

CLIMATE ADAPTATION AND MITIGATION PLAN

FOR ALGER COUNTY, MICHIGAN

Preparing Communities, Forests and Water Resources for a Changing Climate



**Provided by the Superior Watershed Partnership in cooperation
with the Model Forest Policy Program and Climate Solutions University**

Foreword

In 2011, the Superior Watershed Partnership and the Model Forest Policy Program (MFPP) came together to create a climate adaptation plan for Alger County, Michigan. Development of the plan came about because all parties, led by MFPP, recognized the critical need for local community resilience against the impacts of climate change by protecting forest and water resources. This climate adaptation plan for Alger County, Michigan presents the results of a community team effort, deep and broad information gathering, critical analysis and thoughtful planning. Superior Watershed Partnership took the local leadership role to engage with the Climate Solutions University: Forest and Water Strategies program (CSU) and lead their community toward climate resilience with an adaptation plan that addresses their local climate risks and fits their local conditions and culture. This achievement was made possible by the guidance and coaching of the Climate Solutions University: Forest and Water Strategies program (CSU) created by the Model Forest Policy Program in partnership with the Cumberland River Compact. The goal of CSU is to empower rural, underserved communities to become leaders in climate resilience using a cost effective distance-learning program. The result of this collaborative effort is a powerful climate adaptation plan that the community can support and implement in coming years. The outcome will be a community that can better withstand impacts of climate upon their natural resources, economy and social structure in the decades to come.

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Contributing Authors

Jennifer Klipp, Andrea Chenoweth, Carl Lindquist, Hunter King, Natasha Koss and Gregg Bruff

Editors

Gwen Griffith, Toby Thaler, Todd Crossett, Carl Lindquist, Jeff Morris

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ngilliam@mfpp.org, (509) 432-8679; www.mfpp.org

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Executive Summary

Like so many rural communities, Alger County, rich in natural resources, is a beautiful and unique place. It is also a place that is experiencing a changing climate: hotter, drier summers; wetter, milder winters; and warming waters with less ice cover, lower lake levels and algal blooms. These effects of climate change are sure to alter this loveliest of northwoods lake country. These alterations served as a catalyst for the Superior Watershed Partnership and Land Trust (SWP) to take a leadership role in climate adaptation planning for the Upper Peninsula region of Michigan

The Superior Watershed Partnership, in partnership with the Model Forest Policy Program's Climate Solutions University: Forest and Water Strategies (CSU) began working on a climate change adaptation plan in March 2011 for Alger County in Michigan's Upper Peninsula. The SWP, a regional leader in freshwater protection, participated in CSU's rigorous course work, gathered and assessed a variety of data, and solicited the help of other regional experts to create a climate adaptation plan for Alger County. Many stakeholders were involved in creating this plan, including Pictured Rocks National Lakeshore, The Forestland Group, LLC, local business owners, and concerned citizens. Support, in terms of resources, data interpretation, and Climate Adaptation Plan Goals and Objectives recommendations was provided by the U.S. Forest Service, the Northern Institute of Applied Climate Science, and senior staff at the Superior Watershed Partnership. These individuals were dedicated to assessing the threats and opportunities associated with climate change and worked to create a data driven plan to ensure sustainability and resiliency of Alger County's natural resources and economy.

With over a half of million forested acres and a public land to private land ratio of one to one, Alger County is an area whose economic sustainability relies almost solely on the stewardship of its land and water. Significant decline in water or forest quality will impact more than 20 percent of its labor force. As an area that is already economically depressed, the decline of its natural resource health would prove catastrophic, causing a significant decline to the quality of life for all of its residents - plant, animal, and human - and serve as a large drain on the Upper Peninsula region, the Lake Superior watershed, and the State of Michigan. There is already early evidence of tree species migration. Already endangered species such as the Piping Plover, a migratory bird that nests along the shores of Alger County, will struggle to keep its nesting habitat intact as Lake Superior's turbidity and wave action increases. Globally, the issue of freshwater quality, water rights and ownership will continue to be one of the largest issues of our time. Climate change only increases the urgency and severity of water issues. Alternative energy and fuel continues to drive geo-political policymaking and several emerging markets.

Beyond the SWP and CSU, many other partners and regional agencies supported the creation of this plan: The National Park Service, Forestland Group, U.S. Forest Service, and Northern Institute of Applied Climate Science participated by providing data and insight.

SWP and the supporting team devoted 10 months in 2011 to conduct an in-depth assessment of the risks and opportunities related to climate change impacts to forest, water and economics of the community. The priority risks identified include:

- Hotter summers with more drought, leading to a decrease in iconic tree species (such as the Sugar Maple, Eastern Hemlock, and Aspen) and an increase in the cost of living through increased energy and water bills, resulting from air conditioner use and lawn and garden irrigation.
- Decreased forest habitat for terrestrial species such as the threatened Gray Wolf and game birds such as Partridge and Grouse.
- Warmer water temperatures, causing a decline of cold water fish species, such as Lake Trout.
- Decreased ice on Lake Superior and inland lakes, negatively impacting the foundation of the freshwater food chain through diminished plankton such as diatoms, and adversely affecting ice fishing, an important component of the winter tourism industry.
- Increased Lake Superior wave energy, making shoreline infrastructure vulnerable to erosion and potentially damaging the habitat of the Piping Plover, an endangered migratory coastal bird.
- Declining winter tourism dollars, as snow-based activities, such as snowmobiling and skiing, diminish due to lack of adequate snow base, and the cancellation of winter festivals such as the UP 200 dog sled race.
- Disruption of human operations due to increased severe storm events including flooding.

Opportunities available through addressing climate change include:

- An extended summer and fall tourism season.
- The manufacturing of locally produced fuel, such as bio-fuels associated with Alger County forest products businesses.
- The protection of high quality rivers, streams, and lakes, providing healthy fish habitats and public use enjoyment and economy.
- The protection of waterfront property as uniform setbacks are created, ensuring the sustainability of development, and the integrity and health of all shoreline species.
- The education of Alger County residents regarding climate change impacts and opportunities to mitigate those impacts by reducing individual carbon footprints.
- The strengthened partnerships of several local agencies and municipalities including the Superior Watershed Partnership, Pictured Rocks National Lakeshore, U.S. Forest Service, The Forestland Group, the Northern Institute of Applied Climate Science, the Alger County Conservation District, local townships, universities, and school districts.

With this climate action plan, we intend to enhance existing climate change efforts in our region, and to serve as a model for communities around our state and the Lake Superior Watershed.

This adaptation plan seeks to achieve the following goals:

- Make Alger County forests ecologically and economically viable by promoting sustainably produced local forest by-products for fuel while ensuring public enjoyment and the health of wildlife habitat.
- Support the ecological integrity of Alger County water by capitalizing on existing watershed management plans and establishing and implementing a shoreline protection plan.
- Promote public education and awareness of possible effects of climate change by partnering with local schools and the National Park Service.
- Partner with public health agencies and local municipalities to raise public awareness of climate-related health and safety issues, update existing emergency management plans, and improve procedures for dealing with major storm events and flooding.
- Identify economic opportunities for related non-tourism business by partnering with the Alger County Chamber of Commerce and local universities.
- Through partnership with a variety of regional and state agencies, this plan has the potential to position Alger County as a regional leader for climate change adaptation planning and ultimately would see Alger County not only as a resilient community in the face of such change but as a thriving community, one that is well prepared and able to adapt where necessary, as well as flourish where there's opportunity. The successful implementation of this climate adaptation plan will result in numerous beneficial outcomes for Alger County and serve as model for the larger region.

SWP will lead the implementation efforts and collaborate closely with its partners to carry out these education, policy and on-the-ground forest and water activities.

Introduction

Alger County

Alger County, home to over 9,000 people, has eighty miles of Lake Superior shoreline and is located on the southern edge of the lake in the central Upper Peninsula of Michigan. The Munising Bay Watershed sits in the northern half of the county and encompasses 36,296 acres (56.7 sq. miles). The area owes its dramatic topography to the glaciers that moved through the region 10,000 years ago. The forests of the Munising Bay Watershed provide habitat for black bear, moose, white tail deer, grey wolf, as well as a variety of smaller species. While its proximity to the world's largest and cleanest body of fresh water largely defines the ecosystems within the watershed, it also provides for some of the world's most unique and lovely landscapes. Steep ridges covered with Sugar Maple and soaring White Pine stand guard over small hamlets, winding wetlands provide playgrounds for anglers and the specter-like silhouette of a mother moose and her calf. The sweep of Pictured Rocks' grand sand dunes and sheer sandstone cliffs are the fortresses which witnessed the great battles, tragedies, and victories of the indigenous Ojibwa peoples, their legends still etched on little known coves, to be discovered by the patient kayaker.

In spite of Alger County's abundance of natural resources and natural beauty, Alger County is struggling. At 12.8% the unemployment rate is above the national average and the population has been slowly declining as younger families leave to search out employment. The average per capita income is \$22,033.00 compared with the national average of \$27,041.00, representing a nearly 10% difference. The area's unusually high ratio of public land leaves many residents feeling disgruntled and short changed. Two of the area's three largest employers, Neenah Paper and TimberProducts, employ well over 10% of the labor force. While there are fourteen small businesses associated with the forest products industry, jobs within this industry are highly competitive and positions in the construction or tourism sectors are rarely year-around. A sizeable disruption in the timber industry, or the inability for the county to generate revenue from winter tourism would prove catastrophic for the way of life in the county. Yet these are the very aspects of Alger County's economy most at direct risk from climate changes already starting to occur.

The venerable American Ben Franklin once said, "By failing to prepare, you are preparing to fail." Climate change issues are ultimately issues of preparedness. It is for the sake of the uniqueness of the area's natural world and its economic vulnerability based on natural resources that residents must consider, evaluate, and plan for climate change. Alger County, and the Munising Bay Watershed, very literally cannot afford not to.

Climate Change

With an average of 153 inches of snow and an average daily high temperature in January of 22° F, Alger County's Munising Bay Watershed, located in Michigan's Upper Peninsula along the shore of Lake

Superior, is accustomed to intense winter weather. It is not, however, accustomed to heat; or drought; or tornados.

Yet 2010 and 2011 have been record-breakers for both heat and drought and on August 20, 2011 a tornado touched down in the city of Ontonagon, four counties east of Alger County. March of 2010 saw the warmest temperatures in recorded history and, combined with the trend of diminishing ice cover during the winter months on Lake Superior, had the bravest residents plunging in the lake for a swim. In

Current Climate Change Indicators
<ul style="list-style-type: none">• <i>Increased overall temperatures (up 2.7° F in Alger Co. last decade from historical average. Last three decades warmest in 100 years)</i>• <i>Increased drought (records broken in several Upper Peninsula communities in 2010)</i>• <i>Extended spring, summer, and autumn seasons</i>• <i>Increased Lake Superior surface temperatures (4.5° F rise since 1980)</i>• <i>Tree species decline – Sugar Maple, Birch</i>• <i>Wetter, milder winters – more precipitation as rain</i>

the summer of 2011, the National Weather Service posted the driest June 23rd through September 22nd period on record. For that period, the 3.31 inches of rain observed was far less than the next two driest periods (4.28" in 1976 and 5.25" in 1981). The same summer, local hardware stores couldn't keep up with the demand for residential air-conditioning units. Home gardeners saw their water bills rise and those residents with allergies suffered much more intense reactions than normal.

Temperature data collected in Munising, MI (near Pictured Rocks National Lakeshore) since 1900 shows that the 2000s were the hottest decade, with temps 2.7° F over the historical average of the previous century (Saunders et al. 2011). The 1990s were the second hottest decade, and the 1980s were the third hottest. The trend is clearly going up.

These are the issues of climate change. While Yoopers (a term residents of the Upper Peninsula prefer) are able to survive any kind of weather, we are now facing long-term climate changes. Summer predictions of hotter and drier conditions could be both a blessing and curse, providing opportunities for those depending on summer tourism dollars, yet costing residents higher water bills for their lawns and gardens and higher energy bills for air conditioning units. With increased temperature extremes in the summer also comes the risk of severe storm events, like the August 2011 tornado. If expected warming trends are met, Alger County will experience more of these severe storm events, including flooding. The County's Emergency Management Plan is underdeveloped for major storm events and much of the infrastructure is antiquated; the Army Corp of Engineers ranked the infrastructure in the Great Lakes Basin as some of the worst in the country.

According to scientists at the National Oceanic and Atmospheric Administration, (NOAA) seasonal shifts will leave winters wetter and warmer with more "snow on rain" events and less ice cover over the Great

Lakes. Snowmobiling, snow shoeing, skiing, and ice fishing are not only favorite winter hobbies of Alger County residents; they also serve as important contributions to the county's winter economy.

These are the day-to-day implications of a changing climate for Alger County.

In February of 2011, the Upper Peninsula's celebrated UP 200, a dog sled race that serves as a qualifier for the Iditarod, was cut short in Alger County's Wetmore area due to lack of snow and poor conditions, costing the Alger County service industry dollars that it counts on during the winter months.

The fear is that situations like these will not be anomalies, but become the new normal. While Alger County, and specifically the Munising Bay Watershed, is already experiencing small warming trend impacts, it stands to lose much more if predicted climate change forecasts are met. Alger County has an overwhelming dependence on two economic sectors for its survival: the tourism economy and the forest products industry. Both of these industries will undeniably be impacted by any significant major climate shifts and any impact to these industries will certainly affect the quality of life of residents of Alger County.

Climate Change Predictions for the Upper Great Lakes

Although effects will vary throughout the region, climate scientists have made general predictions for the upper Great Lakes, including Michigan's Upper Peninsula. (Kling et al. 2003, Wuebbles et al. 2003, UCS 2009, NRPC 2010, Saunders 2011). Not all climate changes are "negative" – some may have positive effects, including increased economic opportunities. All will have consequences to different degrees. The following table highlights and summarizes major direct and indirect general climate change impacts expected in the Upper Peninsula, including Alger County, from the studies listed above (Fig. 1). Effects already being noticed in or around Alger County are marked with an asterisk (*).

The timeframe for these impacts is that they will be observable and measurable to various degrees by the end of the 21st century – depending on the scenario (high, mid-range or low) of global carbon emissions outlined in ongoing scientific models. For example, temperatures at Pictured Rocks National Lakeshore in Alger County are projected to rise by at least 5° F and could rise as much as 14° F by the end of the century (Saunders et al. 2011). Of course, many effects listed are already being felt and observed – the question is how severe will they become, and how fast.

Impacts of climate change on specific sectors of Alger County's natural and human environment (forests, wetlands, economics, etc.) are explored in following sections.

Current and Predicted Climate Changes	Predicted Direct Effects	Probable Indirect Physical and Biological Effects	Probable Indirect Effects on Human Experience
<ul style="list-style-type: none"> • Warmer summers* • Increased droughts* • Warmer winters, with more precipitation falling as rain rather than snow* • Later freeze-up and earlier ice breakup and snow melt* • Irregular, high intensity storm events* 	<ul style="list-style-type: none"> • Less winter ice* • Increase in evaporation* • Lower lake levels for Lake Superior and inland lakes* • Ephemeral wetlands, hugely important biological areas, will dry up. • Some current open-water areas will become wetlands • Summer lake stratification lengthened* • Changes to forest tree composition • Continued northward migration of native plants and animals* 	<ul style="list-style-type: none"> • Habitats will shrink or disappear for species at the edges of their ranges. • Increases in invasive insects and diseases* • Changes in phenology, potentially disconnecting some critical ecological interactions • Cold water fish habitat will shrink, warm water habitat will increase • More algae • More lake turbidity • Certain tree species, such as Sugar Maple, Hemlock, Paper Birch and Jack Pine will decline* • Rain-on-snow events will cause more winter and spring flooding • Increased danger of forest fires • Habitat for endangered species, such as Kirtland’s Warbler and Pitcher’s Thistle likely to be negatively impacted • Risk of degradation and damage to wetlands due to flooding, erosion and siltation. 	<ul style="list-style-type: none"> • Longer summer recreation season* • Shorter winter recreation season* • Increased cost of living in summer; decline in winter • Possible heat-related health issues • Low lake levels will threaten shipping and infrastructure • Navigation hazards exposed • Recreational fishing quality will change • Degradation of cultural resources, such as shipwreck artifacts • Severe weather events i.e. flooding will affect built environments • Storms effects on public safety, disruption of services • Decline in winter tourism will affect local economy.

(Fig. 1) Overview of Climate Change Effects in Alger County

Source: Superior Watershed Partnership

The Climate Adaptation Team and Process



The Superior Watershed Partnership and Land Trust (SWP), in partnership with Climate Solutions University, had the opportunity to study the complex issue of climate change as it pertains to Alger County, in Michigan's Upper Peninsula, in order to create a long-term and broad scope climate adaptation plan. The resulting Alger County Climate Adaptation Plan details what can be done in Alger County to ensure the health, resiliency, and sustainability of Alger County's forests, waters, and economy.

The Superior Watershed Partnership and Land Trust (SWP) is a regional Great Lakes non-profit organization dedicated to the protection and restoration of Great Lakes watersheds in Michigan's Upper Peninsula. The SWP provides creative leadership and promotes effective, community-based solutions to address emerging Great Lakes issues. Based in Marquette, Michigan, the SWP serves three Great Lakes (Superior, Michigan, Huron), over 25 communities, 15 counties and 5 Native American tribes. The SWP has been recognized by the U.S. Environmental Protection Agency and the State of Michigan for its effective work in watershed protection, storm water management, habitat restoration and addressing pollution prevention in the Great Lakes. The SWP specializes in natural resources planning, aquatic ecosystem restoration, physical and biological field assessments, and special studies related to Great Lakes priority issues. Staff from the SWP has served on numerous regional, state and international advisory bodies including the Lake Superior Binational Forum (US and Canada).

The Project Leader for this process, and resulting plan, was the SWP's Jennifer Klipp. A team of natural resource specialists and business leaders in Alger County was assembled to study the impacts of climate change on Alger County and to ultimately construct a climate adaptation plan to be used by Alger County natural resource experts, business owners, and policy makers. The Alger County Climate Adaptation Planning Team was comprised of Jennifer Klipp, Project Leader; Natasha Koss, SWP Program Manager; Gregg Bruff, Chief of Heritage Education, Pictured Rocks National Lakeshore; Dave Fehringer, Assistant Regional Director, Forestland Group; John Hust, local business owner, and Jill Baugnet, local citizen. This team met several times, assessed the risks and opportunities associated with climate change for Alger County, and delved deep into data regarding current and projected climate change impacts for the county as it pertains to the health and resiliency of its forests, water, and economics.

Once all the data was gathered, Jennifer Klipp disseminated the data to members of the team, matching their expertise, and asking them to identify the risks and vulnerabilities to forest, water, and economics associated with climate change. Jennifer also sought the assistance of other regional experts and stakeholders, including Stephen Handler of the National Forest Service's Northern Institute of Applied Climate Science; Carl Lindquist, Executive Director of the SWP; Geri Grant, Senior Planner for the SWP; Cameron Fuess, GIS Coordinator for the SWP; and Hunter King, Environmental Studies and Sustainability student at Northern Michigan University. Andrea Chynoweth, of the SWP, assisted with research and substantive revisions. Once these risks and vulnerabilities were identified, the team developed a detailed climate change adaptation plan for the benefit of Alger County's natural resources and people.

Alger County Forests and Climate Change

The assessment process began with a focus on impacts to the forests of Alger County. The following table (Fig. 2) outlines direct and indirect effects climate change will have on Alger County forests ecosystems, the flora and fauna that depend on a healthy forest environment, and the impacts on human activity within forests, such as the timber industry and recreation. (The sources and timeline for these predictions are similar to those described for Fig. 1. Again, effects already noticed in and around Alger County are marked with an asterisk (*).

Current and Predicted Climate Change	Predicted Direct Effects	Probable Indirect Physical and Biological Effects	Probable Indirect Effects on the Human Experience
<ul style="list-style-type: none"> • Warmer summers* • Warmer winters, with more precipitation falling as rain rather than snow* • Wetter springs followed by small droughts throughout the summer* 	<ul style="list-style-type: none"> • Compromised tree health, specifically diminished foliage and die-back • Flora and fauna migration northward* • Change in soil conditions 	<ul style="list-style-type: none"> • Vulnerability to non-native pests* • Decline of essential tree species such as Aspen, Eastern Hemlock, and Sugar Maple* • Loss of habitat for game birds including grouse and partridge • Loss of habitat for the threatened Grey Wolf 	<ul style="list-style-type: none"> • Loss of bird hunting grounds • Vulnerability for the timber and forest products industry • Decrease in fall color intensity

(Fig. 2) Climate Change Effects on Forests - Superior Watershed Partnership

Source: Superior Watershed Partnership

The State of Michigan has more forestland than any other state in the Northeast or Midwest; Alger County serves as a perfect illustration of this fact. At 918 sq. miles area, Alger County, located on the southern edge of Lake Superior in the central Upper Peninsula of Michigan, owes its topography to the glaciers that moved through the region over 10,000 years ago. Once covered by a kilometer of glacial ice, Lake Superior and its surrounding lands took their final shape 6,000 years ago.



(Fig. 3) Fall Colors on Lake

Photo Credit: Public Domain

Land management has been a vital aspect of the region. European Americans settled in Alger County 200 years ago and with them came the birth of the timber industry, an industry that still serves as the largest employer of Alger County's residents. Unfortunately, the first wave of forest harvesting nearly decimated the land causing great damage to maple, hemlock, and pine species. Since then, the combination of government designations through the U.S. Forest Service, National Park Service, and the state of Michigan Department of Natural Resources, as well as better forest management practices on private land, has led to a healthy and diversified forest.

Alger County is home to 9,601 people as well as a variety of wildlife. The forests of Alger County provide habitat for black bear, moose, white tail deer, gray wolf, and the endangered Kirkland warbler, as well as a variety of other species. The forests also provide cover for many rivers and streams. Hemlock, Birch, and Aspen serve as habitat for game birds including partridge, grouse, and pheasant.



(Fig. 4) Wolf in Winter
Photo Credit: Public Domain

Forest Ownership and Species Composition

According to the US Forest Service, there are 521,765 forested acres in Alger County; 274,070 acres, or 46% of all Alger County land, is public land. The forests of Alger County are considered “transitional” forests positioned on the northern edge of Northern Hardwood Forest and the southern edge of the Boreal Forest. The ownership and management of those acres falls to four entities: the US Forest Services (22%), other federal agencies (2%), the State of Michigan (20%), and private (55%). The species composition are as follows: 59% Maple/Beech/Birch; 14% White/Red/Jack Pine; 14% Spruce/Fir; 6% Elm/Ash/Cottonwood; 5% Aspen/Birch; less than 1% Oak/Pine/Hickory, other hardwood groups, and non-stocked (USDAFS 2011).

Stability of Natural Communities in Alger County Forests

Hundreds of wildlife species depend on Alger County forests for habitat including the protected Kirtland Warbler (endangered) and Grey Wolf (threatened). Currently, Alger County forests are generally healthy, with low fire vulnerability; however, the anticipated reduction in soil moisture and increased temperatures of climate change will likely cause a shift in species composition over the next 100 years. By some estimates, Michigan forest species' composition is projected to change by up to 70% (MDNRE 2010). The increases in drought-like events over the past 25 summers combined with fluctuating seasonal precipitation have expanded pest territories northward. Furthermore, the projected increase in average annual low temperatures in winter will encourage the long-term survival of certain invasive species that have historically been curtailed due to severe cold snaps experienced in January, February, and March.

Forest Threats

Invasive Pests and Disease



(Fig. 5) Insect Damage in Wood
Photo Credit: Public Domain

The largest threats to the health of Alger County forests are invasive pests and disease. There are several worrisome pests, including the Emerald Ash Borer, the Hemlock Woolly Adelgid, and the most concerning, the Asian Longhorn Beetle. The Asian Longhorn Beetle was discovered in Massachusetts in 2008 and has most recently been detected in Ohio. The Asian Longhorn Beetle has not been detected in Michigan; however, due to its particularly destructive nature, this pest presents the largest concern to Alger County due to its ability to quickly decimate 11 species of deciduous trees including certain varieties of birch, aspen, and maple (including Sugar Maple). As maple is the most dominant species in Alger County forests, and Sugar Maple the most important species economically, this pest stands to impact Alger County forests more than any other. According to a 2010 report from the Michigan Department of Natural Resources and Environment, intensive state-wide response surveys to Asian Longhorn Beetle were conducted at Michigan state parks and campgrounds in the spring of 2011 (MDNRE 2010).



(Fig. 6) Asian Longhorn Beetle
Photo Credit: Public Domain

While the presence of forest pests is not a direct result of climate change, the impacts of climate change provide a more hospitable environment for pests, increasing the range and intensity of destructive potential. The increased temperatures, combined with decreased summer precipitation make forests vulnerable to both pests and disease: “Due to drought-like episodes experienced over the past 25 years many tree species have become vulnerable to disease” (MDNRE 2010). Diseases specific to Alger County forests include *Sirococcus* Shoot Blight and Beech Bark Disease. Unfortunately, *Sirococcus* Shoot Blight, once thought completely eradicated, was again recorded in Alger County in 2010. The USDA Forest Service, the DNRE Forest Management Division, Michigan Technological

University, and Michigan State University are working in partnership to develop appropriate mitigation strategies for this disease.

Tree Species Decline

Several tree species instrumental to the ecological health of Alger County forests have been experiencing declines due to pests, disease, or a combination of both.

Aspen: Reports of wide-spread aspen decline were recorded in 2008; a similar decline in aspen was observed after the extreme 1976-77 drought. It is thought that the droughts of the past decade, most notably in 2002-03 and 2006-07 and some areas of the Upper Peninsula in 2008, have predisposed aspen to attacks by secondary pests (MDNRE).

Sugar Maple: The most concerning of all tree species' decline lies is the Sugar Maple in the western half of the Upper Peninsula. While the Sugar Maple of Alger County has not declined at the same rate, Sugar Maple in nearby counties has declined by 5-28%. A combination of soil conditions, management practices, and drought are considered predominant factors in its decline. Sugar Maple is considered the most important species to the timber products industry and is celebrated for its brilliant reds in the autumn season making it instrumental to the short, but lucrative, fall color tourism season.

Eastern Hemlock: This species is important to the riparian zones along Alger County rivers and wetlands, as its shade provides pockets of cool water. These cold spots in the river serve as ideal habitat for cold water fish species. Eastern Hemlock will diminish with projected temperature increases and changes in soil conditions, raising concerns for the continued necessary shading of streams especially as temperatures are rising.



(Fig. 7) Maple Grove with Autumn Colors
Photo Credit: Public Domain

Climate Mitigation Success Story

The SWP in cooperation with Pictured Rocks National Park coordinated the Alger Energy Saver's program which installed over 3,100 energy efficiency measures in Alger County residents' homes, and inspired almost 95% of participants to either take, or plan to take, next steps to improve their home energy efficiency. The AES business program provided energy assessments for 30 businesses and distributed over 520 free energy efficiency measures and matching funding to motivate businesses to take further energy efficiency steps. As part of the release of the National Park Service's Green Parks Plan, the initiative was highlighted as a success story for other national parks to replicate.

<http://www.nps.gov/sustainability/parks/index.html>

<http://www.superiorwatersheds.org/energysavers.php>



Alger County Water Resources and Climate Change

The second phase of risk assessment looked at impacts to water resources. The following table (Fig. 8) outlines direct and indirect effects climate change will have on Alger County water resources, including Lake Superior, inland lakes and rivers, the flora and fauna that depend on healthy wetlands, and human activities such as recreation and shipping. (The sources and timeline for these predictions are similar to those described for Fig. 1.) Impacts already noticed in and around Alger County are marked with an asterisk (*).

Current and Predicted Climate Change	Predicted Direct Effects	Probable Indirect Physical and Biological Effects	Probable Indirect Effects on the Human Experience
<ul style="list-style-type: none"> • Warmer winters, with more precipitation falling as rain rather than snow* • Warmer summers with increased temperatures and periods of drought.* • Later freeze-up and earlier ice breakup and snow melt* 	<ul style="list-style-type: none"> • Increased water temperatures • Increase in evaporation • Less winter ice • Lower or fluctuating lake levels • Ephemeral wetlands, hugely important biologically, will dry up. Some current lake areas will become shallow wetlands • Warmer water extending lower in the water column will affect lake turnover and nutrient cycling, and potentially lead to permanent lake stratification 	<ul style="list-style-type: none"> • Diminished diatom population • More turbidity • Increase in irregular, high intensity winter storm events • Increased wave action on Lake Superior, leading to shoreline erosion. • Possible decline of whitefish eggs in Lake Superior due to greater turbulence. • Increases in invasive aquatic pests and diseases • More algae • Cold water fish habitat will shrink, warm water habitat will increase 	<ul style="list-style-type: none"> • Decreased commercial/sport opportunities as cold water fish populations are diminished • Increased summer aquatic sport recreation and tourism • Reduced ice fishing tourism as lake ice decreases • Impacts to docks, harbors, shoreline infrastructure as water levels fluctuate. • Impacts on commercial shipping

(Fig. 8) Climate Change Effects on Water Resources

Source: Superior Watershed Partnership

The Great Lakes is the largest freshwater lake system on the Earth. They comprise 84% of North America's fresh water supply and 21% of the global water supply. Lake Superior is the largest of the Great Lakes in surface area and volume and could contain all of the other Great Lakes plus three more lakes the size of Lake Erie within its shores. Long considered the cleanest and most pristine of the Great Lakes, the Lake Superior watershed is rich in natural resources and scenic beauty.

Alger County has eighty miles of Lake Superior shoreline and 47 sub-watersheds in two Great Lakes Basins (Southeastern Superior and Northeastern Lake Michigan). This assessment and resulting Climate Adaptation Plan will focus on Alger County, specifically the Munising Bay Watershed (MBW). The MBW refers to the land area that drains into Lake Superior's Munising Bay. The MBW encompasses 36,296 acres (56.7 square miles) and is home to two endangered or threatened species: the Piper Plover (endangered), a coastal migratory bird that nests on beaches, and Pitcher's Thistle (threatened), a species that grows in shoreline dunes.

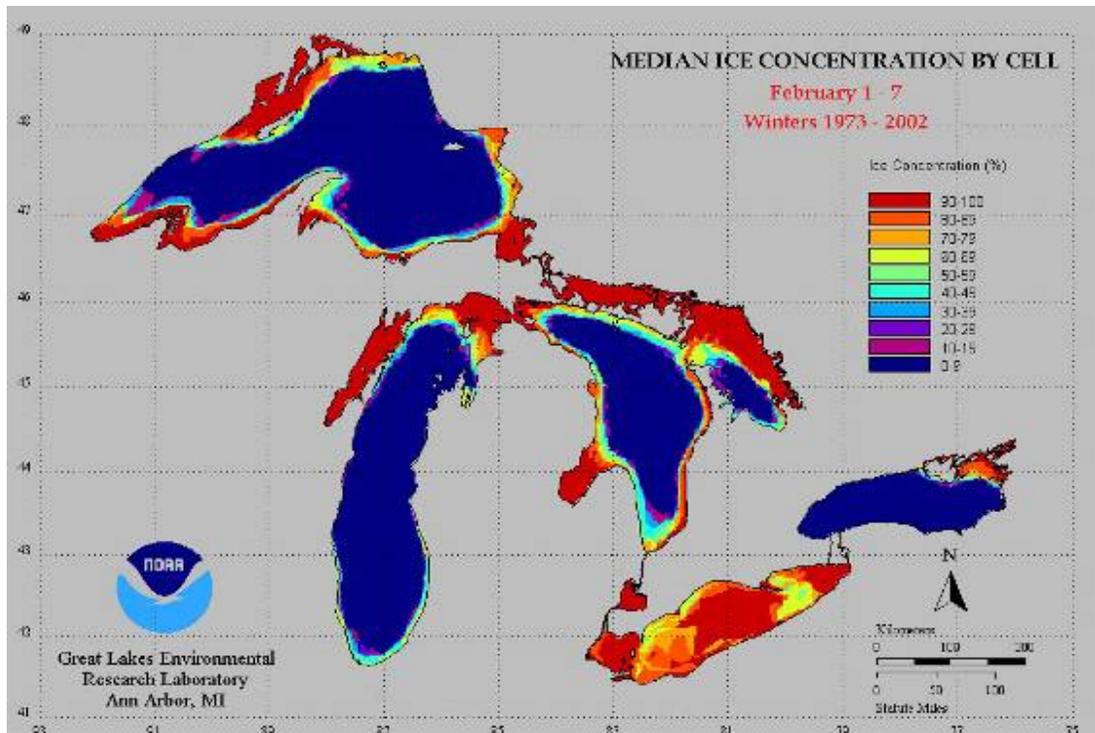
The Munising Bay Watershed is a sub-watershed of the Lake Superior Watershed. The project study area includes several river systems, streams, creeks, forest wetlands, Great Lakes coastal wetlands as well as springs and a high-quality groundwater resource. Current and historic forest cover and land use practices play a crucial role in the long-term health of these water resources.

Unfortunately, the effects of global climate shifts are already evident in the region with evidence of impacts to ecosystems, shipping, recreation, and infrastructure.

Lake Superior

Warming Trends

Due largely to the inability of many species to survive its cold waters, Lake Superior has long enjoyed the reputation of being the most "pristine" of the Great Lakes. However, it is now undeniably experiencing a warming trend. Since 1980, its surface water temperature in summer has warmed twice as much as the air above it. Each decade since 1980, surface water temperature in summer has increased about 2°F (Austin and Colman 2007). August 2010 provided the warmest recorded lake-wide surface temperature in history at 68.3°F, a significant rise above the historical average temperature for that time of year at 55°F. Research at the University of Madison, WI indicates that this is part of a larger trend. In general, Lake Superior is experiencing record highs; warmer water makes for a more suitable habitat for many aquatic invasive species, such as Zebra Mussels, Round Gobi, and Eurasian Ruffe, as well as water borne diseases and parasites that impact terrestrial animals and aquatic plants and animals. Reports of algal blooms and waterborne diseases are examples of the types of temperature-related quality problems that are expected to increase over time.



(Fig. 9) Great Lakes' Median Ice Concentration by Cell
Source: NOAA, Great Lakes Environmental Research Laboratory

Lake Levels and Ice Cover



(Fig. 10) Satellite Image of Lake Superior
Source: NASA Earth Observatory Photo

All of the Great Lakes have been experiencing lower water levels, setting the stage for severe consequences to shoreline infrastructure. The shipping industry and coastal ecosystems, and the measureable levels of Lake Superior represent a particularly complex set of man-made and natural influences. Due to an international agreement with Canada, the International Joint Commission mandated that a specific volume of water had to flow through the Canadian St. Mary's rapids (located immediately north of the American Soo Lock complex on the eastern end of the lake); due to this arrangement, the lake levels are often manipulated at the Soo Locks. However, even with that consideration and minor annual fluctuations in water levels, the summer of 2011 saw the lake sitting 11

inches below the long-term norm for that time of year (Duluth News Tribune 2011). According to Minnesota's SEAGRANT/NOAA, a loss of an inch in water depth translates into a loss of 270 tons of cargo for large vessels (Moen 2006).



(Fig. 11) Fishing Huts on Frozen Lake

Photo Credit: Public Domain

The issue of lake levels and lake ice cover are inter-related. Lake ice plays an important role in balancing the water and thus, regulating evaporation. It also significantly impacts winter weather in Alger County. Unlike typical lakes, Superior evaporates fastest in fall and early winter; the lake's famous cold and dry "Nor'wester" storms wick the still relatively warm water off the lake's surface (for each 18° F increase, air can hold two times more water), often causing over a foot (300 mm) of water evaporation between November and February, and throwing much of it on the South Shore, (including Alger County) as lake-effect snow.

The formation, duration, and extent of ice cover also impacts the water balance of Lake Superior: as the ice sheet keeps water in the lake. As the lake freezes (generally the month of March sees the largest amount of ice cover) less water is pulled off by cold, dry air. Evaporation for this time of year ranges from less than an inch (20 mm) to over 3 inches (87 mm), depending on temperatures and humidity. Ice cover plays an important role for ecosystems, as well. Whitefish eggs and diatoms (a simple plankton that serves as the base of the food chain) fare better when the lake freezes.

Although ice limits photosynthesis by diminishing the south-slanting rays of winter's short days, in most years it provides unique fishing opportunities essential to winter tourism. Once the ice gets thick enough, portable ice-fishing shelters appear along the shoreline.

Expected diminished ice cover could lead to increased winter waves. While this may benefit the growing popularity of surfing in the area, it could erode shorelines and damage shoreline infrastructure (Boen, Miller-McCune 2011). This is of particular concern for the Pictured Rocks National Lakeshore, a park that brings in an approximate 450,000 visitors a year. There is growing concern that the relationship between diminishing ice cover and increased lake turbidity will negatively impact vulnerable shoreline species such as the Piping Plover and Pitcher's Thistle.

Rivers, Wetlands, and Hydrology

Alger County, and specifically the MBW, encompasses a vast network of forested rivers and wetlands. The MBW's forested watersheds are essential to habitat and water quality in the tributaries that feed Lake Superior. Climate change poses a threat to the region and to the wildlife and human populations that depend on the ecosystems for habitat and livelihoods. When considering the impacts of climate change in relation to this region there are several areas of concern.

Trout, a species native to this area, are important to the region's ecology, as well as the tourism industry. Anglers often travel great distances to reach some of the more remote waters of the MBW to fish. However, as rivers warm, Rainbow, Brown, and Brook trout will seek out colder waters for their breeding grounds. The National Fish Habitat Action Plan for Lake Superior identifies the Anna River as a priority



(Fig. 12) Aerial View of Meandering River

Photo Credit: Public Domain

watershed (Davis 2002). The Anna River is part of the Munising Bay Watershed Management Plan, which is the only state-approved watershed plan in Alger County.

Historic and present-day land use practices have impacted critical fisheries habitats in MBW and other areas of Alger County. When considering climate change, bank erosion and lack of riparian buffers require special consideration. If climate change forecasts are met, long periods of dry, drought-like conditions during the extended summer months, combined with the predicted

increase in precipitation in the spring and fall rain events could make rivers particularly susceptible to bank erosion. This concern is further exacerbated by the county's lack of uniform set-back ordinances for development along rivers. In other areas of the Midwest, significant increases in precipitation have caused extensive damage through flooding; heavy downpours are twice as frequent as 100 years ago. In fact, the last 30 years are recorded as the wettest period in the last century and April 2011 was the wettest April in the Midwest in 116 years (NOAA 2011). Alger County's Emergency Management Plan is outdated and does not account for specific strategies in dealing with major flooding events.

While forests within the MBW are sometimes referred to as the "asbestos forest" for their tolerance to fire, predicted reduced soil moisture is expected to result in increased forest fires, and large-scale shifts in soil moisture will undeniably affect certain species. A species vulnerable to climate change impacts is the Eastern Hemlock. Hemlock is a key species to riparian zones and forested wetlands. This coniferous tree serves to keep river and wetland water cool by providing shade; native trout species depend on these cool spots in the river for their breeding.

Public Water Infrastructure

The City of Munising is the only municipality in the MBW that uses a public water system; other areas use private wells. While a fair amount of Munising infrastructure (pipes, roads, sidewalks) have been replaced or upgraded in the last few years, much of the infrastructure is still outdated and the city's waste disposal site, Woodland Land Fill, sits less than a mile from the Lake Superior shoreline. All other townships, locations, and villages use septic systems. Of particular challenge is the inconsistency of governance with the MBW. All townships have separate zoning regulations and there are relatively few oversight measures in place.

In 2005, the US Army Corps of Engineers rated the Great Lakes basin's wastewater infrastructure with a D-, faring the worst over all other forms of infrastructure (ASCE 2005). If expected warming trends are met, the Upper Peninsula will experience more severe storm events, including flooding. As stated above, Alger County does not have an adequate emergency management plan in effect, nor does it have updated infrastructure to absorb some of the severity of major flooding events.

Alger County Economics and Climate Change

The third phase of risk assessment examined the economic impacts of climate change. The following table (Fig. 13) outlines direct and indirect effects climate change will have on Alger County economics, particularly regarding tourism, energy costs, and infrastructure maintenance. (The sources for these predictions are similar to those described for Fig. 1). Many of these impacts are already being felt and observed by Alger County residents and businesses – however at this time it is difficult to predict how and if these trends will continue. Much depends on the severity of physical climate changes to the natural environment, and how fast that happens.

For example, a moderate rise in temperatures will likely create an economic boom for summer tourism in Alger County and will extend the tourist seasons, perhaps for years to come. However, a more severe rise in temperatures resulting in heat waves of prolonged duration would have a negative impact on tourism and outdoor recreation.

Impacts already noticed in and around Alger County are marked with an asterisk (*).

Current and Predicted Climate Change	Predicted Physical and Biological Effects	Probable Direct Effects on Alger County's Economic Conditions
<ul style="list-style-type: none"> • Warmer summers* • Increased droughts* • Warmer winters, with more precipitation falling as rain rather than snow* • Later freeze-up and earlier ice breakup and snow melt* • Irregular, high intensity storm events* 	<ul style="list-style-type: none"> • More heat spells/humidity/poor air quality • Lengthening of biting fly/mosquito season • Changes to flora and fauna composition on Alger County public lands. • Increased risk of flooding, both in severity and frequency • Erosion along shorelines, stream beds, built environment • Less winter ice/increase in evaporation • Lower or fluctuating 	<ul style="list-style-type: none"> • Increased energy and water costs due to air-conditioner use and lawn/garden watering* • Decreased winter heating costs* • Some infrastructure cost increases as snowfall becomes heavier and adds stress to the built environment • Increased shoreline property costs as unsustainable development succumbs to erosion • Longer summer and fall tourism season as seasons are extended* • Increased summer tourism and aquatic sport opportunities • Decreased winter tourism opportunities, such as ice fishing festivals and dog sled races, as temperatures increase, later freeze-up and earlier ice breakup and snowmelt* • Decrease in commercial/sport fishing opportunities as cold water fish habitat is diminished

	<p>lake levels</p> <ul style="list-style-type: none"> • Increased risk of forest fire • Wind/storm damage to trees • Less snow cover on ground; less overall snow days • Pests that cause human disease heading north • Change to fish species composition 	<ul style="list-style-type: none"> • Impact to the timber products industry as forest tree species, specifically varieties of Maple, migrate northward • Increased costs to timber industry and local agriculture due to more invasive species and diseases • Increased opportunities for deer hunting as deer populations increase • Increased cost of shipping • Compromised shoreline infrastructure as water levels recede, navigation hazards exposed and water may be too shallow to allow access to some docks • Degradation of submerged cultural resources, i.e. shipwrecks, as lake is no longer cold and relatively sterile • Visitor safety issues increase as more rescues for inexperienced swimmers and inexperienced boaters who may not have skills to handle storm events • Disruption of natural environment will negatively affect visitor experience to public lands • Increased damage to private and municipal infrastructure due to increase of high intensity storm events • Increased personal health costs as allergies and heat related illnesses increase
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(Fig. 13) Climate Change Effects on Economic Conditions
Source: Superior Watershed Partnership

Alger County Demographics

Alger County is a rural community positioned in the central Upper Peninsula of Michigan. According to the 2010 Census, there are 9,601 people in Alger County, with 10.5 people per square mile. Alger County falls below the state average in average household income (a \$7,000 disparity) and owner-occupied home value (\$111,700 to the state average of \$147,500). Residents aged 50+ comprise the largest demographic and there was a 2.6% population decline compared to the state decline of 0.6%. Alger County, and specifically the MBW, is an economically depressed area with approximately 12.8% of its residents unemployed.



(Fig. 14) Alger County Shaded in Green
Photo Credit: Public Domain

Land Divisions

The county's northern boundary is composed entirely of Lake Superior coast line. The Munising Bay Watershed (MBW) includes all surface waters that drain into Lake Superior at Munising Bay, including portions of the Pictured Rocks National Lakeshore. The MBW is comprised of 36,296 acres. There are four Minor Civil Divisions in the MBW, including Au Train Township (22,670 acres), Grand Island Township (830 acres), the City of Munising (3,364 acres), and Munising Township (9,431 acres).



(Fig. 15) Kayaking on the Great Lakes
Photo Credit: Public Domain

Public Lands

Several state and federal lands sit within Alger County and the MBW boundary: Pictured Rocks National Lakeshore, the Hiawatha National Forest, and Michigan State Forest Lands. The total federal land payment to Alger County is \$423,951; comprised of \$302,188 from Payments in Lieu of Taxes (PILT) monies and \$121,763 from Forest Service Payments.



(Fig. 16) Waterfall in Forest
Photo Credit: Public Domain

Private Lands

Approximately 55% of Alger County land is owned by private landowners. The largest private land holder in Alger County (and the MBW) is The Forestland Group, LLC. The remainder of Alger County's private land is held by forest products companies like Plum Creek Timber, Neenah Paper, closely held small businesses, or private non-industrial land owners. All forest products companies adhere to sustainable forest practices and a majority of the individual land owners have approved forest management plans to qualify for tax incentives.

Transportation Routes

There are four major roads in the MBW: M-28, Co. Rd. 577, Co. Rd. 587, M-94. All of these roads are 2 lane, with some sections of 4 lane for passing purposes. Maintaining high-quality roads is crucial to the county's timber and tourist industries, especially if both these industries are able to capitalize on economic opportunities brought by climate change. Roads are at risk from increased degradation and damage due to the erratic, intense storm events and occurrence of freeze/thaw situations that are predicted. If lake-effect snow events and ice/sleet conditions increase in frequency, this will challenge snow-removal and maintenance efforts in many communities. Furthermore, road maintenance, specifically snow management and removal itself, negatively affects the road surface quality and directly impacts the "green buffers" that separate highways from forests and wetlands through potential erosion and diminished ability to shed water effectively.

Employment

The overall labor force in Alger County is 4,050 with 3,525 people employed. The unemployment rate is 12.8%. According to the *Local County Economic Development Contract, 2007*, the largest employer in Alger County is the Alger Maximum Security Prison (369). Neenah Paper employs 315 people and TimberProducts employs 230. Another 17 people are employed at the Munising's regional office of the Hiawatha National forest. There are also several other small forestry related businesses within Alger County; 12 of these concerns have received training through the Sustainable Forest Education program. Other significant employers in the MBW are the Christmas Kewadin Casino (120 ppl), Munising Memorial Hospital (96 ppl), Munising Public Schools (90 ppl), Glen's Market (36 ppl), County of Alger (36 ppl), Pictured Rocks National Lakeshore (35 ppl), and the People's State Bank (32 ppl). Two Public School Districts sit within the MBW: AuTrain-Onota public schools (a preK-8 school district with total school enrollment: 30 students) and Munising Public Schools (student enrollment: 708, employment: 90).



(Fig. 17) Logging Truck on Back Road

Photo Credit: Public Domain

Tourism



(Fig. 18) Dogsled Race

Photo Credit: Public Domain

Tourism, while hard to attribute exact figures, is the largest industry in Alger County. Restaurants, hotels, bed and breakfasts, and retailers depend on tourism for economic viability. According to the *U.S. Department of Commerce and Bureau of the Census Business Patterns* issued in July 2006, there are 44 Accommodation and Food Service establishments; many of these businesses are only open seasonally. Hundreds of thousands of visitors come to the local attractions in Alger County every year, supporting a significant year-around tourism industry. The presence of Pictured Rocks National Lakeshore (PRNL) provides opportunity for several small recreation concerns, including boat cruises and tours, kayak and canoe rentals, and public and private campgrounds. Beyond the PRNL, hiking, biking, skiing, snowshoeing, fishing (year-round), and snowmobiling provide revenues for the area. Alger County maintains hundreds of hiking, mountain bike, and cross-country ski trails and over 300 miles of groomed snowmobile trails.

Alger County communities host a variety of outdoor sport festivals and races; perhaps the most recognized is the U.P. 200, a 200 mile sled dog race that routes race participants through large tracts of Alger County and serves as a qualifier for the Iditarod.

A changing climate puts these outdoor seasonal tourism attractions at risk. A case in point was the 2011 UP 200 dog sled race. Unfortunately the race had to be prematurely concluded due to poor snow conditions resulting in economic impact to the community.

Over the last ten years, various economic development clubs and organizations in Alger County have worked to develop a clear message, publicizing the area's natural beauty: Alger County is a destination for outdoor enthusiasts and silent sport, hunting, or off-road vehicle use, and the county has worked hard to ensure devotees will be well accommodated. The official Alger County website offers several electronic documents devoted to outdoor recreation including detailed hiking and mountain bike trails, groomed cross-country ski trails and snowmobiling trails, and the location of over 20 of the county's waterfalls. Many shipwrecks in Lake Superior are now protected in bottomland preserves and accessible to recreational divers. In 1985, scientists using a submersible vessel descended for the first time to the deepest part (-1,333 ft./-405 m) of Lake Superior near Pictured Rocks National Lakeshore. Tourism related to shipwreck viewing continues to increase.



(Fig. 19) Snowmobiles

Photo Credit: Public Domain

Synopsis

The abundance of natural resources is crucial to the Alger County economy, providing both the raw materials for industry and the scenic beauty and recreational opportunities for local residents and tourists. There are only two major employers that export goods: Neenah Paper and TimberProducts, both in the City of Munising. Tourism and the forest products industry have the largest economic impact in the MBW, yet it is these two sectors most vulnerable to climate change. Additionally, due to state budget cuts, many programs set up to protect natural resources have been eliminated. One such example is firewood inspections at the Mackinaw Bridge, established to prevent the transportation of Emerald Ash Borer infected fire wood from entering the Upper Peninsula from the Lower Peninsula.

The county is struggling to provide livable-wage, four season jobs for its job force. While residents of Alger County take pride in their communities and the natural beauty that surrounds them, they express concern over the lack of good employment and declining population.

Synthesis of Risks and Vulnerabilities

In order to adequately assess specific impacts of climate change to Alger County, it was necessary to determine the level of **Risk** associated with climate change to both natural resources and the human experience. In the matrices below, **Risk** conveys both the **probability** and the **impact** of the occurrence. Once the **Risk** was determined, it was necessary to assess the ability to cope with these impacts when and where they occur. The **ability to cope** is referred to as **Vulnerability**.

In the matrices below (Fig. 20 and 21), **Risks** and **Vulnerabilities** were ranked using **L**, (low), **M**, (medium), or **H**, (high). A High Risk category, such as flooding, indicates that an impact is both highly likely to occur and expected to bring significant harm. Conditions with a low ability to cope by either people or the ecosystem, such as shoreline / beach erosion, receive a High vulnerability rating. It should be noted that impacts which received **M/Hs** or **H/Hs** denote scenarios that deserve the most focus and ultimately served as the catalysts for the Alger County Climate Adaptation Plan's Goals and Objectives.

In the two tables below, the top anticipated changing climate conditions are analyzed for their impacts to natural resources and their impact to the human populations.

Projected Climate Changes	Risk/Vulnerability	Impact to Natural Resources	Risk/Vulnerability
Seasonal and Weather Changes <ul style="list-style-type: none"> • Summers will be hotter, drier and longer • Autumns will be warmer, last longer, and be wetter • Winters will be shorter and milder • Springs will be wetter and longer • Increase in severe weather events 	<p>H/M</p> <p>M/M</p> <p>H/M</p> <p>L/M</p> <p>M/H</p>	<ul style="list-style-type: none"> • Longer agricultural growing season • More flooding issues due to increased rain 	<p>M/M</p> <p>H/M</p>
Water Resources <ul style="list-style-type: none"> • Warming water temperatures • Less ice on Lake Superior and inland lakes • Lake levels dropping 	<p>M/H</p> <p>M/H</p> <p>M/L</p>	<ul style="list-style-type: none"> • Increased water temperatures will increase stress on cold-adapted fish such as salmon and lake trout • More invasive aquatic species due to warmer water • More waves on Lake Superior due to lack of winter ice, leading to erosion of cliffs and beaches • Lower lake levels may threaten shipping industry • Threats to wetlands due to lack of zoning ordinance in Alger County 	<p>M/L</p> <p>M/H</p> <p>M/H</p> <p>M/L</p> <p>H/H</p>
Forest/Wildlife Resources <ul style="list-style-type: none"> • Increase in invasive pests • Drought and changes to soil conditions • Habitats likely to shift 	<p>M/M</p> <p>M/M</p> <p>H/H</p>	<ul style="list-style-type: none"> • Pests and invasives not regulated by cold snaps • Increased deer population • Decline in tree species, such as Sugar Maple, Hemlock, Paper Birch • Habitat for endangered and threatened species such as Kirtland’s Warbler, Pitcher’s Thistle, Piping Plover, and Grey Wolf will be negatively impacted. 	<p>M/M</p> <p>M/L</p> <p>M/M</p> <p>H/H</p>

Projected Climate Changes	Risk/ Vulnerability	Impact to Human Population	Risk/ Vulnerability
Seasonal and Weather Changes <ul style="list-style-type: none"> • Summers will be hotter, drier and longer • Autumns will be warmer, last longer, and be wetter • Winters will be shorter and milder • Springs will be wetter and longer • Increase in severe weather events 	<ul style="list-style-type: none"> H/M M/M H/M L/M M/H 	<ul style="list-style-type: none"> • Increased summer tourism affecting hospitality • Decreased winter festivals, such as the U.P. 200 Dogsled Race, affecting hospitality industry. • Increased cost of living in summer (i.e. air conditioning) • Decreased cost of living in winter • Disruption to human operations as Alger County does not have a solid emergency management plan for increasingly severe weather events 	<ul style="list-style-type: none"> L/L H/H H/M L/L M/H
Water Resources <ul style="list-style-type: none"> • Warming water temperatures • Less ice on Lake Superior and inland lakes • Lake levels dropping • Increased turbidity on Lake 	<ul style="list-style-type: none"> M/H M/H M/L M/M 	<ul style="list-style-type: none"> • Lower lake levels may threaten shipping industry • Damage to property as shorelines erode • Diminished cold water fish species may threaten sport/commercial fishing opportunities • Increased tourism opportunities for fresh water surfing and wind surfing, emerging sports in Great Lakes region 	<ul style="list-style-type: none"> M/L M/M M/H M/H
Forest/Wildlife Resources <ul style="list-style-type: none"> • Increase in invasive pests • Drought and changes to soil conditions • Habitats likely to shift 	<ul style="list-style-type: none"> M/M M/M H/H 	<ul style="list-style-type: none"> • Pests and invasives not regulated by cold snaps • Increased deer population • Decreased tree population, specifically Sugar Maple, will negatively impact timber products industry and autumn tourism 	<ul style="list-style-type: none"> M/M M/L H/H

(Fig. 20 and 21) Natural Systems Risk and Vulnerability Analysis

Source: Superior Watershed Partnership

Alger County Climate Adaptation Plan

The following action plan was developed to address the high priority risks and opportunities identified by the community and is designed to bring climate resilience to the region.

Goal #1 Keep Alger County forests ecologically and economically viable.

Objective 1.1: Promote sustainable, climate ready infrastructure to support the local forest products industry.

Strategies:

- a. Promote sustainable infrastructure to support the local forests products industry.

Action Plan:

- **Short Term (0-3 years)**- Inventory transportation infrastructure in Alger County and determine status of each regarding load capacity: *Alger County Road Commission, The Forestland Group.*
- **Mid Term (3-10 years)**- Hold meetings with all interested parties to discuss predicted climate change impacts on infrastructure as it will affect the timber industry: *Superior Watershed Partnership, The Forestland Group, U.S. Forest Service.*
- **Long Term (10+ years)**- Locate and secure funding to upgrade infrastructure where needed to provide resilience to coming environmental changes: *Superior Watershed Partnership, Alger County Road Commission.*

Objective 1.2: Promote use of locally and sustainably produced forest byproducts.

Strategies:

- a. Conduct feasibility studies on using forest byproducts to provide local power and/or heat for schools, alone or in conjunction with Neenah Papers.
- b. Encourage local pellet manufacturing.

Action Plan:

- **Short Term** - Explore interest in using forest byproducts from local facilities including Munising schools and Neenah Papers: *The Forestland Group, Superior Watershed Partnership, Michigan Department of Agriculture, Northern Michigan University.*

- **Mid Term** - Explore grant funding for feasibility studies: *Fuels for Schools, Michigan Department of Energy, Michigan Technological University, Northern Michigan University's Center for Economic Education and Entrepreneurship.*
- **Long Term** - Promote potential industrial sites and dock facilities to potential investors: *The Forestland Group, Michigan Department of Agriculture, Alger County Chamber of Commerce, Northern Michigan University's Center for Economic Education.*

Objective 1.3: Encourage forest products industry to plan for changes through development of new methods and products.

Strategies:

- a. Support and cooperate with research and adaptation demonstration activities

Action Plan:

- **On-going:** Keep abreast of potential new products, information, or adaptation resources that might be applicable for the forest industry in Alger County, specifically as they relate to climate change: *The Forestland Group, Michigan Technological University School of Forestry, Northern Institute of Applied Climate Science, Hiawatha National Forest.*

Objective 1.4: Maintain an ecologically healthy and sustainable forest for public enjoyment and wildlife habitat.

Strategies:

- a. Encourage continuous blocks of forests and avoid fragmentation (Commercial Forest Plan).
- b. Monitor and manage deer populations.
- c. Engage in non-native invasive species (NNIS) intervention. i.e. Central Upper Peninsula Cooperative Weed Management Area (SUPSWMA), the “Bugs Me” campaign.
- d. Monitor road infrastructure and new construction for impacts to forest health, such as erosion and sediment build up.

Action Plan:

- For **Strategy a: Short Term:** Form a temporary working group to create a 5 year plan focused on collaborative efforts to address issues of forest fragmentation, deer management, invasive species, and pest infestations

- For **Strategy a: (On-going):** In order to minimize further fragmentation in forest ownership, support Michigan’s Commercial forest tax program, which allows landowners to minimize their tax burden while growing forest products and providing for limited public access: *The Forestland Group, Superior Watershed Partnership, U.S. Forest Service.*
- **Ongoing:** Support working forest conservation easements to maintain sustainable forest production: *Forestland Group, Superior Watershed Partnership, National Park Service, Alger County Conservation District.*
- For **Strategy b: Ongoing:** Support biologically-based deer population management that balances sustainable populations with sustainable forest habitat and quality timber management: *Michigan Department of Natural Resources, Alger County Conservation District, U.S. Forest Service.*
- For **Strategy c: Ongoing:** Support CUPCWMA and other organizations engaged in invasive species education and control efforts: *Superior Watershed Partnership, Alger County Conservation District, Northern Michigan University, Michigan Department of Natural Resources, U.S. Forest Service.*
- **Ongoing:** Promote and support efforts to control and eradicate known infestations: *Alger County Conservation District, Michigan Department of Agriculture, Michigan Department of Natural Resources, U.S. Forest Service.*
- For **Strategy d: Ongoing: Encourage** Alger County Road Commission to cooperate with the CUPCWMA in control efforts on County Road ROWS with effective mowing schedules, equipment BMPs and monitoring: *Superior Watershed Partnership, Alger County Conservation District, The Forestland Group.*

Goal #2 Promote public education and awareness of possible effects of climate change.

Objective 2.1: Increase resident knowledge and awareness of impacts of climate change on the local ecosystem, economy and human well-being.

Strategies:

- a. Use local examples of impacts and actions that will be relevant to Alger County residents.

Action Plan:

- **Short Term** - Write a series of articles about climate change for local newspapers, focusing on local impacts and encouraging awareness of adaptation issues: *National Park Service, U.S. Forest Service, Alger County Conservation District.*
- **Mid Term** - Develop brochures and other written materials specifically aimed at climate change adaptation for Alger County – distribute them to residents, businesses and government leaders: *Superior Watershed Partnership, Munising Downtown Development Association, Alger County Chamber of Commerce, U.S. Forest Service.*

- **Long Term** - Develop and promote public lecture programs in the community and invite regional climate change experts to speak on topics of interest to Alger County residents: *National Park Service, Northern Institute of Applied Climate Science, MSU Extension.*

Objective 2.2: Create synergy between climate adaptation and climate mitigation efforts by increasing resident knowledge and awareness of their personal carbon footprints and move them to take personal responsibility for reducing their own footprints.

Strategies:

- a. Keep the message positive and concentrate on what one person can accomplish and how those numbers “add up.”
- b. Make learning fun by doing.

Action Plan:

- **Short Term** - Work with local school officials to create curriculum and/or activities that focus on what students can do to reduce their own carbon footprints: *National Park Service, Alger County School Districts.*
- **Short Term** – Build on existing county-wide energy conservation efforts, like those demonstrated through the *Alger Energy Savers Program* and efforts through Pictured Rocks National Lakeshore, by forming a citizen coalition interested in speaking with family, friends, and neighbors regarding climate change and ways to reduce their personal carbon footprint : *Superior Watershed Partnership, Pictured Rocks National Lakeshore*
- **Mid Term** - Create an art or writing contest for local students on what they can each do personally to reduce their carbon footprint: *Alger County Chamber of Commerce, Alger County School Districts, Alger County Conservation District, MSU Extension.*
- **Long Term** - Develop an information booth or display that can be taken to community events, fairs and festivals focusing on how individuals can help fight climate change here in Alger County: *Superior Watershed Partnership, National Park Service.*

Objective 2.3: Move residents to become citizen stewards who reach out to friends to carry these messages.

Strategies:

- a. Engage local Transition groups to help spread the word on this topic.
- b. Engage people of all ages and socioeconomic sectors.

Action Plan:

- **Short Term** - Identify and contact Alger County groups and individuals who would be willing to distribute brochures and information (created in Objective 2.1) with their members and constituents: *National Park Service, Alger County Conservation District, MSU Extension.*
- **Mid Term** - Develop a contest with prizes and incentives to encourage residents to share information with their friends, neighbors, and relatives: *Superior Watershed Partnership, Alger County Chamber of Commerce.*

Goal #3 Support the ecological integrity of Alger County watersheds.

Objective 3.1: Use the Munising Bay Watershed Plan (MBWP) as a model for Great Lakes Protection.

Strategies:

- a. Gain community, including community leaders, support for the plan.
- b. Incorporate the MBWP into County, Township, and municipal planning and zoning.

Action Plan:

- **Short Term** - Form a community action committee charged with assuring watershed protection through implementation of the MBW watershed plan, timely completion of its objectives, monitoring the results, and adapting the plan as needed: *Superior Watershed Partnership, Munising Bay Watershed Council, Alger County Conservation District, National Park Service, U.S. Forest Service*
- **Short Term** - Distribute copies of the plan to community leaders and relevant staff people at all levels of government: *Superior Watershed Partnership, Alger County Conservation District.*
- **Mid Term** - Distribute copies of the plan to various places around the County for viewing by the general public: *Superior Watershed Partnership, Alger County Conservation District.*

Objective 3.2: Establish and implement a shoreline protection plan for Alger County.

Strategies:

- a. Compile a complete inventory of Alger County shoreline.
- b. Establish a Lake Superior shoreline protection zone for new development.

Action Plan:

- **Short Term** - For **Strategy a:** Assemble a community action team for implementation of a shoreline protection zone: *Superior Watershed Partnership, Munising Bay Watershed Council, National Park Service, Alger County Conservation District.*
- **Mid Term** - Create a community campaign on shoreline education: *Superior Watershed Partnership, Alger County Conservation District, Munising Bay Watershed Council.*
- **Mid Term** - Gather data pertinent to shoreline protection: *Superior Watershed Partnership, Northern Michigan University, Munising Bay Watershed Council, Alger County Conservation District.*
- **Mid Term** - For **Strategy b:** Research set-back requirements for specific shoreline habitats: *Superior Watershed Partnership, Alger County Conservation District, National Park Service.*
- **Long Term** – Integrate shoreline protection into the above community awareness campaign in Objective 2.1: *Au Train and Munising Township zoning boards, National Park Service.*

Objective 3.3: Develop a State of Michigan approved watershed management plan for priority watersheds in Alger County.

Strategies:

- a. Prioritize watersheds based on threats
- b. Develop priority watershed management plans

Action Plan:

- **Short Term** - For **Strategy a:** Inventory current data and research on watershed protection: *Superior Watershed Partnership, Alger County Conservation District, National Park Service, Michigan Department of Natural Resources, Munising Bay Watershed Council.*
- **Short Term** - Establish a ranking system for management plan development: *Superior Watershed Partnership, Munising Bay Watershed Council, Michigan Department of Natural Resources, Alger County Conservation District.*
- **Short Term** - For **Strategy b:** Secure required funding necessary to accomplish development of watershed management plans: *Superior Watershed Partnership, National Park Service, Alger County Conservation District.*
- **Mid Term** - Establish a watershed council to assist in the creation of a broad-based watershed management plan: *Superior Watershed Partnership, Munising Bay Watershed Council, National Park Service, Alger County Conservation District.*
- **Mid Term** - Secure state approval: *Superior Watershed Partnership, Alger County Conservation District, Michigan Department Natural Resources.*

Goal #4 Identify and promote public awareness of climate-related public health and safety issues through risk assessment and management.

Objective 4.1: Increase public awareness of health related issues associated with climate change including asthma, allergies, Lyme disease, heat stress and water-borne and vector-borne diseases.

Strategies:

- a. Use Centers of Disease Control data/information to convey risks to area residents.
- b. Attend local/regional health fairs and other appropriate venues to present information.

Action Plan:

- **Short Term** - Develop brochures and other written materials from up-to-date information on this topic from trusted organizations: *Alger County Health Department, National Park Service.*
- **Mid Term** - Attend health and related fairs with public information booth and distribute created materials: *National Park Service, Superior Watershed Partnership, Alger County Health Department.*

Objective 4.2: Increase public awareness of human safety related issues associated with climate change, such as severe storm events and flooding.

Strategies:

- a. Use Union of Concerned Scientists information to convey risks to area residents.
- b. Use information from the Wisconsin Initiative for Climate Change Impacts (WICCI) to convey risks to area residents.

Action Plan:

- **Short Term** - Create educational materials from up-to-date information on this topic from trusted organizations: *Superior Watershed Partnership, Northern Institute of Applied Climate Science.*
- **Mid Term** - Identify and attend appropriate public venues, fairs and events with information booth and materials: *Superior Watershed Partnership, National Park Service, U.S. Forest Service.*

Objective 4.3: Provide assistance to city, county and regional planners/officials regarding severe storm event forecasting and adaptation.

Strategies:

- a. Use sources mentioned above and other reliable data to convey appropriate information to planners and decision-makers.

Action Plan:

- **Short Term** - Identify appropriate interested and affected groups and host meetings to begin discussion of this topic: *Superior Watershed Partnership*.
- **Mid Term** - Review and revise Emergency Management Plans to address municipal and public response to major storm events: *Superior Watershed Partnership, Alger County Commissioners, Alger County Municipal and Township Boards*.

Goal #5 Identify and capitalize on economic opportunities presented by a changing climate.

Objective 5.1: Identify economic opportunities related to the tourism industry in Alger County.

Strategies:

- a. Work with local government, business and community leaders to plan for tourism opportunities that may arise due to predicted climate change in Alger County.
- b. Focus on climate change predictions that will be beneficial for tourism; i.e. longer shoulder season, more warm weather aquatic sports, more opportunities for property rentals, etc.
- c. Identify and promote winter tourism activities (“silent sports”) that don’t rely on specific snow depth.

Action Plan:

- **Short Term** - Meet with community and business leaders to initiate discussion and awareness of this topic: *Alger County Chamber of Commerce, Northern Michigan University*.
- **Mid Term** - Based on community discussions, develop a plan and specific goals to help local businesses: *Alger County Chamber of Commerce, Munising Downtown Business Authority*.
- **Mid Term** - Create educational materials and enlist the media to promote awareness of climate change adaptation issues for the general public: *Superior Watershed Partnership, National Park Service, Northern Michigan University’s Center for Economic Education and Entrepreneurship*.
- **Long Term** - Promote those tourism activities likely to increase, and plan for the effects of this increase: *Alger County Chamber of Commerce, Michigan Tourism Council (Pure Michigan)*.

Objective 5.2: Identify economic opportunities related to non-tourism businesses in Alger County.

Strategies:

- a. Meet with targeted non-tourism businesses to initiate discussion and awareness of this topic.
- b. Encourage development of climate-based job growth in green technologies, alternative energy, energy efficiency, expected infrastructure needs, etc.

Action Plan:

- **Short Term** - Research similar efforts in other similar Great Lakes counties and gather data pertinent to the objective and strategies: *Superior Watershed Partnership, National Park Service, Northern Michigan University's Center for Economic Education and Entrepreneurship.*
- **Mid Term** - Conduct feasibility study into possibility of increasing "green" climate change-related jobs in the County or bringing new related businesses into the county: *Northern Michigan University's Center for Economic Education and Entrepreneurship, Michigan Department of Agriculture.*
- **Long Term** - Create educational materials and promote awareness to the general public, similar to the Action Plan for Objective 5.1: *Northern Michigan University's Center for Economic Education and Entrepreneurship.*

Objective 5.3: Identify economic challenges, opportunities and other climate change adaptation issues faced by local municipalities and policy makers.

Strategies:

- a. Connect climate change predictions to potential infrastructure needs by local communities, such as increased flood control measures, impacts on government services, traffic issues, etc.

Action Plan:

- **Short Term** - Research strategies and methods for assisting local governments on planning for climate change adaptation: *Alger County Chamber of Commerce, Munising Downtown Business Authority, various local municipalities, including county and township Commission Boards.*
- **Short Term** - Establish a ranking system for management plan development: *Michigan Department of Economics, Northern Michigan University's Center for Economic Education and Entrepreneurship.*
- **Mid Term** - Secure required necessary funding: *Michigan Department of Economics, Northern Michigan University's Center for Economic Education and Entrepreneurship, Alger County Chamber of Commerce.*
- **Mid Term** - Secure state approval: *Northern Michigan University's Center for Economic Education and Entrepreneurship, Alger County Chamber of Commerce.*

Implementation and Anticipated Results

Climate change in Alger County is not a matter of “**When?**” or “**How?**”; instead it is a matter of “**Now What?**”. The Alger County Climate Change Adaptation Plan identifies the risks of climate change to Alger County and measures it against the county’s water, forest, and economic vulnerabilities. By working with a large network of partners, the implementation of this plan works to the benefit of Alger County by providing a framework for resiliency and sustainability of the county’s natural resources. It provides a road map for ensuring healthy water and forests resources, and in turn, creates an economically viable community, one mindful of protecting its most precious assets and capitalizing on opportunities.

The implementation of this plan will prepare residents for a changing tourism industry, capitalize on an evolving forest products industry, prepare and educate individuals about the tangible effects of climate change as it relates to forest, water, and human health and safety, and ensure that all species within Alger County remain healthy.

The SWP will be taking a leadership role in facilitating adaptation actions by a number of cooperating partners. The following table presents specific adaptation plan action steps for each goal and objective according to their time frame of short (1-3 yrs), medium (3-10 yrs) and long term (10-25 yrs).

Goal	Objective	Short Term Action Steps (1-3 Years)	Time Frame	Action Leader
Goal # 1: Keep Alger County forests ecologically and economically viable.	1.1 Promote sustainable, climate ready infrastructure to support the local forest products industry. (Promote local forest products industry)	1.1.a. Inventory transportation infrastructure in Alger County and determine status of each regarding load capacity and identify necessary upgrades.	2012	Alger County Road Commission
	1.2 Promote use of locally and sustainably produced forest byproducts	1.2.a. Explore interest from local facilities in utilizing forest products.	2012	SWP

	1.3 Encourage forest products industry to plan for changes through development of new methods and products	No Short Term Actions Identified	2012	Forestland Group
	1.4 Maintain an ecologically healthy and sustainable forest for public enjoyment and wildlife	1.4.a. Form a temporary working group to create a 5 year plan focused on collaborative efforts to address issues of forest fragmentation, deer management, invasive species, and pest infestations	2012	Alger County Conservation District
Goal # 2: Promote public education and awareness of effects of climate change	2.1 Increase resident knowledge and awareness of climate change on the local ecosystems, economy and human well-being.	2.1.a. Write a series of articles about climate change for local newspapers, focusing on the local impacts and encouraging awareness of adaptation issues	2012	SWP
	2.2 Create synergy between climate adaptation and mitigation increasing resident knowledge and awareness of their personal carbon footprints and move them to take personal responsibility for their reducing own carbon footprints.	2.2.a Work with local school officials to create curriculum and/or activities focusing on what students can do to reduce their own carbon footprints	2013	National Park Service

		2.2.b Build on existing county-wide energy conservation efforts, like those already demonstrated through the <i>Alger Energy Savers Program</i> and efforts through Pictured Rocks National Lakeshore, by forming a citizen coalition interested in speaking with family, friends, and neighbors regarding climate change and ways to reduce their personal carbon footprint	2012	Alger Energy Savers Program
	2.3 Move residents to become citizen stewards who reach out to friends to carry their messages.	2.3.a. Identify and contact Alger County groups and individuals who would be willing to distribute brochures and information (created in Objective 2.1) with their members and constituents	2012	SWP
Goal # 3: Support the ecological integrity of Alger County watersheds.	3.1 Use the Munising Bay Watershed Plan (MBWP) as a model for Great Lakes Protection.	3.1.a. Form a community action committee charged with assuring watershed protection through implementation of the MBW watershed plan, timely completion of its objectives, monitoring the results, and adapting the plan as needed	2012	SWP
		3.1.b. Distribute copies of the plan as an educational tool to community leaders and residents Alger County	2012	SWP
	3.2 Establish and implement a shoreline protection plan for Alger County.	3.2.a Assemble a community action team compile a complete inventory of Alger County shoreline	2012	SWP
	3.3 Develop a State of Michigan approved watershed management plan for priority	3.3.a. Inventory current data and research on watershed conditions and protection in Alger County	2012	SWP

	watersheds in Alger County.			
		3.3.b Establish a ranking system for management plan development for subwatersheds in Alger county	2012	SWP
		3.3.c. Secure required funding necessary to develop a priority watershed management plan	2013	SWP
Goal # 4: Identify and promote public awareness of climate – related public health and safety issues through risk assessment and risk management.	4.1 Increase public awareness of health related issues associated with climate change.	4.1.a. Develop brochures and other written material from up-to-date information on the topic of public health related issues associated with climate change from trusted organizations	2012	Alger County Dept. of Health
	4.2 Increase public awareness of human safety related issues associated with climate change.	4.2.a. Develop educational materials from up-to-date information on the topic of public safety associated with climate change, such as severe storm events and flooding	2012	SWP
	4.3 Provide assistance to city, county, and regional planners/officials regarding severe storm event forecasting and adaptation	No short term action steps identified		
Goal # 5: Identify and capitalize on economic opportunities presented by a changing climate	5.1 Identify economic opportunities related to tourism industry in Alger County	5.1.a. Meet with community and business leaders to initiate discussions and awareness of the topic of economic opportunities related to a changing tourism industry	2012	Alger County Chamber of Commerce

	5.2 Identify economic opportunities related to non-tourism businesses in Alger County	5.2.a. Research similar efforts in other similar Great Lakes counties and gather data regarding economic opportunities related to non-tourism businesses in Alger County	2012	SWP
	5.3 Identify economic challenges, opportunities and other climate change adaptation issues faced by local municipalities and policy makers	No short term action steps identified		

Goal	Objective	Medium Term Action Steps (3-10 Years)	Time Frame	Action Leader
Goal #1: Keep Alger County forests ecologically and economically viable.	1.1 Promote sustainable, climate ready infrastructure to support the local forest products industry.	1.1.b. Hold meetings with all interested parties to discuss predicted climate change impacts on infrastructure as it will affect the timber industry	2015	SWP; The Forestland Group
	1.2 Promote use of locally and sustainably produced forest byproducts.	1.2.b. Explore grant funding for feasibility studies	2015	SWP
	1.3 Encourage forest products industry to plan for changes through development of new methods	No medium term action identified	Ongoing	The Forestland Group

	1.4 Maintain an ecologically healthy and sustainable forest for public enjoyment and wildlife habitat	No medium term action identified	Ongoing	The Forestland Group; National Park Service
Goal #2: Promote public education and awareness of possible effects of climate change	2.1 Increase resident knowledge and awareness of impacts of climate change on the local ecosystem, economy, and human well-being	2.1.b. Develop brochures and other written materials specifically aimed at climate change adaptation for Alger County-distribute them to residents, businesses and government leaders	2015	SWP
	2.2 Create synergy between climate adaptation and climate mitigation efforts by increasing resident knowledge and awareness of their personal carbon footprints and mover them to take personal responsibility for reducing their own footprints	2.2.c. Create an art or writing contest for local students on what they can do to personally reduce their carbon footprint	2015	Alger County Conservation District
	2.3 Move residents to become citizen stewards who reach out to friends to carry these messages	2.3.b Develop a contest with prizes and incentives to encourage residents to share information with their friends, neighbors, and relatives	2015	SWP

Goal #3: Support the ecological integrity of Alger County watersheds	3.1 Use the Munising Bay Watershed Plan (MBWP) as a model for Great Lakes Protection	3.1.c. Distribute copies of the plan to various places around the County for viewing by the general public	2015	SWP
	3.2 Establish and implement a shoreline protection plan for Alger County	3.2.b. Create a community campaign on shoreline education	2015	SWP
		3.2.c. Gather data pertinent to shoreline protection	2015-2016	SWP
		3.2.d. Research set-back requirements for specific shoreline habitats	2016	SWP
	3.3 Develop a State of Michigan approved watershed management plan for priority watersheds in Alger County	3.3.d. Establish a watershed council to assist in the creation of a broad-based watershed management plan	2016-2018	SWP; Munising Bay Watershed Council
		3.3.e. Secure state approval	2017-2018	SWP
Goal #4: Identify and promote public awareness of climate-related public health and safety issues through risk assessment and management	4.1 Increase public awareness of health related issues associated with climate change including asthma, allergies, Lyme disease, heat stress and water-borne and vector borne diseases	4.1.b. Attend health and related fairs with public information booth and distribute created materials	2015	Alger County Health Department
	4.2 Increase public awareness of human safety	4.2.b. Identify and attend appropriate public venues, fairs and events with information booth	2015	National Park Service

	related issues associated with climate change, such as severe storm events and flooding	and materials		
	4.3 Provide assistance to city, county, and regional planners/officials regarding severe storm event forecasting and adaptation	4.3.a. Review and revise Emergency Management Plans to address municipal; and public response to major storm events	2015-2017	SWP; Alger County Commissioners
Goal #5: Identify and capitalize on economic opportunities present by a changing climate	5.1: Identify economic opportunities related to the tourism industry in Alger County	5.1.b. Based on community discussions, develop a plan and specific goals to help local businesses	2015	Alger County Chamber of Commerce
		5.1.c. Create educational materials and enlist the media to promote awareness of climate change adaptation issues for the general public	2015	National Park Service
	5.2 Identify economic opportunities related to non-tourism businesses in Alger County	5.2.b. Conduct feasibility study into possibility of increasing “green” climate change-related jobs in the County or bringing new related businesses into the county	2015	Northern Michigan University’s Center for Economic Education and Entrepreneurship
	5.3 Identify economic challenges, opportunities and other climate change adaptation issues	5.3.a Secure required necessary funding	2017	Northern Michigan University’s Center for Economic Education and

	faced by local municipalities and policy makers			Entrepreneurship; Michigan Department of Economics
		5.3.b Secure state approval for Alger County management plan	2017-2018	Northern Michigan University's Center for Economic Education and Entrepreneurship; Alger County Chamber of Commerce

Goal	Objective	Long Term Action Steps/Ongoing (10-25 Years)	Time Frame	Action Leader
Goal #1: Keep Alger County forests ecologically and economically viable	1.1 Promote sustainable, climate ready infrastructure to support the local forest products industry	1.1.c. Locate and secure funding to upgrade infrastructure where needed to provide resilience to coming environmental changes	2021	SWP; Alger County Road Commission
	1.2 Promote use locally and sustainably produced forest byproducts	1.2.c. Promote potential industrial sites and dock facilities to potential investors	2021	The Forestland Group; Northern Michigan University's Center for Economic Education
	1.3 Encourage forest products industry to plan	1.3.a. Keep abreast of potential new products, information, or adaptation resources that might be	Ongoing	The Forestland Group;

	for changes through development of new methods and products	applicable for the forest industry in Alger County, specifically as they relate to climate change		Northern Institute of Applied Climate Science
	1.4 Maintain an ecologically healthy and sustainable forest for public enjoyment and wildlife habitat	1.4.b. In order to minimize further fragmentation in forest ownership, support Michigan’s Commercial forest tax program, which allows landowners to minimize their tax burden while growing forest products and providing for limited public access	Ongoing	The Forestland Group; U.S. Forest Service
		1.4.c. Support working forest conservation easements to maintain sustainable forest production	Ongoing	The Forestland Group; SWP
		1.4.d. Support biologically-based deer population management that balances sustainable populations with sustainable forest habitat and quality timber management	Ongoing	Michigan Department of Natural Resources
		1.4.e. Continued partnering and support of CUPCWMA and other organizations engaged in invasive species education and control efforts	Ongoing	SWP; Hiawatha National Forest
		1.4.f. Continued partnering and support efforts to control and eradicate infestations	Ongoing	SWP; Hiawatha National Forest
		1.4.g. Encourage Alger County Road Commission to cooperate with CUPCWMA in control efforts on County Road ROWS with effective mowing schedules, equipment BMPs, and monitoring	Ongoing	The Forestland Group; Hiawatha National Forest
Goal #2: Promote public education and awareness of possible effects of	2.1 Increase resident knowledge and awareness of	2.1.c. Develop and promote public lecture programs in the community and invite regional climate change experts to speak on topics of	2021	National Park Service

climate change	impacts of climate change on the local ecosystem, economy and human well-being	interest to Alger County residents		
	2.2 Create synergy between climate adaptation and climate mitigation efforts by increasing resident knowledge and awareness of their personal carbon footprints and move them to take personal responsibility for reducing their own footprints	2.2.d. Develop an information booth or display that can be taken to community events, fairs and festivals focusing on how individuals can help fight climate change in Alger County	2021	National Park Service
	2.3 Move residents to become citizen stewards who reach out to friends to carry these messages	No long term action identified		
Goal #3: Support the ecological integrity of Alger County watersheds	3.1 Using the Munising Bay Watershed Plan (MBWP) as model for Great Lakes protection	No long term action identified		
	3.2 Establish and implement a shoreline protection plan Alger County	3.2.e. Integrate shoreline protection into the above community awareness in Objective 2.1	2021	National Park Service

	3.3 Develop a State of Michigan approved watershed management plan watersheds in Alger County	No long term action identified		
Goal #4: Identify and promote public awareness of climate-related public health and safety issues through risk assessment management	4.1 Increase public awareness of health related issues associated with climate change including asthma, allergies, Lyme disease, heat stress and water-borne and vector-borne diseases	No long term action identified		
	4.2 Increase public awareness of human safety related issues associated with climate change, such as severe storm events and flooding	No long term action identified		
	4.3 Provide assistance to city, county and regional planners/officials regarding severe storm event forecasting and adaptation	No long term actions identified		

Goal #5: Identify and capitalize on economic opportunities related to the tourism industry in Alger County	5.1. Identify economic opportunities related to the tourism industry in Alger County	5.1. d Promote those tourism activities likely to increase, and plan for the effects of this increase	2021	Alger County Chamber of Commerce
	5.2 Identify economic opportunities related to non-tourism businesses in Alger County	5.2.c. Create educational materials and promote awareness to the general public, similar to the Action Plan for Objective 5.1	2021	Northern Michigan University's Center for Economic Education and Entrepreneurship
	5.3 Identify economic challenges, opportunities and other climate change adaptation issues faced by local municipalities and policy makers	No long term action identified		

Outcomes

The effective implementation of this plan will:

- Maintain the health of 598,869 forested acres in Alger County.
- Protect threatened and endangered species such as the Grey Wolf and the Piping Plover.
- Preserve hunting, fishing, hiking, skiing, kayaking, and other outdoor sport activities for public enjoyment and ensuring a resilient and vibrant tourism industry.
- Protect the breeding grounds of cold water fish species such as the Brook Trout, Michigan’s State Fish.
- Decrease the presence of invasive aquatic species.
- Protect homeowners from property damage associated with unsustainable development and shoreline infrastructure erosion.
- Ensure economical resiliency and sustainability in Alger County for decades, through the public and private sectors, specifically the forest products industry.
- Provide climate change related education through a collaboration of the public schools, local units of government, private industry such as the forest products industry, and other vested agencies.
- Protect 80 miles of Lake Superior shoreline.
- Prepare Alger County’s public water infrastructure for climate change, ensuring safe water for over 9,000 residents.
- Reduce the dependency on fossil fuels for energy in Alger County.

It wasn’t raining when Noah built the ark. Climate change is upon us. The effects of climate change in Alger County are tangible and measurable. They stand to change the face of the county in irreversible ways. It is paramount that the people of Alger County begin to critically think about climate change and prepare for its effects so that the best of Alger County—its natural resources and its quality of life—is resilient in the face of change. The implementation of the Alger County Climate Adaptation Plan will serve as an insurance policy for the future. The same way we protect our cars, our boats, our homes, and our health against change or misfortune, we must now prepare Alger County against the probability of change due to a natural resource shift caused by climate change.

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Michigan Waterfall

Photo by Aaron Peterson, aaronpeterson.net.