Preparing for Extremes

THE DYNAMIC GREAT LAKES

MICHIGAN'S DYNAMIC ENVIRONMENT

"Nothing is permanent except change." — *Heraclitus*

Spend a year in Michigan, and you may think Heraclitus was inspired by the state's dynamic environment. The weather changes frequently and sometimes drastically. We have four distinct seasons. Coastal communities experience different conditions than inland areas experience due to the moderating effects of the Great Lakes.

There is plenty of year-to-year variability: some winters are mild and dry (El Niño years) while others are colder and snowier (La Niña years). Water levels can also naturally fluctuate daily, seasonally and over years and decades. Levels were significantly lower in the 2000s than they were in the 1980s. Considering all this, it is no secret that life in Michigan – especially on the coasts – means dealing with change.

Ups and Downs

Whether future climate matches the predictions of scientists, consider this: it doesn't matter. ***The reality is that weather, climate and lake levels will continue to be variable.*** *Instead of reacting to the highs and lows in temperature, precipitation and lake levels, coastal communities need to expect and prepare for these ups and downs.*

The effects of a changing climate add yet another layer of variability. In recent decades, we have seen more severe and frequent extreme events like the Ludington storm in 2008 (see sidebar), and heat waves like those experienced in Michigan during summers of 2006 and 2010. Scientists expect these trends to continue. Whether or not they do, climate and lake levels will continue to be variable. For instance, lake levels may seem low now, but they will eventually rise again. Building coastal infrastructure expecting low levels to persist indefinitely will leave us unprepared for when they rise again. **To prepare for variability means to prepare for a range of outcomes.**

Plan for Highs and Lows

Climate models provide our best guesses for the future, but they are not crystal balls. Some coastal communities are hesitant to adjust their long-term plans because of this uncertainty. But we don't need to know exactly what will happen in the future to start preparing our communities now. Planning for a wide range of outcomes rather than a specific scenario is smarter since there will always be natural variability and unpredictability no matter how sophisticated the models. Planning for a specific scenario may pigeonhole us if the future looks different. For example, instead of planning for lake levels to go down, which they may or may not

Road damage on Lake Michigan Drive near Ludington due to runoff from the June 12, 2008 storm that dumped 10 inches of rain in 12 hours. Photo: Chris Pierce

Floodington

On June 12, 2008, a massive storm inundated the city of Ludington, Michigan with 10 inches of rain in 12 hours. The rain flooded waterways and caused erosion that damaged numerous roads and infrastructure, including the sewer main that carries 90 percent of the city's sewage. The storm sent large amounts of debris and sediment into the harbor, and beaches and boat launches were closed due to contamination. The storm cost the city nearly $400,000 in emergency repairs and clean-up, and hundreds of homeowners reported basement flooding and wind damage.

Outside of the city, numerous rural roads were inaccessible due to road washouts. For nearly a month people couldn't access their houses the standard way, in some cases driving 20 miles out of their way. Earlier that same month, much of the Lower Peninsula was hit with intense storms that led to deaths of at least six people, widespread property damage due to floods and strong winds, sewer overflows, and the loss of electrical service to more than 520,000 homes and businesses. In recent decades, we have seen more severe and frequent extreme events like the downpour in Ludington in 2008, or the summer heat waves of 2006 and 2010. If caught unprepared, these events can be costly to communities, and potentially dangerous to public health and quality of life.

CLIMATE VARIABLE	POTENTIAL IMPACTS
Extreme storms, increased runoff	■ increase in non-point source pollution ■ combined sewer overflows ■ beach closures due to contamination ■ sedimentation of harbors and nearshore ■ shoreline erosion and wind damage ■ road and bridge washouts ■ flooding ■ pipe and culvert damage
Droughts	■ reduced crop production ■ reduced groundwater recharge ■ loss of wetland and stream habitat ■ concentrations of pollutants
Heat waves	■ increased demand for beaches ■ public health concerns for elderly and poor populations ■ added stress on the power grid ■ reduced air quality in urban areas
Fluctuating lake levels	■ stranded or flooded docks and boat ramps ■ erosion damage to shorelines during high water periods ■ disruptions to navigation, energy production and drinking water supply ■ management issues as bottomlands are exposed during low water

This upgraded road/stream crossing in the Big Sable watershed in northwest lower Michigan is now more resilient to erosion damage from heavy downpours. Photo: Chris Pierce

Ways to prepare for extremes:

- Use updated rainfall data when designing new infrastructure.
- Use planning and zoning power to regulate floodplains, coastal land use, placement of structures, shoreline protection structures.
- Remove dams to restore natural floodplain processes.
- Conduct assessments to identify properties and infrastructure vulnerable to flooding, erosion and lake level changes.
- Adjust placement of lake-based water intake pipes.
- Revise loading and unloading policies for cargo ships.
- Update dredging plans and needs.
- Upgrade road/stream crossings.
- Stabilize stream and river banks.

do, we plan for changing lake levels. We can never be 100% sure of what will happen in the future, but we can look to the past for help: preparing for the highest highs and the lowest lows (temperatures, precipitation events, lake levels) we've seen in the last 100 years is likely sufficient to address much of the variability we will see in the next 100 years.

For coastal communities, preparing for variability means preparing for the impacts of extreme events like heavy downpours, floods, droughts and heat waves. It also means preparing for fluctuating lake levels. Communities face a range of potential issues if caught by surprise by these events (see table above). Given the costs of these impacts to communities, both financial and quality of life, communities cannot afford to be caught unprepared for extreme events and lake level fluctuations.

Increase Adaptive Capacity

The general guiding principle for preparing for variability is to increase adaptive capacity. **Adaptive capacity** is the ability of built, natural, and human systems (e.g., roads, rivers, healthcare) to accommodate climate variability with minimal potential damage or cost. To increase adaptive capacity, we must improve ecosystem and infrastructure resiliency. **Resiliency** is the ability of a system to cope with disturbances. The more resilient our ecosystems and infrastructure are, the higher their capacity to adapt in the face of climate-related variability. For example, heavy downpours like the Ludington storm are becoming more frequent, which increases the need for resilience to large quantities of runoff, erosion and flooding.

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Key Terms

- **Adaptive capacity:** Ability to accommodate climate variability with minimal potential damage or cost.
- **Resiliency:** Ability of a system to cope with disturbances.
- **Vulnerability:** Susceptibility to harm from climate variability.
- **No regrets actions:** Activities or policies that provide benefits to Great Lakes communities regardless of what the future climate looks like.

Identify Vulnerable Areas

Communities need to identify which assets, locations, services and activities are most vulnerable to extreme events and lake level fluctuations, then focus their resources on adding resiliency to those areas. For example, in the Ludington storm, most of the damage to the city's infrastructure was at one location on South Madison Street. A culvert became plugged and water went around it, undermining and collapsing the road. Officials now know this location is vulnerable to heavy downpours and can focus stormwater management efforts here. For help in identifying vulnerabilities, see *Resources*.

In addition to structural solutions, communities can use policy and planning to guide development away from the most vulnerable areas, and to think ahead about what to do under extreme conditions. Examples include developing emergency response plans for flooding and heat waves, contingency plans for drought periods, floodplain zoning, promoting water conservation and efficiency and ensuring that engineering designs account for a wider range of temperature, precipitation, water levels and sedimentation.

No Regrets

Many of the actions to increase adaptive capacity and resiliency are "no regrets" policies and actions. **No regrets actions** are those that will provide benefits (such as cleaner air and water, improved habitat and recreational opportunities, enhanced quality of life and cost savings) to Great Lakes communities regardless of what future climate looks like. In fact, many of the preparation examples identified below were not implemented specifically to prepare for climate extremes, but for other reasons such as beautification, habitat restoration, cost savings or convenience. Regardless of the reason, if a community takes action to restore and improve resiliency, it is preparing for climate extremes.

Adapting to Climate Change

There is widespread scientific consensus that global climate is changing. The potential impacts of climate change in the Great Lakes region include:

- Increase in average temperature (especially at night)
- Shorter winters, longer growing season
- Wetter winter and spring, drier summer and fall
- More extreme storms
- Higher proportion of precipitation falling in extreme events
- More droughts, more runoff, more floods.
- More frequent, severe and longer lasting heat waves
- Warmer lakes, reduced lake ice

A climate-resilient community is one that takes proactive steps to prepare for these impacts. Proactive planning is often more effective than responding to extreme events as they happen. By preparing for extremes, communities will also be contributing to climate change adaptation.

Resources

Climate Ready Great Lakes: Assisting Great Lakes Communities with Climate Change Adaptation. www.regions.noaa.gov/great-lakes/?page_id=395

Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments. Available at http://cses.washington.edu/db/pdf/snoveretalgb574.pdf

WHAT DOES PREPARING LOOK LIKE?

This rural road was completely washed out by an extreme storm on June 12, 2008. The Conservation Resource Alliance and Big Sable Watershed Restoration Committee are working to prevent this type of damage in the future.

Volunteers work to terrace an eroding bank and install native plants on a Big Sable river bank. CRA and partners use these techniques to prevent erosion and protect fish habitat in the Big Sable watershed. Photos: Chris Pierce

Stream Restoration

The Conservation Resource Alliance (CRA) works with many partners to restore stream habitat in northwest lower Michigan. The CRA and Big Sable Watershed Restoration Committee has upgraded two road/stream crossings in the Big Sable River watershed. "A lot of our watersheds are plagued with undersized structures (culverts) which have many negative ecological implications. They negatively affect aquatic species passage and sediment and nutrient flow, and they fragment habitat and lead to system-wide hydrological changes and flooding." said Chris Pierce, from the CRA. After the massive June 12, 2008 storm, 19 of the 48 road crossings in the watershed were washed out or damaged by erosion, blocking vehicle access for a month in some locations. However, according to Pierce, neither of the crossings that had been repaired by CRA and partners were damaged.

WHAT DOES PREPARING LOOK LIKE?

The following photos highlight activities that Michigan communities and businesses can undertake to increase their resiliency to the natural variability that will occur even if climate change predictions are different than expected.

Stormwater Control Measures

This rain garden in Spring Lake captures runoff and removes pollutants. When implemented throughout a community, stormwater control measures such as rain gardens, rain barrels, porous pavement and green roofs can help with runoff and flood reduction and maintain water quality.

Softshore Engineering

Softshore engineering is the use of natural features to protect shorelines instead of hard infrastructure (sea walls, rip-rap, groins, etc.). This approach encourages interaction between the lake and the shoreline, allowing the shoreline to naturally respond as lake levels fluctuate. Softshore engineering is most suitable where hard infrastructure is not needed for shoreline access or as protection from wave erosion.

Floating Docks

This floating dock system at Straits State Marina in Mackinaw City moves up and down with lake levels, allowing boaters access to their boats as lake levels fluctuate.

Wetland Restoration

The significant role that wetlands play in filtering runoff and reducing flooding makes wetland restoration a tremendous opportunity for increasing ecosystem resiliency.

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