Our Wetland Ecosystem – An Overview of The Ridges Sanctuary's Wetland Habitat in the Past, Present, and Future

Jackie Lanear

The Ridges Sanctuary is a unique environment that offers diverse habitats, plant and animal life, and aesthetics to the Bailey's Harbor area. Since the founding of The Ridges Sanctuary in 1937, and even in the thousands of years before that, this land has been evolving, growing, and thriving as a wetland community. In the last 200 years, though, there has been a shift in the balances of this ecosystem due to direct and indirect human interaction. However, the presence of this protected land is vital for the regional ecosystems, the human community, and the systems of the world at large. As the world continues to change, it becomes increasingly important to build our knowledge of the past to familiarize ourselves with the present we exist in so that we may plan for a desirable future. Covering each of these points, this report gives an abbreviated look at the geological timeline that brought about Door County as it is known today. Then, the wetlands that currently span the globe are brought to light in greater detail to build a better understanding of why these ecosystems are so important. Finally, this report looks ahead to what might be done to support the future of wetland ecosystems at many different levels of collaboration.

A Brief Geological Summary – How Did The Ridges Get Here?

A vibrant geology underlies the Ridges Sanctuary, building the foundation for the land and ecosystems seen around Door County today. The geology and land as they are seen today have changed significantly over the course of millions of years, cycling through periods of freezing, thawing, flooding, drying, growth, and extinction.

The earliest layers of rock present in the upper layers of the Door County region are from the Ordovician period (488-444 million years ago), which is present in minor sections of the southern bay side of the peninsula as sections of Maquoketa shale. This Maquoketa shale is also present under much of the wider-spread upper bedrock type in the rest of the county present from the Silurian period, spanning from ~444 million to ~419 million years ago. (Carson et al., 2016) This more common stone present is Niagara Dolomite, though other kinds of rock are present in varying quantities locationally from glacial movement. Silurian period bedrock is some of the youngest in the state of Wisconsin! (Kuhns, 2010)

Dolomite (referring to the type of rock as opposed to the mineral; used interchangeably with dolostone (*Dolostone*, n.d.)) is a type of carbonate formed from ancient mud accumulation within the seas and lakes of this region, notably starting during

the Silurian period. Over time, with the help of environmental factors like low levels of dissolved atmospheric carbon dioxide, high water temperatures, and high pressure, the mud reacted with calcium carbonate ions from shelled sea creatures, leading it to solidify and form limestone. This limestone additionally reacted with the high quantities of magnesium present in the water, leading to the chemical formation (precipitation) of the dolomite present in the region today (*Carbonate Rocks*, n.d.).

At the time of the Silurian period, the Great Lakes region existed as a larger body of shallow saltwater known as the Silurian Sea. The land formations were not the same land seen today, but instead two "supercontinents" known as Laurasia and Gondwanaland in the north and south, respectively (Paselk, 2012). The rest of the Earth was covered by heightened sea levels thanks to the melt of glacial regions, releasing larger quantities of water into seas. This melt is attributed to rising global atmospheric temperatures, with averages around 20°C towards the end of the period (though temperatures became steady over a longer-term relative to the rapid fluctuations seen in prior geological periods) (*Silurian Oceanography*, n.d.). This late-period warm water sea in the present-day Great Lakes region is the source of the frequent fossils present around Door County beaches and nature preserves. The surge of macroscopic life returning to the sea following the Ordovician mass extinction were hard-shell invertebrates, jaw-less and jawed fish, and coral, which contributed to creating layers of dolostone at the bottom of the sea from the accumulation of calcium carbonate remains in addition to fossilizing. This period also had the first recorded presence of evolved terrestrial vascular plant life (Fischer et al., 2009)! The presence of the Silurian Sea and the organisms in it directly led to the formation of Door County's bedrock in a world with conditions vastly different than Earth today.

Millions of years and many periods after the rule of the Silurian Sea, Laurentia (the land that makes up present day North America) was beginning to experience an intensive ice age. Temperatures were cold enough to facilitate massive amounts of ice and snow year-round, manifesting as an ice sheet covering much of the Northern section of the land. This glacier was typically 1-2 miles thick but over thousands of years of this frigid period, temperatures fluctuated and led to frequent recessions and advances of the ice front. Referred to as the Laurentide ice sheet, it was present for much of the Pleistocene epoch, which spanned from around 2.6 million to 11.5 thousand years ago. (Carson et al., 2016) Most of Wisconsin rested on the southern edge of this sheet, apart from the southwestern corner (now called the Driftless region). Because of this positioning, the land was subject to continuously being depressed by the weight of the ice sheet as well as being carved and turned over by the movements of the sheet. (Kuhns, 2010) This meant a great deal of large rocks formed in the millions of years prior to this ice age were split and broken up in the process of these movements, creating the smaller rock material that is found in much of

Door County's topsoil (this is known as glacial till). Beyond physical weathering of the bedrock material, this ice sheet shifted the range of the Mississippi drainage basin from the weight located particularly over the Great Lakes, altering the ultimate destination of rainwater falling within the region.

Carved out by the advancing and receding Laurentide ice sheet, glacial melt, and the heave of mountain formations, the Niagara Escarpment is a large arc of layered sediments stretching from just south of Door County (running alongside the bay side of the peninsula) to New York, a path taken by snaking through Ontario and around the northern edges of several Great Lakes (*Escarpment Geology — Escarpment Biosphere Conservancy*, 2025). Only the top layers of this cuesta (which is the term to refer to the entire bowl shape formed by the escarpments and gradual slopes around them (Schaetzl, 2026)) are visible now, but it's functionally a layer cake of different hardened sediments and remains of the life within the Silurian Sea in the form of rock layers like sandstone, shale, and limestone. These rocks feature variation in their levels of hardness, which is a key piece of information as to why the escarpment exists visibly today. Alternating layers of harder and softer stone types from cycles between drastic geological movement and the more relaxed presence of sea life interact uniquely with environmental conditions to form geological features of note. Specifically, within the scope of Door County, the dramatic western bluffs of the Escarpment are present today thanks to the soft Maquoketa shale being carved away by water and atmospheric conditions, leading to the eventual fall of harder dolomite present above it.

Similarly to the shaping of the Niagara Escarpment by water over time, the dolomitic bedrock of Door County has been altered from continual environmental weathering. Although dolomite is less soluble than limestone, it shares the calcium carbonate base that makes it susceptible to dissolution by water over time (the chemical composition for dolomite is $CaMg(CO_3)_2$ compared to limestone's composition of $CaCO_3$, meaning dolomite has an extra Mg ion and CO_3 group) (*Dolostone*, n.d.). This solubility creates both horizontal and vertical splits in the rock from rain and groundwater seepage, which are characteristic of karst geology. These cracks allow for water to flow quickly and freely into the ground, leading to quick recharge of the aquifer systems that Door County sources much of its drinking water from (*Groundwater | Door County, WI*, 2024). This recharge is primarily sourced from snowmelt and precipitation, including the runoff of this water. Runoff has the potential to pick up pollutants, and due to the ease of infiltration of this water source, there is a higher risk for contamination to spread quickly within the aquifers that Door County residents and visitors rely on (Sherrill, 1978).

Each of these unique time periods and geological events have played a role in the formation of the ridge and swale complex present today. The formation of Lake Michigan through the carving of ancient rock depositions (seen more commonly along northern shorelines), the weight of the ice sheet, and the courses of water flowing from the ice sheet melt (leading to large glacial till deposits, also called moraines, seen particularly along southern shorelines) created the edges and depth of the lake surrounding Door County (Lopez, 2023). Lake Michigan is the sculptor of the ridge and swale system, influencing the other geological factors left behind that create the ecosystem's composition. Depositions of glacial till and quantities of silt and sediment are the layers that rest on top of the bedrock, pushed from below water to shore over cyclical periods of around a hundred years by rolling movements of the lake. Specific silt and sediment that filled into early Bailey's Harbor included sand, multiple kinds of clay, a black organic bog layer, and multiple kinds of till layers. The cycle of alternating "push-recession" movements of the lake began when the lake was about 2917 feet north of the current shoreline, which is where the first ridge is located. Depending on the patterns of the lake (particularly in relation to precipitation patterns of "wet years" versus "dry years") determine the size and frequency of ridge formation. Smaller ridges form more frequently, about 30-40 years apart, while larger ridges form less frequently with a gap of about 150 years. (Kuhns, 2010)

From the ground up, over millions of years, all these changes have influenced each other to create layers that tell a story of what the land once was, as well as what it is today. The bedrock, topography, water, and soil layers built by these events form the foundation for the unique environment seen and valued today. In further sections, the capacity in which the Ridges' geology and ecology influence one another will be explored, including consideration for anthropological influence within these interactions.

The Ridges as a Wetland – Behaviors, Functions, and Importance

Globally, there are currently an estimated 1.4 billion hectares of wetlands in different levels of quality (Global Wetland Outlook, 2018). That level is declining, though, and has been since the boom of large-scale development and industrialization. A unique feature of the Ridges Sanctuary is the presence of multiple kinds of ecosystems, including a previously mentioned rare kind of wetland called a ridge and swale complex (the namesake of the properties). Ridge and swale wetlands are unique to coastlines and bordering rivers, but forested ridge and swale systems are even more unique to the Great Lakes region. The combined ecosystem aspects of a boreal forest and a rare wetland mean the area is incredibly biodiverse and offers unique ecosystem services, highlighting

different degrees of value brought to the area by this system (which will be explored in detail in the next paragraphs).

It is important to clarify what exactly qualifies as a wetland, and different organizations offer variety between how they are defined. Per the Wisconsin DNR, the existing statutory definition for a wetland is "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". (Merryfield et. al., 2000; 1978 State Legislature) On the DNR's website, the definition is simplified even further: "Wetlands are places on the landscape where water is close to, at, or above the soil for at least part of the year" (*Wetland Ecology and Science* | | *Wisconsin DNR*, n.d.). One of the primary sources of international definition, delineation, and protection for wetlands known as the Ramsar Convention defines wetlands as

> "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (p.)

with an additional article adding that wetlands of designated importance "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (*What Are Wetlands?*, n.d.). However, most extensive wetland designating definitions can be summarized with three primary points:

1. "Wetlands are distinguished by the presence of water, either at the surface or within the root zone"
2. "Wetlands often have unique soil conditions that differ from adjacent uplands"
3. "Wetlands support vegetation adapted to the wet conditions (hydrophytes) and conversely are characterized by an absence of flooding-intolerant vegetation" (Mitsch and Gosselink, 1993).

It's important to define guidelines for wetland qualifications because clear definitions help legislation and protective measures get more support, assist in deciding what land to collect data on, and offer a better picture for landowners if they may be wondering about what type of land they have. Though laying out specific lines can be beneficial in some scenarios, it doesn't usually capture the full picture. In reality, wetlands are complex and may only meet some of these defining points depending on time and environmental conditions. This is an added layer of complexity that must be considered in the process of conserving wetlands, and an issue that is often faced by scientists, conservation groups, and advocates.

Why is it important to conserve wetlands? Above all, it should be valuable to appreciate an ecosystem for existing even without consideration for what it may offer for direct and indirect anthropological benefits. However, this reasoning alone is often not enough to justify defending lands that have been historically viewed as "useless" or "wasteful". Understanding what ecosystem services are provided by wetlands on both a small and large scale can offer a more concrete reasoning for protecting wetlands from development or destruction. The Wisconsin DNR determines these values based on a variety of categories, including floral diversity, fish & wildlife habitat, flood control & water quality, shoreline protection, groundwater recharge & discharge, and human uses including aesthetics, recreation, education, and science (*Wetland Ecology and Science | | Wisconsin DNR*, n.d.). To explore each of these concepts, it would be useful to employ an example—in this case, the ridge and swale complex would be perfect to consider!

When examining the Ridges under the most generalized guidelines (in this case, examining the ecosystem using the Mitsch and Gosselink summarized guidelines), each of the qualifications are met soundly. The combination of semi-permanent water-filled swales and thin soil means that there is consistently surface water or water around the root systems of the plants present. When comparing soils between the lowland (wetland) area and upland area of Baileys Harbor, there is a notable difference. Upland soils tend to have "thin, loamy rocky soils rich in forest detritus organic matter", while lowland soils in the Sanctuary area "vary from thin, sandy young accumulations on the ridges, to thin-to-thick high organic (hydric soil) accumulation in the swales". (Kuhns, 2010) Specifically focusing on the "hydric soil" aspect, this kind of soil with a high quantity of organic matter and moisture is particularly characteristic of wetland areas. The last qualification of wetland-supported vegetation (presence of hydrophytes, absence of flood-intolerant plants) is also met, given the variety of plants flourishing in the swale areas of the Sanctuary. Some examples of this vegetation include reed grasses, sedges, and willows, all of which grow in or around flooded/marshy swales. Additionally, flood-resistant trees are plentiful in the area as well, including boreal trees like tamarack, white cedar, balsam fir, and spruce. (Kuhns, 2010) However, there is more complexity to the Ridges than just these three traits that "make it a wetland". Digging further, there is more richness to the ecosystem in both what is found there and what those individual aspects do within the wider system.

As mentioned in the geology outline section, the bedrock of this region features prominent karst geology (meaning there are both horizontal and vertical cracks running throughout the bedrock due to dissolution from water). Because of these points of exposure in the rock, precipitation and runoff can easily infiltrate the aquifer system without many sources of filtration. An important exception, however, is the wetlands present in the area! The calm waters, hydric soil, and unique plant roots present different

methods for removing toxins/pollutants and restoring water quality before it gets the chance to enter aquifers or the nearby lake. Calm waters give polluting particles a chance to settle to the bottom of the water body, allowing soil to store or transform these pollutants (some pollutant examples being heavy metals or microplastics). Plant roots can capture some of the excess nutrients that can be picked up by runoff from agricultural fields, which serves as an alternative form of filtration that benefits the wetland plants, to some degree. (*Functions and Values of Wetlands, 2002*) However, an excess of these pollutants entering wetland systems can alter the landscape for the worse, so the capacity for filtration is not endless and can be reduced by overuse (*Wetland Ecology and Science | | Wisconsin DNR*, n.d.).

The other aspects of water control within the Ridges system would be groundwater discharge and flood control. Because the water table is typically high on the lake side of the Door County area, the soils and glacial till don't act as a functionally strong buffer between the groundwater and the surface. Precipitation can easily percolate into the soil and karst geology (as previously mentioned), so heavy rainstorms or extreme melting events in the winter or spring bring the potential for flooding risks in urban areas, also exacerbating the potential for contaminated runoff water to rush into the lake without any limiting factors. However, the Ridges is that missing buffer—like other wetlands, it captures some amounts of excess water that would otherwise flow directly into the lake, filters it, then releases it on a delayed timeline that prevents rapid swelling of water levels. Without buffers like this, there would only be a slight delay and a major spike in water levels, meaning potential for flooding both from rapid water level rise and high amounts of urban runoff. The thin soil mentioned above also indicates the source of the water found in the swale system: during wet months where the water table reaches higher than the depth of the soil present in the swales, springs of groundwater fill the "low sections" to create pools of standing water that serve as animal habitats, ideal growing conditions for aquatic plants in the wetland system, and an effective form of filtration (*Functions and Values of Wetlands,* 2002, *Great Lakes Ridge and Swale,* 2026).

Diversity within the flora and fauna is one of the most charismatic aspects of wetland systems, a case highlighted uniquely by the Ridges. A great example of this would be the disproportionate number of orchids present in this ecosystem compared to the rest of the state. The hydric soils and cool ambient temperatures help provide appropriate habitats for orchids and their fungal hosts, allowing them to flourish in this environment. Similarly, boreal forests are prime territory for trees with high moisture tolerance, such as the species previously listed, creating a combined boreal wetland ecosystem. On the fauna side of diversity, rare and threatened species like the Hine's Emerald Dragonfly and migratory birds of concern all call the Ridges home, benefitted by the unique ecosystem

structures they rely on for breeding, nurseries, and food. Without the kind of habitat provided by the Ridges, these plants and animals wouldn't have a chance to flourish the way they do here (*Preservation – the ridges sanctuary*, 2025)! Each chain of plant and animal interaction builds on one another as well, creating a flow of energy through the wetland system that encourages and supports a more biodiverse system (*Functions and Values of Wetlands, 2002*).

From the perspective of direct human interaction, wetlands serve a great deal of economic, aesthetic, and scientific benefits. Within the example of the Ridges, the economic benefit is clear: by preserving the quality of the land in the area, the organization can bring in money to support the conservation, research, and education efforts for the land, so the money goes back in! By supporting and sustaining research on the wetland area, the natural processes of the ecosystem can thrive while we become more knowledgeable about those processes and their benefits. The conservation efforts also allow those systems to thrive while maintaining the aesthetic of the area, boosting enjoyment for visitors and users of the land, highlighting the recreational and aesthetic benefits of the land.

On a larger than regional or human scale, wetlands are also defenders of the planet's health! Wetlands and peatlands are major sources of carbon storage—the plants that grow in these hydric soils capture atmospheric carbon, which partially contributes to the process of global warming. This carbon is removed from the atmosphere during the growing process, then when the plants die, that carbon is retained in the dead matter of those plants in the soil. Due to the properties of the rich, moist soil in these lands, that carbon doesn't escape back into the atmosphere if the soil is not disturbed. Because of this process of capture and retainment, wetlands (or, more specifically, peatlands) are major carbon sinks that hold far more carbon than large forests (Kopansky, 2019) The combination of the carbon capture capabilities, the dense plant layers within the ecosystem, and the presence of the boreal forest creating a stabilized microclimate through evapotranspiration (which is the evaporation of water off of the leaves of trees, a process similar to human sweat) create an effective process of larger climate stabilization from the combined efforts of million acres of wetlands worldwide.

The Human Footprint – How do we Impact Wetlands?

Despite the highlighted values observable within wetland habitats (both human- and non-human-centric) we have not been historically kind to wetlands—deeming them to have no value, filling/burning/dredging them, and setting policy to encourage this

destruction for the sake of agricultural and industrial development. Half of original Wisconsin wetlands have been lost (*Wetland Ecology and Science | | Wisconsin DNR*, n.d.) to some amount of development, and the remaining acreage are at high risks for mismanagement, pollution, and decline.

Prior legislation sets the stage for what drastic mismanagement can look like. During periods of major development (and especially during lulls between development), local and state government legislature encouraged (and would even pay for) the filling, dredging, and burning of wetlands on private property for the sake of creating land with "functional value". Each of these damages come with a cost, as the price of disturbing wetland soils exists as disruptions to biodiverse areas (jeopardizing dependent species), removing natural flood protection and management resources, and releasing stored carbon back into the atmosphere. Essentially, these practices reversed all the benefits of the presence of a wetland for the sake of agricultural and industrial pursuits. These were some of the primary challenges that brought about the loss of so many acres of wetlands, but the present challenges faced jeopardization of the remaining land that people are beginning to fight to protect.

The challenges faced today tend to manifest indirectly compared to the destructive tendencies seen in past actions. Agriculture and land use battling for space is still a problem, but more complex factors like pollution, flow disruption, unsustainable use, poor planning, and climate change all impact wetland quality and longevity (*Strategic plan of the convention on wetlands 2025-2034 1.*, 2025). Each of these factors poses unique difficulties and solving them requires intricate planning and community cooperation to create successful progress. In the case of pollutants, excess nutrients from agricultural runoff (the same issue leading to large algae blooms in lakes), road salt saturation, pesticides/herbicides, waste leaks, and road contaminants like oil, heavy metals, and microplastics all have direct access to wetland systems. With this many potential pollutants reaching wetland systems, it's even more crucial that these inputs can be limited and potentially eliminated. Preserving the quality of wetlands to allow their other functions to thrive is vital, and large influxes of any of these pollutants create a strain on those beneficial functions. Other issues like flow disruption, unsustainable use, and poor planning all link together to form a picture of direct human misuse, meaning that planning and strategizing for improving practices within communities once again becomes a prominent need to maintain the quality, capacity, and diversity of wetlands. As for the wicked problem of climate change, it's hard to state just one way it is negatively impacting the capacity of wetlands, and there isn't necessarily a direct handful of strategies to immediately improve or avoid its impact. However, working through some of the other challenges also faced by wetlands (such as those previously listed) reduces strain on the

systems and presents potential strategies for change that can be applied to larger obstacles like regional impacts of climate change. This isn't a comprehensive list of impacts on wetlands, either. Local ecosystems often have specific challenges based on cultural and economic practices in the area, so every wetland has different issues to manage.

Though humans have introduced many challenges and destructive actions into wetland systems in the past, there have been larger recent efforts to mitigate and reverse these impacts. As early as the 1960's, there has been a public effort to push for a shift in perspective around wetlands. Moving away from the idea of wetlands as "useless" and towards the idea that wetlands serve a larger purpose in benefitting the natural landscape. In the 1970's-1990's, research and policy defenses around wetlands began booming. Much of the delineation (mapping) of wetlands we rely on today were created in the 90's, as well as many of the permitting processes for building on, owning, and protecting wetlands. Regulations such as the Clean Water Act serve as cornerstones for environmental defense, especially in ecosystems like wetlands that have previously been held in public disregard. These efforts have stalled out in recent years, but private organizations have taken up some of this dropped defense from the public sector.

Another effort beyond the state or national effort that exists to protect and manage wetlands is the Ramsar Convention. Mentioned in earlier paragraphs, this international convention's strategic plan was first created in 1996 and has since been revised and readopted on four occasions to maintain relevancy and efficacy, with the most recent plan adopted in 2025. The convention's mission is to encourage "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". The organization itself works under three pillars, those being

> "(i) the wise use of all wetlands through national plans, policies and legislation, management actions and education; (ii) the designation and effective management of suitable wetlands for inclusion on the list of Wetlands of International Importance; and (iii) international cooperation on transboundary wetlands and shared species". (*Strategic plan of the convention on wetlands 2025-2034 1.*, 2025)

This convention recognizes 2.5 million acres of wetlands worldwide as designated "Ramsar Sites of International Importance", creating a legally binding obligation for ongoing stewardship and protection of these sites by the convention's member countries. Creating and implementing frameworks for the betterment of wetland systems worldwide is an important step in the process of defending global environmental health. Though it may not be perfect, and membership does not guarantee proper execution of this plan, it does

create a foundation for present and future generations to improve on the state of wetlands globally.

Concluding: What Can Be Done?

Given the size of the challenges being faced by wetland systems both locally and worldwide, it's easy to feel hopeless about the future of these ecosystems and the wider impact of losing them. This is especially true when it's unclear what you as an individual can do to fight these challenges. Fortunately, there is plenty to be done at all levels of organization, from individuals all the way to national and internation governmental agreements. The best part is that methods for involvement exist in many different varieties, meaning that there is something out there that everyone can do to defend the future of wetlands.

One of the strategies of utmost importance for building defenses for these ecosystems is education. This can look like educating yourself or others, but either method builds a connection to these ecosystems and the communities that depend on them. For example, reading this paper is a great place to start! Becoming more familiar with the terminologies associated with the challenges and defenses of wetlands helps create a more informed reader and citizen. Becoming better informed helps you create the future you want to see in your communities through planning, action, and networking. You're able to learn from other local communities within your network, apply both background and new information to a collaborative planning process, and act as an effective steward in the process of implementation. Education is a powerful tool (and often underappreciated as such) as it serves as a base for which all change stems from, especially in the future of conservation, research, and policy.

In the vein of more direct action, becoming involved in preexisting organizations that support and manage wetland ecosystems is an effective use of resources to create positive change for wetland communities. This can look like volunteering time, money, or resources, but all of these serve to uplift and create opportunities for expansion in these organizations. In reading this, it's likely that you're already supporting The Ridges Sanctuary, which directly contributes to the research, conservation, and education opportunities for the unique ridge and swale wetland system. However, if you're looking to go above and beyond, there are plenty of organizations of all levels, both public and private, that can always use more support. Statewide, the Department of Natural Resources (DNR) can always use more support. One project, the DNR Wisconsin Wetland Inventory, is working towards keeping updated delineation records of statewide wetland areas.

(*Wetland mapping*, 2024) However, much of this mapping has only been done as recently as the 1990's, and modern mapping technology has grown considerably over more than 30 years. Since then, LiDAR has increased the scale at which wetlands can be mapped, giving more detail to wetland boundaries, especially between seasons. This is where public support becomes a point of importance. The WWI project is understaffed and underfunded, limiting the potential progress for this updated delineation. By having a tool like detailed mapping, policy protections and land ownership can become more refined and protected, ideally leading to better management and protections in the future. Other private organizations at the state level include the Wisconsin Wetlands Association (*How we work | Wisconsin wetlands* association, 2021) or Clean Wisconsin (*Wetlands*, 2025), which both provide opportunities for engagement and involvement in the capacity that suits personal interests and pursue the betterment of education, policy, advocacy, and research for wetland ecosystems. At the national scale, widely known organizations like Ducks Unlimited (*Conservation | ducks unlimited*, n.d.) the Environmental Law Institute (*About the Environmental Law Institute | Environmental Law Institute.*, n.d.) create different learning and engagement opportunities to help defend wetlands nationwide. As an individual, you can help, but that help is often found by having strength in numbers through personal contributions towards a larger cause.

Awareness, as stated in the paragraph about education, is a powerful tool! This is especially relevant in application, such as within politics or land ownership. Being a conscientious voter and choosing to support candidates and legislation that defends wetlands is a powerful choice that can create effective protection and management strategies in the long-term, which is exactly what these ecosystems need. This means that advocacy and action (especially voting) are vital, as these choices can often determine the future of the land we live on. The Ramsar convention discusses the importance of legal involvement in the process of protection as well, with a target goal 4.3 looking to "[s]trengthen existing legal and policy measures to enhance implementation" (*Strategic plan of the convention on wetlands 2025-2034 1.*, 2025). Within a smaller scale of living on the land, owning property with known or potential wetlands requires extra time and support to ensure the health of these systems. The Wisconsin DNR has different resources to support landowners in identifying and managing wetlands on their property (*Waking Up to Wetlands | Know Before You Buy of Build*, 2026), but this can also look like making smaller strategic choices for improving the health of wetlands. Some of these choices may include following ordinances and policies implemented to improve environmental health (for actions such as waste placement, well drilling, or logging), avoiding spreading/releasing contaminants onto your property, or building aggressive protection practices.

These are some strategies that can be employed to support wetlands, but it is not an exhaustive list. There is much to be done in the defense of the environment, and getting involved and engaged is a great step forward in building a healthy future for the Earth and its wetlands. With such a long history leading to the creation of these crucial ecosystems, it is deeply special that we get to experience them as they are right now. It's only fair that we work to defend them, given how much these lands do for us. Building a relationship of reciprocity with the land is the future that the Earth deserves, and it's entirely possible with shifting frameworks through education, altered practices, and deepened respect for our wetland systems.

Citations

About the Environmental Law Institute | Environmental Law Institute. (n.d.-a). Www.Eli.Org. Retrieved August 21, 2026, from https://www.eli.org/about-environmental-law-institute

Carbonate Rocks. (n.d.). Geology Is the Way. Retrieved August 21, 2026, from https://geologyistheway.com/sedimentary/carbonate-rocks/

Carson, E., Brown, S., Mickelson, D., & Schneider, A. (2016). Quaternary Geology of Door County, Wisconsin. In *Wisconsin Geological & Natural History Survey* (pp. 1–52). UW Extension. https://data.wgnhs.wisc.edu/pubshare/B109.pdf

Conservation | ducks unlimited. (n.d.). Www.Ducks.Org. Retrieved August 21, 2026, from https://www.ducks.org/conservation

Dolostone. (n.d.). Geology Is the Way. Retrieved August 21, 2026, from https://geologyistheway.com/sedimentary/dolostone/

Escarpment Geology — Escarpment Biosphere Conservancy. (2025). Escarpment.Ca. https://escarpment.ca/about/escarpment-geology

Fischer, D., Liu, T., Yip, E., & Yu, K. (2009). *The Silurian Period*. Berkeley.Edu. https://ucmp.berkeley.edu/silurian/silurian.php

Functions and Values of Wetlands. (2002, March). US EPA. https://www.epa.gov/sites/default/files/2021-01/documents/functions_values_of_wetlands.pdf

Global Wetland Outlook. (2018). *Global Wetland Outlook*. Global Wetland Outlook. https://www.global-wetland-outlook.ramsar.org/

Groundwater | Door County, WI. (2024). Wi.Gov. https://www.co.door.wi.gov/531/Groundwater

How we work | Wisconsin wetlands association. (2021, June 3). Wisconsin Wetlands Association | Helping People Care for Wetlands. https://www.wisconsinwetlands.org/about-wwa/how-we-work/

Kopansky, D. (2019, February 1). *Peatlands store twice as much carbon as all the world's forests*. UN Environment. https://www.unep.org/news-and-stories/story/peatlands-store-twice-much-carbon-all-worlds-forests

Kuhns, R. (2010). *Geology and Natural History of the Baileys Harbor - Ridges Sanctuary Area Door County, Wisconsin* (pp. 1–44).

Lopez, S. (2023, August 10). *Geologic History of Lake Michigan: Wisconsin, a virtual glacial ghost town - Wisconsin Marine Historical Society*. Wisconsin Marine Historical Society. https://wmhs.org/geologic-history-of-lake-michigan-wisconsin-a-virtual-glacial-ghost-town/

Merryfield, N., Epstein, E., Galvin, A., Judsiewicz, E., & Smith, W. (2000). *A Data Compilation and Assessment of Coastal Wetlands of Wisconsin's Great Lakes*.

Mitsch, W., & Gosselink, J. (1993). *Wetlands* (1st ed.). Van Nostrand Reinhold.

Paselk, R. (2012, August 10). *Silurian Period | Natural History Museum*. Natmus.Humboldt.Edu. https://natmus.humboldt.edu/exhibits/life-through-time/visual-timeline/silurian-period

Preservation - the ridges sanctuary. (2025, January 22). The Ridges Sanctuary. https://ridgessanctuary.org/focus/preservation/

Schaetzl, R. (2026). *Cuestas*. Msu.Edu. https://project.geo.msu.edu/geogmich/cuestas.html

Sherrill, M. (1978). *Geology and ground water in Door County, Wisconsin, with emphasis on contamination potential in the Silurian dolomite*. USGS.Gov. https://doi.org/10.3133/wsp2047

Silurian Oceanography. (n.d.). Www.Marscigrp.Org. Retrieved August 21, 2026, from http://www.marscigrp.org/sil91.html

Strategic plan of the convention on wetlands 2025-2034 1. (2025b). https://www.ramsar.org/sites/default/files/2025-09/Convention_on_Wetlands_fifth_strategic_plan_e.pdf

Waking Up to Wetlands | Know Before You Buy or Build . (2026b). Wi.Gov. https://www.co.door.wi.gov/DocumentCenter/View/2975/Wetland-Brochure

Wetland Ecology and Science | | Wisconsin DNR. (n.d.). Dnr.Wisconsin.Gov. Retrieved August 21, 2026, from https://dnr.wisconsin.gov/topic/wetlands/ecology

Wetland mapping | | Wisconsin DNR. (2024). Wisconsin.Gov. https://dnr.wisconsin.gov/topic/Wetlands/inventory.html

Wetlands. (2025c, October 30). Clean Wisconsin. https://www.cleanwisconsin.org/our-water/wetlands/

What are wetlands? (n.d.). Retrieved August 21, 2026, from https://www.ramsar.org/sites/default/files/documents/library/info2007-01-e.pdf