

Planning for

# Coastal Resiliency

*in Northwest Michigan's Dunes*

A Guidebook for Local Leaders



# Planning for Coastal Resiliency in Northwest Michigan's Dunes: A Guidebook for Local Leaders

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*The statements, findings, conclusions, and recommendation in this report are those of Networks Northwest and do not necessarily reflect the views of the Department of Environmental Quality and the National Oceanic and Atmospheric Administration.*





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# Coastal Resiliency: Overview

Coastal areas are economic powerhouses, supporting tourism, commerce, fisheries, and more for communities everywhere along the Great Lakes. In Northwest Michigan, Lake Michigan coastal resources are some of the region’s most valued and cherished resources, beloved for their beauty and the recreation opportunities they provide.

Dunes, which cover 37,000 acres in Northwest Michigan, are especially important coastal resources. The region’s dunes represent some of the most important—and diverse—coastal dune systems in the Great Lakes region. With nine different types of dunes, some of which are among the most high quality dunes in the Great Lakes, coastal areas are a hallmark of the region and its identity.

Coastal areas contain many dynamic, ever-changing physical environments like steep slopes and bluffs, dunes, and sandy beaches that must retain their dynamic features in order to function properly within the



ecosystem. From the perspective of the built environment, the dynamic nature of dunes and coastal areas make them vulnerable to hazards like erosion that can cause damage to human life and property.

What’s more, their vulnerability to natural disasters is increasing because of factors like new development, extreme weather events, and geological processes. Dunes are prone to natural movement and erosion more than other areas, and sand is easily

impacted by development or construction. Inappropriate development of coastal and shoreline areas disrupts the natural process of beach creation and replenishment, and may exacerbate erosion and other hazards.

The potential hazards in these high-value areas make the protection of coastal areas a top priority for many Northwest Michigan communities. These communities are exploring opportunities for improving *coastal*

*Coastal resilience* means building the ability of a community to “bounce back” after hazardous events such as hurricanes, coastal storms, and flooding – rather than simply reacting to impacts.

National Ocean Service (NOAA)

*resilience*, referring to their ability to “bounce back” after hazardous events like coastal storms and flooding. Improving resilience—through anticipating, preparing for, responding to, and adapting to changing conditions, and recovering rapidly from hazardous events with minimal damage—is a key objective for communities that want to reduce the vulnerability and risks associated with coastal areas.

Coastal communities and property owners can improve resilience and reduce risks through a variety of techniques, which can be generally categorized into three approaches:

- *Natural or Nature-Based Approaches*, such as natural or engineered wetlands and dunes, can reduce the impact of waves and provide other ecosystem benefits, such as providing wildlife habitat.
- *Structural Interventions* like seawalls and breakwaters reduce coastal risks by decreasing shoreline erosion,

wave damage, and flooding.

- *Non-Structural Interventions* include local land use policies and building codes that regulate development in coastal areas, along with emergency response plans and systems designed to mitigate impacts from coastal hazards and disasters.

No one agency or partner regulates or implements these multiple approaches to coastal resilience. Some of these techniques are put in place by private property owners; but their use can be allowed or prohibited by state, federal, and local laws. In order to be most effective, therefore, coastal resiliency approaches should be considered in the context of a collaborative framework that distributes responsibility between federal, state, and local agencies and the public.

The responsibilities and roles of local and county government are central to this collaborative framework. While state and

federal agencies have some regulatory and permitting control, local governments must take the lead in plan and implementing resiliency policies that are outside the purview of state and federal agencies. Many policies, plans, and other “non-structural” resiliency techniques require local government action and adoption: master plans, zoning, hazard mitigation plans, and land conservation efforts all require local leadership and action. For these local partners that are striving to protect coastal lands while continuing to allow for their use and development, this guidebook provides an overview of coastal resilience planning issues and techniques. In recognition of the unique hazards found in dune areas, the guidebook focuses on dunes and other high-risk erosion areas.

**37,000**

Acres of dunes in Northwest Michigan

**9,250**

Acres of privately-owned dunes in Northwest Michigan

**9**

Types of dunes in Northwest Michigan

# Understanding Dunes & Coastal Hazards

Dunes occur in different shapes and sizes, formed by interaction with the flow of air, water, wind, sand, waves, vegetation and ice. They are subject to unique hazards related to the potential for the movement of sand and subsequent erosion, which can result in the loss of property or necessitate the relocation of homes as sand or soil is lost over time. Roadways along the shoreline may experience bank erosion which contributes to cracking and overall structural instability. The foundation of a structure, or underground utility pipes, in a dune area may become fully exposed and vulnerable to weather, extreme temperatures, water damage, or other sources of risk. At the other end of the spectrum, active dunes may result in deposition, with roads, parking lots, driveways, and structures becoming covered or buried in sand.

These processes, and the likelihood of their occurrence, vary depending on how the dune was formed, and the different characteristics of each type of dune. Understanding the types of dunes, and the hazards associated with each, is central to appropriate planning and development.

## Wooded dune and swale

Wooded dune and swale complexes are large areas of parallel and alternating wetland swales (that is, a low or shallow area) and upland beach ridges (dunes) found in coastal embayments and on large sand spits along the Great Lakes shoreline. Upland dune ridges are typically forested, while low swales support a mix of herbaceous or forested wetland types. The repetitive pattern of dune and swale provides habitat for wildlife species that depend on both aquatic and sandy environments. And, since water levels can vary dramatically between swales, dune and swale complexes are often also home to a diverse mix of wetland plants.

Wooded dune and swale complexes are relatively

stable compared to other dune systems. However, those closest to the shoreline are often only sparsely vegetated and tend to be somewhat active in terms of sand movement.

One of the most critical features regarding dune and swale complexes is the hydrologic connection between the swales. The flow of surface streams and groundwater is necessary to maintain conditions in wetland swales, and to support critical wetland plants and wildlife species. The most significant consideration for coastal communities, homeowners, and road commissions in these areas, therefore, focuses on keeping the hydrology between the swales intact. For example, roads built in these complexes should feature adequately sized culverts that allow for the free flow of water within and between the swales.

## Parabolic dunes

Parabolic dunes were formed by strong winds and storms that created a repeated series of blowouts, or saddle-shaped or U-shaped depressions in a stabilized sand dune (see photo). The ridges of parabolic dunes are typically vegetated with grasses, shrubs, and trees, while the blowouts in between the ridges are usually very open with a few sparsely scattered clumps of grasses, herbaceous plants, and sometimes shrubs. Parabolic dunes are among the most common type of dune system in the Northwest Michigan. Both vegetated and open parabolic dunes are found throughout the region.

Northwest Michigan is home to some important parabolic dunes also known as “perched dunes.” Perched dunes are found “perched” atop bluffs that vary in height from 90 to 450 feet about lake level. Low perched parabolic dunes are located on either low-lying flat glacial lake plains or sand bars. High perched parabolic dunes—all of which, in Northwest Michigan, are found in Manistee, Benzie, and



Leelanau—are located on top of glacial moraines and can rise to over 450 feet in height. Their higher elevations leave them more exposed to the wind, meaning they can be more active and hazardous than low perched parabolic dunes.

Blowouts in parabolic dunes sometimes remain active, meaning that sand is still moving on a regular basis; and even parabolic dunes that appear stable can become unstable. Some older parabolic dunes are actually forested, demonstrating that they have been stable for some time. However, many Great Lakes dune forests have been buried by blowouts or extreme storm events. The unpredictable nature of parabolic dunes means that development within these systems should occur with caution, sound site planning, and good building design that takes active sand movement into consideration. Improperly sited development is especially hazardous in high perched parabolic dunes due to active sand movement, coupled with erosion, particularly during storms and high water periods.

## Complex Dune Fields

Complex dune fields refer to dunes that contain features found in other dune systems; in fact, they may just be an evolutionary transition between two different dune types. Dune fields don't have an easily recognized, repetitive pattern across the landscape

like you would find with parabolic or wooded dune and swale complexes.

Complex dune fields can be found on glacial lake plains (low perched) or end moraines (high perched) and can be vegetated or open, and are scattered throughout Northwest Michigan, though relatively rare compared to other dune types. They're typically taller than dune and swale complexes but shorter than parabolic dunes. One of the most recognized complex dune fields in Michigan is the "dune climb" at Sleeping Bear Dunes National Lakeshore, just west of Glen Lake. This is a high perched, open, complex dune field, and the largest in Northwest Michigan.

While complex dune fields likely aren't as hazardous as parabolic dunes, those with little to no vegetation tend to be quite active, especially when dune fields are open and exposed to on-shore winds. Further, even though most complex dune fields tend to lack steep slopes, active sand erosion and sedimentation can still cause problems for coastal landowners, businesses, and road commissions. Building within or adjacent to open complex dune fields can create problems associated with wind erosion and sedimentation such as exposure of building foundations, road base, and underground utilities; the burial of structures, roads, and driveways; and damage to vehicles and boats.

*Parabolic dunes*



*Complex dune field*



*Wooded dune and swale*



## Coastal Dune Types of Northwest Michigan

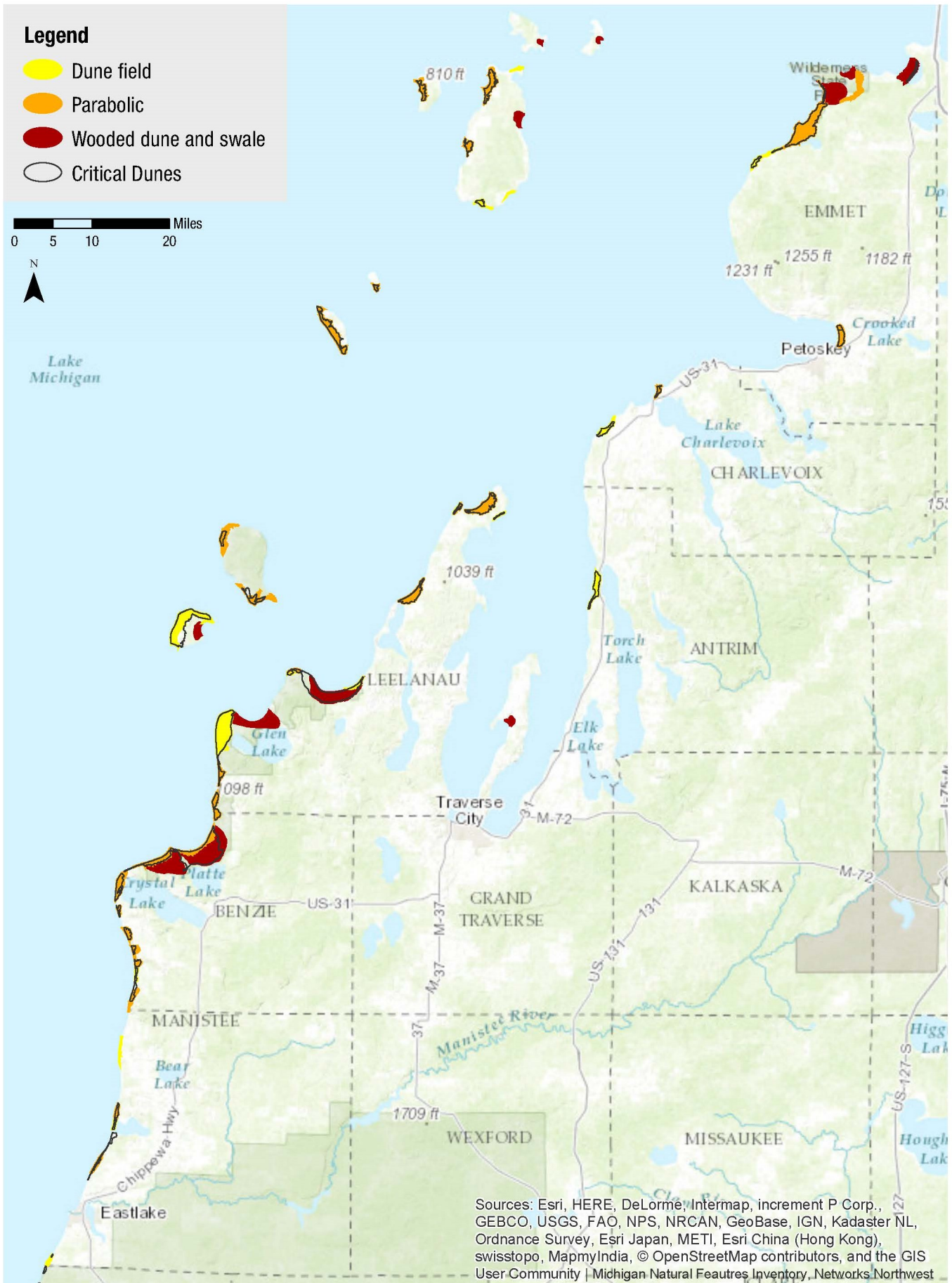
Dune Type	Acres	% in Public Ownership
Wooded dune	16,331	84%
Low perched parabolic dune	2,849	67%
High perched parabolic dune	1,124	53%
Low perched vegetated parabolic dune	8,253	63%
High perched vegetated parabolic dune	2,648	63%
Low perched dune field	442	45%
High perched dune field	3,578	95%
Low perched vegetated dune field	2,252	39%
High perched vegetated dune field	922	0%

## Critical Dunes and High-Risk Erosion Areas

Because of their sensitive features, “critical dune areas” are considered to be a unique, irreplaceable, and fragile resource with significant recreational, economic, scientific, scenic, and ecological benefits, the State of Michigan regulates development within designated “critical sand dune areas” of the state. 20 townships within Northwest Michigan, located in Manistee, Benzie, Leelanau, Antrim, Charlevoix, and Emmet counties include areas designated as critical dunes. In these areas, the alteration or use of critical dunes is permitted only when the protection of the environment and ecology is assured. However, state law does not regulate dune systems in their entirety, but only on a parcel-by-parcel basis. As such, protection of these important, fragile resources is often inconsistent or piecemeal, offering only limited protections—making community-wide planning, conducted at the local level, a key element in protecting the ecosystem.

In addition to critical dune areas, high-risk erosion areas are also regulated in coastal communities. The DEQ is the regulatory agency administering the High Risk Erosion Area Program. The DEQ defines high-risk erosion areas as the shorelands of the Great Lakes and connecting waters where erosion has been occurring at a long-term average rate of one foot or more per year. The erosion can be caused from one or several factors, including high water levels, storms, wind, ground water seepage, surface water runoff, and frost. State high risk erosion area regulations establish required setback distances for various construction activities. However, like regulations that address critical dunes, high-risk erosion areas do not address entire ecosystems.

# Coastal Dunes & Critical Dune Areas in Northwest Michigan



# Planning Issues & Techniques

When planning for and implementing coastal resiliency measures, land use policy is among the most powerful tool available to local units of government. Master plans, hazard mitigation plans, and other community plans help us understand where and how our communities are vulnerable to coastal hazards. Identifying and adopting planning and development practices to compensate for these vulnerabilities is a first, critical step to improving coastal resiliency, and, ultimately to reducing risks to lives, property, and ecosystems in the future.

## Master Plans

A master plan is a guide that helps communities make decisions about where and how development should occur. Master plans include data, maps, research, and community input that together paint a picture of a community's current conditions, build a vision of the community for the future, and make recommendations about actions to take on various community issues.

Master plans are very closely tied to zoning: zoning ordinances, which regulate how land can be used and developed, must be



consistent with an adopted master plan.

Coastal resiliency is an important consideration for Great Lakes shoreline communities working to create or update master plans. Incorporating coastal resiliency into the community's vision, goals, and objectives will support any zoning or other policy changes that address coastal protection (see sidebar on page 9 for sample master plan language).

Master plans also offer an opportunity for communities to prioritize vulnerable areas for protection. Plans may identify hazardous areas, like floodplains or steep slopes, and recommend that new development be limited or designed for low impact in

these areas; and/or they may direct development to more stable areas.

Master plans in Northwest Michigan almost universally call for the preservation of natural resources. Some include general statements, while others include specific supports for water quality, land preservation, or stormwater-related issues. However, some communities, elsewhere in the state, have taken an additional step by adopting "special purpose" plans aimed at specific issues, like coastal development, sustainability, and resiliency. For example, the City of Holland has adopted a master plan that specifically references the community's concerns over climate change and goals of

developing a greener community (see sidebar), and incorporates resiliency principles that will help the City react and adapt to long-term environmental changes.

Regardless of how or where coastal resiliency is addressed in a master plan, it's important to remember that master plans are only guides, and have no authority over how land is ultimately used. In order to be effective, master plans must be implemented with zoning ordinances and other local policies.

## Hazard Mitigation Planning

The phrase “hazard mitigation” refers to actions a community takes before, during, or after a disaster to permanently eliminate or reduce risks from natural or man-made hazards. Effective hazard mitigation, which is essential to emergency management, preparedness, response, and recovery, relies on the development of local hazard mitigation plans.

Hazard mitigation planning helps communities understand natural hazards and the risks they pose to people and property, by identifying potential hazards, such as severe winter weather events or erosion, that are likely to occur in a community. They include strategies that will reduce the likelihood that these events

will cause significant impacts when they occur, and provide guidance for addressing and responding to any events or impacts that do occur.

Each county in Northwest Michigan has adopted a hazard mitigation plan. Many of these plans identify shoreline erosion as a potential natural hazard, and include mitigation and prevention strategies for shoreline erosion and other coastal hazards like flooding. Shoreline strategies include actions such as:

- Conduct inventories of shoreline erosion sites
- Require soil erosion permits to show additional detail of shoreline or high-erosion areas, including slide areas, drainage control, grading, debris flow measures, and vegetation placement
- Identify potential open space

designations for future acquisition or conservation easements by land conservancies, county, townships

- Public education and awareness
- Building code enforcement through permits

Another important aspect of hazard mitigation planning is creating eligibility for disaster recovery and related grants from the Federal Emergency Management Administration (FEMA), which are critical to recovery when and if disasters do occur. Hazard mitigation plans are adopted both locally and at the state level. And must be updated regularly, in conjunction with state and county emergency management partners.



# Master Plan Language

To support zoning regulations, local master plans should identify and address coastal planning as a goal. This is generally done in the part of the plan dealing with natural resources. Some sample natural resource goals and objectives are included below.

## Goals

1. Protect, conserve, and preserve fallow fields, wetlands, woodlands, floodplains, critical sand dunes, groundwater and groundwater recharge areas, surface water, lake and stream shores, view-sheds, topography, wildlife, wildlife corridors, environmentally sensitive lands, dark skies and clean air.
2. Protect development and preserve coastal features by siting new development away from areas prone to coastal flooding and erosion
3. Promote conservation programs and alternative energy sources such as recycling, water, wind power, solar technology, and bio-fuels.
4. Preserve and maintain accessible County public lands and support acquisition of land for increased public access.
5. Preserve and enhance natural and environmental resources and the quality of surface and ground water for all current and future residents.

## Objectives

1. Review and strengthen zoning provisions to better protect all natural resources of the community.
2. Involve citizens and local organizations to achieve community consensus for protection of resources and sensitive lands.
3. Explore funding options and other creative strategies for preserving natural resources and creating recreational opportunities.
4. Work in direct cooperation with local, state, and federal agencies to ensure all applicable environmental permits and conditional approvals are in place.
5. Educate landowners and developers on the importance of environmental conservation practice, such as low impact development and conservation easements that contribute to preservation of natural systems.
6. Support efforts to educate citizens and stakeholders about water quality trends, threats from poorly managed stormwater runoff and other threats to water quality, and actions that can be taken by individuals and businesses to protect water quality.



## Land Conservation

Some coastal lands, because of their value as recreation or scenic areas, or because of their vulnerability to hazards, might be best served by being permanently protected from development. Communities planning for coastal resilience may consider land conservation techniques that allow them to identify and permanently preserve these unique, hazardous, vulnerable, or high-value coastal lands.

One such technique is through outright property purchase. Many communities in Northwest Michigan have worked with nonprofit partners, raised funds, contributed their own local dollars, or approved millages to purchase properties like bluffs and dunes for

permanent preservation. Examples include Houdek Dunes in Leelanau County, Arcadia Dunes Natural Area in Benzie and Manistee Counties, and Elberta Dunes South in Benzie County. Once owned by the community or a nonprofit or public partner agency, these properties are often opened to the public for recreational use.

Another, similar technique is that of acquiring conservation easements for high-priority shoreline areas, in partnership with local land trusts or conservancies. Easements are a legally binding agreement between a landowner and a land trust or agency. The terms of these agreements vary from property to property, but always

require the property owner to sell some or all of their property rights to the land trust or other agency. Conservation easements typically prohibit all or most development on a property. These restrictions are attached to the land and are transferred to subsequent owners to prohibit any future development. In return for giving up this right, landowners may receive a tax break in addition to the sales price for placing an easement on their land.

## Recreation Plans

Because many permanently protected coastal areas are opened to the public for recreational use following preservation, some communities may actually identify their land conservation goals both in a

## Case Study: Elberta Dunes Natural Area

Elberta Dunes Natural Area was purchased by the Village of Elberta in 2014, in partnership with the Grand Traverse Regional Land Conservancy. The Natural Area consists of 63 acres of open and forested dunes, meadow, and shoreline, with over 1,400 feet of Lake Michigan frontage. Its ridgelines offer spectacular views of Lake Michigan, Betsie Lake, the Betsie River State Game Area, and the Betsie River Valley; and its forests, field, and dune areas are home to a variety of plants and wildlife species. This unique property has long been used by the public for recreation, and in 2011 was officially purchased and designated by the Village of Elberta as a public natural area. A Michigan Natural Resources Trust Fund grant was received in 2010 to assist with property acquisition, with fundraising efforts led by the Grand Traverse Regional Land Conservancy. Funding from the MNTF was made possible by the adoption of a recreation plan that included the property purchase as an action item. The Village took ownership of the Natural Area in 2011.

An endowment fund has been established to support activities that will facilitate public access and passive recreation at the Natural Area, and to protect its natural features. The fund may also support options to purchase contiguous land for similar purposes.

master plan and in a five-year recreation plan. Recreation plans, which are developed either by a single, local unit of government, or in partnership with neighboring governments, help a community plan for and prioritize recreation needs and improvements. They identify the community's vision and goals for recreation improvements, and outline specific actions to take to meet needs. Public input opportunities in the recreation planning process provide for two-way communication between the public and officials about community recreation needs; and data and public input help communities to assess population trends and specific park needs.

Prioritizing these needs helps a community budget for improvements and identify opportunities for the partnerships, volunteer assistance, and grant funding that are needed for permanently protecting coastal areas and dunes. Recreation plans can also aid communities in accessing state recreation grants: a 5-year recreation plan that is approved by the Michigan Department of Natural Resources renders the community eligible to apply for Michigan Natural Resources Trust Fund (MNRTF) grants, an important funding source for recreation activities in Michigan communities. A number of communities in Northwest Michigan, including the Village of Elberta (see case study, page 10), have developed recreation plans



identifying the permanent protection of important and vulnerable coastal areas as local objectives, and were later successful in obtaining MNRTF grant dollars to purchase identified properties for conservation purposes. In addition to MNRTF dollars, recreation plans also help in other grant applications, by demonstrating community need and consensus.



# Coastal Resiliency Planning Process

Coastal resiliency planning processes are similar to other community planning processes, with steps including analysis of existing issues; public input; analysis and plan development; and monitoring and evaluation:

- **Analysis of existing issues.** Any planning and conservation efforts must be built on sound decision-making—which in turn depends on good information. As a first step, communities must scope the problems, issues, or stressors that are driving the resiliency planning process. To understand which properties are vulnerable or sensitive, communities may consider creating a natural features inventory, and/or using the resource list in this guide to get started. A particularly valuable resource for coastal communities to consult is the Dune Inventory and Coastal Erosion Potential maps created by the Michigan Natural Features Inventory in 2017, available online at <http://arcg.is/2hjEJmz>.
- **Public and stakeholder input.** Public planning processes generally involve a number of interests, among them coastal residents, tourism, natural resources, and transportation; and working with those different interests is a vital component of any planning process. Surveys, public forums or town hall meetings, and public hearings can help communities understand which properties are of highest public interest, how and which of those properties should be used or preserved, and which regulations are appropriate. These public input processes can help communities assess risk and vulnerability to coastal hazards.
- **Analysis and plan development.** Analyzing natural features information, along with public input, helps the community identify patterns, relationships, and potential future outcomes in coastal areas. During the course of this analysis, communities can begin to identify solutions, such as new zoning techniques or priorities for preservation, that can improve coastal resiliency, based on the priorities and objectives resulting from the analyses and stakeholder input.
- **Monitoring and evaluation.** All strategies and efforts should be measured to determine their effectiveness. Once plans have been adopted and its recommendations have been implemented, local governments or community partners should monitor and evaluate the effectiveness of the plan, and adjust their implementation approach to address unexpected or forthcoming issues that are impacting coastal areas.



# Zoning Issues & Techniques

Zoning helps define how properties are used, what new buildings look like, and how much development can occur in a community—all factors that have important and far-reaching impacts on coastal resiliency.

While master plans act as a guide for future development or land preservation, local zoning is a law that can be enforced by a community. It is where the “rubber meets the road,” in many cases, for the goals outlined in a master plan. A number of techniques can be adopted through local zoning laws to improve coastal resiliency, including shoreline protection setbacks, cluster development provisions, and other.

## Shoreline Protection Setbacks

Vegetative buffers, also known as greenbelts or riparian buffers, are planted setbacks used along waterways, wetlands, and any other sensitive areas.

Setting aside buffers of naturally growing grasses, shrubs, and trees has been shown to protect the health of streams, wetlands, rivers, or lakes. These strips of natural vegetation along the shoreline provide a natural boundary between the shoreline



and development, and can help in preventing erosion, filtering stormwater, and keeping sediment and nutrients from reaching lakes, rivers, and streams. Perhaps even more importantly when considering shoreline development along dunes or high risk erosion areas, setbacks also provide benefits such as flood control, bank stabilization, and habitat preservation, and are necessary to protect development and ecosystems from the impacts of storms. A single storm is capable of removing several feet of bank or bluff, and can greatly reduce beaches and foredunes—with subsequent impacts to any development on or near the dune or beach.

Appropriately designed setbacks are particularly important in controlling erosion hazards in dunes or bluff areas along the coast. For erosion mitigation, the setback should be measured from a proper reference point, such as the top of the bluff, to directly reduce the potential erosion impacts on built structures. It's also important to consider historic patterns or recession and erosion when considering setbacks.

Local governments can use zoning to encourage or require the use of greenbelts to mitigate and address runoff, erosion, and other shoreline issues. An effective buffer ordinance will:

- Specify a minimum distance or width of the buffer based on

local conditions and needs, and require them to be permanently preserved. There are a variety of resources online for adopting specific “need-based” setbacks.

- Prohibit the use of chemicals within the setback.
- Prohibit the alteration of land within the setback, and/or removal of native vegetation, in order to prevent destabilization of the dune area.

It’s important to note that, while dune grass and tree plantings along a dune or bluff that are protected by setbacks can help to promote foredune development and therefore increase storm protection, they can nevertheless be quickly removed by high water during storms; so proper siting of development is critical, in addition to shoreline setbacks, in order to ensure that the shoreline is properly vegetated and stabilized.

Shoreline protection setbacks are, in many ways, the most important zoning tool local governments can consider; and a number of Lake Michigan coastal communities have adopted shoreline protection setback provisions in the interest of enhancing shoreline health and resiliency (see sidebar, page #, for locally-adopted shoreline protection setback ordinances).

## Limitations on Shoreline Structures

Healthy, wide beaches provide the most effective shore protection against storms and other shoreline hazards. Yet, in some shoreline areas where erosion has already occurred, property owners may install or maintain seawalls as a protective mechanism. Yet, similar to other types of development in dune areas, seawalls can contribute to the potential for natural hazards. They can cause degradation of shoreline areas on the waterside of the wall, along with additional erosion of adjacent shorelines on either side of the wall. When waves impact seawalls and revetments, they cause the beach to lower, or erode, lakeward of the structure. Over time, an armored shoreline depletes the sediment supply to the

beach—eventually eliminating it in its entirety.

Communities may consider zoning that prohibits the construction of seawalls, with provisions that favor engineered natural shorelines or revetments, or retaining walls, except where there is no other practical alternative.

## Environmental Impact Statements

An environmental impact statement (EIS) may be required by local zoning for development proposals in sensitive or vulnerable environmental areas like bluffs, dunes, or other shoreline areas. An EIS identifies the anticipated effects on the environment of a proposed development or project, often as part of a site plan review process. If the impact statement identifies impacts that are unacceptable, design measures or other relevant mitigation measures can be taken to reduce or avoid those effects.

Many zoning ordinances require general impact statements that provide information on factors that may impact the community. Impact statements often describe site particulars such as the site configuration, density, expected demographic characteristics, and community services needs and impacts, such as sewage treatment, and how these services are to be provided. An EIS, typically required to be completed by a licensed engineer, takes this concept a step further. EIS regulations may require that proposals include information on factors like site topography, drainage, and threatened or endangered species. Developers may also be required to show the impact of the proposed development on factors such as soil erosion, shoreline protection, wildlife habitat, air pollution, water pollution (ground and surface), and noise. For vulnerable areas, environmental impact statements or assessments may also require information such as a natural hazards inventory that identifies site-specific hazards like flooding or erosion.

EIAs allow decision-makers to consider a proposed

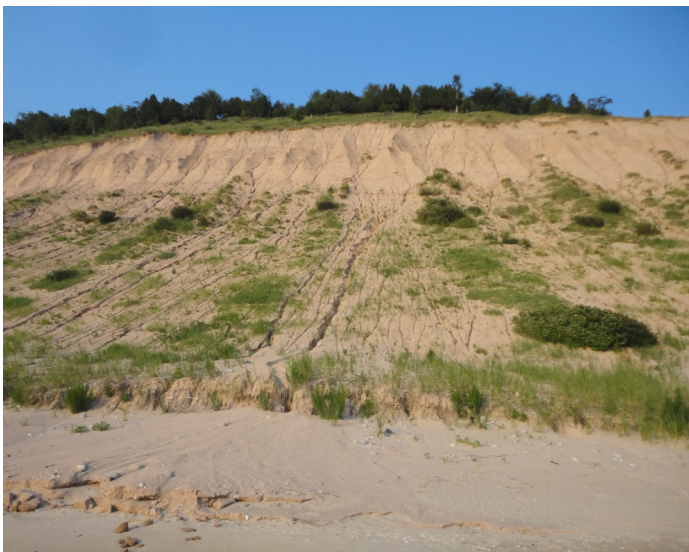
# Case Study: Leelanau Township Environmental Overlay

Leelanau Township, the northernmost township in Leelanau County, adopted an overlay zoning district in order to identify and protect areas that are considered to be environmentally sensitive to the effects of development due to soil types, drainage, vegetation, wildlife habitats; or other factors that are subject to being polluted, degraded, impaired, or destroyed if allowed to be developed in a manner inconsistent with their conservation. The overlay regulations are applied in addition to other applicable regulations for each zoning district. All uses must comply with the standards in the overlay.

- The ordinance identifies “sensitive” areas include wetlands, dunes, inland lakes and streams, shorelands, ridgelines, floodplains, and shoreland bluffs. Dunelands are defined as "designated sand dune areas" and "critical dunes" within the State of Michigan Critical Sand Dune Atlas, Michigan Department of Environmental Quality, Geological Survey Division, April 1996, pp. 39-40 and 43. 2; or Sand Dune areas designated by the Michigan Department of Environmental Quality pursuant to Part 637, Natural Resources and Environmental Protection Act of 1994, as amended. Shorelands are defined as those areas lying within five hundred feet (500') of the waterfront setback datum.
- Conditions for approval include permits from all regulating agencies, including the Michigan Department of Environmental Quality.
- Specific setbacks for each type of sensitive area are established based on the area’s environmental characteristics. Bluff setback requirements are based on a mathematical formula combining bluff height and grade, recognizing that higher and steeper bluffs are more likely to be unstable.
- The ordinance also includes limitations on vegetation removal and impervious surface coverage within setbacks, along with planting requirements.

The ordinance is available online at <http://www.leelanau.co/leelanautwp.asp>.





development in the context of potential hazards, and to allow development only when those hazards are appropriately mitigated.

## Bluff Protection Zones

Bluffs and dunes are among the most vulnerable geographic features along the shoreline. To minimize risks in bluff areas and address issues like the potential for erosion, communities can adopt zoning regulations specifically for bluff areas.

Bluff protection zoning is designed to ensure that buildings are placed at a safe distance back from the bluff top, through carefully determined setbacks. Communities can use a formula to determine a setback that is specific to the unique conditions and needs of the bluff, rather than using a fixed distance. Setbacks may be based on bluff slope angle measurements as determined by a professional engineer or land surveyor. Alternatively, communities may specify a minimum fixed distance for a setback.

To further reduce erosion hazards, bluff protection zoning may also require that the amount of disturbed area on the bluff is minimized, and that the natural habitat is preserved to the greatest extent possible, particularly existing native vegetation. Some ordinances also require stormwater management plans and measures that direct all runoff from any impervious surfaces away from the bluff.

## Overlay Districts

Overlay districts add an extra layer of regulatory protection in areas that are of special historical, environmental, or cultural concern. Some communities use overlay districts in coastal areas to add an extra layer of land use considerations in areas that are of special concern. Overlay districts might provide for multiple resiliency techniques, such as site plan review and design standards, environmental impact statements, shoreline protection setbacks, native landscaping, and impervious surface restrictions in order to mitigate the impacts of development in coastal areas.

## Cluster Development

Communities that wish to direct development to appropriate locations may consider zoning techniques that allow for cluster developments. This type of planned residential or mixed-use development allows for some flexibility in density or design in order to promote environmentally sensitive and efficient use of the land. Cluster developments are often designed to preserve sensitive natural resources such as floodplains, wildlife habitats, and wetlands, and can also be used to protect shoreline or mitigate the impacts of development on coastal areas.

Cluster developments typically cluster houses and structures on less environmentally sensitive soils, which helps to reduce erosion and sedimentation by minimizing the disturbance and removal of vegetation. Cluster developments also preserve greater amounts of open space; and regulations can be structured to ensure that sensitive or vulnerable environmental areas within the cluster development are permanently preserved.

## Coordinating with Related Regulations

While local zoning regulates the majority of property in a community, some coastal areas are subject to state or federal regulations. The State of Michigan regulates development within designated “critical sand dune

areas” of the state, along with “high-risk erosion areas” in coastal communities (see sidebar, page #).

While activities in these areas are restricted, state regulations don’t regulate coastal areas or dune systems in their entirety, but only on a parcel-by-parcel basis. This can leave large parts of an ecosystem inadequately protected, potentially contributing to its fragmentation of the ecosystem,

When localities partner with state and federal agencies, conservancies, and others on coastal resiliency measures, outcomes are improved. An understanding of state and federal coastal regulations, along with shoreline processes, vulnerabilities, and resiliency techniques, can help local governments craft regulations that “fill the gaps” and work to better protect coastal ecosystems in their entirety. Additionally, local governments can work constructively to enhance state and federal regulations by calling for coordination in permitting as part of the review process for developments in vulnerable areas.

## Emmet County Shoreline Bluff Protection Ordinance

Emmet County administers zoning for multiple townships along the Lake Michigan shoreline, some of which include steep slopes, dunes, and bluffs along the water. A number of issues arose along the shoreline, including “slumps,” where parts of a bluff fell into the shoreline along M-119, gave rise to “emergency” regulations to protect the bluffs. From the start, property owners and other stakeholders had concerns that the regulations were too stringent; and efforts began to revise the regulations to review the ordinance and its goal. An ad hoc committee was formed to explore how best to regulate these vulnerable areas, with representatives including township official and property owners. The County hired a geologist to study shoreline soils in detail and to provide recommendations on how best to regulate shoreline and bluff development. The ad hoc committee was closely involved in drafting the regulations, which ultimately only regulated dunes on the shoreline itself, and exempted critical dunes, per State regulations. Because most properties include buildable areas on the other side of M-119, the ordinance tries to direct development to the other side of M-119. Since the ordinance was adopted in 2002, only two reviews have been conducted.

The ordinance is available online at [www.emmetcounty.org/community-resources/ordinances](http://www.emmetcounty.org/community-resources/ordinances).

# Zoning Analysis

Networks Northwest conducted an analysis of local land use policies in 42 coastal communities in Northwest Michigan, in order to identify the frequency and type of coastal resiliency policy measures along the shoreline. Master plans and zoning ordinances were reviewed to determine whether communities along the Lake Michigan shoreline have adopted coastal zoning land use provisions such as land conservation goals, greenbelts, and bluff protection measures.

	# Communities	Sample Plans & Ordinances
<b>Zoning provisions</b>		
Bluff protection zoning	19	<a href="#">Emmet County</a> ; <a href="#">Onekama Township</a> (Manistee County)
Greenbelts/vegetative buffers	34	<a href="#">Milton Township</a> (Antrim County) <a href="#">Emmet County</a> <a href="#">Bingham Township</a> (Leelanau County)
Limit removal of shore cover	32	<a href="#">Village of Elk Rapids</a> (Antrim County) <a href="#">Village of Suttons Bay</a> (Leelanau County)
Limit shoreline structures	42	<a href="#">Hayes Township</a> (Charlevoix County) <a href="#">Crystal Lake Township</a> (Benzie County)
Environmental impact statement	18*	<a href="#">Leelanau Township</a> (Leelanau County) <a href="#">Emmet County</a> Filer Township, Manistee County
Overlay districts	23	<a href="#">Leelanau Township</a> (Leelanau County) <a href="#">Emmet County</a> <a href="#">Manistee Township</a> (Manistee County)
Coordinated site plan review/state and federal permitting	22	<a href="#">Leelanau Township</a> (Leelanau County) <a href="#">Charlevoix Township</a> (Charlevoix County)
Cluster development	44	Gilmore Township, Benzie County <a href="#">Glen Arbor Township</a> (Leelanau County)

\* An additional 15 communities include the requirement of an environmental impact statement or assessment as a decision of the Planning Commission, Board of Trustees, and/or Zoning Administrator.

# Data & Mapping Resources

For communities that are looking to enhance their coastal resiliency planning and zoning techniques, accurate and up-to-date data and maps are essential. Whether communities are interested in adopting master plans, hazard mitigation plans, recreation plans, or zoning ordinances, identifying dune location and type is a critical first step. Fortunately, data and maps are increasingly available online.

## Coastal Dunes and Erosion Data and Maps

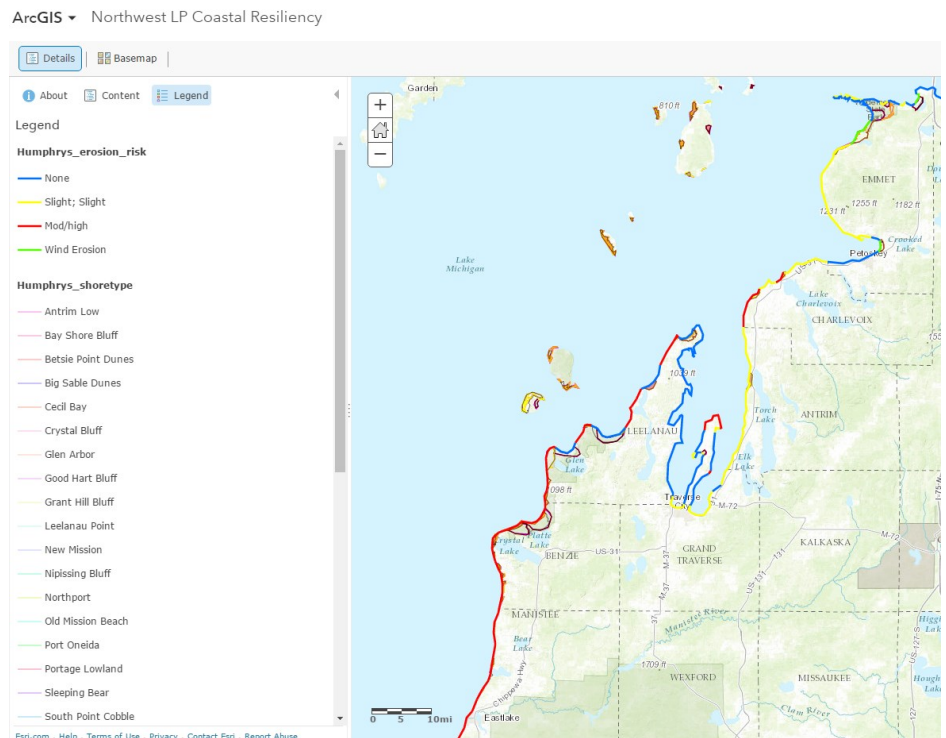
In 2016, the Michigan Natural Features Inventory (MNFI), with funding from the Coastal Zone Management Program, mapped all of the coastal dunes located in the Northwest Lower Peninsula from the Mackinac Bridge down to the southern border of Manistee County. The resulting spatial database includes information on the type of dune, acreage, and ownership (private or public) in each coastal community in Northwest Michigan. To help explain this new data resource, MNFI created an online Story Map entitled, [Coastal Dunes of Michigan's Northwest Lower Peninsula](#) (as pictured on the following page). The Northwest Michigan Coastal Dunes Story Map contains a

wealth of information related to coastal dunes, including the process and results of the MNFI analysis, as well as links to related resources.

For those interested in viewing maps associated with the coastal dunes, the spatial data is available online at [Northwest Lower Michigan Coastal Resiliency](#) through the ArcGIS online web map application (as pictured below). The ArcGIS Online website allows users to visualize the various data associated with coastal dunes in this region. Once at the website, users can zoom in and out, pan, search, and display different spatial backgrounds. For more advanced users, the spatial

data can be downloaded from the website and integrated into their own geospatial data.

In addition to information on coastal dunes, the Northwest LP Coastal Resiliency web map also contains geospatial data on coastal erosion. Coastal erosion is a major issue along all Great Lakes shorelines, but it seems particularly critical along the Lake Michigan coast. To help facilitate decisions regarding coastal erosion, MNFI digitized an existing hard copy map of shoretypes created in the 1950's by C. R. Humphrys, which includes a database that provides a significant amount of information collected by direct observation.





## How to Use Data and Mapping Resources

Spatial visualization can be a powerful tool for making land and water based decisions. The coastal dunes data developed as part of this project can be used to support decisions about planning, zoning, and development requests. The GIS Story Map on coastal dunes in the Northwest Lower Peninsula helps explain why it's important to understand the difference between dunes types. Not all dunes are the same, and understanding these differences can facilitate better planning outcomes. For example, intact hydrology is critical to dune and swale complexes, while perched open dunes are not only highly dynamic, but also susceptible to bluff erosion. Additionally, most communities are aware of the Critical Dunes Act and the associated maps for their municipality. The maps created by MNFI include all dune systems associated with the present day coastline. As a result, local communities have a new opportunity to determine how the dunes outside of the critical dune boundary are treated in the future.

The new maps developed by MNFI show the different types of dunes, where they are located, the relative size of aggregated dune systems (different types of dunes that are adjacent to other types), and the

ownership patterns of each dune system. Many of the larger dune systems in the Northwest Lower Peninsula are entirely or predominantly in public ownership, however, there are also a significant number of dune systems in private ownership. Local communities can use this information to target new ordinances, conduct landowner outreach and education, or work with local conservancies and/or state agencies on long-term protection strategies.

In addition to information on coastal dunes, the web map also contains spatial data on coastal erosion in the northwest Lower Peninsula. Although the Michigan Department of Environmental Quality is responsible for a database on high risk erosion areas, this information is incomplete. The Humphrys shoretype data provided as part of this project is not new data but rather newly digitized data from the 1950's. A key part of the shoretype data is information on coastal erosion. Local communities can use this spatial information to help determine the potential for coastal erosion within and adjacent to their jurisdiction. Armed with this new information, local communities can start to chart out a course of action for dealing with existing structures and infrastructure that may be at risk, as well as guiding future development projects away from areas prone to erosion.

**Coastal Dunes of Michigan's Northwest Lower Peninsula**

Michigan Natural Features Inventory  
Discover. Define. Define.

Introduction | Designated Critical Dunes | Rest of the Dunes | How Big and Where? | Story Behind the Numbers | Dune Types and Locations | Wooded Dune and Swale Complex | **Parabolic Dunes** | Complex Dune Field | Taking Action

### Parabolic Dunes

Parabolic dunes are the type of dunes most people think of when they try and picture coastal dunes in their mind. According to researchers, parabolic dunes were formed by strong winds and storms that created a repeated series of blowouts in large dune ridges (Carter et al 1990). The ridges of the parabolic dunes are typically vegetated with grasses, forbs, shrubs, and trees, while the blowouts in between the ridges are primarily open with a few sparsely scattered clumps of grasses, forbs and shrubs.

Although many of these blowouts were formed thousands of years ago, some are still active, meaning that sand is still moving on a regular basis. New blowouts can still form, so even parabolic dunes that appear "stable" now can become "unstable" in the future. Hansen et al. (2010) found that parabolic dunes in P.J. Hoffmaster State Park, Ottawa County, were actively migrating over lower, stable parabolic back dunes further inland.

In terms of number of sites, the most common type of dune system in the NWLP is actually low perched, vegetated, parabolic dunes. Both vegetated and open, low perched parabolic dunes are found throughout the region and are most commonly found in exposed bays, such as Petoskey State Park in Little Traverse Bay, and Cathead Bay located at the tip of the Leelanau Peninsula (image to the right). Low perched dunes are located on either low-lying flat glacial lake plains or sand bars.

High perched parabolic dunes are located on top of glacial moraines and can tower more than 450 feet above the Lakes surface. It is theorized that these dunes were formed during periods of very high water levels such as the Nipissing stage of the Great Lakes when water levels were approximately 25-30 feet higher than today (approximately 4-6,000 years BP). Because they are located at higher elevations, high perched dunes tend to be more exposed to the wind, and can actually be more active and hazardous than the low perched parabolic dunes discussed above.

Interestingly, all high perched parabolic dunes in this region are located in Leelanau, Benzie, and Manistee Counties. These dunes can be particularly hazardous to improperly sited development because of the active sand movement of the dune, coupled with erosion at the base of the moraine from storms, particularly during high water periods.

Older parabolic dunes located behind the front (or barrier) dunes are typically vegetated with mature trees, demonstrating that they have been stable for quite a while, sometimes hundreds of years. However, there are multiple examples of dune forests along the Great Lakes that have been buried by blowouts or extreme storm events. Due to the unpredictable nature of parabolic dunes, development within these systems should be done with caution, sound site planning, and good building design that takes active sand movement into consideration.

# Resiliency Resources Online

Coastal Dunes of Michigan's Northwest Lower Peninsula  
(Story Map)

<http://mnfi.maps.arcgis.com/apps/MapSeries/index.html?appid=a2232d34a57644baac2687f5481033c2>

Northwest Lower Peninsula Coastal Resiliency Maps  
(ArcGIS Online Map Viewer)

<http://arcg.is/2hjEJmz>

Great Lakes Shoreline Viewer: A Coastal Risk and Climate Adaptation Tool

[www.greatlakesshoreviewer.org](http://www.greatlakesshoreviewer.org)

Resilient Great Lakes

[www.resilientgreatlakescoast.org](http://www.resilientgreatlakescoast.org)