water level, least bitterns above water level in rigid emergents, grebes on floating wet dead vegetation, and so on.

An important concept related to structural diversity is that of *edge*. Many animal species utilize edges, or boundaries between structurally different vegetation. In wetlands, these can be between two types of vegetation or between vegetation and water. A monotypic stand of cattails, for instance, will support fewer nesting birds than vegetation with irregular, long edges along the water, or other vegetation types. The name for this type of complexity is *interspersion*. Both the extent of vegetation-water interspersion and vegetation-vegetation interspersion have generally suffered due to alteration for human use. For example, agriculture aims at promoting one species on each field, suppressing the unwanted ones with cultivation, pesticides, and herbicides. Diversity is intentionally limited.

When ecosystems are tampered with, they are generally simplified. The development of ecological complexity takes time, and humans are usually in a hurry. Ecological complexity increases because each species is reacting differently to different conditions and influences. When a person alters a system, he or she has usually only one or two objectives in mind. Side effects are usually ignored because they cannot be understood or because addressing them may interfere with the main objective.

In many open wetlands in the southern areas of the state – shallow marshes, sedge meadows, wet meadows and wet prairies – where the water table has been lowered and where fire has been suppressed, native and non-native shrubs and trees have started to invade. Glossy and common buckthorn are typical aggressive non-native shrubs that establish themselves. Native shrubs and trees that invade disturbed wetlands include: red-osier dogwood, gray dogwood, willows, prickly ash, quaking aspen and box elder.[1]

1. Wetland Types [1]

While each wetland is unique, they may be classified by the communities of plants that live there. The wide diversity of wetland plant species includes submerged plants, floating-leaved plants, and emergent plants. Wetland plants also include shrubs (such as willow and bayberry), trees (such as red maple and swamp oak), moss, and many other vegetation types.[2] Generally, the term marsh or meadow applies to a wetland dominated by grass-like plants (such as sedges, reeds, grasses, and cattails) as well as wildflowers. Swamps are wetlands with considerable shrub or tree cover. Figure 1 shows a representative wetland cross-section transitioning along the hydrologic gradient including aquatic submergent and emergent vegetation, grasses, shrubs, and upland forest cover. The types of wetland plants found in a particular site can provide a good indication of the characteristics and quality of the site.

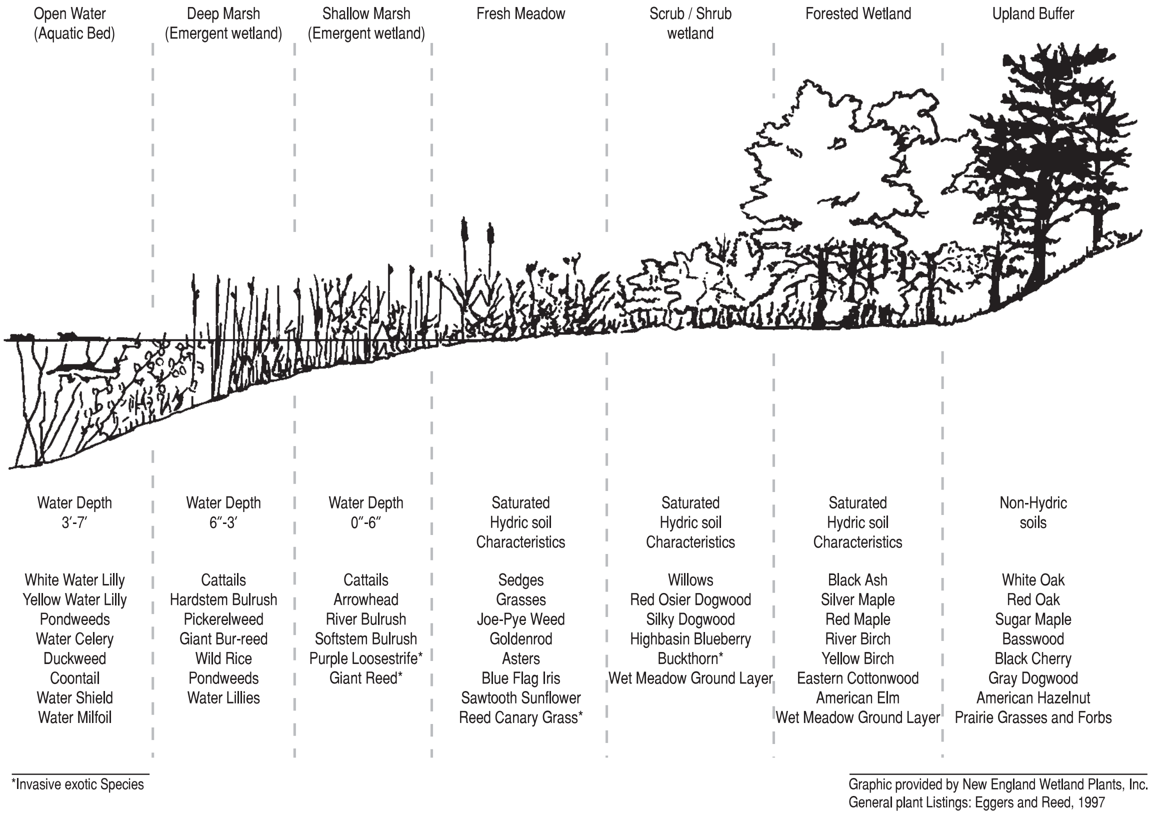


Figure 1. Typical Wetland Cross Section

Open Water Wetlands occur where there is less than 7 feet of standing water. They differ from marshes in that the water is seldom, if ever drawn down. The aquatic plants in these communities occur at or below the surface and are known as submergent vegetation. Submergent plants are rooted or attached to the bottom of the pond and may have leaves that float at the surface such as water lillies. Because these communities almost always have deep water, they will not support most emergent vegetation (plants that rise out of the water). Typical open water plants include pondweed, water lily, coontail, and duckweed.

Marshes, both deep and shallow, often occur adjacent or blend in to one another on a gradient. They may exist along pond edges, quiet lakeshores and bays or on gently sloping stream banks that are not prone to strong winds or fast-flowing water. Common marsh plants include cattail, bulrush, bur-reed, and pickerel weed. The water level of marshes, especially shallow marshes, may vary considerably from year to year. Shallow marshes may become dry during drought periods. Two categories of marshes can generally be distinguished as follows:

Deep Marshes, with more than 6 inches of standing water, may contain both submergent and emergent plants.

Shallow Marshes, with less than 6 inches of standing water, generally contain only emergent plants.

Inland Fresh Meadows are characterized by saturated soils with little to no standing water. They contain a mixture of grasses, sedges and wildflowers, known as forbs. In Wisconsin, four types of inland fresh meadows occur:

Sedge Meadows are dominated by sedges: grass-like plants generally in the plant genus *Carex*. "Sedges have edges" is a useful way to help identify these sharp-leaved, triangular-stemmed plants. Grasses and forbs may be present, but are not as abundant. Sedge Meadows often occur on peat or muck (organic) soils.

Wet Meadows are dominated by grasses and generally a large variety of forbs, such as goldenrod and aster. The invasive and very aggressive reed canary grass often thrives in wet meadows that have been disturbed by drainage or plowing.

Wet (or Low) Prairies are similar to Wet Meadows, although they are somewhat drier. Usually found in the southern part of the state, grasses such as prairie cord grass and particular species of wildflowers characterize this wetland community. Wet prairies are rare now because they were easily drained for agriculture. Only a few pockets remain, notably in Dunlap Hollow, Sugar River, Lodi Marsh (although disturbed), and the Arboretum.

Calcareous Fens generally occur in places where springs or seeps bring calcium-rich groundwater to the surface, turning both soil and water somewhat alkaline. Often white deposits appear on the surface where minerals have precipitated out of the water. Characteristic plants in this community can tolerate the harsh growing conditions. Among the rarest of the state's wetland communities, calcareous fens contain some of the most threatened and rare plant species, such as the white ladyslipper orchid.

Shrub Swamps are dominated by woody growth less than 20 feet tall. Two general types of shrub swamp are present in Wisconsin as follows:

Shrub Carrs grow on saturated soils throughout the state and are home to red osier dogwood and a number of willow species. The shurb-carr community may encroach on sedge meadows that become drier as a result of drainage or disturbance. The absence of fire also allows shrubs to invade sedge meadows.

Alder Thickets frequently grow along streambanks in northern and central Wisconsin. The tall, multi-stemmed speckled alder dominates this community, and its dense overhanging branches help keep streams cool.

Wooded Swamp refers to forested wetlands often associated with ancient lake basins and old river channels. Two types of wooded swamp occur in the state as follows:

Floodplain Forests are forested wetlands associated with seasonally flooded river floodplains and old river channels (oxbows). This community may experience extremes in depth and duration of flooding, occasionally having standing water in deeper zones well into the growing season. The floodplain forest typically becomes very dry late in the growing season and may resemble an upland community to the untrained eye. Characteristic tree species include silver maple, river birch, eastern cottonwood, black willow, American elm, and swamp oak.

Lowland Hardwood Swamps contain hardwood tree species such as black ash, red maple, and yellow birch. Water often inundates these swamps regularly, such as in spring, and they occur on saturated soils.

Open Bogs contain distinctive plants associated with saturated, nutrient-poor, acidic soils. Two kinds of bog occur in Wisconsin as follows:

Sphagnum Bogs occur in depressions where sphagnum moss forms a thick mat. Over time the sphagnum slowly builds thick organic peat soils. Since groundwater or streams that would normally flush a wetland rarely flow into or through bogs, the soil becomes very acidic. Plants that live in bogs must be adapted to the extremes in acidity. Remarkably, sphagnum moss not only survives in acid conditions but also contributes further to a bog's acidity. Typical bog plants include members of the blueberry family, such as the native cranberry, leatherleaf, bog rosemary, and Labrador tea. Other characteristic species include the insectivorous pitcher plants and sundews, various orchids, and sedges.

Coniferous Bogs are sphagnum bogs that contain tamarack or black spruce trees.

E. Wetland Functions, Values, and Benefits [1]

The loss and degradation of wetlands in the U.S. has resulted in a decline in the important benefits that wetlands provide to society:

1. Fish and Wildlife Habitat

Wetlands are perhaps the most important resource feature in terms of wildlife habitat, fisheries, and species diversity. It is here that the food webs of land and aquatic environments are interwoven and create highly productive ecosystems. By increasing the available habitat, species diversity is increased, which leads to healthier, more vibrant ecological communities.

Many animals spend their whole lives in wetlands; for others, wetlands are critical habitat for feeding, breeding, resting, nesting, escape, cover, or travel corridors. Wisconsin wetlands are also spawning grounds for northern pike, nurseries for fish and ducklings, critical habitat for shorebirds and songbirds and lifelong habitat for some frogs and turtles. Wetlands also provide essential habitat for smaller aquatic organisms in the food web, including crustaceans, mollusks, and insects.

Some of the most valuable wetlands for fish and wildlife provide diverse plant cover and open water within large, undeveloped tracts of land. This function may be considered particularly important if the habitat is regionally scarce, such as the last remaining wetland in an urban setting.

The more valuable wetlands usually support a greater variety of native plants (high diversity), than sites with little variety or large numbers of non-native species. Also, wetland communities that are regionally scarce are considered particularly valuable. Many of the rare and endangered plant species in Wisconsin are found in wetlands.

2. Flood Protection

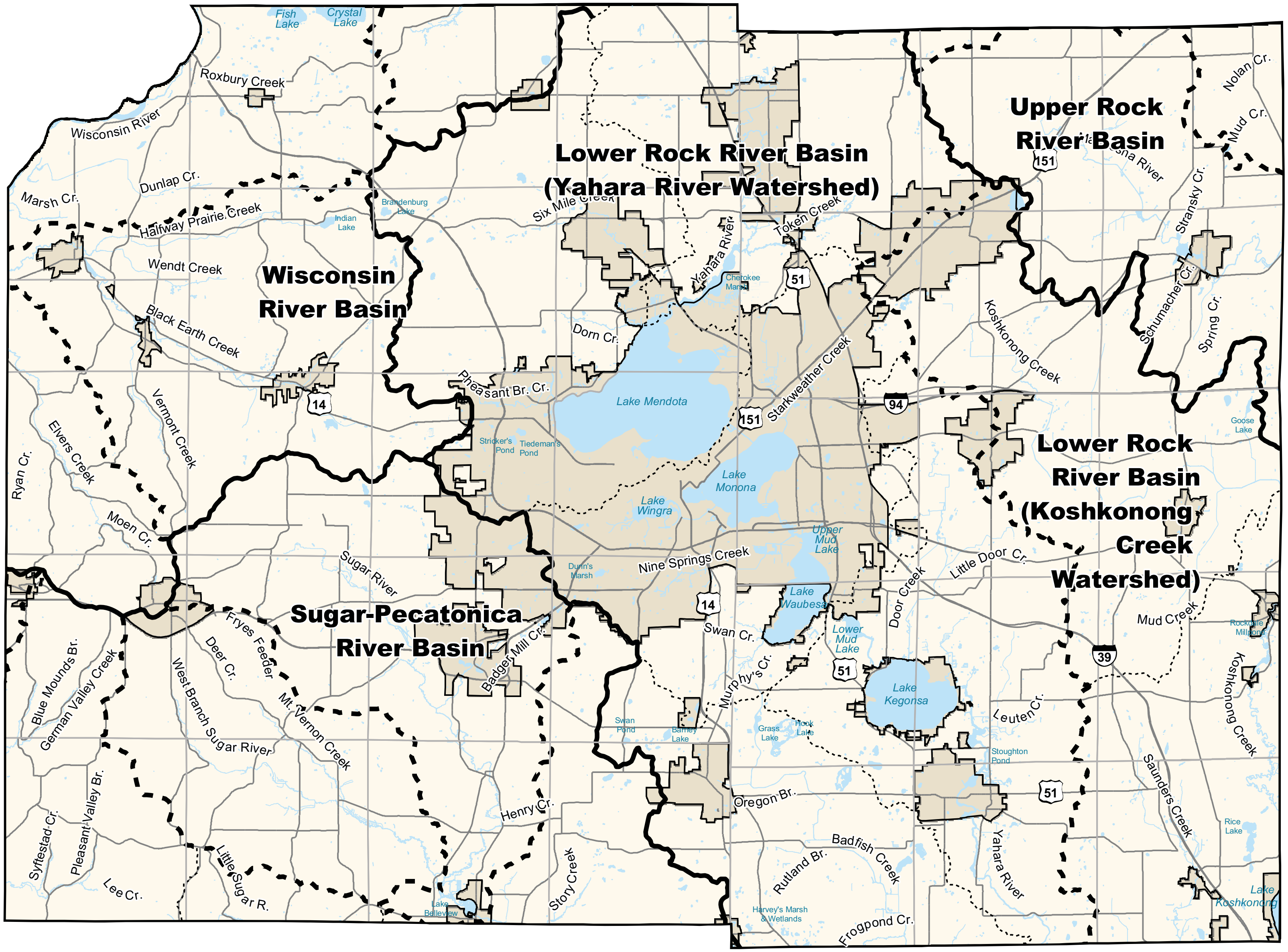
Water flows according to topography, from high elevations to low areas. A watershed encompasses those areas draining to the same surface water features such as a river, stream, or lake. Likewise, “river basin,” “watershed,” or “sub-watershed” are different ways of expressing the same physical feature at different scales. Map 3 illustrates the major surface water features in Dane County.

Wetlands play a particularly important role in stabilizing the local hydrology within a watershed. During rainfall or snowmelt, wetlands slow water movement, storing excess water. During periods of heavy rainfall, wetlands serve as buffer zones against flood damage. A large volume of water can be held in a wetland area (as much as 326,000 gallons per wetland acre one foot deep) without undue damage to the wetland community, thus protecting downstream properties.[3]

Flood protection may be especially important in cities and villages, where impervious areas (pavements and roofs) contribute to increased runoff volume and velocity. This ability to delay storm and snowmelt runoff can reduce the frequency and severity of flooding downstream. This function can provide significant economic benefits to downstream property owners.

Throughout Dane County, wetlands have been substantially altered over the last century by dredging, ditching, tiling, filling, and road and utility construction. As a result, many of their functions, like flood control, have been diminished.[4]

Avoiding construction and development in wetlands is an important means of protecting public safety and property. Wetlands are not good places for development. High water tables, the potential for flooding, and soils that shrink and swell seasonally can pose severe problems when a home, commercial development, or road is built in a wetland.



Water Resources

Dane County, Wisconsin

Major Basin Boundaries

Watershed Boundaries

Sub-Watershed Boundaries

Lakes, Rivers, & Streams

Map 3

Jan. 2008

Projection:
Lambert Conformal Conic
Dane County Coordinates - NAD 83(91)

Prepared by: The Capital Area
Regional Planning Commission

N

0 10,000 20,000 40,000 Feet

3. Water Quality Protection

Wetlands are particularly important for pollution control and improving water quality. Wetlands act as large biological filters which intercept nutrients and trap other pollutants through deposition and uptake by plants and animals.[4] This function can be diminished if the wetland is overwhelmed by outside inputs.

Wetland plants and soils have the capacity to store and filter pollutants ranging from pesticides to animal wastes. Calm wetland waters, with their flat surface and low flow characteristics, allow toxins and nutrients to settle out of the water. Plants take up certain nutrients from the water. Other substances can be stored or transformed to a less toxic state. As a result, our lakes, rivers and streams are cleaner and safer. Larger wetlands and those which contain dense vegetation are the most effective in protecting water quality. Especially if surrounding lands contribute runoff, sediment, manure, or other pollutants to its surface waters, the value of this function may be particularly high.

However, wetlands which filter or store sediments or nutrients for extended periods may be overwhelmed and undergo fundamental changes themselves. Sediments will eventually fill wetlands, and nutrients will eventually change the vegetation to more tolerant species. Such changes can result in the loss of diversity, habitat degradation, and the ability of wetlands to trap nutrients and sediments over time.

4. Shoreline Protection

Shoreland wetlands act as buffers between land and water. They protect against erosion by absorbing the force of waves and currents and by anchoring sediments. Roots of wetland plants bind lakeshores and streambanks, providing further protection. Trout streams and other high quality waterways often depend on shoreland wetlands. Without this wetland buffer, the shoreline becomes undercut and collapses. When this happens, streams often become wider, shallower and more turbid. Water temperatures rise and habitat quality deteriorates. Overall benefits include the protection of stream habitat and man-made structures, as well as land which might otherwise be lost to erosion. This function is particularly important in waterways where boat traffic, water current or wind cause substantial water movement which would otherwise damage the shore. In the past, elimination of these shallow zones – and thus wetland vegetation – has led to increased erosion problems.

5. Groundwater Discharge and Recharge

Groundwater discharge is the process by which groundwater bubbles to the ground surface. In some cases, groundwater discharge sites are obvious, through visible springs or by the presence of certain plant species. Groundwater discharge is important for creating permanently moist conditions that give rise to unique wetland plants and animals. Groundwater discharge is also important for stabilizing stream flows, especially during dry summer months, as well as maintaining streamflow and areas of open water in shallow streams and ponds during winter freeze. Groundwater discharge through wetlands can enhance aquatic communities in downstream areas. It also can contribute to high water quality in our lakes, rivers and streams. Groundwater discharge wetlands areas are often the places where streams are born.

Groundwater recharge is the process by which surface water moves into the groundwater system. Although recharge usually occurs on upland areas, some wetlands play an important role in replenishing groundwater supplies. For example, vernal pools are a type of wetland often found in agricultural areas that usually flood during the spring melt and dry up as the water percolates into the ground. The filtering capacity of wetland plants and underlying soils help protect groundwater quality. In other cases, wetland areas that were once groundwater discharge areas may become recharge areas with the lowering of the water table due to human impacts (e.g., municipal well water withdrawals and impervious surfaces).[8] Groundwater discharge wetlands on organic soils are degraded when they are drained. This is due to oxidation of the soil and the subsequent wind erosion or subsidence can lead to soil loss or destruction of soil structure.

6. Recreation, Education, and Scenic Beauty

Wetlands are some of our favorite places to canoe, cross country ski, hike, bird watch, photograph, or simply drive by. They provide peaceful open spaces and present rich opportunities for hunters, anglers, scientists and students alike. Wetlands located within or near urban settings and those frequently visited by the public are especially valuable for the social and educational opportunities they offer. Open water, diverse vegetation, and lack of pollution also contribute to the value of wetlands for recreational and educational purposes.

Wetlands provide exceptional educational and scientific research opportunities because of their unique combination of terrestrial and aquatic life and physical / chemical processes. They are great places for teaching these concepts and it is particularly easy to give young people a feel for the biological world through the study of wetlands. Many species of endangered and threatened plants and animals may be found in wetlands. These areas may also be associated with nearby archaeological sites of early Native Americans who relied on these areas for food and fiber. While wetlands are extremely important resources for nature study, interpretation and education, these areas are also fragile and generally not well suited to intensive use.[4]

Wetlands are also important in enhancing scenic beauty and shaping urban form. They often provide logical barriers or boundaries to urban development, as well as buffers between communities and incompatible land uses.[4]

7. Open Space Corridors

Wetlands are an important source of open space for both humans and wildlife. They are also commonly associated with other important resource features such as lakes, ponds and streams, floodplains, shoreland areas, woodlands, parks, etc. – presented in Table 2 and also displayed on Map 6. Open spaces are important elements of urban form and function. Urban areas and development projects that work well as living places invariably include open, green spaces in their design. For wildlife, open-space corridors are important for cover and travel between natural areas. Open space corridors that incorporate large wetland areas can help maintain and improve conditions for both wildlife and humans. Roads and development projects which do not respect the continuity of open space corridors tend to separate formerly contiguous areas, reducing the proper functioning of these corridors.

Table 2
Open Space Functions Associated With Environmental Resource Features

	Resource Features								
Function	Lakes, Ponds, & Streams	Wetlands	Floodplains	Shoreland Buffer Strips	Steep Slopes	Woodlands	Parks	Unique Vegetation or Geology	Problem Soils
Protect Water Resources, Drainage & Hydrologic Functions	▲	▲	▲	▲		△			△
Provide Pollution Control		▲	△	▲	▲	△	△		
Protect Public Health, Safety, and Property	▲	△	▲		▲				▲
Provide Outdoor Recreation and Education Opportunities	▲	△	△	△		△	▲	△	
Provide Wildlife Habitat	▲	▲	△	△		▲	△	△	
Enhance Scenic Beauty and Shape Urban Form	▲	▲	△	▲	▲	▲	▲	▲	

▲ Primary Function   △ Secondary or Supplemental Function

Source: Dane County Water Quality Summary Plan, 2004

F. Wetland Impacts [3]

The most critical wetland impacts have been due to the direct loss of wetland acreage from ditching, draining, filling, dredging and impoundment. Degradation has also resulted from adverse changes in water quality and quantity from urban and agricultural runoff. This can open the door for invasion by aggressive plant species, which push out beneficial wetland plants and animals. Overall, the decrease in the quality and areal extent of wetlands and their proximity to urban land uses has decreased the effectiveness of many wetland functions.[8]

These disturbances tend to reduce or change the quality of a wetland and its functional values, not to mention its aesthetic appeal. The biological diversity or richness of plant and animal species in an area can be seriously impaired through disturbance. A good wetland restoration project attempts to restore the original hydrology, plants, and animals to the site along with the associated values and benefits.

1. Ditching, Draining, and Filling


Door Creek Wetlands Drainage Ditch

The major human impact on wetlands is the result of trying to convert them to either dry land or open water. During drought, wetlands fed primarily by overland runoff tend to dry up. Many shallow wetlands of this type can be cultivated in dryer years. Since the topography of the surrounding region is generally not altered, the natural flow patterns remain. Whether or not cultivation is successful is dependent on the amount and timing of seasonal rainfall.

Partial drainage, very common in Dane County as elsewhere in southern Wisconsin, results from attempts to drain and farm either low, wet areas adjacent to wetlands, or the wetlands themselves. Farming in such wet areas is often hampered by spring flooding and short growing seasons due to frequent frosts. In many cases, farming was started during the droughts of the 1930s and despite drainage attempts has not been successful. In shallow wetland areas where effective drainage can be achieved, farming has been successful.

The effects of partial drainage of wetlands include nuisance invasions of nettle, ragweed, and trees or shrubs, and reduced water quality. Unfortunately, it is often considered necessary to drain sedge meadows and fens heavily to get the water away from adjacent farm fields. The wetland is degraded even though it is not directly cultivated.

When a wetland is partially filled, it is usually done from the edge toward the center. Thus, the slow transition from upland through shallow water to deep marsh is removed, along with the characteristic plant communities. Often this effect is increased by dredging the center to make a lagoon, such as at Vilas Park in Madison. Fill material such as soil, rocks, cement and gravel brought into a wetland can have direct and indirect adverse impacts. Filling is usually quite obvious. A wetland that has been completely filled, however, may not even be recognized as a former wetland. The fill material may contain seeds of undesirable species that can invade wetland areas. Filling one portion of a wetland may result in a shift in hydrology, increasing or decreasing water into other areas of the wetland. For example, water pooling behind a dike or road will cause a shift in wetland vegetation to adapt to the changed water depth.[1]

The natural shallow edge is the link between land and water, and as such serves many functions. Turtles go ashore and frogs enter to lay eggs. The breeding of certain frogs requires very shallow water. Many types of birds feed in shallow water or on exposed mud. Relatively shallow areas support the emergent growth such as cattail used by most marsh birds to support and conceal their nests. For example, the least bittern prefers narrow strips of cattail parallel to the shore.

2. Dredging

Wetlands are often deepened by dredging. Cherokee Lake is an example of this on the north side of Madison west of the Cherokee Neighborhood – the spoils of which were placed in Cherokee Marsh east of the golf course (doubling the impact). In many cases in southern Wisconsin, cottage or housing development along a shoreline has meant dredging of a deep marsh or even removal of peat from a bog or sedge meadow. The purpose of dredging is usually to provide access for boats along the shore or to remove undesirable sediment. The results of such channelization include: formation of berms or spoilbanks with associated bank erosion: shrub and tree invasion; decline in water quality from nutrient leaching; destruction of habitat; interference with movement of animals to and from the shore; and disturbance due to passing boats.

It has also been common practice to dig holes in wetland soil to make ponds. However, the spoil is often dumped nearby and becomes a source for disturbance vegetation to gain a foothold. The sides of the holes are usually too steep to support much emergent vegetation. An alternative to dredging holes has been blasting. But the resulting ponds were found to be too small and predator-prone. The digging out of springs has also been common practice.

3. Impoundment

Cherokee Marsh

Another way to make a wetland deeper is to impound water. This may be desirable where there are many wetlands and few lakes, but this is not the case in Dane County. Impounding water to make an open lake or pond destroys the emergent vegetation and disrupts the wetland ecosystem entirely. For example, even though the Tenney Locks were constructed at Lake Mendota's outlet in 1912, there has been a dam at the site since around 1850. Current lake levels are estimated to be approximately 7 to 8 feet above natural conditions. Each succeeding dam was built higher, backing up more water and flooding the wetlands of Cherokee Marsh. Wetland plants along the Yahara River have broken away from the underlying peat to form floating mats. Using air photos and original public land survey records, the City of Madison has documented a loss of over 640 acres of wetlands along the Upper Yahara River in the past 160 years.[9] A project is currently underway to protect these floating plant mats by establishing emergent and submergent plants along the river's edge. Several innovative techniques have been developed using various kinds of wire fencing to facilitate the establishment of native wetland plants in a difficult environment. Plantings are protected from the destructive forces of wave action, carp uprooting, and muskrat predation.[9]

In other cases, flooding can be quite beneficial, especially in restoring a previously drained wetland. Horicon Marsh is a classic example of this. Lately, it has become more usual to consider the entire ecosystem when planning management practices, which benefit not only the target species but the rest of the wetland as well. For example, a common problem with impoundments is the excessive growth of algae and nuisance aquatic plants due to high nutrient levels in the water, usually caused by poor land management in the watershed. By retarding flow, impoundment can intensify this problem. This needs to be taken into account in any wetland restoration project that depends on impoundment.

4. Pollution and Sedimentation

Wetlands are not always filled by direct action. Urban drainage includes sediment, salt, oil, debris, and whatever else is washed in from a village or city following a rain event. However, fine sediments such as silt and clay are particularly troublesome for several reasons. Fine sediments are stirred up by the least agitation of the water, such as by wind or animals. For example, an organic bottom sediment (parts of leaves, sticks and similar debris), when shaken in a jar, will settle out entirely in about fifteen minutes; whereas the finest clay particles will take two or three days to settle. Marsh waters are rarely still that long, especially if carp are present. The suspended sediment cuts down light penetration and may interfere with the respiration of invertebrates and fish. Where a lot of sediment enters a marsh, one usually finds both a silt deposit and suspended silt.

Erosion and deposition of large amounts of bare soil is another source of wetland disturbance from upland areas. In wetlands bordering construction sites and cultivated fields, sediment from erosion loss is often carried into the wetland. The addition of nutrients and runoff of pesticides, fertilizers, or manure from both urban and rural areas can also alter wetland vegetation and habitat.

Plant indicators of such soil disturbance are often found along the edges. Where highway or housing development have caused extensive deposition of topsoil and subsoil in adjacent wetlands, surface soil characteristics may be completely changed from organic to inorganic. It is not unusual in heavily developed areas to see cattails or reed canary grass growing out of such deposits, since they are more tolerant than the more sensitive species. This degradation can be fairly rapid.

5. Invasive Plants[1]

If a wetland is extensively disturbed, an opportunity exists for aggressive plants to establish themselves and displace the more sensitive species. Disturbance of wetlands can be the result of cultivation; subsidence or erosion of muck soils; siltation or the accumulation of sediment from agricultural and urban activities; soil compaction due to cattle grazing or driving heavy machinery over a wetland; ditching for pipeline, sewer lines, or underground cables; draining; or filling. Once the wetland soil or water has been disturbed invasive species can gain a foothold and may eventually out-compete the less aggressive native plants.

Exotic species brought in from other countries can out-compete native species due to the absence of natural enemies (predators, parasites, and diseases). They are planted in gardens as ornamentals and escape into the wild by birds carrying berries or by other means. The exotic species can force out the native species and change the character of a wetland community. The most common invasive wetland plants are reed canary grass, purple loosestrife, common reed grass, and buckthorn. They move into disturbed areas and are typically quite aggressive. Getting rid of them is usually difficult.

These plant species occur frequently in disturbed wetlands. Becoming familiar with them helps in determining the extent of disturbance. For example, many sedge meadows have become shrub dominated because of the lowered water levels and the introduction of exotic buckthorn. Sedimentation associated with stormwater runoff has smothered sedges and allowed the invasion of reed canary grass, a Eurasian species more tolerant of drier conditions. In wetter areas, eutrophication from nutrient-carrying sediment favors the cattail, which, although native, behaves as an aggressive weed and outcompetes other, more desirable plants when fertilized. Typically, reed canary grass dominates wet meadows while hybrid cattail dominates marshes. Totipotency – the ability of a plant to reproduce from any part – enhances dispersal and is a problem with many exotics. This is especially so with purple loosestrife, an invasive exotic spread through cultivation as a garden ornamental.[8]

Reed Canary Grass *(Phalaris arundinacea)*

Beginning in the 1800s, people intentionally planted European strains of reed canary grass throughout the United States for forage, especially on lands subject to periodic flooding. Most agencies have discontinued planting reed canary grass and actively discourage its use. Today, many disturbed wetlands in Wisconsin support large stands of reed canary grass, where the grass may dominate vast areas to the exclusion of other plant species. Once established, the invading grass spreads aggressively via underground rhizomes or stems. The grass also produces enormous quantities of seed that germinate in disturbed soil and crowd out other vegetation or float downsteam to colonize stream banks. A recently completed DNR project, using satellite imagery and extensive ground-truthing, has mapped wetland areas dominated by reed canary grass across the entire state. Over a half million acres of Wisconsin's 5.2 million acres of wetland are dominated by this plant, nearly ten percent. In Dane County, approximately 27 percent of the wetland acreage is dominated by reed canary grass (Map 4).[10]

> "…[My] observation with [reed canary grass] is that it is wise not to plant it if one wishes to ever get rid of it." — C.C. Deam, 1940.
>
> "Of all the invasives in Wisconsin, reed canary grass is the worst."— Joy Zedler, UW-Wisconsin Restoration Ecologist.
>
> Source: Thompson and Luthin

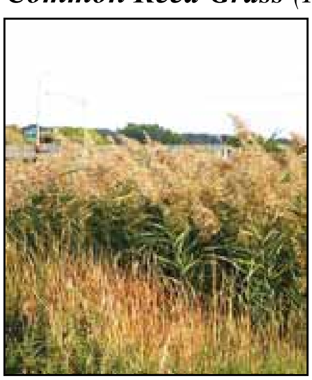
Reed Canary grass is a major problem in wetlands. Areas invaded by reed canary grass may be of little use to wildlife. It forms dense, nearly pure stands that displace all other species from large areas of the wetland, especially sedge meadows. Human disturbance such as nutrients from stormwater runoff and alteration of water levels, such as ditching, encourage reed canary grass invasion.[3]

While a number of control techniques have been attempted, no simple solution has been found for eliminating reed canary grass to date.

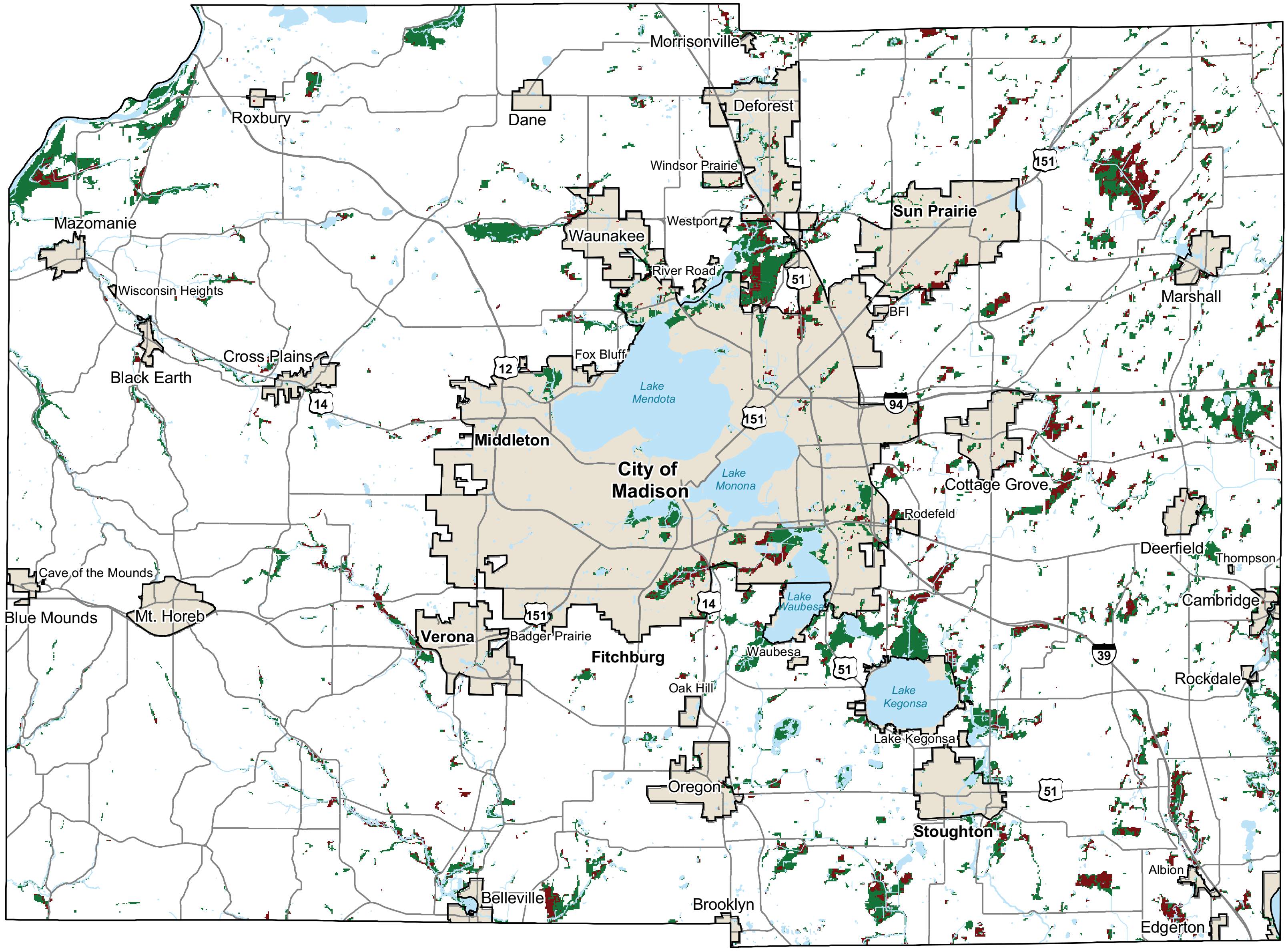
Purple Loosestrife *(Lythrum salicaria)*
Purple loostrife arrived from Europe in the early 1800s, imported as a garden perennial and viaseeds carried in the ballast water of ships. The species has spread across the country, replacing native wetland vegetation. Purple loosestrife is a nuisance exotic weed that is extremely invasive in Wisconsin's wetlands. Although colorful, this plant is extremely undesirable because it prevents many desirable native wetland plants from becoming established. A purple loosestrife produces 100,000 to 2.5 million tiny seeds annually. Once established in a wetland, loosestrife displaces native vegetation. Although attractive, it is virtually useless to wildlife. A DNR survey conducted in the 1980s found various sites in Dane County invaded by purple loosestrife (Map 5)

If a site has large stands of purple loosestrife that can't be controlled by hand pulling or selective chemical control, biological control might be an option. Several species of insects native to Europe are being released statewide that eat and control purple loosestrife. If a site is larger than four acres and is heavily infested, beetles may be received to help control the plants. Contact the UW-Extension or your local DNR aquatic plant manager about the availability of beetles and request a brochure on loosestrife. Currently the Dane County Conservation League has two mass rearing cages set up in Dunlap Hollow to raise large numbers of beetles there. Additional releases have been conducted in other parts of the county as well.

Common Reed Grass *(Phragmites australis)*



Common reed grass is found throughout the world. In Europe, this tall grass has a long history of being used as thatch for roofs. In North America it is found in marshes, wet shores, ditches and swales, tamarack bogs, and open water up to 6 feet deep. The grass is tolerant of salt and thrives in roadside ditches. Because it produces few fertile seeds, reed grass spreads most commonly by its rhizomes. Although a native species, this plant is invading the coastal wetlands of Lake Superior, Lake Michigan, and the Mississippi River floodplains, forming dense stands and crowding out native plant communities. It is possible that these aggressive strains are of Eurasian stock.



Reed Canary Grass Invasion Sites

Dane County, Wisconsin

RCG Dominated (>50% Cover)

Other Vegetation (<50% RCG Cover)

Upland

Service Area

Map 4

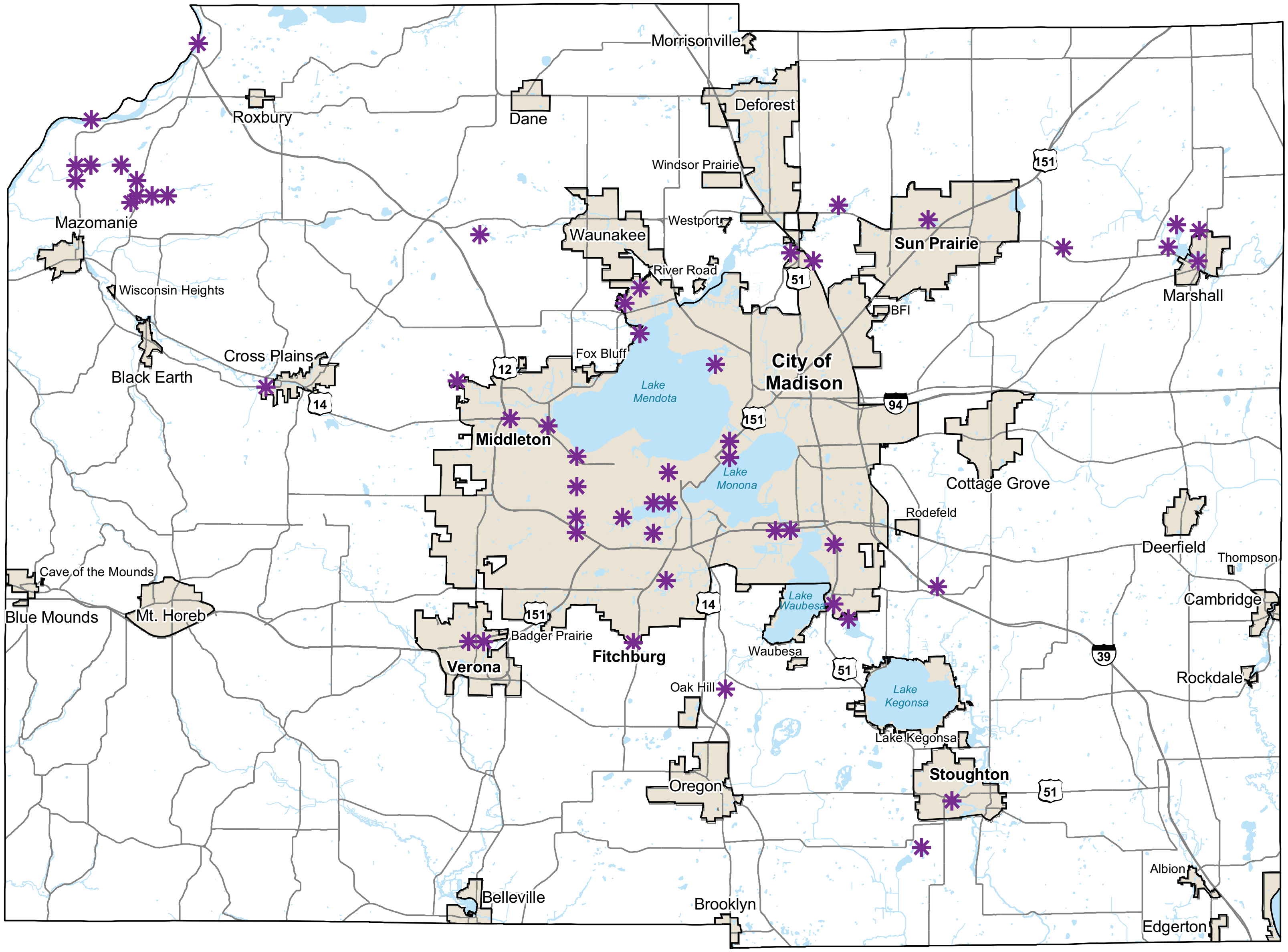
Jan 2008
Reed Canary Grass: Hatch, B. and Bernthal T. in preparation. 2007. WIDNR
Service Area: CARPC 2008

Projection:
Lambert Conformal Conic
Dane County Coordinates - NAD 83(91)

Prepared by: The Capital Area Regional Planning Commission

0 1.25 2.5 5 Miles

N



Purple Loosestrife Invasion Sites

Map 5

Dane County, Wisconsin

* Known Locations of Purple Loosestrife

Service Area

Jan. 2008
Purple Loosestrife Locations: Great Lakes Indian Fish and Wildlife Commission www.glifwc-maps.org.) 2007
Service Area: CARPC 2008

Projection:
Lambert Conformal Conic
Dane County Coordinates - NAD 83(91)

Prepared by: The Capital Area
Regional Planning Commission

N

0 1.25 2.5 5
Miles

Reed grass can gain a foothold when a small segment of plant washes up on the shore of a lake or river. Once established, it invades the adjoining marsh, bog, or fen driving out native plants and reducing diversity. In southern Wisconsin, areas of disturbed soil and ditches close to highways where road salt concentrates are susceptible to such invasion. Several methods of control are being studied. Cutting and treating cut stems with herbicide shows some promise.

Glossy Buckthorn *(Rhamnus frangula) and*
Common Buckthorn *(Rhamnus cathartica)*
Glossy buckthorn is a small tree or tall shrub native to European wetlands. Due to its hardiness and ability to survive a variety of soil types and conditions, it was an ideal plant to use as hedges during the second half of the last century. Its initial introduction was in the eastern part of the U.S. and soon spread westward and into Canada. In Wisconsin, it is invading wetlands and shading out native vegetation. Common buckthorn is a related upland species that can invade meadow wetlands, particularly along the drier borders. While common buckthorn has long thorns on the ends of the twigs, glossy buckthorn has no thorns.

Both species are spread when birds eat the berries and disperse seeds in their droppings. Wetlands are susceptible to invasion by glossy buckthorn. Ironically, the only wetlands that glossy buckthorn apparently cannot invade wetlands dominated by the more aggressive reed canary grass.

The best method of control is to pull out young buckthorn seedlings. Once the seedling has become a larger sapling and is too big to pull, cut the stem close to the ground and paint the cut surface with herbicide. Chemical control is ineffective if not done within a few hours of cutting, and the tree will resprout vigorously if cut and left untreated.

A good time to detect trees and treat them is in the fall, since the species holds leaves longer than most native wetland trees and shrubs, or in the spring since it leafs out earlier. With large infestations, priority should be given to treating the largest fruit-producing trees, then focus on then mid-sized trees, and finally seedlings. Cut and remove the fruit-bearing trees to an offsite location, if possible. Once an invasion occurs, only routine ongoing removal will keep the species in check.

Cattails as Indicators of Disturbance [11]
Cattails are well known, characteristic wetland plants found throughout most of the world. Species found in Wisconsin are broad-leaved cattail *(Typha latifolia)* and narrow-leaved cattail, *(T. angustifolia)*. Overly dense clusters of cattails in a wetland may indicate a disturbance problem.

In recent decades many naturalists in Wisconsin and other parts of North America have become alarmed to find species-rich natural plant communities replaced by nearly pure stands of cattails. In Wisconsin the concern is mainly with narrow-leaved cattail and “hybrid cattail,” a cross between narrow- and broad-leaved cattail *(T. x glauca)* which have been increasing in range and abundance.

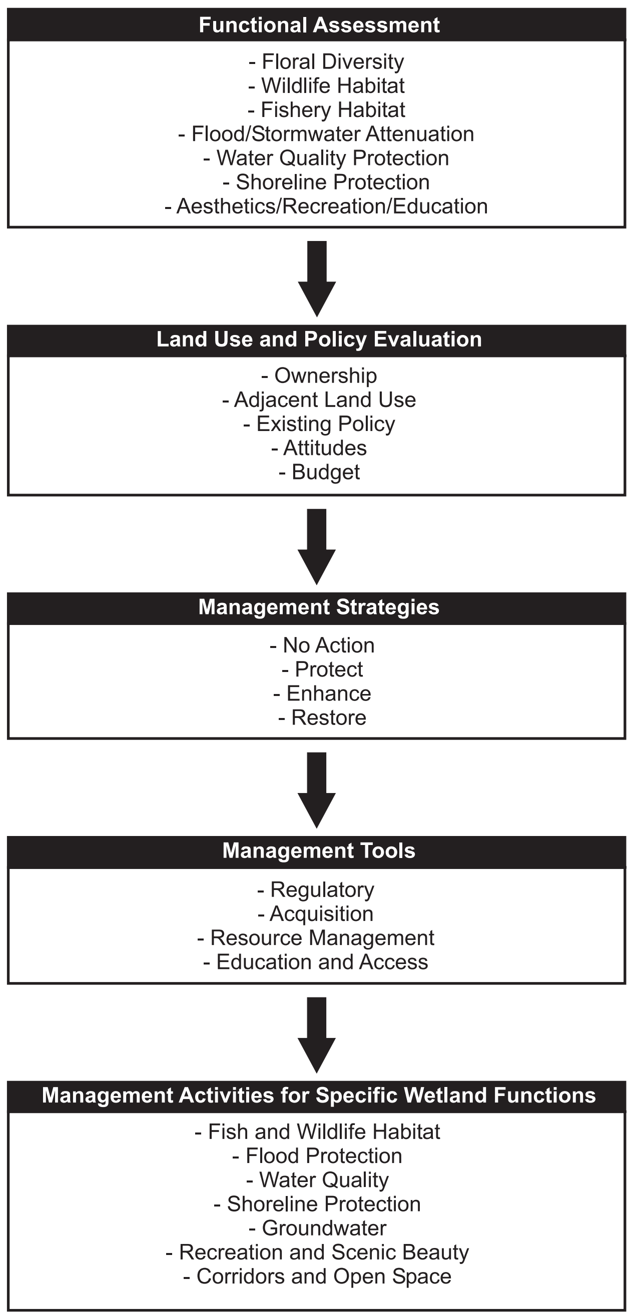
Broad-leaved cattail is native to North America, where it is ecologically important in many nutrient-rich marshes, sedge meadows, fens, and shores. The spread of narrow-leaved cattail may be partly due to increased eutrophication, or nutrient enrichment, of wetlands and increased use of road salt. Where it becomes established in sedge meadows and fens in southeastern Wisconsin it often forms very dense stands that appear to exclude most native species. In contrast, broad-leaved cattail forms less dense stands.

The main ecological effect of narrow-leaved cattail in North America, however, may be through hybridization with broad-leaved cattail to form hybrids. Earlier thought to be sterile, the hybrids are now known to produce some fertile offspring and to generate back-crosses in what might be an actively evolving hybrid swarm. The hybrid has greater tolerance to water-level fluctuations and road salt than the native. The hybrid spreads rapidly by rhizomes (averaging 4 meters per year at Eagle Spring Lake near Eagle, WI) and it dominates many wetlands, including those of lower Green Bay and the Yahara River marshes along the Highway 12/18 Beltline southeast of Madison.[12] It has also invaded and seriously reduced the biodiversity of numerous prairie pothole wetlands. More research is needed to document the effects of the spread of the narrow-leaved and hybrid cattails.

III. WETLAND MANAGEMENT STRATEGY AND TOOL DEVELOPMENT [8]

It is important to understand that each wetland is unique. The physical setting and characteristics of the wetland determine the functions it can provide. How high a wetland is rated for certain functions and the number of functional categories in which it rates can help determine the wetland management strategy to be taken, as well as the appropriate tools to be used. Figure 2 illustrates the process a person could use in making management decisions for a specific wetland area or parcel.[4]

Figure 2. Wetlands Resource Management Planning Process



Source: Adopted from UW-Madison Institute for Environmental Studies 1990

A. Functional Assessment of Wetlands

The first set of factors in this approach is assessing the wetland functions and values at a particular site. There are various assessment methodologies that the DNR and others have developed to assess the health of wetlands and the benefits they provide. Some assessment methods require a great deal of professional expertise, while others can be done by trained volunteers.

DNR's *Rapid Assessment Methodology for Evaluating Wetland Functional Values* (Appendix A) was originally modified from the Federal Highway Administration method (Adamus et al., 1987) to be regionally specific to Wisconsin. It requires approximately four to eight hours of evaluation per wetland. While it provides a legally defensible evaluation in regulatory disputes, it can also be used as a less formal checklist to help guide resource evaluation and prescribe management activities. The evaluator should be someone with a basic knowledge of wetlands ecology, with some interdisciplinary training in botany, zoology, and hydrology; or teams of individuals could be formed with the necessary qualifications.

The checklist can be used to assess the important functional characteristics of each potential site relatively quickly, providing the basis for more focused or in-depth evaluation during subsequent planning stages. The summary provides a four-level ranking system (Low, Medium, High and Exceptional) for each function. The qualitative nature of the answers which follow the summary sheet can be effectively used to aid in developing alternative management strategies (Figure 2). The checklist is meant to be used in an objective manner and to document best professional judgment. It also provides documentation and justification for management decisions.[4]

B. Land-Use and Policy Evaluation

The second set of factors in this approach include an evaluation of land-use and policy elements, which may be useful in determining subsequent management strategies and tools. This includes an assessment of the ownership and use of both the wetland and adjacent upland areas, as well as an assessment of budget and policy issues that govern its management. These may be determined by considering the following types of questions:[8]

- Who owns the wetland site and who owns the adjacent upland areas?
- What is the land use adjacent to the wetland and within the watershed? How much of it is urban? residential? agricultural? forested? pasture? recreation area? parkland? highway or road?
- What is the existing policy concerning wetlands in general and this site in particular?
- Which government agencies or private organizations have jurisdiction or interest?
- What are the attitudes regarding wetlands on the part of the landowners, the public, and the responsible policy makers?
- What resources are available for wetland management?

When the functional classification and the land-use and policy indicators have been determined, a decision can then be made as to which management strategy is most appropriate for a specific wetland area.

C. Wetland Management Strategies [2]

Management strategies for specific wetland areas can be regarded in four basic categories:

1. No action
A wetland may already be adequately managed, both legally and physically, for the specific function(s) it provides; or there may be so little interest, budget, or justification that additional management efforts will not be successful or warranted at this time.[8]

2. Protection

This strategy is suitable for a site with currently desirable form or functions, but which may be threatened by existing or future impacts. Protection does not result in a gain of wetland acres or function. The most common forms of protection have been through federal and state wetland laws, local zoning, acquisition, and easements (such as for upland buffers).[8] Physical protection from urban and agricultural runoff may be needed as well.


Sugar River Wetlands Southwest of Verona

Groundwater availability, surface water runoff, water quality, and erosion control are all interconnected elements of wetland protection. Erosion control and stormwater runoff management can be practiced in urban development in many ways. Some examples include: minimizing impervious pavement; building two-story buildings with smaller roof areas; incorporating more open space in development through "conservation design" techniques; maximizing groundwater recharge in areas where soil conditions allow; minimizing development on steep slopes; keeping slopes in natural vegetation; using flat / grassed filter strips or swales; rain gardens and catchment ponds; as well as providing buffer zones for surface water bodies.


Stormwater Pond

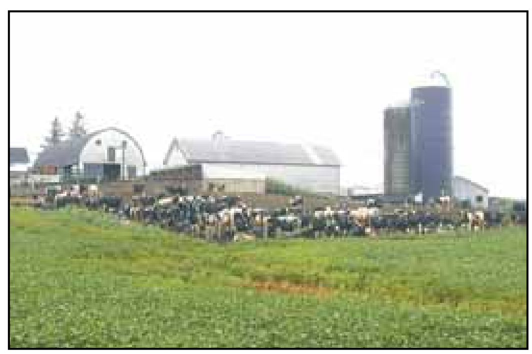
An earlier management approach was to let sediment enter a natural shallow pond with emergent vegetation. The plant stems slowed the current and caused the sediment to settle out. Eventually, however, the sediment would need to be removed. Such treatment is not allowed for protected wetlands and is not recommended for wetland restoration projects. Instead, a new pond for sediment catchment should be constructed between the development and the wetland. Special attention is particularly needed where runoff enters a buffer area so that it is spread out and does not cut channels or gullies through the buffer – whether it be forest, field, or meadow. It is also important to evaluate the adverse impact and increased runoff volumes from development caused by expanded impervious area in the watershed. Such runoff volume increases usually change the natural hydrology of the wetland, resulting in long-term adverse impacts.

Runoff management on agricultural lands has a long history from a soil conservation standpoint, since running water can carry tremendous amounts of soil and nutrients with it. For example, on many steep dry hillsides in Dane County, grazing results in extremely close cropping of the vegetative cover. This damages the cover, increasing runoff rates and volumes and making erosion likely. Stock are often allowed free access to stream banks for watering purposes. Without any protective devices, the banks are stripped of vegetation and trampled down. Sometimes feedlots even include stream banks. This is a common and damaging practice in southern Wisconsin that is easily preventable.

Protection of springs is also needed. Springs have both scientific and scenic value, yet the prevailing idea has been to "improve" them by digging them out into ponds. Plants and animals in the water near the springhead may be displaced, and the berms allow invasion by exotics, and often have steep sides, which hamper wildlife access to the water's edge. Although most of these changes would not be drastic for the wetland, there seems to be no clear evidence of gain from digging out springs. Often springs are used as stock watering areas, which usually means trampling and erosion of stream banks and deterioration of water quality.

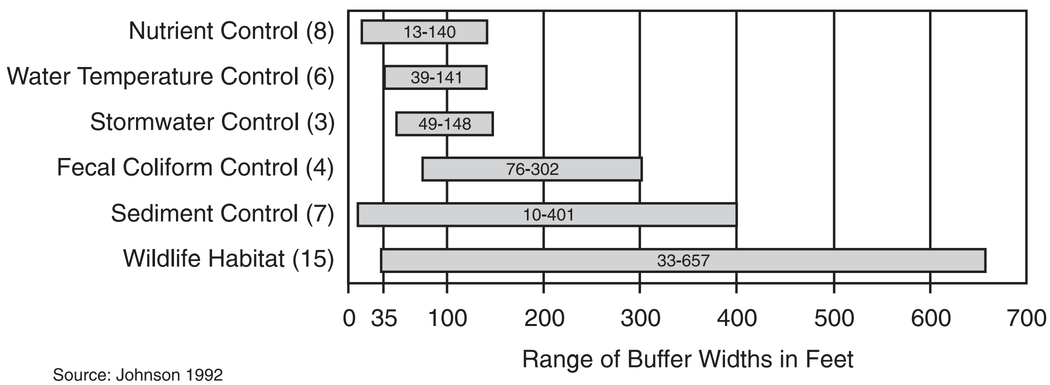
Sometimes protection is simply a matter of doing something differently than before, like fencing off an area that can result in significant improvement. Suggestions for runoff and erosion control measures can be found in any good soil conservation reference, or by simply contacting the County Land Conservation Division.

Protection also applies to nutrient management. Agricultural runoff carries fertilizers and manure. Urban runoff carries a variety of similar wastes from lawns and pets as well. Controlling these nutrients at the source is a much more effective strategy than trying to address the problem after they have been washed into the water. Buffer zones and catchment basins tend to be helpful only if the nutrients can be deposited and incorporated into the organic material there.



Greater emphasis has recently been placed on providing buffer areas between agricultural and urban land uses and adjacent surface waters. Under most circumstances, buffers necessary to protect streams, lakes, and wetlands should be a minimum 75-100 feet in width (Figure 3). Generally, buffer widths toward the lower end of the range help maintain the *physical and chemical* characteristics of aquatic resources. For example, pollutant removal increases with increasing buffer width up to about 100 feet where a point of diminishing returns is reached. In other words, after about 70-80 percent removal is obtained, much greater widths are needed to gain the next increment of removal.[13] Additional stormwater structures and practices may be necessary to avoid channelized flow, which negates buffer effectiveness. The type of vegetation used in a buffer strip influences its effectiveness. In general, buffer strips with native prairie grasses are more effective than wooded buffer strips, because of the superior erosion protection and filtration provided by dense grass ground cover.

Figure 3. **Recommended Shoreline Buffer Widths**
Based on (x) studies



Source: Johnson 1992

Buffer widths toward the upper end of the range appear to be the minimum necessary for maintaining the *biological* qualities of many streams, lakes, and wetlands. Most resource management objectives can be accomplished using a buffer width of 300 feet. Some designers propose a multiple zone approach that allows more intense land uses farther away from a core undisturbed zone.[14]

3. Enhancement

Nine Springs Wetlands Boardwalk and Observation Deck

This strategy is intended to increase one or more of the current functions performed by an existing wetland. Enhancement results in a change in wetland function(s), but does not result in a gain in wetland area. Enhancement may be undertaken for a purpose such as water quality improvement, floodwater storage, or wildlife habitat. Care needs to be taken since it can lead to a decline in other functions. Enhancement activities range from simple measures to more complex activities. Generally, wetland enhancement activities are used to restore severely degraded wetlands to higher quality sites. A wetland site may also have the potential to become more productive, useful, or aesthetically pleasing through additional improvements. For example, building a path or walkway can encourage greater public awareness and appreciation. [8] Enhancement may also include management activities that do no involve changes in soils or hydrology, but may affect wildlife habitat and vegetation. These activities help compensate for natural processes that no longer exist. Examples include: prescribed burns, controlling invasive species, planting upland buffer zones, and providing nest boxes for wildlife.[1]

However, careless wetland enhancement can change the physical characteristics of a functioning wetland. Enhancing a wetland in one way can degrade it in other ways. Examples include impounding water behind a dike or dam at higher levels than historically present, or dredging a pond in a relatively undisturbed wetland. Adding more water to a wetland may create better habitat for fish, but it will decrease the ability of the wetland to hold flood waters and change the natural hydrologic regime of the wetland and its original habitat. These activities usually require permits and result in enhancing one wetland function at the expense of others. As more is learned about wetland diversity and functions, some practices undertaken with good intentions years ago, such as dynamiting ponds in woodlands or sedge meadows or planting reed canary grass, are today seen as unfortunate mistakes. Enhancement techniques should be evaluated carefully because one generation's enhancement could create unintended problems for the next generation.[1] When wetland enhancement is undertaken, the project goals should include minimizing any decrease in current wetland functions.

4. Restoration

This strategy is intended to return a degraded wetland or former wetland to pre-existing conditions or as close to that condition as possible. Restoration and enhancement projects may be difficult to distinguish from one another. The distinction is that restoration entails returning a wetland to a former state (e.g., filling a ditch so that a drained wetland becomes flooded again). Enhancement entails changing a wetland so that one or more functions are increased *beyond* their original state (e.g., diverting a small stream into a wetland so that the area has deeper water).

Lodi Marsh Restoration Site

A wetland may have been of higher quality in the past, but may have been degraded as a result of urban and agricultural activities. Many former wetlands of the state are significantly disturbed and have been altered by ditching, drain tile installation, stream channelization, and sedimentation. These areas generally have hydric soils typical of wetlands and may have some wetland plants growing among weeds or crops. The key to wetland restoration is reestablishing the original hydrology and restoring natural processes of the area, including the original native plant cover. The cause of the degradation will usually determine the restoration strategy.[1]

Two general types of restoration are as follows:

1) *Rehabilitation* – restoration in an existing wetland
2) *Re-establishment*– restoration in a former wetland

Rehabilitation results in a gain in wetland function, but does not result in a gain in wetland area. A degraded wetland is a wetland with one or more impaired functions due to human activity. When determining whether or not a wetland is degraded, the following should be considered: physical alteration, such as the conversion of one wetland system to another; chemical contamination, such as that washing in from adjacent lands; and biological alteration, such as the significant presence of non-native invasive species. An example would be fencing out cattle to allow the wetland vegetation to regenerate, or eradicating invasive exotic species and replacing them with native plants.

Wetlands Rehabilitation Project in Tenney Park

Re-establishment results in the restoration of a former wetland and a net gain in wetland area. A former wetland is an area that was once a wetland but has been modified to the point it no longer has the hydrologic characteristics of a wetland. For all practical purposes, the area is considered an upland. An example of re-establishment would be filling a ditch or breaking field tiles to re-establish a former (drained) wetland.

Experience gained from hundreds of wetland restorations, enhancements, and alterations implemented across the state during the last 50 years indicates that the most cost-effective and successful approach to wetland restoration is to restore degraded/formerly drained wetlands by undoing that which was done to harm them.[1]

5. Creation

This strategy is intended to convert a non-wetland (either dry land or unvegetated water) to a wetland. Putting a wetland where one did not exist before is usually a difficult undertaking. The primary challenge in creation projects on dry land is bringing water to a site where it does not naturally occur, and establishing wetland vegetation on soils that are not hydric. Creating wetlands from open water is less difficult, because of the existing water source. However, it often requires placing sediment or other fill into existing aquatic habitats, destroying one kind of aquatic habitat to create another. Wetlands may be created by impounding water behind a dike or dam or excavating surface soils in upland areas to create a depression. These efforts are costly and labor-intensive and the resulting "wetland" may not fit into the landscape and may never function as a natural wetland. The engineering and regulatory challenges of these projects are so complicated that professional expertise and oversight are almost always required.

While creation is possible, it typically requires significantly more planning and effort than restoration projects, and the outcome of the effort is more difficult to ensure or predict. Many attempts to convert uplands to wetlands usually result in ecosystems that do not closely resemble natural wetlands and provide limited wetland functions, such as water quality protection. The best applications for created wetlands is to recreate the filtration and nutrient absorption of a natural wetland for wastewater or stormwater treatment, not to create a replacement for a natural wetland.

The outcome of a creation and enhancement project is often difficult to predict because essentially these projects try to produce a new ecosystem. With restoration projects, outcomes are more predictable (although there may still be some uncertainty depending on the type of wetland, extent of degradation, and many other factors). But for the most part, restoration is more likely to have a positive outcome in terms of improving wetland resources.

6. Mitigation

Minimization Using Elevated Trestle Supports as Part of a High Speed Rail Line Project in Cherokee Marsh

An additional term associated with discussions of restoration, enhancement, and creation is mitigation. Mitigation is often short for "compensatory mitigation" and means wetland restoration, enhancement, or creation for the specific purpose of compensating for the unavoidable damage or destruction to a wetland resulting from a development project. There are usually a number of regulatory requirements that must be met to ensure that the wetland activity provides adequate compensation for the associated wetland loss; most notably, following a sequence of first avoiding, then minimizing, and finally compensating or restoring wetlands in another area. When compensation in another area is the only option, it is crucial to find a site in the same area of the watershed so as to minimize the adverse impacts of wetland loss on the watershed and its hydrology. Replacement often requires restoring a larger amount of wetland than the amount lost to provide a margin of safety and to account for the temporary loss of function before the restoration achieves success. Experience in mitigation indicates that small mitigation projects are generally not successful. Therefore, large mitigation projects are often "banked" and many small wetland losses are credited to the banked wetland for several years. More information on the regulatory requirements of compensatory mitigation can be obtained from agencies involved in wetland regulation, especially the Army Corps of Engineers or the Wisconsin DNR.

D. Wetland Management Tools [4,8]

Overall, the terms protection, restoration, and enhancement describe a collection of management actions or activities. Any combination of these strategies may be used in managing a specific wetland area. Determining which of these management strategies is most appropriate for a specific site is the principal focus of the management decision process, which leads to specific management tools (Figure 2).

The tools available to implement a wetland management strategy fall into the following four general categories:

1) Laws and Regulations
2) Alternative Land-Use Management Techniques (Acquisition)
3) Wetland Resource Management Activities
4) Education and Access

1. Laws and Regulations

The *Dane County Wetlands Resource Management Guide* is based on existing laws and regulations and does not propose those laws and regulations be expanded or changed. This section describes the existing legal and regulatory framework for protecting wetlands. Protection through regulation is appropriate where public access is not needed, and allows lands to remain in private ownership. Existing regulations include wetland and shoreland zoning, subdivision regulations, official mapping, and federal, state and local permit processes.

Where public access is required for recreation, for structures such as detention basins, or where access is needed for public maintenance of stream channels and structures, it is generally necessary to acquire lands through dedication or purchase. Public acquisition through dedication or purchase may also be required to protect important wildlife habitat or resource areas that are vulnerable to development and which are not adequately protected through zoning or other regulatory means. In other cases, conservation easements may be used where fee-simple title is not needed.

The following highlights some of the regulatory mechanisms for protecting wetlands and associated water features.

Federal

- **Section 10** of the Rivers and Harbors Act 1899 regulates all structures or work in or affecting the navigable waters of the United States, including wetlands, such as dredging and discharge of fill materials.

- **Section 404** of the Clean Water Act of 1977 requires the U.S. Army Corps of Engineers to regulate the discharge of dredge and fill materials into waters of the United States.

- **Section 401** of the Clean Water Act of 1977 requires state water quality certification before a permit is issued for construction or operation of facilities that may discharge into navigable waters, including wetlands.

- **1996 Federal Farm Bill**, administered by the U.S Dept. of Agriculture, includes the Wetland Reserve and Swampbuster programs which provides cost-share funding for restoring wetlands drained for agricultural purposes prior to December 23, 1985, while denying USDA farm benefits for wetlands altered after that date.

State of Wisconsin

- DNR Administrative Code **NR 1.95** establishes the basis for state wetland regulations, stating as a matter of policy that “wetlands shall be preserved, protected, restored, and managed to maintain, enhance or restore their values.” DNR makes regulatory decisions concerning the issuance of permits for activities which affect wetlands such as sewer extensions, dredging and filling, stream course alteration, etc.

- **NR 103** establishes water quality standards for wetlands. NR 103 requires that all practicable alternatives be taken to avoid and minimize impacts to wetlands, and that permitted actions produce no significant adverse impacts to wetland functions and values.

- **NR 299**, Wis. Stats., establishes the procedures and criteria for making water quality certification determinations under the authority granted by Section 401 of the Clean Water Act. NR 299 certifications apply to all federal permits in which discharges to the waters of the state are concerned. Denial of certification is a veto of a federal permit. Certification decisions are based on standards and procedures established in state water quality standards for surface waters (**NR 102**) and wetlands (**NR 103**). These standards are also applicable to most DNR regulatory, planning, resource, and financial aid determinations which may impact the quality and use of wetlands.

- **NR 350** establishes the standards for wetland compensation mitigation following the general sequence of first avoiding, then minimizing, and finally mitigating unavoidable wetland losses. Mitigation is the restoration, enhancement or creation of wetlands for the purpose of compensating for unavoidable wetland impacts that remain after all appropriate and practicable avoidance and minimization has been achieved. Replacement must first be considered on-site or in close proximity to the area being impacted. Off-site replacement may be allowed if on-site replacement opportunities are not expected to have long-term viability (such as incompatible adjacent land uses), or off-site replacement would provide greater ecological value. In most cases, the Standard Compensation Ratio is 1.5 acres of wetland compensation for each acre of wetland impacted.

Peat Being Removed and Replaced by Mineral Soils as Part of a Runway Expansion Project at

Wetland mitigation banks have also been developed in some areas of the county and the state. They help facilitate off-site wetland mitigation requirements for unavoidable wetland losses in a predefined service area. Examples include the WDOT wetlands bank at Patrick Marsh, associated with the reconstruction of U.S. Highway 151, and the Dane County Highway and Transportation Department banking site at Lodi Marsh, associated with the runway expansion at the Dane County Airport.

While previously only allowed for municipal and state highway transportation projects, the scope of wetland mitigation has recently been expanded to include private development as well. A developer may purchase credits from an approved mitigation bank and apply them in the Compensation Service Area. This is defined as the area within a 20-mile radius of the project site, the same county, as well as the same DNR Geographic Management Unit (GMU) or river basin. In Dane County this includes the Lower Wisconsin, the Sugar-Pecatonica, the Upper Rock, and Lower Rock River basins. However, there currently are no private wetland banks in Dane County.

- **Chapters 30 and 31**, Wis. Stats. deal with the authority of DNR to regulate activities in and near navigable waters, and the construction and operation of dams and bridges. Wetlands below the ordinary high water mark are regulated under this chapter using NR 103 standards.

- **Chapter 92**, Wis. Stats. requires each county to create a special Land Conservation Committee (LCC) responsible for developing and encouraging the implementation of federal, state, and local programs aimed at conserving soil, water, and associated natural resources. Land Conservation Department (LCD) staff work directly with farmers, landowners and businesses to promote conservation and install Best Management Practices.

- Wisconsin State Statutes also provide shoreland (**s. 59.692**), wetland (**s. 59.692, 61.351**, and **62.231**), and floodplain (**s. 87.30**) zoning oversight. They require the adoption of local ordinances regulating activities in the shoreland zone and 100 year floodplain that include at least state minimum requirements. DNR rules further lay out the minimum requirements for shoreland and wetland regulations in unincorporated areas (**NR 115**), wetland regulations in incorporated areas (**NR 117**), and floodplain regulations in incorporated and unincorporated areas (**NR 116**). **NR 115** is currently being revised; the first such revision since it was originally adopted in 1968.

- With regard to water quality, significant progress has recently been made in terms of statewide water quality performance standards (**NR 151**), stormwater permit requirements (**NR 216**), as well as Dane County's own recently updated Erosion Control and Stormwater Management Ordinance (**Chapter 14**). These requirements include infiltration and, in the case of Dane County, temperature control requirements for all development activity in watersheds possessing coldwater streams. Also under the unique authority granted to the Dane County Lakes and Watershed Commission (**Wisconsin Act 324**), Dane County may establish minimum water quality standards that supercede less restrictive city and village requirements.

Local

At the local level, pertinent laws begin with county jurisdiction over unincorporated areas, and with specific cities, villages and towns with their own regulations. In keeping with **NR 115** and **NR 116**, Dane County has adopted shoreland, shoreland-wetland, and floodplain zoning ordinances (for the unincorporated areas only). Ordinances include a specific listing of permitted uses in the shoreland-wetland district, as well as listing other allowed uses requiring a conditional-use permit. The ordinance specifies that all uses *not* listed are prohibited unless a rezoning should occur, which shall not have a significant impact on any of the wetland functions. Final approval of the zoning amendment must be made by DNR whose authority supersedes that of the county. It is important to note Dane County ordinances are more stringent than the state minimum requirements, and encompass all wetlands greater than two acres in size, compared to the state minimum five-acre standard. It should be further noted that given the cumulative impact of wetland loss (especially in urbanizing areas), national research suggests the current size cutoff in most zoning ordinances (either 5 or 2 acres) is too large.

Cumulatively, wetlands smaller than 2 acres can perform important water quality functions, especially in watersheds that have few remaining wetlands.

Under to **NR 117**, cities and villages are also required to adopt wetland protection ordinances for municipal shoreland areas. To aid cities and villages in establishing and meeting shoreland-wetland zoning standards, DNR published a model ordinance. In Dane County, all of the cities and villages have also adopted the more restrictive two-acre county standard.

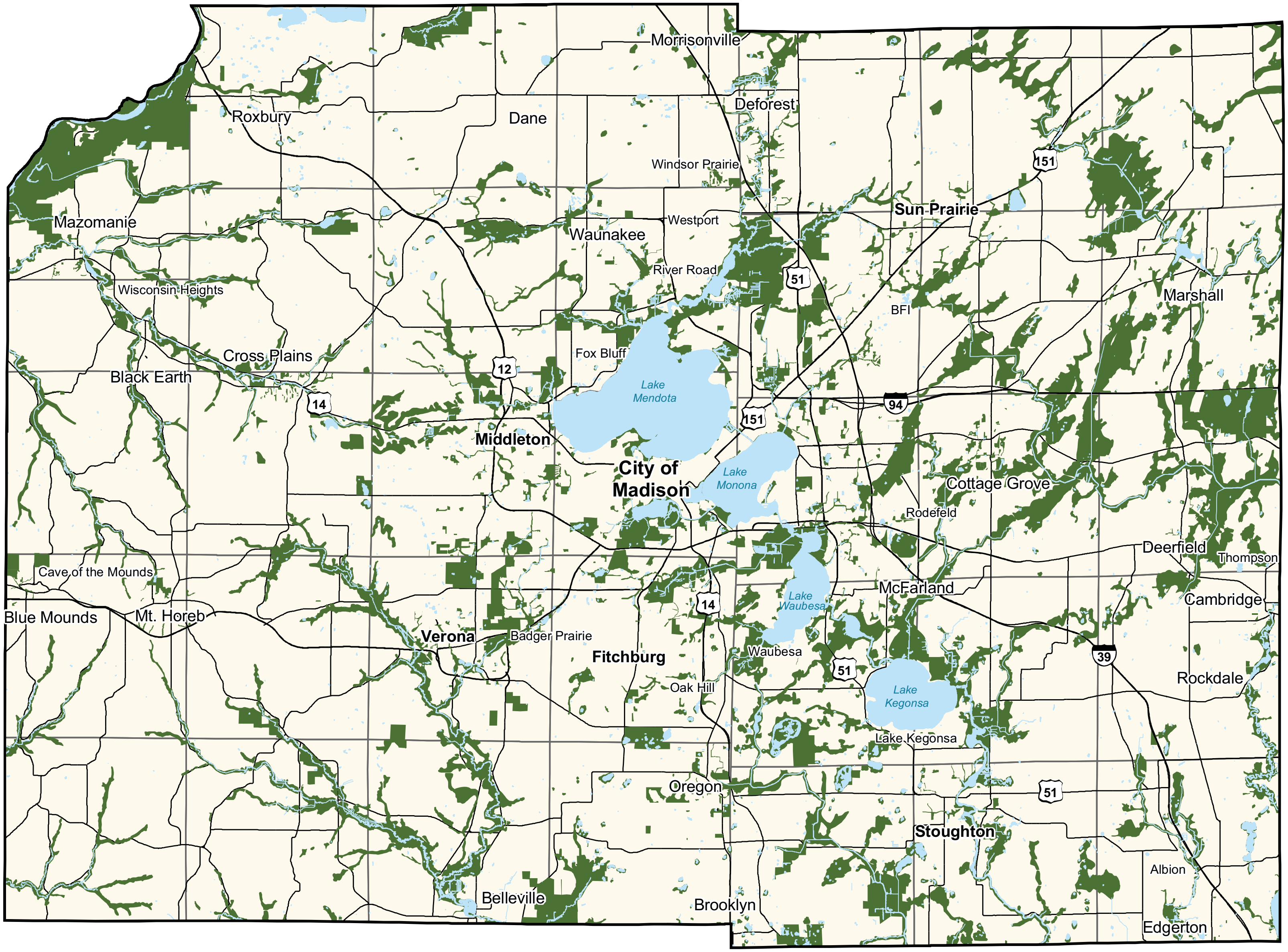
In addition to zoning, communities may use subdivision regulations to protect wetland resources. Subdivision ordinances apply when a parcel of land is divided into lots for sale or development. Many communities use subdivision regulations to protect wetland resources by imposing site restrictions, design standards, and open space dedication requirements. Subdivision regulations often include specific design standards for width and alignment of parkways and drainageways, and public easements adjacent to streams to anticipate potential flow volumes. Besides easements, the regulation may require dedication of land to the public for resource protection and open space or recreation purposes. Often plat approval is conditioned upon compliance with design standards for critical areas, or adequate protection or preservation of certain environmental features in the site development plan.

It is also often advised that a municipality adopt a comprehensive land-use plan to provide a legal basis for land use decisions. "Smart Growth" legislation (**§66.1001 Wis. Stats.**) defines nine basic elements, various consistency requirements, and procedures for adopting local comprehensive plans by January 1, 2010. Many municipalities are in the process of developing their plans with public input and participation. This is especially important when natural areas such as wetlands are protected, even partially, by local land use decisions not mandated by state or federal law.

Areawide Water Quality Planning

Although communities can expect urban areas to expand to accommodate anticipated future growth, residents can (and do) insist that their municipalities require developers to address the impacts of their development on the ground and surface water resources of the area. As the designated areawide water quality planning agency for Dane County, the Capitol Area Regional Planning Commission (CARPC) oversees the approval of amendments to existing Urban Service Areas. These reviews are done in order to avoid impacts to ground and surface waters, as well as foster efficient provision and use of public services and facilities, such as sanitary sewer service, promulgated under **NR 121**. These decisions are guided by the *Dane County Water Quality Plan*, the *Dane County Land Use and Transportation Plan*, as well as other adopted county and municipal plans.

The Regional Development Plan Map (Map 6) illustrates the framework for making decisions relative to growth and development in the region.[15]



Regional Development Plan Map

Dane County, Wisconsin

Map 6

Open Space Corridor	
Incorporated Area	
Urban Service Area	
Limited Service Area	

Jan 2008
Open Space Corridor: CARPC 2008
Service Area: CARPC 2008

Projection:
Lambert Conformal Conic
Dane County Coordinates - NAD 83(91)

Prepared by: The Capital Area Regional Planning Commission

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The map shows the following three elements:

1) Urban Service Areas – areas of planned urban development expected to receive public sanitary sewer service;
2) Rural Areas – rural development using on-site wastewater treatment systems and farmland preservation areas; and
3) Open Space Corridors – sensitive natural areas and environmental resources intended to be protected from development.

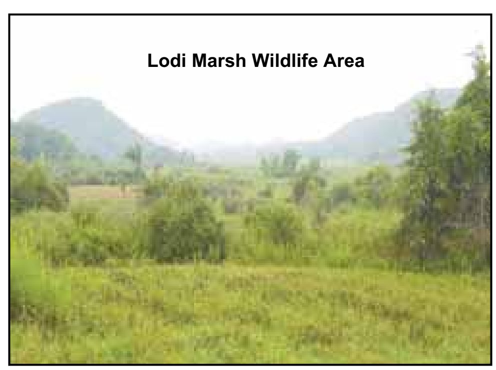
Open Space Corridors may be further distinguished between urban *Environmental Corridors* and rural *Resource Protection Areas*.

As amendments to the Urban Service Areas are proposed, CARPC staff evaluate the anticipated development and recommend measures to address the anticipated impacts of development. Environmental Corridors, including wetlands, are protected from urban development. Usually, specific erosion control and stormwater management measures are included as a condition of approval of the amendment area. Project sponsors are usually willing to accept these requirements. Recommendations may also be included to maximize infiltration of rainfall in order to offset loss of groundwater recharge. These measures are incorporated into the design and construction of the development, and result in reducing the adverse impacts of development, especially in conjunction with a community's own ordinances and stormwater plans.

In some cases, innovative development designs may incorporate additional measures for resource protection. For example, planned unit development districts and cluster design have been used which involves increasing densities in some areas of the development while leaving the remaining areas in permanent open space. Overall density is maintained while the amount of open space is maximized. Maximizing open space helps provide a natural buffer between the development and the wetland, thereby minimizing adverse impacts.

2. Alternative Land-Use Management Tools (Acquisition) [4,16]

Existing laws and regulations may not be sufficient in carrying out an effective wetland management strategy. Various alternative land-use management tools have been developed which provide additional flexibility and landowner incentives for promoting wetland resource protection, restoration, and enhancement goals.



Acquisition plays one of the most important roles in wetland management. In addition, the lands surrounding the wetland may be just as important as the wetland area itself.

Typically, public acquisition and incentives are needed for environmentally sensitive areas which cannot otherwise be adequately protected by regulation. There are various acquisition techniques which are available, depending on the circumstances surrounding the property and agreements that can be reached with landowners. Such agreements require mutually acceptable and beneficial terms for all parties.

In this regard, this *Dane County Wetlands Resource Management Guide* establishes a useful planning framework and additional justification for focusing financial and technical resources into these important areas. More specifically, cities, villages, towns and counties are authorized under state statutes to acquire and develop property for a variety of purposes including (among others) parks, recreation, public use and natural resource protection. Acquisition of property rights may be accomplished in several ways, including: (1) purchase of fee-simple interest in a property; (2) purchase of lesser interest in the property (e.g., easements); (3) acquisition of development rights; (4) dedication of lands by developers; or (5) gifts and donations.

Fee-Simple Purchase

The simplest method of acquiring a wetland and surrounding property is through fee simple purchase. Traditionally, local units of government have acquired public parkland, recreational and other natural resource areas through outright purchase. Fee-simple acquisition is the purchase of all rights to a specific property. Local units of government often seek financial assistance for purchase and development of parklands and natural resource areas from federal and state cost-share funding programs (e.g., State Stewardship Fund, Community Development Block Grants, DNR matching funds, etc.).

Private sector involvement in the purchase of critical environmental resource areas and recreational and open space lands has also increased in recent years. For example, land trusts are private non-profit groups directly involved in land transactions, through donation or purchase, that protect open space and recreational lands and natural resource areas. In Dane County the Natural Heritage Land Trust performs this role. The Land Trust partners with state and local public agencies to help protect lands, and also works with them in building future plans. Another aspect of this is that management (removal of exotic species, habitat restoration, etc.) is often enhanced through the actions and activities of concerned citizens involved with other non-profit conservation organizations and friends groups.

Purchase of Easements/Development Rights

In instances where fee-simple title is not needed, the acquisition of partial interest in a property or easement may be more appropriate. Under an easement the owner continues to own the land but sells or donates certain rights. These may include the right to develop, the right to drain, crop, etc. Common examples of easements include the following:

(a) Conservancy easements – to preserve or restore environmentally sensitive sites without allowing public access.

(b) Access easements – to allow public access to private lands for hiking, fishing or other recreational purposes, or for maintenance of drainage facilities.

Acquiring easements is also appropriate for lands bordering sensitive areas. These surrounding areas serve as important buffers, providing protection from upland land uses and impacts, enhancing water quality, providing valuable wildlife habitat, etc.

A Purchase of Development Rights (PDR) Program allows a landowner to sell his or her development rights to a parcel of land. The buyer, usually a public agency or conservation organization, buys the "development potential" of the land from the seller, who keeps ownership of the property and receives cash payment for the development rights. The development potential is defined as the difference in value between the current use of the land (e.g. farmland) and its market value as developed land. Thus the seller can choose to sell the property or pass it on to other family members to continue to farm and enjoy later on, but they cannot develop it. The use of the land is restricted to agriculture or open space, depending on the rights sold, and usually recorded through a deed restriction which follows the title on the land. The Town of Dunn currently administers a PDR program used to maintain and protect productive farmland from development. Protection of wetlands could also be incorporated into these agreements.

A variant of this preservation tool is the Transfer of Development Rights (TDR) Program. A TDR program allows the transfer of development rights or potential from properties in "sending areas" to properties in "receiving areas." Sending areas are designated areas where the community wishes to preserve resources or limit development. Productive farmlands and environmentally sensitive areas are examples of sending areas. Receiving areas are designated as appropriate for new or additional development, usually areas provided with public sewer and water, roads, and other public infrastructure. TDR programs are being studied in Dane County, but have not yet been implemented.

Dedication of Lands by Developers

Overall, urban *Environmental Corridors* and rural *Resource Protection Areas* form a continuous Open Space Corridor system throughout the county and its cities and villages (Map 6). In Urban Service Areas, adopted Environmental Corridors provide an important basis for land dedication by developers and subdividers, especially environmentally sensitive features such as wetlands, floodplains, streams and drainageways. The Environmental Corridors are commonly used to help direct development away from these areas, and provide necessary buffers. Density tradeoffs may also be used for enhancing or protecting a particular resource, while providing flexibility and minimizing any loss in development potential for the site.

In rural areas, Resource Protection Areas are defined in town plans and protected through zoning or other regulations. There is less pressure for development of these lands, therefore less land is usually needed for public open space and recreational use. As a result, most of the lands in rural resource protection areas remain in private ownership. These lands are typically more conducive to easements or similar private agreements.

Pheasant Branch Conservancy

At the local level, subdivision and Planned Unit Development (PUD) ordinances often require that a portion of the property be dedicated by the developer for the purpose of park, open space, or providing access to lakes and streams. In lieu of dedication, the developer may provide a payment of fees during the land development process. In addition to providing recreation and open space areas, dedication is a commonly used tool to preserve and protect drainage greenways on developing lands, and to help maintain water quality.

Gifts or Donations
Landowners may also give land or partial rights to the land for public use to a local unit of government or public trust. Gifts are usually granted because the landowner wishes to preserve the natural qualities and value of the land, as well as receive certain tax benefits. Another type of agreement establishes a life estate condition on the property. Through this, a property could be donated (or sold) to a unit of government when the donor or direct heirs die.

3. Wetlands Resource Management [4,8]

Wetlands resource management means modifying or manipulating a wetland to restore an historic function, improve an existing function, or further protect it from adjacent land-use impacts. Wetland resource management tools generally include hydrologic modifications, biologic improvement, water quality / stormwater management, education, and improved access.

Hydrologic Restoration
By altering the natural water-level fluctuations a few inches for relatively short periods of time, it may be possible to restore and improve the functions and value of a wetland. In many cases this may simply entail reversing the impact that has occurred. For example, if a channel is dug through a wetland, the water is drained more quickly out of the wetland, thus dropping the water table. If this channel were removed or modified to direct flow back through the wetland, the water table would likely return to near historic levels, with an accompanying return of associated wetland plants and animals.

Common methods for restoring water levels in wetlands include:

1) Plugging drainage ditches or breaking subsurface tiles — probably the most cost-effective alternative, where feasible.

2) Restoring original flow patterns, stream channels, meanders, or open water areas — local stormwater management may be needed to control both the quantity and quality of flow.

3) Controlling water flowing out of the wetland by placing an outlet control structure down-gradient — although potentially expensive or impractical in some cases


Original Stream Meander Evident in Door Creek Wetlands

Biologic Improvement
Biologic improvement is generally associated with returning an impaired wetland to a more natural condition. This can be done by selectively removing unwanted plant species, transplanting desired native species, or adding beneficial species. Biologic improvement can also aid in the development of a particular wetland function such as restoration of wildlife habitat, flood control or sediment trapping. Biologic improvement may include:

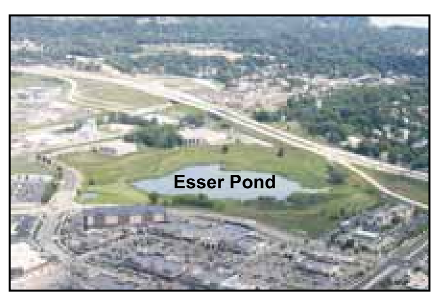
1) Functional improvement – to restore the utility of a site, such as for wildlife habitat or sediment trapping.

2) Resource improvement – to attempt to restore a native community at a site to achieve a stable and enhanced ecosystem.

3) Aesthetic improvement – to emphasize the visual aspects and natural feeling, such as through natural landscaping.

Water Quality / Stormwater Management
Proper erosion control and runoff management during construction and after development are critical to protecting wetlands and downstream waterways. Development does not have to occur in the wetland to have an effect on the wetland. Effective construction site erosion control measures such as berms and stone weepers can be used to reduce erosion and sedimentation from a construction site. For larger development projects, runoff can be intercepted or impounded in detention / sediment basins or wet ponds until the sediment and other pollutants can settle out, thereby minimizing the effects of pollution and nutrient / sediment loading on receiving water features.

Another area of urban stormwater management is the design and maintenance of the stormwater drainage system itself, usually managed by a municipality. The primary emphasis in the planning and management of the stormwater drainage systems is on preparing overall stormwater management plans, which incorporate both water quantity and quality considerations. Management practices applicable to stormwater management systems include stormwater detention and infiltration practices, incorporating natural drainage into the stormwater collection network where possible (rather than reliance on underground storm sewers), channel and shoreline stabilization, vegetation management, and protection of floodplains, wetlands and infiltration areas.



A note of caution is warranted here, however. In communities where planners are grappling with stormwater issues, routing stormwater to a wetland can appear to be an attractive solution that utilizes the sediment and nutrient retention functions of wetlands, while avoiding the need to dedicate developable land to stormwater treatment facilities. However, wetlands have a limited capacity to store peak flows of stormwater and retain sediments and nutrients before they become degraded. Furthermore, state stormwater standards prohibit the use of wetland areas for stormwater management. Algal blooms, duckweed blooms, monotypic stands of cattails, common reed, and reed canary grass are all signs that a wetland is being overloaded with nutrients. Consideration should be given to installing "treatment trains" or series of pollutant removal practices prior to discharging to the wetland itself (such as sedimentation forebays, infiltration trenches, etc.).

Given the potential for wetland degradation, plans for routing stormwater to a natural wetland or modifying a natural wetland to increase its storage capacity or water quality functions should be scrutinized carefully, even where upland stormwater treatment practices are present. Where site conditions are favorable, constructing an artificial wetland or infiltration basin in an upland area is a preferable stormwater management option, prior to discharge to a natural ecosystem.

Given the difficulty and expense of treating urban stormwater once it has reached surface waters, it is imperative that local governments and private property owners do as much as possible to attack the problem at the source; such as controlling litter, collecting leaf, yard, and garden waste, street cleaning, and controlling erosion and runoff from construction sites. In order to have a significant overall impact on urban nonpoint source pollution, it is necessary to pursue all of these approaches and management practices together – both public and private, on-site as well as off-site.

Adjacent lands can also impact the scenic qualities of a wetland. Incompatible development can be blocked from view by aesthetic barriers or some form of natural screening such as trees or shrubs. The adjacent development itself may also be altered in such a way as to make it more compatible with the scenic qualities of the wetland, such as using natural-looking colors and materials. Buffer strips of natural vegetation can also provide an effective barrier, helping to reduce the negative impacts of urbanization.

Farmers can also adopt conservation best management practices to protect wetlands from sediment, nutrients, and pesticides. Traditional practices generally include contour farming, conservation tillage, grassed waterways, diversions, and terraces. In some cases, structural measures may be required such as manure storage structures, or nutrient management plans used to systematically apply manure and fertilizers to cropland. In other cases, enrollment in the Wetland or Conservation Reserve Programs may be warranted – all part of an overall land management system.

The overall objective of upland management is to increase infiltration, reduce runoff, and minimize erosion and the potential for sedimentation. While soil loss and agricultural productivity is a concern nationally, in Dane County water quality is also a primary concern. The process for addressing these and related problems is continually evolving, each case beginning with a farm conservation plan. A conservation plan recommends protection measures or BMPs based on the natural resources a farmer has under his control. Since nutrients, especially nitrogen and phosphorus, are closely associated with the sediment and the stormwater runoff, BMPs can significantly decrease sediment and nutrient loading to area waters.

While traditional soil and water conservation practices have been developed to maintain agricultural productivity and help protect water resources, additional land management practices may be needed. These land management practices serve to increase infiltration, protect water quality, and improve habitat diversity and natural productivity. There are a variety of practices and incentive programs to choose from, based on a specific application. Buffer areas of natural vegetation are particularly effective in trapping sediment and nutrients, as well as providing nesting cover and habitat for wildlife. Wetlands no longer being actively farmed can likewise be restored, also trapping nutrients and sediment more effectively and capturing and releasing floodwaters more gradually.

The Dane County Land Conservation Division is often the first point of contact in providing assistance to farmers in addressing these concerns. In addition, programs such as the USDA Conservation Reserve and Wetland Reserve Programs provide funding to retire active farmland and restore wetlands in highly sensitive areas, especially along waterways. This is in addition to various other federal, state, and local incentive programs for protecting farmland and restoring wildlife habitat.

4. Education and Improved Access

Promoting a better understanding and appreciation of wetlands by the general public is an important part of any wetland management program. Awareness is the first step in protecting, enhancing and restoring these significant resources. Such awareness might best be achieved at a wetland site, making the wetland an educational tool, in and of itself. Examples include self-guided nature trails, guidebooks, signposts, etc. Wetlands are often not easily accessible. Depending upon the management strategy selected, it might be desirable to provide limited access to the wetland. Footpaths, trails and boardwalks are useful, sometimes simple forms of providing access for outdoor resource appreciation. In other cases it may be better to manage access by blocking entry points and posting signs to prevent misuse or damage to sensitive areas (e.g., all-terrain vehicles, four-wheel drives, etc.).

Education can also have a significant impact when property owners receive information on how their actions can affect a certain wetland. Case studies could be showcased describing examples of successful restoration projects and efforts. The principal aim is to increase public understanding of and appreciation for the values and functions of wetlands, and the need for their protection and enhancement. A change in attitude will bring about a change in an individual's actions. The key is that each person must realize their actions whether positive or negative, do make a difference.

E. Management Activities for Specific Wetland Functions

If it is determined that a particular function is of high quality for a wetland, the management goal may be to protect or enhance that particular function. Specific management strategies and tools can then be developed for the various functions exhibited by a particular wetland. Appendix B provides examples of activities that may be undertaken to promote various wetland functions.[17]

IV. WETLAND RESOURCE MANAGEMENT PROJECTS [1]

Public interest in the renewal of natural ecosystems has grown steadily during the past few decades. While protecting and preserving habitat is the key to environmental health, there is growing recognition that restoration and enhancement efforts are also needed to recover ecosystems that have been previously degraded or destroyed. Prior to the mid-1970s, the draining and destruction of wetlands were accepted practices – even encouraged. Wetlands were regarded as wastelands and many were ditched and drained to support agricultural uses, filled for urban development, diked for water impoundments or to reduce flooding, or dredged for marinas. Indirect impacts from pollutants contributed by rural and urban runoff, as well as invasion by non-native species continue to degrade and destroy the wetlands that remain.[2]

Wetlands vary considerably in size, type, and complexity. In some cases, one person's efforts (fencing out cows, providing a buffer of natural vegetation, or removing invasive exotic species) can substantially improve a degraded site. On the other hand, teamwork and the help of specialists are usually required for restoring large sites with extensive damage. A restoration project may require a team of people with expertise in areas such as ecology, hydrology, engineering, and planning, among other skills.[2]

A. Approaches to Wetland Resources Management

The first consideration for renewing wetland functions is to remove the factors causing the degradation or loss in the first place, and let nature do the repair. This method is often called the *passive approach*. For example, if wetland vegetation and water quality are degraded primarily as the result of livestock grazing, then removing them may be the only activity needed to restore the wetland ecosystem. Passive approaches are most appropriate when the degraded site still retains basic wetland characteristics and the source of the degradation can be stopped. The benefits of this approach include low cost and a high degree of certainty that the resulting wetland will be compatible with the surrounding landscape.[2]

For many sites, passive methods are not enough and a more *active approach* may be needed. Active approaches involve physical intervention in which humans control or manipulate site processes. Active methods may include excavating a site to remove fill, changing the water flow with control structures (e.g., weirs or culverts), intensive planting and seeding, exotic species control, etc. The design, engineering, construction, and cost for such work can be significant.[2]

Improving a wetland can be seen as lying along a spectrum, from the simplest and least costly activities to the most complicated and expensive (Figure 4). Each wetland can benefit from an individually tailored plan based on its history, level of disturbance, the plants and animals that are present, and the land use practices that occur on the surrounding landscape.

Figure 4. Wetlands Resource Management Spectrum of Activities

Source: Wisconsin Wetland Association 2000

Many wetlands can benefit from simple conservation management techniques. For example, a sedge meadow may only need a prescribed burn to help control invading brush. Managing this sedge meadow would protect an important wetland type and avoid the need to undertake a more expensive full-scale restoration later on.

There are many ways to actively manage a wetland area; the purpose of this Guide is not to outline all of them. Recommended management activities vary from site to site depending on location, the characteristics of the plant community, and management goals. A variety of relatively inexpensive and simple conservation activities can improve a wetland's health. The following conservation activities are examples of actions that can be taken to help target and address the negative effects of past and present disturbances to the wetland. The Wisconsin Wetland Inventory maps (DNR), and the *Wetlands of Dane County* (Bedford and Zimmerman) can provide useful background information in formulating wetland conservation projects. However, nothing can replace the information gained by visiting a potential site.

1. Simple Conservation Activities

Develop a buffer area – Upland buffer areas along wetlands, streams, and drainageways are important natural features which protect the resource and water quality and provide wildlife habitat, scenic beauty, and space for recreational trails. In both agricultural and urban areas, establishing a buffer zone protects wetlands from sedimentation, excess nutrients, and pollution from chemicals such as pesticides and herbicides applied to neighboring lawns and fields. A natural swath of vegetation of at least 100 feet is recommended for water quality protection. If this is not possible, a narrower buffer is better than none at all. Increasing buffer widths beyond 100 feet will be primarily beneficial for wildlife. Most protection and resource management activities can usually be accomplished within a buffer width of 300 feet. Some buffer designers propose a multiple zone approach that allows successively more intense land uses farther away from a core undisturbed zone.[4]

Resource agencies such as USFWS, DNR, NRCS and Dane County LCD and Parks Department often work with landowners in establishing buffer zones through cost-share and financial incentive programs. The Conservation Reserve and Wetland Reserve Programs are both familiar and often popular in rural areas. In urban and urbanizing areas, buffers may be required as a result of municipal zoning or other land use requirements.

Landscape with native plants – High quality uplands can provide important habitat for many wetland wildlife species. Developing and maintaining diverse upland plant communities will increase the health and diversity of a wetland. Planting a variety of native prairie grasses and wildflowers would be beneficial. In most cases, planting native shrubs and trees provides important nesting habitat, food, and shelter. In general, buffer strips planted with native prairie grasses are more effective than wooded buffer strips in terms of filtering runoff and preventing erosion. Consult a native plant nursery to select the best plantings for a particular site.

Fence out livestock – If cattle, horses, or other livestock graze in or very near the wetland, fence them out to 100 feet or more from the wetland's edge. If a pond or wetland serves as livestock drinking water, try to find an alternative water source. Cattle trampling can destroy sensitive wetland plants and break the wetland sod, providing an opportunity for invasive species to become established. Some species of wetland grasses and wildflowers are favorite food items and disappear quickly under grazing pressure. Manure also becomes a source of excess nutrient and unwanted seeds. Undesirable plants like reed canary grass often establish themselves in grazed wetlands and along their edges.

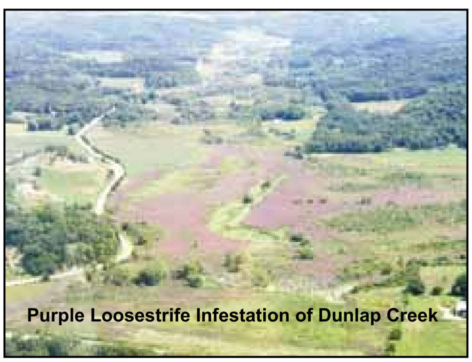
Control sources of pollution – Since wetlands, streams, rivers, and lakes are located downhill from other areas, they commonly collect chemicals which have been used in the watershed. Runoff from upland areas often carries large amounts of nutrients from commercial fertilizer, manure or pet wastes. Petroleum products, salt, or other compounds such as pesticides, herbicides, fungicides, and detergents are also carried in runoff. These pollutants may stress or kill sensitive wetland plants and animals. If possible, divert runoff to other areas or spread the water evenly over the landscape so that it filters slowly into the ground before reaching the wetland. One alternative is to divert excess stormwater into a buffer zone to slow its velocity and allow sediment and nutrients to settle before the water drains to the wetland. This strategy is applicable to both urban and rural areas alike. In other cases, detention basins or settling ponds may be needed. Likewise, effective construction erosion control measures should be used in all construction projects. When used properly, these measures protect disturbed soils from getting transported by the rainfall (through the use of mulch, polymers, phased disturbance, silt fencing, etc.), and capture the sediment that is carried in the runoff (sediment basins, diversion berms, and stone weepers, etc.) Any construction activity upslope from a wetland can lead to the erosion of the exposed soil into the wetland, and can be particularly destructive.

Control sources of excess water – Drain pipes, culverts, and ditches – specifically designed to drain excess water from upland sites – often empty into wetlands, flooding sensitive lowland habitats. Although wetlands are water-dependent, excessive water can alter the diversity and damage the integrity of a wetland ecosystem. For example, excess water in urban areas can change a valuable sedge meadow into a less desirable cattail marsh.

Control water outlets – In agricultural areas, many wetlands have historically been drained through ditching, installing underground drain tiles, and dredging channels to remove water away from the site. All that may be required to restore the hydrology of a wetland is to plug a ditch or drain conduit. However, undoing drainage systems can be a complicated endeavor, especially if it involves a drainage district or has the potential to affect neighboring properties.

Use heavy equipment only in the winter – To prevent damaging the soil surface and plant community, avoid taking heavy equipment into or near a wetland until the ground is frozen. Carefully consider the impacts before cutting trees or removing vegetation. Municipal zoning ordinances may regulate the removal of trees and vegetation along shoreland areas.

Control Invasive Plants – Some of the most common and persistent wetland plants are aggressive non-native or exotic species that out-compete native plants. The cumulative loss of habitat from invasive species cannot be overstated. The most common invasive wetland plants are reed canary grass, purple loosestrife, common reed grass, and buckthorn.



Purple Loosestrife Infestation of Dunlap Creek

A wetland restoration plan will likely need to address existing invasive species, as well as anticipate others that may colonize the site at some future time. More details on the biology and control of these invasive species can be found on DNR websites, among other sources.

Management with Fire – Wetlands associated with the prairie / oak savanna ecosystem in southern parts of the state were historically influenced by natural and human-caused fires. Prairie fires swept through sedge meadows and low prairies, often killing or setting back the encroaching shrubs and trees. These wetland ecosystems today benefit from prescribed burns that remove thatch and expose the soil to light, which allows sedges and forbs to germinate. Check with the local DNR office and discuss a prescribed burn with the local fire department. Training and assistance is provided by DNR, the Wisconsin Prescribed Fire Council, and local conservation organizations (e.g., Pheasants Forever, Prairie Enthusiasts, and others). DO NOT ATTEMPT A CONTROLLED BURN WITHOUT EXPERIENCED ASSISTANCE.

Mowing / Brush Removal – In situations where burning is not an option, mowing or brush removal can be just as effective in controlling encroaching brush. In winter when the ground is frozen, mow high, about 6 to 8 inches, to effectively remove brush without damaging the dormant vegetation. DO NOT MOW DURING THE NESTING SEASON.

Attracting Wildlife – Wildlife will be attracted to wetlands managed with the techniques mentioned previously, including invasive plant control, buffer zones planted with native species, and prescribed burns where appropriate. In addition, duck nest boxes with predator guards can increase nesting success. Many bird species use cavities for nesting, such as wood ducks, hooded mergansers, bluebirds, tree swallows, to name a few. In general, the best way to attract wildlife is to restore the landscape as closely as possible to how it existed prior to human interference.

2. Restoration Projects

In contrast to simple conservation activities, restoration projects are more complicated. They usually require considerable planning, financing, and may also need federal, state, and local permits. Outside sources of funding may be available to help finance the project. There are also various agencies and organizations available to provide technical advice and support.

Federal and state laws and municipal and county ordinances have been enacted to help protect wetlands. If a restoration project involves moving earth or diverting water, a permit will likely be needed.

The "Section 404" program is the primary federal program governing activities in wetlands. The goal of the program is to minimize adverse impacts to U.S. waters, including wetlands, and thus regulates filling, grading, and other land-disturbing activities. If the restoration is in an existing wetland, the Corps and the DNR need to be contacted. A Corps permit usually requires "water quality certification" from the DNR. A Corps permit is not valid without state water quality certification. The Corps may review the site and then ask to see final restoration plans before issuing or denying the permit.

For any restoration project, it is important to involve DNR staff early in the planning phase. Waterway and wetland laws regulate activities in Wisconsin wetlands and navigable waters. DNR staff comments and initial review can assist the applicant in preparing a plan which satisfies state statutes. If the plan is to alter the hydrology of the site with a ditch plug or filling, the DNR requires that the potential floodplain impacts and changes to flood elevations and to ditch characteristics be evaluated. A navigable waterway is a stream with a defined bed and bank, and sufficient flow sometime during the year to float the smallest water craft (such as a canoe). Public rights associated with the state's navigable waters are protected by law. State law protects fish, other aquatic life, wildlife, and the public use of the water.

In addition to state law, local units of government have various regulations concerning wetlands, floodplains, and shorelands through zoning ordinances. Check with the appropriate local unit of government (town, village, city or county) to see which ordinances might apply to a particular project.

An advantage of working with federal programs such as the Conservation Reserve and Wetlands Reserve programs is that agency staff can provide technical assistance and help expedite the permitting process. In addition, management activities such as prescribed burns or brush clearing in a shoreland zone may require local permits. In either case, it is usually best to get professional advice at the early stages of a project's design.

B. Evaluating Restoration Potential of a Site

An investigation into the history of a wetland is important when planning a restoration. An NRCS soil survey contains soil maps which are aerial photos overlain with black lines and abbreviations representing the mapped soil units. Soil descriptions and characteristics are provided in the associated tables and text. Areas containing hydric soils are the places to begin formulating a wetland restoration project (Map 1). NRCS offices also have Wetland Inventory maps. Inventory maps may include information on conditions, cropping, and drainage history of a particular site. NRCS Wetland Inventory maps show the following categories of land:

PC – ***Prior Converted*** refers to a former wetland that has been drained to the point that it can be farmed most of the time. The hydrology and vegetation have both been altered. They are generally characterized by the presence of wetland (hydric) soils, but lack wetland hydrology or vegetation.

FW – ***Farmed Wetlands*** are lands that are partially altered but because of wetness cannot be farmed every year. Usually the vegetation has been altered (cropped). They are generally characterized by the presence of wetland hydrology and soils, but lack wetland vegetation. Wetland vegetation can usually be re-established by discontinuing farming and allowing the land to revert back to its natural condition.

W – ***Wetlands*** generally possess the necessary wetland characteristics including wetland vegetation, hydrology, and soils. Some of these areas may have been altered or farmed in the past.

NW – ***Non-Wetland*** refers to upland areas or wetland areas that have been so well drained that they no longer have any wetland characteristics.

NI – ***Not Inventoried***, the lack of any symbol also indicates that the site has not been evaluated by NRCS.

These terms are used primarily for farm program purposes and are not absolute determinations of wetland condition. It should be realized that the history of these lands can be quite involved and complex. The land can also be subject to legal ramifications concerning various agricultural subsidies (e.g. Swampbuster), voluntary incentives (e.g. Conservation and Wetland Reserve Programs), and regulatory wetland permit programs. Nevertheless, these classifications can be helpful in focusing initial planning efforts. It is important to compare this information with information contained in DNR Wisconsin Wetland Inventory maps. This may provide additional insight into the former vegetation and hydrology of a site that may still be present in adjacent areas.[4]

1. Hydrology

To determine if a site is restorable, it is necessary to determine if, when, and how it was drained. By examining photos and talking to long-time local residents, it can be determined when a site was drained, if it was ditched or tiled, if it was cropped, and assemble the details of the history of the site. The most common hydrologic alterations are ditching, tile draining, and diversions or channelization.

2. Soils

An important factor in the restoration potential of a wetland is the condition of its soil. A significant disturbance common in wetlands is sedimentation caused by soil erosion from runoff following rainfall or rapid snowmelt. Over time, many wetlands within agricultural and urban watersheds have filled with sediment. Early settlers cut trees and grazed livestock on hillsides that eroded into the low-lying wetlands and streams. Farming practices over the last 100 years may have caused a significant loss of topsoil, and the eroded sediment has buried the original wetland soil. Road projects, construction for housing, and wetland filling all carry sediments to wetlands, especially along the edges. Depending on the landscape and history of a site, several inches to several feet of soil may be covering original wetland soils. In the unglaciated driftless area of southwest Wisconsin, post-settlement erosion from steep slopes has filled wetland and valleys with up to 20 feet of sediment. If sediment accumulation is suspected, it can be checked by digging a small trench in the soil. Typically, brown upland soils occur on top with buried black wetland soils below. Digging several pits along a line from the lowest elevation to near the upland edge will give a good idea of the amount of sedimentation on the site.

3. Vegetation

The characteristics of the plant communities of a site are also important in planning a restoration. What plants occur on the site? You don't have to be an expert botanist to gather valuable information. Learning to identify the few invasive plants is an important starting point. Use a field guide to identify the most common wetland plants at a site. It is easiest to identify plants when they are in bloom. A wetland area with many different types of plants and no invasive species, may indicate a good quality wetland community. Conversely, an area with only one or a few different types of plants, and one or more invasive species, may indicate a lower quality wetland community. Use reference sites for comparison. Are there similar areas nearby that have not been as severely altered; perhaps unditched sites or public lands nearby? What is the vegetation there?

Where wetland plants occur is also important because it denotes an area where some degree of wetland hydrology remains. Native plants may exist in such locations and may need to be protected and promoted. Areas with invasive weeds will need control measures as part of the restoration process.

4. Restoration Potential

The aim of all the background research is to determine the condition of a site, if and how it has been altered and drained, what the site may have looked like before the alterations took place, existing opportunities, and potential future impacts. This information will be used in deciding what steps to take in the restoration or management of the site. Generally there are three possibilities:

1. ***The wetland needs conservation and management.***
   A wetland site may be found to be relatively diverse and not significantly altered. If it supports a native plant community, it may be of great value as a conservation and protection site for native wetland plants, mammals, amphibians, reptiles, and birds. The site may require some management and little else. Restoration efforts may best be focused on upland buffers planted with native species to increase wildlife habitat and use.

2. ***The wetland is very degraded but can be restored.***
   The site may have undergone significant changes due to draining or cultivation, and supports little to no native wetland vegetation. In the process of researching the site, artificial drainage features may have been discovered, and there is enough information to plan the restoration. A survey may also be needed to ensure that neighboring lands will not be flooded if the original hydrologic conditions are restored.

   Restoration activities could cause problems for neighbors, especially if it alters the movement and amount of water on their land. Part of the original wetland may be owned by an adjacent landowner. One option is to join in partnership with the neighbor to restore a larger site, and to ensure that the hydrology is adequately restored. Another option might be to wait for neighboring land to come up for sale, or to scale the project back.

3. ***The wetland cannot be restored.***
   If a site lacks drainage features such as ditches or tile lines, there may be nothing that can be done to restore the hydrology, short of massive excavation. Excavation may also be fruitless if the water table has been drawn down on the site, or the site has been fully converted in some other way. Time, money, and effort may be more productively spent on restoring or reclaiming other, more promising sites.

   On the other hand, because of its low position in the watershed (since it was, after all, a wetland at one time) the area might be an ideal location for a stormwater management facility. Areas such as these can provide unique opportunities in addressing runoff from future development and should not be discounted entirely.

Potential wetland restoration sites need to be evaluated very carefully. Occasionally wetland restorationists purchase an existing wetland assuming they can flood it or dredge it to alter its function, only to find out later that they are unable to obtain the necessary DNR permits. Typically, DNR determines (for good reason) that the existing wetland should remain intact and not changed in type. For example, impounding water on a healthy sedge meadow or dredging a healthy wetland can destroy most of the natural plant and animal diversity these wetlands support. While the open water created in such a project may attract waterfowl initially, once wetlands are altered, they become prone to invasion by non-native plants, and their habitat value diminishes over time. They are also often very expensive to maintain. Instead, purchasing drained cropland with wetland soils and restoring the hydrology and vegetation is usually more effective, economical, and ecologically-sound. The focus should be on reclaiming a wetland that has been previously converted or lost.

Something else to consider, Chapter 88, Wis. Stats. creates county drainage boards and the drainage districts under their jurisdiction for the purpose of improving the drainage of agricultural land (Map 7). It is not permissible to fill, alter or otherwise disturb drainage ditches in a drainage district without the expressed consent of the Dane County Farm Drainage Board. Lateral drains on an individual property are not similarly restricted.

Look for the following features in a potential wetland restoration site:

- Not already mapped as being a wetland in either the Wisconsin Wetland Inventory (DNR), or Wetland Inventory (NRCS).
- NRCS mapped soils are hydric soils, indicating a wetland previously existed.
- NRCS mapped as "farmed wetland" (needing vegetation restoration), or "prior converted" wetland, needing hydrology and vegetation restoration).
- Site has functioning drainage features: drain tiles, ditches, diversions, pumps.
- Topography allows restoration of hydrology without affecting neighboring properties (may require a topographic survey).
- If actively cropped, wetland plants are found along the edges or between cropped plants.
- Buffer areas can be incorporated into upland portions of the site to lessen pollution impacts and sedimentation from adjacent land uses.

When purchasing prior converted cropland, it is a good idea to continue to have the site farmed and maintained until the wetland restoration project is ready to begin. Farming the site will keep invasive wetland weeds from taking over while the management and construction plans and permits are being finalized.

C. Tackling a Project [2]

Good planning is a critical, but often overlooked stage of the restoration process. Inadequate planning is often cited as a major reason projects fail to restore self-sustaining, naturally-functioning ecosystems.

Planning a wetland restoration is not a simple task. This important process is critical to the outcome of the project. Each plan will have an individualized goal and implementation approach based on its unique characteristics. It is usually a good idea to work with wetland consultants and restoration professionals during the planning phase. A final plan should consist of the following elements:[1]

- A set of restoration goals or "vision map" of what the site could look like when restored
- Plans for contracting professional services and applying for permits (if necessary)
- An estimate of the time required for each activity
- A budget for each step

1. Choosing a Site

Site selection is part of the planning process. All restoration and enhancement projects must be carefully selected in the watershed to meet specific hydrologic, soil, and vegetation requirements. Site selection is a process of setting goals and then looking for sites with characteristics that will support those goals. Alternatively, a particular site may offer significant opportunity for promoting one or more resource goals. Either way, especially in the early stages of planning, one site may be replaced by another site as the site conditions are examined or the project goals refined. The best approach to site selection is to be flexible.

There are six factors to consider when choosing a restoration or enhancement site:

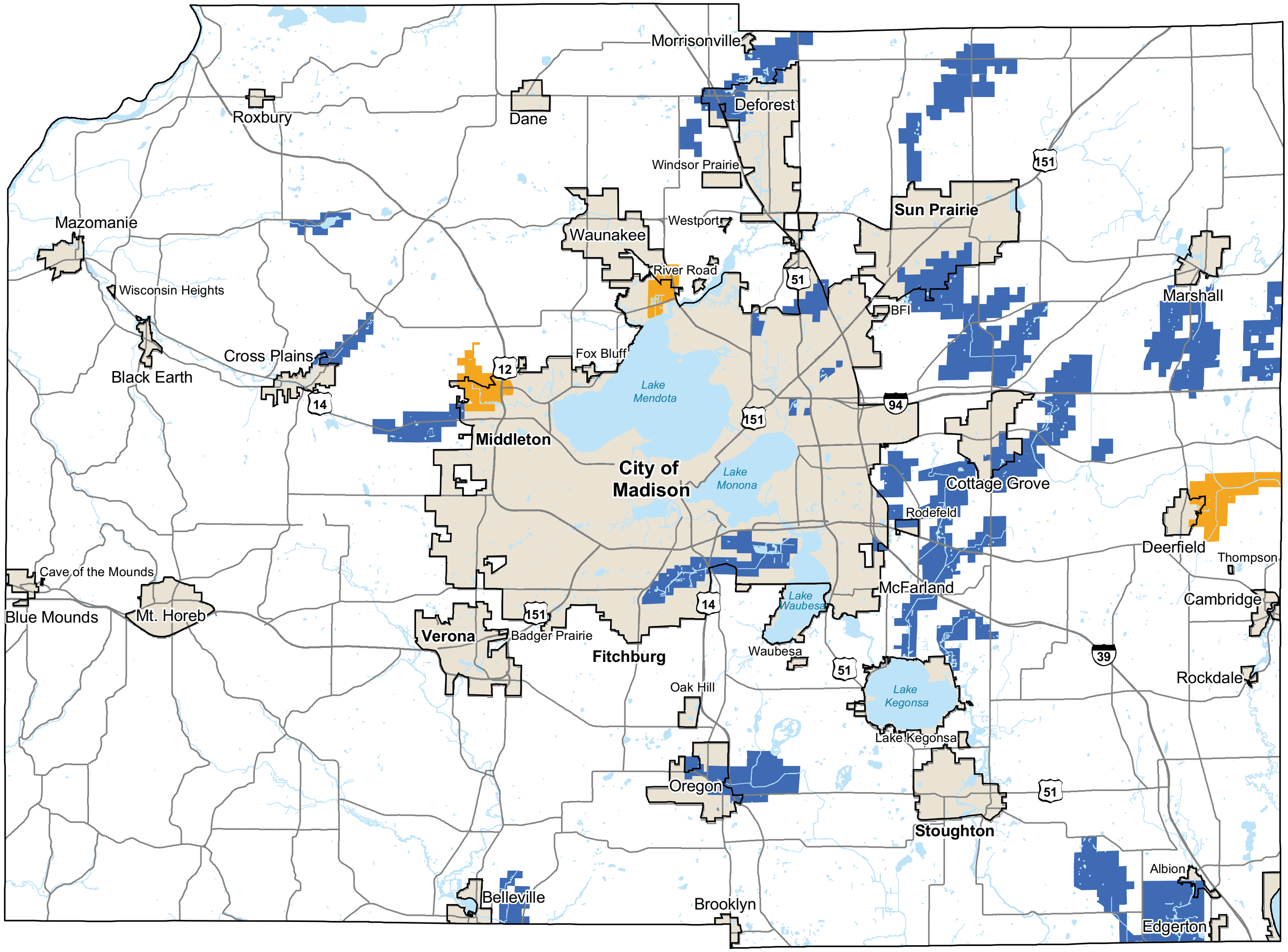
- Hydrology
- Topography and geology
- Soils
- Vegetation
- Land ownership
- Legal and permit requirements

Steps in the Planning / Implementation Process:

- Choose a project site
- Collect past and present information on the local landscape
- Collect past and present information on the project site
- Collect data on reference sites
- Formulate goals, objectives and target criteria based on watershed, project site, and reference site information
- Formulate goals, objectives and target criteria based on watershed, project site, and reference site information
- Choose from a selection of restoration tools
- Implementation
- Publicize the project
- Monitoring
- Adaptive management
- Long-term management
- Long-term protection options for landowners

Source: Interagency Workgroup on Wetland Restoration 2003

Information on the first four factors may be obtained by conducting a landscape / site evaluation (below). When choosing a project site, specifically consider how to achieve the necessary amount of water and duration of inundation for the proposed wetland type. Look for potential locations with the hydrology, topography, and geology typical of the type of wetland to be restored. Look also for the presence of wetland soils or drained wetland soils, which indicate places that would be appropriate for wetland restoration. Choosing a site that is close to an area with native wetland species or finding a site that already has native species might aid natural colonization of the site. The best sites are likely to be near wetlands similar to the target type. Determining the ownership of a project site is a critical step. Find out if there are any easements, liens, covenants, or other aspects of the parcel that may restrict its use for the project. Also consider the potential impact on neighboring properties. Agency requirements may also determine the suitability of a site for the intended project. Find out from local, state, and federal agencies what permits or authorizations may be necessary to undertake the project. Successful site selection produces locations that will support the wetland project goals. It is possible the



Drainage Districts

Dane County, Wisconsin

Active District | Inactive District | Service Area

Map 7

Projection:
Lambert Conformal Conic
Dane County Coordinates - NAD 83(91)

Prepared by: The Capital Area
Regional Planning Commission

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Miles

Jan. 2008
Drainage Districts: Land Conservation 2007
Service Area: CARPC 2008

goals may need to be revised based on the constraints of the available sites, if they do not exactly meet the original purposes.

2. Collecting past and present information on the local landscape

All wetlands exist in a landscape that has an enormous influence on how the wetland develops and functions. Look at the landscape and identify the major natural features and the patterns in the way these natural features occur. For example, is the area fairly flat, hilly, or sloped? These factors affect surface and groundwater drainage and ponding patterns. Are land uses in the surrounding landscape changing rapidly, as is often the case near urbanizing areas? The distribution of wetlands is influenced by natural features of watersheds, such as topography, soil types, groundwater, surface waters, floodplains, and vegetation communities. Identify the human influences. Typical land uses include urbanized lands, agriculture, grazing, forestland, open grassland, streams, lakes, wetlands, or park / recreational open space. Adjacent or regional land uses may or may not be compatible with restoring a former wetland or with the goals of a wetland enhancement project.

For example, urban and industrial areas may be sources of excess sediment and pollutants, such as oil and heavy metals that wash off paved areas into streams and wetlands. Agriculture is often a source of pesticides and fertilizers that can harm wetlands. These land uses can impair the health of newly established wetlands. On the other hand, farms are capable of providing valuable adjacent upland habitat if there are uncultivated buffer areas between the wetland and the fields. Consider not only existing land uses, but also future changes to the landscape such as encroaching development. Local zoning and planning documents can be examined to identify proposed conservation sites in relation to future development areas.

3. Collecting past and present information on the project site

The site assessment is a more focused version of the landscape evaluation. Past conditions can provide valuable information on impacts to the site that may affect restoration outcomes. Characterize the current conditions of the site, such as the current hydrology, soils, vegetation, and water quality. Look at human structures, land use, and adjacent land use impacts. Talk to agencies about appropriate regulations. Talk to adjacent landowners and identify important social or economic factors that could affect the restoration. Conduct a functional assessment and land use and policy evaluation as discussed in Chapter III of this Guide.

4. Collecting data on reference sites

A standard method for setting restoration targets is to base them on the wetland conditions prior to alteration. However, in most cases, there is not enough detailed background information on plant species and cover, animal species and abundance, soil conditions, or hydrology to set target criteria. Because historical information is often missing, most restorationists depend on local "reference sites," which are sites that represent the least disturbed wetlands of the target type in the area. The ecological conditions at reference sites usually indicate the natural communities that can be supported under current conditions. Changes to the land, water sources, or other aspects of the surrounding landscape since the Europeans first arrived usually make it difficult or impossible to restore a wetland to its original or pristine condition. Reference sites provide insight into what is possible now. To collect reference site data, examine the least altered wetlands nearby that are in the same landscape position (e.g., along a river, in an isolated depression, etc.). Looking at multiple wetlands can help in understanding the natural range of variation for a particular wetland type.

Reference sites are valuable models of the ecological conditions that are achievable. Group I wetlands (discussed in Chapter V) provide useful reference sites – and should themselves be protected for this very reason.

5. Formulating goals, objectives, and target criteria based on watershed, project site, and reference site information

> "The first rule of restoration is to have a goal….You have to know where you're headed in order to know how to get there and when you've arrived." — Jeff Nania, Wisconsin Waterfowl Association.

Goals are general statements about the project strategy and the desired results, and reflect the motivations for undertaking a project.

The following are some examples of restoration goals:[1]

Historic Restoration – returning a site to a close approximation of the original wetland hydrology and condition.

Restoration Within Limits – often only a part of the original wetland may be owned, and some ditches may need to be retained to avoid flooding neighboring lots. Nevertheless, it may still be worthwhile to create the best restoration possible within the constraints of existing circumstances.

Small Shallow Marsh Scrapes – creating a series of shallow water bodies that attract wetland wildlife in lands formerly converted from wetlands to cropland. Usually successful at attracting waterfowl, these projects may not be self-sustaining wetlands in the long term. This approach is not recommended for functional native wetlands.

Wetland Resources Management / Enhancement – these projects aim to increase the overall plant and animal diversity on a site through active management. Many sites are severely degraded by invasive plants. An example of a resource management / enhancement plan would be to initiate a prescribed burn, eliminate the invasive plant species, and plant a buffer zone of native prairie grasses to encourage wildlife habitat and nesting areas.

Keep in mind, enhancement is not bulldozing a pond in the middle of a wetland and heaping up spoil piles around the perimeter of the newly constructed pond. The perceived value of open water to waterfowl will be at the expense of many other species. The barren, drier spoil piles are also ideal sites for reed canary grass to become established. The water flowing into the pond may also drain the wetland surrounding the pond, increasing the likelihood of reed canary grass thriving there as well. Once this invasive grass takes hold, the pond has very limited wildlife use. All other native plants are shaded out. Frogs, toads, salamanders, and turtles cannot navigate through the combined obstacle of spoil piles and reed canary thatch. The overall diversity of the site is ultimately diminished.

Instead, positive wetland goals might be to promote a diversity of native plant and animal species, to improve water quality in local streams, or to reduce the impacts of flooding. Goals provide an overall framework or vision for the site, in the context of the local environment.

The next step is to develop ***objectives*** that provide specific targets. These may be focused on hydrology, soils, topography, or biological factors that need to be changed on the project site in order to establish or restore a wetland. Progress is determined by measuring performance standards or ***target criteria*** that are linked to each objective. Target criteria often include a numerical end-point and a time line to reach that endpoint. Target criteria should have the following characteristics:

- measurable and objective
- collectable with simple methods that generate comparable data
- produce repeatable results

Incremental targets may also be established to reflect how the site is likely to change as it evolves from its initial condition toward a more established community. Examples might include monitoring water levels, flow rates, and patterns; plant and wildlife surveys; water quality analyses; etc.

Non-ecological factors such as agency requirements and socioeconomic factors can alter what may reasonably be achieved (financial resources, available labor / volunteer resources, and concerns of adjacent landowners, etc.). Discuss the project goals and objectives with agencies that regulate and manage natural resources. Do not assume that wetland restoration or enhancement projects are exempt from permits or other authorization – some are, but most are not.

A major limiting factor is money. Typically, the more engineering that is needed the more expensive a project will be. Various sources of both public and private resources are available to help finance a project including federal, state, and local programs and grants, business donations, and volunteer services through private organizations or groups.

Other potential constraints may arise from adjacent landowners or lack of community support. Local communities should be involved if the project could result in controversial effects on public lands. Neighbors may feel that the project could damage their property through potential flooding or other effects. Consult local experts and agencies if there appear to be any potential community or adjacent landowner issues.

6. Deciding on methods for implementing changes designed to meet the goals and objectives

In general, the best approach is to use the simplest methods possible because the more complex a wetland project, the greater the chance that something may go wrong. Implementation should be achieved through the least destructive means and the most ecologically-sound solutions possible.

If natural processes cannot be initiated with passive methods, then implementation should focus on bioengineering or soft engineering solutions over traditional hard engineering solutions. Soft, engineering methods are based on natural processes. This approach is an alternative to the traditional hard engineering solutions that often replace ecosystem functions with human-designed structures. For example, hard engineering solutions to controlling erosion along a stream bank, such as rip rap, destroys natural wetland processes. Instead, soft engineering solutions to stream bank erosion might include the following:

- planting native vegetation, especially fast growing species such as willows
- shoring banks with logs that will decompose in time
- stabilizing the bank with "geotextile materials" that do not decompose, but are covered with soil and allow root growth through the material

Prioritize activities and start with those that add the greatest value to wetland habitat and species diversity. Prescribed burns, brush control, tree plantings, berm or plug repair, maintenance of upland buffer areas, and controlling invasive plants are all important management activities but will vary in importance depending on the site. The most worthwhile activities should focus on providing wildlife habitat by establishing varied native vegetation.[1]

Table 3 contains some of the most common and obvious examples of wetland damage and typical corrective measures. The table also lists some precautions. If the damage is severe or has been present for a long time, reversing the damage may not be as simple as it may first appear. Appendix B contains additional examples of actions that may be taken to restore or enhance wetland characteristics.

Table 3. Common Wetland Problems and Corrective Measures

Wetland Damage	Reason for Damage	Suggested Correction	*Considerations*
Hydrology			
Water Quality Impairment	Excess sediment or nutrients in runoff from adjacent area	Work to change local land use practices; install vegetated buffers/ swales/constructed treatment wetlands; install sediment traps.	Sediment traps will need periodic cleaning; an expert may be needed to design buffers and swales.
Water Quality Impairment	Excess sediments from eroding slopes	Stabilize slopes with vegetation/ biodegradable structures	Many corrective methods exist; look for most sustainable and effective methods.
Altered Hydrology (drained)	Ditching or tile drains	Fill or plug ditches or drains; break tiles.	Organic soil may have decomposed so that the elevation of the site is lower than it used to be.
Altered Hydrology (drained)	Former wetland diked off from its water sources	Remove/breach dikes or install water control structures.	Substrate elevation may not be correct for vegetation; add soil or control water level with low maintenance structures.
Altered Hydrology (constrained)	Road crossing with undersized culvert	Replace with properly sized culvert or with a bridge.	Hydrologic expert needed to correct this.
Soils			
Raised Elevation	Soil dumping or fill	Remove material.	Fill may have compressed soil to lower than initial elevation; take steps to avoid erosion.
Subsidence	Soil removal; oxidation of organics; groundwater removal	Add fill; allow natural sedimentation.	Fill must support target wetland; test fill for toxic compounds.
Toxic Soils	By-product of on-site or off-site industrial process; dumping; leaching and concentration of natural compounds.	Treatment systems or methods appropriate to the soil / pollutants; remove material; cover with appropriate soil.	Work with experts to choose treatment methods that cause least amount of indirect damage; choose a different site to avoid serious toxin problems (also potential environmental liability issues).
Vegetation			
Loss of Biodiversity	Change in original habitat	Restore native plant and animal community using natural processes.	Allow species to colonize naturally; import species as appropriate.
Loss of Native Plant Species	Invasive and/or non-native plants; change in hydrology; change in land use	Remove invasive, non-native plants (allow native plants to re-colonize); try to reverse changes in hydrology.	Pick lowest impact removal method; repeat removal as non-natives re-invade; alter conditions to discourage non-native species.

Source: Interagency Workgroup on Wetland Restoration 2003

7. Restoration Tools [1]

Wetland restorationists have assembled a “bag of tools” over the years and a plan will likely use one or a combination of these tools. Which combination of tools will depend on the site, available resources, and intended goals.

Ditch plugs
Many wetlands sites have a ditch or several ditches that drain the wetland, effectively lowering the water level and making the wetland more vulnerable to invasive species. The quickest and least expensive option for reversing the harmful effect of a ditch is to plug it at the lowest point. By pushing an earthen plug into the ditch, the drainage stops and water backs up into the wetland. Current recommendations are to plug at least 150 feet of ditch if the soils are organic and 100 feet if soils are mineral. The plug should rise 33 to 20 percent above grade to compensate for soil settling. A gentle slope with at least a 1 to 8 rise to run ratio is best. Ditch plugs may require periodic extensive maintenance to ensure that they remain functional.

Ditch fill and Re-contouring
Back filling the entire ditch is an alternative to a plug. Typically, ditches are rimmed by a parallel soil berm, called a spoil bank, made up of the earth excavated when the land was ditched. Spoils can create an unnatural rise in topography that serves as a barrier to water flowing across the site. The spoil piles can harbor invasive plants or other upland weeds, and are a conduit for predators to readily enter and traverse the wetland.

To return the site to its historic topography, ditches are filled with the spoil piles from either side of the ditch, the land is recontoured to approximate the original topography of the site. While ditch filling may be more costly than using a plug, the actual cost per acre is less because more wetland can be restored using a ditch fill than with a ditch plug alone. The ditch fill also does not usually require further maintenance, as may a ditch plug.

Drain Tile
Drain tiles are perforated, hollow tubes buried underground, usually in an array of parallel tile lines. As water infiltrates into the soil, it collects in the tile and drains off site to a ditch or stream. Drain tiles are very efficient at water removal. Once the lines are located, remove them and fill the trench. Clay tiles can be crushed and reburied.

Stream Channelization and Realignment
As well as being tiled or ditched, a site may include stream channelization and realignments as well. For example, a meandering stream may have been moved and its channel straightened, widened, and deepened. It may be possible to restructure and restore the original waterway using old aerial photos and the topography of the site. The spoil is put back into the ditch and the site regraded as close as possible to the historic grades of the original meandering stream channel. Reconfiguring a stream requires experienced assistance. Any stream work will require DNR permits.

Berms, Dikes, Dams, and Levees

Collectively referred to as berms, these structures must be properly designed to prevent failure due to over-topping, seepage, sloughing, or collapse. Berms are often used to increase water levels in a wetland above historic levels to create open water. They can also protect a neighboring property from flooding. A DNR permit may be required, depending on how much water the embankment will hold.

Water Control Structures

Water control structures control flows into and out of a wetland. Such structures include spillways, pipes with drop inlets, and stoplog water controls. Spillways, a low point in a berm, provide an escape for excess water above the design level. Stoplog and drop inlet structures give the owner or manager of the property more control over filing or draining the area. Berms in conjunction with water control structures can be used to temporarily control invasive species and to manage for a native plant community. However, long-term reliance on water control structures is cost-prohibitive and does not restore self-sustaining wetland ecosystems.

Scrapes

Many small "pothole" wetlands are being constructed, often in clusters, in cropland across the state. On suitable sites, topsoil is stripped away to expose sub-surface soils, which are removed to create a berm. Then the topsoil, composed of wetland soils and seed bank is redistributed over the surface of the newly formed basin. These pothole wetlands often create suitable wetland habitat for waterfowl and amphibians. Because no single design can fill all wildlife habitat requirements, clusters of scrapes should vary in size, shape, and depth to create habitat diversity.

A common problem for scrapes, however, comes from wind-borne seeds of prolific wetland plants, such as cattails and willows. Purple loosestrife and reed canary grass also commonly move into these sites after a few years. While scrapes may provide an appropriate remedy in some situations, in the long term they may not become self-sustaining wetlands. A small scrape constructed within an area that could support a much larger restoration does not realize the full potential of the site.

Native Vegetation: Seeding, Planting, and Management

A functioning wetland needs a rich mix of native vegetation. Wetland vegetation provides food, cover, and habitat for wildlife, in addition to scenic beauty. The mixture of plants that colonize a site can indicate the health and diversity of a successful restoration. Reintroducing native vegetation on a wetland site can be done a number of ways:

> Leave Existing Plant Communities Intact – great care should be taken to avoid damaging these reservoirs of native plants during restoration.
>
> Rely on the Native Seed Bank – the length of time some dormant seeds remain viable is extraordinary. Some restorations rely on this seed bank to germinate and grow after historic water levels have been re-established.
>
> Rely on Colonization from other Wetlands – seeds travel on water, wind, duck feathers, animal fur, and in bird and animal droppings. Likewise, invasive exotic species can also arrive quickly and establish dominance. In general, relying on passive re-colonization in a restored wetland may prove disappointing. More active management may thus be needed.

Planting Seed, Rootstock, Shrubs and Trees – native vegetation can be collected by hand or purchased from a local supplier who grows or collects local plant stock. It is important to use local Wisconsin plants in restoration. Plants imported from other regions of the country may be less successful and can contaminate the local "gene pool."

Upland Plantings – the edge of the wetland gradually merges with uplands and wetland wildlife species travel and use uplands for nesting, food, and shelter. Planting upland areas also buffers wetlands from invasive species, sediment, and polluted runoff. For example, upland plantings could include re-creating natural prairie with warm season prairie grasses and flowers, shrubs, or tree plantings, depending on the site. A buffer should be at least 100 feet wide, with an optimum width of 300 feet or more.

8. Implementation

After determining what site changes are necessary, prepare to implement the changes by developing project designs such as field procedures, construction plans, and specifications. The work should be described as specific as possible but in easy-to-understand language, especially if volunteers will be doing the work.

Most projects will need some level of documentation to direct implementation; more complex projects will probably need construction plans. Good designs include at least these elements:

- specific / diagrams for all installation / construction features
- descriptions of site preparations needed
- descriptions of how to install features, such as plants, etc.
- plans to prevent construction impacts, such as erosion
- lists of plant species, numbers to be planted, and planting locations
- plans for site maintenance
- monitoring features, such as groundwater wells, or gages
- consider educational elements, such as exhibits, signage and boardwalks

The design of restoration or enhancement projects can be highly technical and may require hydrologists, ecologists, engineers, or landscape architects. Construction documents are usually prepared by engineers for use by contractors in the field for constructing a project. Try to find firms that have done wetland restoration work in the past. Be sure the ecological advisors work with the engineers to produce plans that accurately reflect the methods developed for the project. During construction, have the work inspected to be sure that the plans are being followed accurately.

Each restoration project is unique and should have its own specific plan. Poor planning and poor construction are the two most common reasons why wetland restoration projects fail, and repairing a poorly constructed project is usually difficult and sometimes impossible. The project timetable will be influenced by size, the permitting process, the kind of work being done, and when contractors can schedule the work. Construction schedules depend on weather and site conditions. Some soil types can only be accessed during the driest time of year or in winter when frozen ground can support heavy equipment. Planting and seeding have timetables as well. Plantings occur in October and November before the ground freezes, or in April and May after the thaw but before temperatures are high.[1]

9. Publicize the project

After talking with the neighbors and the appropriate agencies, and after developing feasible goals and objectives, consider writing a small article for the local newsletter or newspaper describing the project and its benefits. Publicity at the end of the planning phase lets people know about the work and may turn up local issues that may not have been considered. Often, publicity builds public support and encourages volunteers to help install and monitor the project.

10. Monitoring

A common misconception about wetland restoration or enhancement is that once a project is implemented, nature will do the rest. In reality, many wetland projects need mid-course corrective actions such as re-planting seedlings that were washed away by a storm, and digging more channels to get water to remote parts of the site.

Monitoring is systematic data collection that provides information on changes that can indicate problems or progress towards target criteria or performance standards. This, in turn, will indicate whether the project goals are being met. It can also give information on routine maintenance that may be necessary to keep the site functioning well. Monitoring information should be compared to the target standards to assess whether the site is developing as planned. If it is not, determine whether remedial measures should be taken or whether the original goals should be reevaluated.

The parameters to be measured at a particular site are based on the project objectives and target criteria. For example, the speed at which the plant community establishes itself will probably be the most important change to document. Plants that colonize the site may be used as a measure of progress in achieving restoration goals. Primary objectives might include restoring historic hydrology at the site and colonization by a high number of native plant species. As water levels stabilize and the plants become established, birds, amphibians, and mammals will make greater use of the wetland. One of the most important activities is to keep invasive species from becoming established. Immediate action can control invasive species.[1]

Monitoring should be considered a long-term activity. At a minimum, a site should be monitored until it meets all performance standards, which can take from several years to decades. In the meantime, use the monitoring data to inform others, present the project to local groups, and write articles for local newspapers or professional journals. This information will allow scientists, policy-makers, and landowners to make better decisions about wetland resources, including wetland restoration, enhancement, and protection techniques.

11. Adaptive Management

Natural ecosystems are complex. Even starting out with detailed information about a site, the way it responds to changes can be unpredictable. As the project progresses it may need to be nudged back in line, particularly if it is progressing in a way different than what was planned. Unforeseen events may also occur, such as an unexpected plant species colonizing the site. These unforeseen elements may be beneficial or detrimental. In either case, decisions need to be made about how to adapt the project to account for the new element.

Adaptive management is a technique that involves incorporating new information into all stages of a wetland project. Using adaptive management means continuously evaluating the project in light of new information, generating ideas and making decisions about how to further refine the project. This process is similar to a "feedback loop" in which information about what is happening determines how best to go forward with the next step of the project. Adaptive management is an ongoing process that should be applied through the life of the project.

For example, if the site is not developing as anticipated, there are two basic options: make changes to the site to try to get it "back on track," or allow the site to continue developing in the new direction. Since natural ecosystems are variable, sites may diverge from objectives, but this difference may not require significant changes to the site. For example, the site may be developing a native wetland community, but one that is different from what was expected. If this new community is what might be considered normal for the wetland type and the watershed, it may not be necessary to change it.

Typical problems include the hydrology not being properly restored, incorrect aquatic elevations, and rapid invasions by non-native species. The following are some typical remedial measures:

- re-grading the site to correct the aquatic elevations
- contouring channels or installing structures to redirect water flow
- adjusting water control structures or altering structure operations
- removing invasive plants, re-planting native species, or installing a cover crop

12. Long-Term Management

A wetland is an ecosystem that evolves and changes in response to the surrounding environment. It is not realistic to expect that when the implementation stage is complete, the work is done. Long-term management is often required to keep the site functioning as it was designed to function, and to keep human impacts to a minimum. For example, long-term management is often needed in the following circumstances:

- maintain a specific plant community by burning, mowing, or otherwise managing the vegetation on a periodic basis
- address problems such as invasive species or excessive sediment deposition
- address unexpected events such as structural failure (see Adaptive Management above)

In addition, a long-term management plan may be needed to identify who will be responsible for the site and what kinds of activities should or should not occur there.

13. Long-Term Protection Options for Landowners [1]

Land use planning, development, and agricultural activities within a watershed can impact a wetland restoration. For example, a new subdivision up-slope from the site can have adverse impacts due to sedimentation or chemical pollution from runoff. Particular attention should be paid to land use practices if a stream or river passes through the wetland, and necessary measures taken to address these problems as they occur. This may include contacting the proper authorities for blatant pollution violations, as well as fostering citizen-support and political advocacy for land use decision-making and natural resources planning.

A well-restored wetland should outlive us all. Therefore, long-term security should be considered. The following measures are among the simplest methods of providing long-term protection for a site

Donation
Donation of land is an effective and simple way to protect it. A donor can give land to a qualified charitable conservation organization or unit of government for conservation purposes and receive tax benefits.

Purchase of Easements/Development Rights
An easement is a voluntary agreement used to transfer certain rights of use to a qualified non-profit organization, government body, or other legal entity without transferring title of the land. The landowner can receive tax benefits or cash payment, depending on the situation. Easements contain restrictions that run with the land for a set period of time, sometimes in perpetuity. An easement is a flexible and effective means of accomplishing resource protection goals while the landowner continues to own the property.

Deed Restrictions or Covenants
Deed restrictions are clauses placed in deeds restricting the future use of a property. When land containing a wetland is transferred to another property owner, deed restrictions can prohibit uses or activities that would destroy, damage, or modify the wetland. Unlike conservation easements, which provide long-term protection because of third-party oversight, the enforcement of deed restrictions is less reliable, and a future landowner can petition the court to vacate the deed restriction, or simply just ignore it. Deed restrictions are enforced by the zoning authority and can be in perpetuity.

Sale
Sometimes landowners must sell their land containing wetland for financial or other reasons. If they are concerned about its future protection, they may consider some of the financial options above, or seek a purchaser who shares their values and goals for wetland protection and management. Local nonprofit conservation organizations, friends groups, land conservancies,

hunting clubs, and land trusts may be interested in the property. In Dane County, The Natural Heritage Land Trust would be a good place to start. They have significant experience working with landowners and bringing groups together focused on resource conservation and protection. In addition, state and federal government agencies or local units of government may be interested in the property for the purpose of preserving community open space and outdoor recreation areas, especially if the property lies adjacent or is connected to another public area or in a planned environmental corridor.

The options listed above can be used individually or in combination. What works best depends on a variety of factors that need to be considered before any action is taken. Voluntary protection efforts have increased in recent years. While income and property tax reductions are incentives, the greater driving forces may be the conservation sentiment of the landowner and of the community. Landowners and neighbors who have a strong sense of stewardship will continue to seek ways to protect their land in the long term, and to allow future generations to appreciate and enjoy the wetlands as they have done.

D. Financial and Technical Assistance [1]

Since wetlands are deemed widely valuable, various federal, state, and private programs exist to assist landowners in protecting, restoring, and enhancing wetlands – including adjacent uplands. These programs offer landowners technical assistance and advice, help with the regulatory process, and sometimes provide funding.

1. Federal Programs

Wetland Reserve Program (WRP)
http://www.nrcs.usda.gov/programs/wrp/
Administered by the local office of the Natural Resources Conservation Service, WRP is a voluntary program offering landowners financial aid for restoring wetlands. If a property is accepted into the program, NRCS staff will provide technical assistance for design and implementation of the restoration project. The permitting is simpler for these sponsored restorations. The levels of involvement vary depending on the number of years in the program (10-year, 30-year, and permanent easements are available), the amount of cost sharing or cash payments involved, and the restriction placed on the property.

Conservation Reserve Program (CRP
http://www.nrcs.usda.gov/programs/crp/
One of the primary conservation programs authorized under the Federal Farm Bill, CRP provides incentives for farmers to take highly erodible cropland or land contributing to a serious water quality problem out of production for 10 to 15 years. The program, administered by the USDA Farm Service Agency, provides landowners with technical assistance in design, permitting, and implementation of wetland restoration projects. Landowners receive an annual rental payment while the land is in the reserve program, although the landowner may be required to share up to 50 percent of the costs of restoration. In addition, the Conservation Reserve Enhancement Program (CREP) is a new initiative that expands the CRP's effectiveness. Landowners can receive additional rental payments and cost-share incentives to establish long-term, resource-conservation covers on eligible land.

Environmental Quality Incentives Program (EQIP)
http://www.wi.nrcs.usda.gov/programs/eqip.html
NRCS administers EQIP, which provides cost sharing up to 75 percent for certain conservation practices that support water and natural resource maintenance and improvement. Examples include grassed waterways, filter strips, manure management facilities, among others. The program also encourages land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management.

Wildlife Habitat Incentives Program (WHIP)
http://www.wi.nrcs.usda.gov/programs/whip.html
WHIP provides technical assistance and cost-share agreements where NRCS pays up to 75% of the cost of establishing and improving wildlife habitat. Participants prepare a wildlife habitat development plan in consultation with their local conservation district. The plan describes landowner goals and practices for improving wildlife habitat, and includes an installation schedule and details on the steps necessary to maintain the habitat for the life of the agreement (typically 5-10 year contracts).

Partners for Fish and Wildlife (PFW)
http://ecos.fws.gov/partners/viewContent.do?viewPage=home
The U.S. Fish and Wildlife Service (FWS) sponsors PFW to assist private landowners with wetland and associated upland habitat restoration. FWS will pay up to 100 percent of restoration costs, depending on the quality of the site and nature of the work. Most funding is typically directed towards the restoration of wetland hydrology for such projects as installing ditch plugs or breaking drain tiles. In addition, the PFW has landowner assistance available for upland buffer areas associated with wetlands or projects protecting threatened or endangered species.

North American Wetland Conservation Act (NAWCA)
http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm

The FWS provides funds for wetland conservation projects carried out by partnerships between public and private organizations. Funds can be used to acquire land and water rights, or to restore, manage, or enhance wetland systems and other habitat for migratory birds and other fish and wildlife. All funds must be administered for the long-term conservation of the associated lands and waters.

2. State Programs

The Wisconsin DNR Bureau of Wildlife Management provides funding for wetland restoration in priority areas of the state. Funding for wetland restoration efforts on private lands comes from the sale of the state waterfowl hunting stamp and federal funds. DNR Wildlife Biologists can also assist landowners with technical advice about how to best design a wetland restoration to maximize wildlife benefits.

The DNR also provides funding to municipalities, private conservation groups, and watershed associations through various River and Lake Planning and Protection grants, and Targeted Resource Management grant programs.

In addition, the Wisconsin Forest Landowner Grant Program (WFLGP) provides funds to protect and enhance forests, prairies, wetlands, and water bodies. WFLGP reimburses up to 65 percent of the cost of eligible practices to qualified landowners.

3. Private Groups and Associations

There are also a number of private non-profit organizations dedicated to wetland restoration. They provide direct assistance and funding to match with federal and state programs. The following is a partial list of such organizations:

- Wisconsin Wetlands Association http://www.wiscwetlands.org/
- Wisconsin Waterfowl Association http://www.wisducks.org/
- Ducks Unlimited http://www.ducks.org/states/25/index.html
- Wings Over Wisconsin http://www.wingsoverwisconsin.org/
- Pheasants Forever http://www.pheasantsforever.org/
- Local Watershed Associations and Friends Groups http://danewaters.com/other/friends.aspx
- Natural Heritage Land Trust http://www.nhlt.org/

4. Private Consultants

Some restoration projects may require more assistance than what is available from state and federal programs or private organizations. The U.S. Army Corps keeps an updated list of wetland consultants. The DNR also maintains a list of consultants and native plant nurseries that carry wetland species. Other firms may be found under Environmental and Ecological Services in the local phone directory, or asking the advice of individuals or associations with wetland restoration experience. A wetland consultant experienced in wetland restoration can provide site planning, help avoid and minimize adverse wetland impacts, and assist with planting and site management.

Tamarack Bog Near Goose Lake

V. WETLAND RESOURCE MANAGEMENT OPPORTUNITIES [3]

Wetland resource management opportunities exist throughout Dane County. It is largely an issue of priority and finding the necessary resources to tackle a project.

As part of the resource inventory foundation of the *Dane County Water Quality Plan*, a study of wetlands in Dane County was conducted by Bedford and Zimmerman in 1974. The purpose of the study was to provide the basis for planning, decision-making, and strategies for managing wetland resources in the county. Although the study was conducted in the early 1970s and needs to be updated, much of the information is still useful today.

The wetlands covered in the study included all of those known or suspected at the time to be of particular value. The most valuable of these were studied in detail. The 1974 report contains narrative descriptions, plant lists, and detailed maps of the most significant wetlands. This is a particularly useful reference for those individuals in the early stages of designing their own wetland project.

The authors state, however, that they did not perform as extensive an inventory of the Drumlin and Marsh area. Because of its value for pheasant habitat, it had already received considerable attention from the wildlife management section of DNR. Their report was meant to complement rather than repeat DNR efforts. The emphasis of the study was also primarily focused on locating and evaluating those wetlands that still function substantially as they did in pre-settlement times.

The study was conducted on the belief that the information necessary to determine the type of wetland (such as deep-water marsh, or sedge meadow), its condition (such as eutrophic, or partly drained), and its value can be read from indicators seen in the field. Additional information concerning the hydrology, water chemistry, and vegetation in a wetland can provide a clearer and deeper understanding of its condition and value.

A. Wetland Groupings

Wetlands are grouped based on a rough-cut assessment of their present or potential biological condition, scientific value, public use, extent of degradation, and immediate or long-range threats. The results are intended to be used in the service of the following activities:

- planning wetland acquisition;
- preventing wetland destruction;
- understanding the general effects of existing as well as future wetland loss;
- establishing guidelines for use, management, and preservation of wetlands;
- designating wetlands of outstanding scientific and educational value and those most suited for recreation and public use;
- identifying wetlands in need of further studies.

The purpose of grouping wetlands is to facilitate decision-making in planning and design. While all wetlands have value, decisions must sometimes be made as to where specific approaches and efforts may best be targeted.

It should be pointed out that a missing or low grouping should not be interpreted that an area may be further degraded or destroyed. Instead, it provides insight into the management strategy most appropriately targeted to a particular site. Since large wetland areas were historically converted and the competition for land is intense, any remaining remnant of the natural soils or plant and animal communities is worth preserving. Even though a wetland may be degraded or aesthetically unappealing, it still serves an important purpose and function in the hydrologic regime of the watershed. As long as anything natural remains, there is the possibility of improvement to the point where the area can be restored to a functioning wetland.

Wetlands have been placed in different groups based primarily on their biological condition (i.e., excellent, good, fair, poor, non-existent). Biological condition was based on the intensive fieldwork of Bedford and Zimmerman in 1974 taking into account:

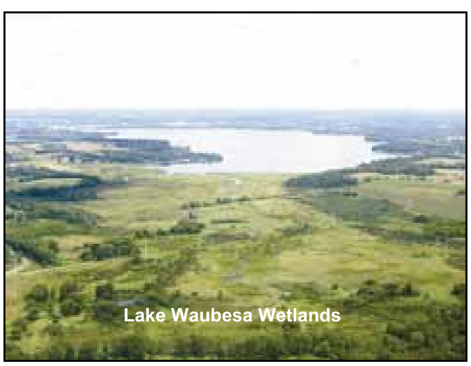
- water quality and natural water level cycles
- plant and animal species and structural diversity
- edge gradation
- wildlife production or use
- lack of invasive species

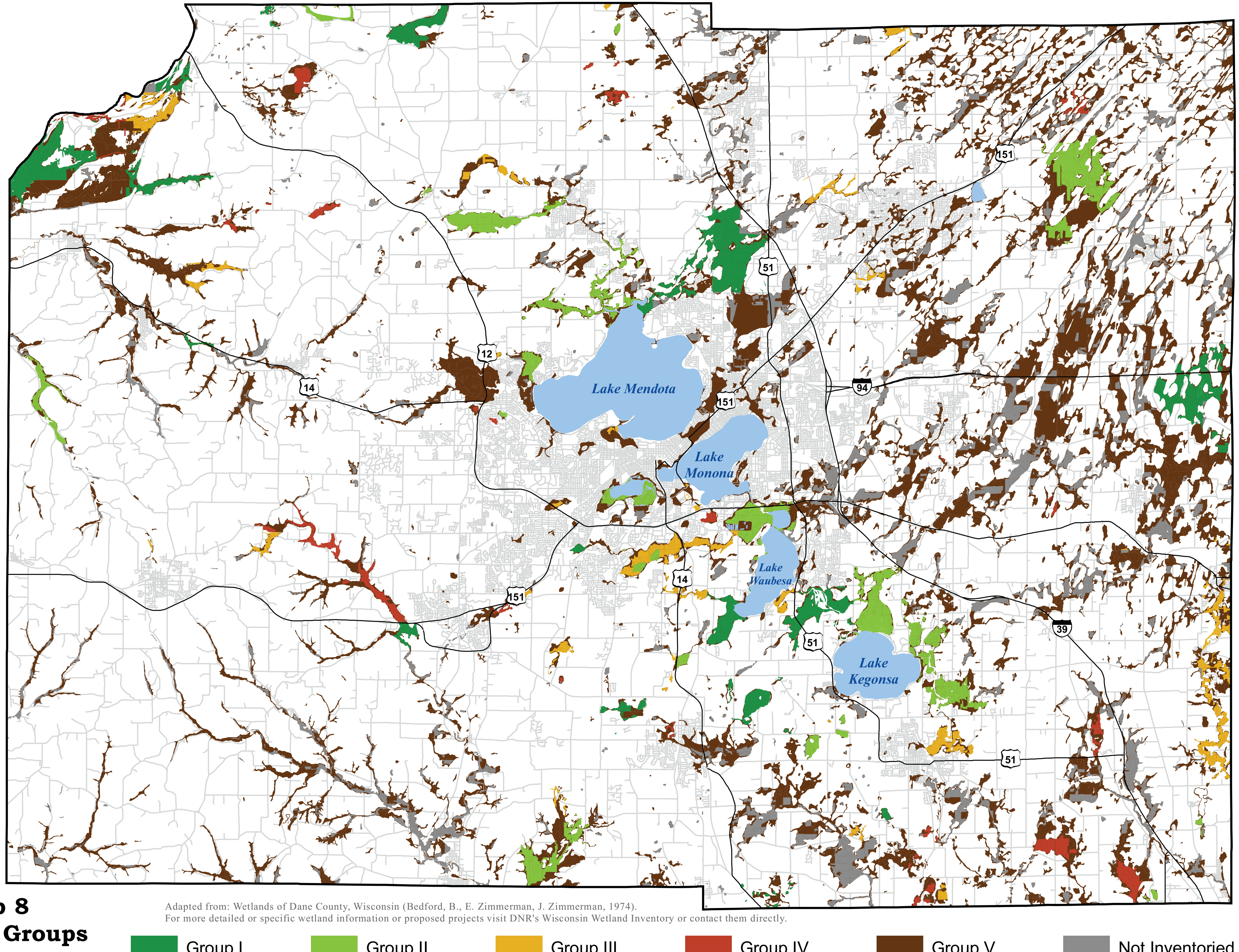
Additional ecological and cultural factors have also been taken into account, such as its role in watershed protection, scarcity of type, recreation and educational value, size, proximity to other wetlands, buffer zones, and scenic value. The concurrent presence of two of these features moved a wetland up from its initial position to the next higher group. Four or more features moved a wetland up two groups.

The wetland groups derived from that study are shown in Map 8 and described below.

1. Group I Wetlands

Wetlands in this group are the best in the county and, in some cases among the most valuable in southern Wisconsin. A few function substantially as they did at the time of early settlement, so far as can be told. Although showing signs of disturbance, they remain virtually intact. Because of the scarcity of wetlands which approximate natural ecosystems in their functioning, these wetlands have been included in Group I. Every effort should be made to protect them.





Map 8
Wetland Groups
Dane County, WI.

Adapted from: Wetlands of Dane County, Wisconsin (Bedford, B., E. Zimmerman, J. Zimmerman, 1974).
For more detailed or specific wetland information or proposed projects visit DNR's Wisconsin Wetland Inventory or contact them directly.

Jan. 2008

2. Group II Wetlands

This group contains the rest of the large peat deposits (those not in Group I) which are particularly valuable for protecting the Yahara River and chain of lakes. Most of the wetlands in this group fall into the so-called “undrainable” category and, therefore, are large or deep enough to have resilience. Alterations have not had a profound effect. These wetlands should get the same protection as those in Group I. It is important to point out that the wetlands in this group are not beyond enhancement to original values and functions.

3. Group III Wetlands

While the wetlands in this group do not currently have outstanding values, they serve as support systems for those which do. Furthermore, they enhance the environment as a whole. Although substantially altered, these wetlands support wildlife and provide open space. While all reasonable efforts should be made to ensure their protection, enhancement may be an especially important consideration, improving one or more degraded functions such as flood protection, water quality improvement, or wildlife habitat.

4. Group IV Wetlands

These wetlands have been altered and degraded by unsuccessful drainage attempts and are often dominated by invasive species, such as reed canary grass. They still provide important services as a wetland such as for watershed protection or heavy use by migratory waterfowl during spring flooding. Many wetlands in this group can be managed as either restorable habitat for wildlife or as marginally productive agricultural lands. The fact that they can still be listed as wetlands after many decades of drainage attempts indicates that they are not well suited for agriculture. Some of them have value for watershed protection, wildlife use, or open space. Their best use appears to be enhancement or restoration for one or more of these purposes, rather than continued attempts at drainage. Restoration of Patrick Marsh northeast of Sun Prairie is a good example of this. Further degradation of these wetlands should be discouraged.

It should be noted that relatively few wetlands are listed as being in Group IV as compared to the actual number that exist in Dane County. Many wetlands which would have been placed in

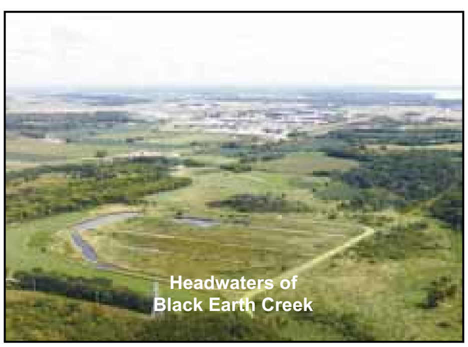
Group IV could not be visited during the 1974 study because of project time limitations. Wetlands that could not be visited are included in areas labeled as being "Not Inventoried." More investigation is needed to evaluate and group these wetlands.

Ephemeral or temporary ponds have also not been listed. These areas are difficult to map because of their small size. DNR is working on a project to improve their ability to identify and better protect these areas. They fill with water almost every spring or after heavy rains long enough to serve as breeding pools for amphibians such as frogs and salamanders. While they can be emptied permanently by extensive ditching, this is usually not practical if the area is only a few acres. Cultivation and grazing do not appear to destroy their value for waterfowl; however, they do provide critical life cycle habitat for some species (e.g., tree frogs when such ponds are located next to woodlands). In such cases they need to be identified and protected.

5. Group V Potentially Restorable Wetlands

These areas no longer exist or function as wetlands. Drainage, filling, dredging, or a combination thereof, has destroyed all the functions and values of the natural wetland. **Map 1** indicates the large number of wetlands that have been lost.

In watersheds that have been adversely affected by drainage, flooding, and deteriorated water quality, restoration projects should be considered. Example sites include former wetlands on Koshkonong Creek downstream from Sun Prairie, Door Creek downstream from Cottage Grove, Oregon Branch of Badfish Creek, Black Earth Creek downstream from Middleton, and Badger Mill Creek downstream from Madison.



Potential restoration sites should also be considered for improving or expanding existing wetlands. The MMSD lagoon restoration project is a good example of this along Nine Springs Creek. Other potential sites include Deansville Marsh near Marshall, Goose Lake near Deerfield, Story Creek near Belleville, the Mainstem and West Branch of the Sugar River, Black Earth Creek, Token Creek, Halfway Prairie, Wendt, and Dunlap Creeks, among many other opportunities.

Map 8 can help in determining where the best opportunities exist.

VI. CONCLUSION

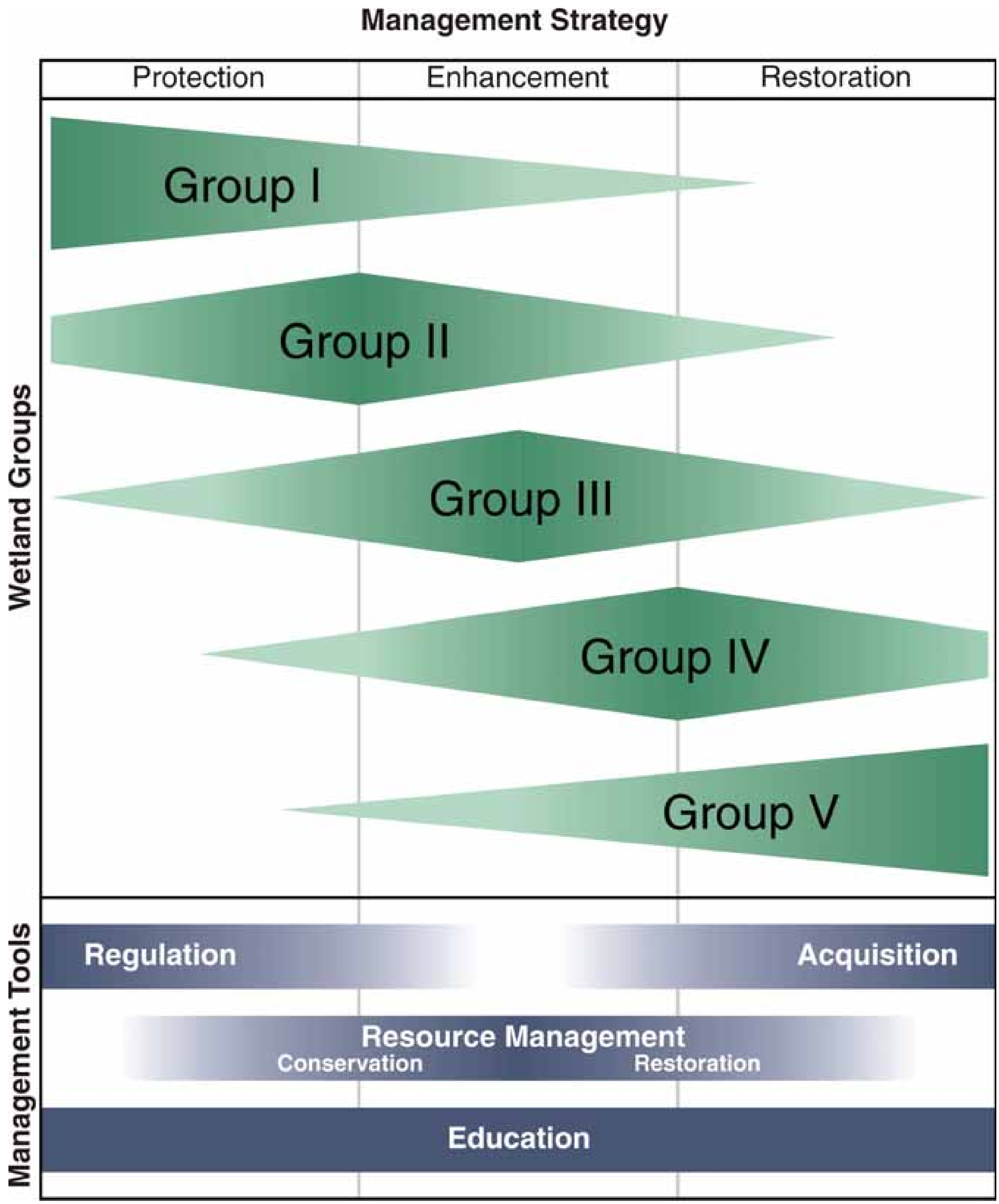
Since the time of the 1974 *Wetlands of Dane County* study, it has become increasingly recognized that all wetlands have value – particularly since there are fewer of them remaining. In the 1974 study, total wetland destruction was described as "not worth discussing" except to note the benefits that had been lost along with the wetland. The former wetlands on Map 1 were all but written off, believed to be forever lost.

Since those early years, however, significant advances have been made in the art and science of wetland restoration, as well as public opinion and policies for protecting wetland resources. In light of this, the wetland groupings should not imply that one group is more valuable or has higher priority than another (as in the original study) but, rather, that management strategies within a group will have similar priority, focus, or emphasis. For example, efforts focused on Group I wetlands should probably be directed at protecting the existing wetland resources (Figure 5). This would rely heavily on regulation and conservation resource management activities. On the other end of the spectrum, efforts focused on Group V wetlands should probably be directed at restoring prior-converted wetlands. This would rely more heavily on acquisition and resource restoration management activities.

Intermediate Group II, III, and IV wetlands will likely be the focus of combinations of strategies for preventing wetlands from becoming more degraded on the one hand, and improving them to generally higher quality on the other. Management activities should generally be focused on keeping wetlands from falling into a more impacted group, while restoring and improving wetlands that have been previously degraded. Usually, this can be accomplished by examining the communities of plants that live in these areas as indicators of their overall quality and health. In addition, landowner and community education is needed on all aspects of wetland resources management.

The 1974 study was quite visionary in its effort to assess wetlands throughout Dane County, as well as suggesting management priorities and strategies. This was done at a time when the general public did not fully understand, appreciate, or particularly value the idea of protecting or restoring these submerged lands. Today, this work can be renewed and advanced by individuals and groups picking up where these early pioneers left off, following the process outlined in this guide, thereby reversing the loss of wetlands that has occurred over the last century. Only recently has this loss begun to slow. More effort will be needed to reverse the course. Landowner participation and community support are essential for accomplishing this.

Figure 5. Wetland Resource Management Strategies and Tools for Various Wetland Groups



VII. SUMMARY

Wetlands are among the most complex and least understood of natural community types. Most wetlands also serve multiple functions. One of the greatest threats to wetlands has been the incremental and piecemeal destruction often described as "death by a thousand cuts." The loss of wetland resources has become a national problem. Efforts are needed at the local level to protect, restore, and enhance the wetlands that remain, preserving the many benefits which they provide.

The selection and cost of specific management tools and targeted activities will depend on a number of factors. These factors will be based on an assessment of the site characteristics; an evaluation of the land use, policy and financial constraints; and focused on a desired management strategy and outcome. Each management opportunity (e.g., willingness of the landowner, availability of funding, etc.) should be considered on a site-specific basis, using the process outlined in this guide as an overall framework in cooperation with federal, state and local resource management agencies, resource conservation organizations, and private property owners.

In the end, the management strategy for each wetland will be as unique as the wetland itself. The most appropriate management efforts will be determined by considering all the natural resource elements, as well as the partnerships and cooperation that may be developed among the various interests. The *Dane County Wetlands Resource Management Guide* provides the overall framework or basis for forming those relationships and taking the actions necessary for protecting, restoring and enhancing the wetlands of Dane County, and promoting water quality improvements in its ground and surface waters.

***

END NOTES

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Appendix A:

January, 2001

____

File or Docket Number

Wisconsin Department of Natural Resources

RAPID ASSESSMENT METHODOLOGY FOR EVALUATING WETLAND FUNCTIONAL VALUES

GENERAL INFORMATION

Name of Wetland/Owner:
Location: County _______________________; ¼, ¼, Section , Township , Range
Project Name:
Evaluator(s):
Date(s) of Site Visit(s):

Description of seasonality limitations of this inspection due to time of year of the evaluation and/or current hydrologic and climatologic conditions (e.g. after heavy rains, snow or ice cover, during drought year, during spring flood, during bird migration):

WETLAND DESCRIPTION

Wisconsin Wetlands Inventory classification:
Wetland Type: shallow open water, deep marsh, shallow marsh, seasonally flooded basin, bog, floodplain forest, alder thicket, sedge meadow, coniferous swamp, fen, wet meadow, shrub-carr, low prairie, hardwood swamp
Estimated size of wetland in acres:

SUMMARY OF FUNCTIONAL VALUES

Based on the results of the attached functional assessment, rate the significance of each of the functional values for the subject wetland and check the appropriate box. Complete the table as a summary.

FUNCTION	**SIGNIFICANCE**				
	Low	Medium	High	Exceptional	N/A
Floral Diversity					
Wildlife Habitat					
Fishery Habitat					
Flood/Stormwater Attenuation					
Water Quality Protection					
Shoreline Protection					
Groundwater					
Aesthetics/Recreation/Education					

List any Special Features/"Red Flags":

SITE DESCRIPTION

I. HYDROLOGIC SETTING

A. Describe the geomorphology of the wetland:

- ❑ Depressional (includes slopes, potholes, small lakes, kettles, etc.)
- ❑ Riverine
- ❑ Lake Fringe
- ❑ Extensive Peatland

B. **Y N** Has the wetland hydrology been altered by ditching, tiles, dams, culverts, well pumping, diversion of surface flow, or changes to runoff within the watershed (circle those that apply)?

C. **Y N** Does the wetland have an inlet, outlet, or both (circle those that apply)?

D. **Y N** Is there any field evidence of wetland hydrology such as buttressed tree trunks, adventitious roots, drift lines, water marks, water stained leaves, soil mottling/gleying, organic soils layer, or oxidized rhizospheres (circle those that apply)?

E. **Y N** Does the wetland have standing water, and if so what is the average depth in inches? _____“
Approximately how much of the wetland is inundated? _____%

F. How is the hydroperiod (seasonal water level pattern) of the wetland classified?

- ❑ Permanently Flooded
- ❑ Seasonally Flooded (water absent at end of growing season)
- ❑ Saturated (surface water seldom present)
- ❑ Artificially Flooded
- ❑ Artificially Drained

G. **Y N** Is the wetland a navigable body of water or is a portion of the wetland below the ordinary high-water mark of a navigable water body? List any surface waters associated with the wetland or in proximity to the wetland (note approximate distance from the wetland and navigability determination). Note if there is a surface water connection to other wetlands.

II. VEGETATION

A. Identify the vegetation communities present and the dominant species.

	floating leaved community dominated by:
	submerged aquatic community dominated by:
	emergent community dominated by:
	shrub community dominated by:
	deciduous broad-leaved tree community dominated by:
	coniferous tree community dominated by:
	open sphagnum mat or bog
	sedge meadow/wet prairie community dominated by:
	other (explain)

B. Other plant species identified during site visit:

III. SOILS

A. NRCS Soil Map Classification: ____

B. Field description:

❑ Organic (histosol)? If so, is it a muck or a peat?

❑ Mineral soil?

- Mottling, gleying, sulfidic materials, iron or manganese concretions, organic streaking (circle those that apply)
- Soil Description: ____
- Depth of mottling/gleying: ____
- Depth of A Horizon: ____
- Munsell Color of matrix and mottles
  - -Matrix below the A horizon (10"depth): ______________________________
  - -Mottles: ____

V. SURROUNDING LAND USES

A. What is the estimated area of the wetland watershed in acres? ____________

B. What are the surrounding land uses?

LAND-USE	ESTIMATED % OF WETLAND WATERSHED
Developed (Industrial/Commercial/Residential)	
Agricultural/cropland	
Agricultural/grazing	
Forested	
Grassed recreation areas/parks	
Old field	
Highways or roads	
Other (specify)	

VI. SITE SKETCH

FUNCTIONAL ASSESSMENT

The following assessment requires the evaluator to examine site conditions that provide evidence that a given functional value is present and to assess the significance of the wetland to perform those functions. Positive answers to questions indicate the presence of factors important for the function. The questions are not definitive and are only provided to guide the evaluation. After completing each section, the evaluator should consider the factors observed and use best professional judgement to rate the significance. The ratings should be recorded on page 1 of the assessment.

SPECIAL FEATURES/"RED FLAGS"

1. **Y N** Is the wetland in or adjacent to an area of special natural resource interest (NR 103.04, Wis. Adm. Code)? If so, check those that apply:

- ❑ Cold water community as defined in s. NR 102.04(3)(b), Wis. Adm. Code, including trout streams, their tributaries, and trout lakes
- ❑ Lakes Michigan and Superior and the Mississippi River
- ❑ State or federal designated wild and scenic river
- ❑ Designated state riverway
- ❑ Designated state scenic urban waterway
- ❑ Environmentally sensitive area or environmental corridor identified in an area-wide water quality management plan, special area management plan, special wetland inventory study, or an advanced delineation and identification study
- ❑ Calcareous fen
- ❑ State park, forest, trail or recreation area
- ❑ State and federal fish and wildlife refuges and fish and wildlife management areas
- ❑ State or federal designated wilderness area
- ❑ Designated or dedicated state natural area
- ❑ Wild rice water listed in ch. NR 19.09, Wis. Adm. Code
- ❑ Surface water identified as an outstanding or exceptional resource water in ch. NR 102, Wis. Adm. Code

2. **Y N** According to the Natural Heritage Inventory (Bureau of Endangered Resources) or direct observations, are there any rare, endangered, or threatened plant or animal species in, near, or using the wetland or adjacent lands? If so, list the species of concern:

3. **Y N** Is the project located in an area that requires a State Coastal Zone Management Plan consistency determination?

Floral Diversity

1. **Y N** Does the wetland support a variety of native plant species (i.e. not a monotypic stand of cattail or giant reed grass and/or not dominated by exotic species such as reed canary grass, brome grass, buckthorn, purple loosestrife, etc.)?

2. **Y N** Is the wetland plant community regionally scarce or rare?

Wildlife and Fishery Habitat

1. List any species observed, evidenced (e.g. tracks, scat, nest/burrow, calls), or expected to utilize the wetland:

2. **Y N** Does the wetland contain a number of diverse vegetative cover types and a high degree of interspersion of those vegetation types?

3. **Y N** Is the estimated ratio of open water to cover between 30 and 70 percent? What is the estimated ratio? ______%

4. **Y N** Does the surrounding upland habitat likely support a variety of animal species?

5. **Y N** Is the wetland part of or associated with a wildlife corridor or designated environmental corridor?

6. **Y N** Is the surrounding habitat and/or the wetland itself a large tract of undeveloped land important for wildlife that requires large home ranges (e.g. bear, woodland passerines)?

7. **Y N** Is the surrounding habitat and/or the wetland itself a relatively large tract of undeveloped land within an urbanized environment that is important for wildlife?

8. **Y N** Are there other wetland areas near the subject wetland that may be important to wildlife?

9. **Y N** Is the wetland contiguous with a permanent waterbody or periodically inundated for sufficient periods of time to provide spawning/nursery habitat for fish?

10. **Y N** Can the wetland provide significant food base for fish and wildlife (e.g. insects, crustaceans, voles, forage fish, amphibians, reptiles, shrews, wild rice, wild celery, duckweed, pondweeds, watermeal, bulrushes, bur reeds, arrowhead, smartweeds, millets...)?

11. **Y N** Is the wetland located in a priority watershed/township as identified in the Upper Mississippi and Great Lakes Joint Venture of the North American Waterfowl Management Plan?

12. **Y N** Is the wetland providing habitat that is scarce to the region?

Flood and Stormwater Storage/Attenuation

1. **Y N** Are there steep slopes, large impervious areas, moderate slopes with row cropping, or areas with severe overgrazing within the watershed (circle those that apply)?

2. **Y N** Does the wetland significantly reduce run-off velocity due to its size, configuration, braided flow patterns, or vegetation type and density?

3. **Y N** Does the wetland show evidence of flashy water level responses to storm events (debris marks, erosion lines, stormwater inputs, channelized inflow)?

4. **Y N** Is there a natural feature or human-made structure impeding drainage from the wetland that causes backwater conditions?

5. **Y N** Considering the size of the wetland area in relation to the size of its watershed, at any time during the year is water likely to reach the wetland's storage capacity (i.e. the level of easily observable wetland vegetation)? [For some cases where greater documentation is required, one should determine if the wetland has capacity to hold 25% of the run-off from a 2 year-24 hour storm event.]

6. **Y N** Considering the location of the wetland in relation to the associated surface water watershed, is the wetland important for attenuating or storing flood or stormwater peaks (i.e. is the wetland located in the mid or lower reaches of the watershed)?

Water Quality Protection

1. **Y N** Does the wetland receive overland flow or direct discharge of stormwater as a primary source of water (circle that which applies)?

2. **Y N** Do the surrounding land uses have the potential to deliver significant nutrient and/or sediment loads to the wetland?

3. **Y N** Based on your answers to the flood/stormwater section above, does the wetland perform significant flood/stormwater attenuation (residence time to allow settling)?

4. **Y N** Does the wetland have significant vegetative density to decrease water energy and allow settling of suspended materials?

5. **Y N** Is the position of the wetland in the landscape such that run-off is held or filtered before entering a surface water?

6. **Y N** Are algal blooms, heavy macrophyte growth, or other signs of excess nutrient loading to the wetland apparent (or historically reported)?

Shoreline Protection

1. **Y N** Is the wetland in a lake fringe or riverine setting? If NO, STOP and enter "not applicable" for this function. If YES, then answer the applicable questions.

2. **Y N** Is the shoreline exposed to constant wave action caused by long wind fetch or boat traffic?

3. **Y N** Is the shoreline and shallow littoral zone vegetated with submerged or emergent vegetation in the swash zone that decrease wave energy or perennial wetland species that form dense root mats and/or species that have strong stems that are resistant to erosive forces?

4. **Y N** Is the stream bank prone to erosion due to unstable soils, land uses, or ice floes?

5. **Y N** Is the stream bank vegetated with densely rooted shrubs that provide upper bank stability?

Groundwater Recharge and Discharge

1. **Y N** Related to discharge, are there observable (or reported) springs located in the wetland, physical indicators of springs such as marl soil, or vegetation indicators such as watercress or marsh marigold present that tend to indicate the presence of groundwater springs?

2. **Y N** Related to discharge, may the wetland contribute to the maintenance of base flow in a stream?

3. **Y N** Related to recharge, is the wetland located on or near a groundwater divide (e.g. a topographic high)?

Aesthetics/Recreation/Education and Science

1. **Y N** Is the wetland visible from any of the following kinds of vantage points: roads, public lands, houses, and/or businesses? (Circle all that apply.)

2. **Y N** Is the wetland in or near any population centers?

3. **Y N** Is any part of the wetland is in public or conservation ownership?

4. **Y N** Does the public have direct access to the wetland from public roads or waterways? (Circle those that apply.)

5. Is the wetland itself relatively free of obvious human influences, such as:

   a. **Y N** Buildings?
   b. **Y N** Roads?
   c. **Y N** Other structures?
   d. **Y N** Trash?
   e. **Y N** Pollution?
   f. **Y N** Filling?
   g. **Y N** Dredging/draining?
   h. **Y N** Domination by non-native vegetation?

6. Is the surrounding viewshed relatively free of obvious human influences, such as:
   a. **Y N** Buildings?
   b. **Y N** Roads?
   c. **Y N** Other structures?

7. **Y N** Is the wetland organized into a variety of visibly separate areas of similar vegetation, color, and/or texture (including areas of open water)?

8. **Y N** Does the wetland add to the variety of visibly separate areas of similar vegetation, color, and/or texture (including areas of open water) within the landscape as a whole?

9. Does the wetland encourage exploration because any of the following factors are present:
   a. **Y N** Long views within the wetland?
   b. **Y N** Long views in the viewshed adjacent to the wetland?
   c. **Y N** Convoluted edges within and/or around the wetland border?
   d. **Y N** The wetland provides a different (and perhaps more natural/complex) kind of environment from the surrounding land covers?

10. **Y N** Is the wetland currently being used for (or does it have the potential to be used for) the following recreational activities? (Check all that apply.)

ACTIVITY	CURRENT USE	POTENTIAL USE
Nature study/photography		
Hiking/biking/skiing		
Hunting/fishing/trapping		
Boating/canoeing		
Food harvesting		
Others (list)		

11. **Y N** Is the wetland currently being used, and/or does it have the potential for use for educational or scientific study purposes (circle that which applies)?

Appendix B: Management Activities for Specific Wetland Functions

Adapted from the UW-Madison Institute for Environmental Studies 1990 Water Resources Management Workshop

	Fish and Wildlife Habitat	Flood Protection	Water Quality	Shoreline Protection	Groundwater	Recreation and Scenic beauty	Corridors and Open Space
Legal and Regulatory							
Provide that land-use master plans explicitly consider wetland functions and values	X	X	X	X	X	X	X
Enforce current shoreland-wetland zoning including buffer requirements	X	X	X	X	X	X	X
Enforce shoreland zoning to prevent development activities in the littoral zone	X		X	X		X	X
Enforce floodplain zoning to prevent development activities in the floodplain	X	X	X		X	X	X
Implement conservancy zoning that includes wetlands	X	X	X	X	X	X	X
Use other zoning techniques such as cluster and large-lot zoning, and overlay zoning to protect critical lands adjacent to wetlands	X	X	X	X	X	X	X
Review permit applications for dredging, filling, and other land use permits to ensure protection of undisturbed sites or restoration of disturbed sites	X	X	X	X	X	X	X
Control the sources of polluted runoff in the watershed by enforcing industrial, commercial, municipal, and agricultural discharge requirements	X		X			X	
Enforce erosion control and stormwater management ordinances for urbanizing areas	X	X	X		X		
Protect and promote upland recharge areas to help maintain wetland hydrology	X	X	X	X	X		
Restrict motor vehicles, snowmobiles, powerboats, or off-road vehicles in sensitive areas	X			X		X	X
Prevent the cultivation of vernal pool wetlands, which are excellent sources for groundwater recharge and important breeding and migration areas	X				X		
Enforce threatened and endangered species regulations	X						
Enforce restrictions on the propagation of pest species such as purple loosestrife	X						
Enforce noxious weed ordinances on adjacent lands	X						
Promote design standards or guidelines for development such as using natural colors, materials, and screening						X	

	Fish and Wildlife Habitat	Flood Protection	Water Quality	Shoreline Protection	Groundwater	Recreation and Scenic beauty	Corridors and Open Space
Resource Management							
Restore or maintain natural hydrology by removing or plugging drain tiles and open channels that have drained surface water or lowered the local groundwater table	X	X	X	X	X	X	X
Dredge open-water areas in degraded wetlands to increase fish and wildlife use, diversity, and create greater water-holding capacity, but being careful not to disrupt healthy wetlands	X	X	X			X	X
Create weirs, berms, dams, or other barriers to outflow from degraded wetlands to artificially pond the water, being careful not to disrupt healthy wetlands	X	X	X			X	X
Restore meanders in channelized streams or create longer flowlines through the wetland to reduce the velocity and extend the detention time for runoff water to deposit sediment and allow for increased pollutant removal/nutrient uptake	X	X	X				
Implement urban and agricultural Best Management Practices (BMPs) to reduce polluted runoff from areas adjacent to the wetland and in general	X	X	X	X	X	X	
Maintain vegetative buffers around wetlands to slow runoff velocities and reduce excessive nutrient loading	X	X	X	X			
Identify and control sources of nutrient or heavy metal runoff into the wetland that might be killing native species or reducing their ability to compete with non-native species	X		X			X	
Place hay bales or silt fences upgradient from the wetland during land disturbance, re-route surface water around severely eroded slopes	X		X	X			
Construct sedimentation basins to allow nutrient-laden sediments to settle out prior to entering the wetland	X	X	X				
Gradually grade the land approaching the wetland to increase the surface area for stormwater storage and groundwater seepage	X	X	X		X		
Route surface water runoff into groundwater recharge wetlands	X	X	X	X	X		
Fence sensitive areas to prevent access by livestock	X		X	X			
Establish wetland vegetation for streambank stabilization			X	X			
Re-grade wetland slopes to promote natural, gradual transitions from peripheral wet-meadow plant species to emergent and floating-leaved plant species	X			X			
Manage vegetation to enhance or restore natural diversity, re-seed or transplant desired plant species for food and wildlife cover	X					X	
Provide trails or viewing points to connect corridor segments and allow visual access						X	X
Provide wildlife access such as culverts under busy roads							X
Provide natural habitat features and structure such as snags, windfalls, and dead trees	X						

	Fish and Wildlife Habitat	Flood Protection	Water Quality	Shoreline Protection	Groundwater	Recreation and Scenic beauty	Corridors and Open Space
Maintain habitat for threatened and endangered species	X						
Control exotic or nuisance vegetation through selective cutting, pulling, burning, flooding, or biological and chemical means	X						
Discourage nuisance species such as carp	X						
Conduct prescribed wetland burns to simulate pre-settlement disturbances to the wetland and to favor fire-adapted natural species	X						
Construct nest islands for waterfowl	X						
Provide bird boxes such as wood duck and bluebird houses	X						
Establish maintenance programs to clean up litter						X	
Plant buffers such as tree breaks or tall grass to shield surrounding urban land uses						X	
Provide access for the enjoyment of the special features, for education, etc.						X	
Alternative Land Use Management – Acquisition							
Use alternative growth-management techniques such as TDRs to protect critical wetland areas, including adjacent lands	X	X	X	X	X	X	X
Provide for tax incentives for the preservation and protection of wetland areas	X	X	X	X	X	X	X
Acquire lands by outright purchase by state or county agencies, land trusts, or other conservancy groups	X	X	X	X	X	X	X
Designate and purchase wetlands to preserve particularly important or special features such as for outdoor recreation, nature study, natural resource areas, etc.	X	X	X	X	X	X	X
Acquire portions of adjacent farmlands for buffer strips on wetland edges through fee-simple purchase or conservation easements	X		X	X	X		X
Secure conservation easements for the wetland from private landowners, including possibly access from adjacent areas	X		X	X	X	X	X
Encourage the formation of neighborhood land trusts to purchase a wetland that supports significant fish and wildlife habitat, as well as other features	X	X	X		X	X	X
Identify wetland sites for restoration of native vegetation	X					X	X
Identify lands that create corridors of undeveloped lands that include wetlands	X					X	X
Identify wetland sites for conservancy	X	X	X			X	X
Identify upland sites for stormwater and detention purposes	X	X	X				
Identify areas for scenic easements						X	X

Education							
Educate the public about wetland functions and values — how to appreciate, enjoy and protect them	X	X	X	X	X	X	X
Educate the adjacent landowners and area developers about Best Management Practices (BMPs) to protect, enhance, and restore the special wetland features	X	X	X	X	X	X	X
Educate and assist landowners with the protecting and re-establishing natural vegetation and wetlands along the shoreline	X	X	X	X	X	X	X
Educate the public about the natural functioning of wetlands for storing stormwater runoff, trapping sediment, and pollutant removal		X	X				
Educate adjacent land-users about the need to control non-point pollution sources originating from their property, such as fertilizers and pesticides	X		X				
Publicize the location and goals of the Nine Springs E-Way, Cherokee Marsh, Door Creek Wetlands and other Corridors / Natural Resource Areas	X						X
Educate the community through nature-watch programs, informational trail signs, or pamphlets on the importance of wetlands for wildlife	X						
Educate wetland owners and the general public regarding the importance of native vegetation diversity and the impact of aggressive exotic species on native communities and species	X						
Educate the general public with trail signs indicating natural wetland springs					X		