

**MATCH-E-BE-NASH-SHE-WISH BAND OF POTTAWATOMI  
INDIANS CLIMATE CHANGE ADAPTATION PLAN**



Prepared for: Match-e-be-nash-she-wish Band of  
Pottawatomis Indians

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**Forward:**

The Gun Lake Tribe believes that our land, resources and people are the basis of our spiritual life. Since the birth story of our people our resources and land have been our only way to live.

All of our cultural resources, including our food and traditional medicines are non-renewable. With this in mind, climate change can have astronomical effects on our traditions and everyday lives.

**Signature:**  **Date:** 10-22-15

**DK Sprague**  
**Gun Lake Tribe, Tribal Chairman**

## Gun Lake Tribe Overview and Setting

### Population/Demographics

The Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians, also known as the Gun Lake Tribe (Tribe), is a federally recognized Indian Tribe located in southwest Michigan. In 1992 the Tribal community made a decision to pursue federal acknowledgment. The Tribe used their well-documented history and petitioned the Branch of Acknowledgment and Research (BAR) and the Bureau of Indian Affairs for acknowledgment instead of pursuing a bill in the United States Congress. The BAR process is a very complex procedure and a Tribe must satisfy vigorous regulations to be acknowledged. In August of 1999, the Tribe was re-established in their government-to-government relationship with the United States of America through this process. Currently, the Tribe has an enrolled citizenship of 435 individuals. The Reservation is composed of 359 acres held in trust by the United States Government for the community; however, the Tribe does not have a recognized “exterior reservation boundary”. The Tribe holds an additional 479 acres in agricultural, residential, and industrial lands not held in trust. The seven-member Tribal Council is an elected body, which has been empowered by the community through the election process to act on behalf of the Tribal Citizens. The Tribe expanded and built the 83,000 square feet Gun Lake Casino in 2011. In 2014, the Tribe broke ground to establish a permanent government campus in Shelbyville, MI.

**Table 1.1** lists the demographics among the citizens of Gun Lake Tribe from January 2015.

**Table 1.1 – Gun Lake Tribe Demographics in 2015**

<b>Age Group</b>	<b>Average Age: 24.84</b>
Ages 0-18: 201	<b>Gender</b>
Ages 19-60: 204	Male: 216
Ages 60+: 30	Female: 219

### Economy

Allegan County is primarily an agricultural area that is rapidly becoming urbanized as the population centers of Grand Rapids to the northeast and Kalamazoo to the southeast expands into Allegan County. A section of the City of Holland lies within the northwest portion of the county. The current unemployment rate is 9%, with a total workforce of 4,806,000 (State of Michigan employment statics, 2013).

The Gun Lake Tribe is one of the largest employers in Allegan County, through a combination of commercial and governmental positions employing approximately 850 full time workers.

According to Tribal officials, the Gun Lake Casino provides \$30 million in annual vendor spending on goods and services, and brings around 60,000 new guests to the area annually.

## **Geography and Land Use**

The Gun Lake Tribe is located approximately 25 miles south of Grand Rapids, located in southwest Michigan. All of the current land holdings of the Tribe are in Allegan County. Allegan County has 25 miles of coastline along Lake Michigan and it is the 18th largest county in Michigan. Still mostly rural in nature maintaining an agriculture and tourist-based economy, Allegan County is one of the fastest growing regions of the state.

## **Geology and Natural Resources**

The geology of the Reservation and Tribal fee land are typical of the area. The bedrock in Allegan County consists of Mississippian sandstone and shale, which are part of the Michigan Basin. The upper bedrock layers in the northeastern part of the county are sandstone of the Marshall Formation. Overlaying these bedrock formations is a mass of glacial drift about 50 to 400 feet thick. The drift was deposited during the Wisconsin Glaciations. The present surface features are generally the result of this glacial deposition, which occurred when the glacial ice receded about 10,000 years ago (Soil Survey of Allegan County, Michigan, NRCS).

## **Great Lakes Region Climate Change**

The Great Lakes Region of the United States is a land of many striking features: cold water streams and lakes, vast wetlands and forest, wild rice “mnomen” beds, and the Great Lakes themselves. It is now known that climate change will affect this region the State of Michigan. It is the responsibility of both tribal and state agencies to make changes to reduce these effects on our atmosphere and planet.

The Anishinaabe people of the Great Lakes Region hold close ties to all of these striking features. All of these natural resources are tied to Anishinaabe culture, spiritual life, and traditions. It is these natural resources that are threatened by climate change that will affect the traditions of the Anishinaabe people. The Gun Lake Tribe believes these traditional uses, spiritual relations, and culture must be noted when addressing climate change in the Great Lakes Region. The Gun Lake Tribe Climate Change Adaptation Plan has been adopted by Tribal Council in order to protect our water, land and natural resources for seven generations.

Growing evidence suggests the climate of Michigan is already changing. Climate models predict:

### **Summer Heat Index Changes**

- Every summer in Michigan will be hotter than 2005—the state’s hottest summer of the last half century.
- Detroit and other southern Michigan cities will experience almost 65 days per summer with highs over 90 degrees Fahrenheit and 23 days per summer with highs over 100 degrees Fahrenheit.

- Detroit and other southern Michigan cities will face around two heat waves per summer like the one that killed hundreds in Chicago in 1995.
- Michigan air quality will deteriorate as hotter weather causes more severe smog problems (assuming similar levels of tailpipe and smokestack emission occurrence). This will have serious consequences for public health, including a greater incidence of asthma attacks and other respiratory conditions.

**Dangerous Storms and Flooding**

- Heavy rains have become more common throughout the year in Michigan, leading to a greater incidence of flash flooding. Flash floods are anticipated to increase more than 25% over the next 20 years.
- Michigan winters and springs, when flood risk is already high, would become more than 25% percent wetter.
- Crops and livestock face substantially more heat stress, decreasing crop yields and livestock productivity/mortality.
- Warmer winters and a growing season up to six weeks longer will enable pests like the corn worm to expand their range.

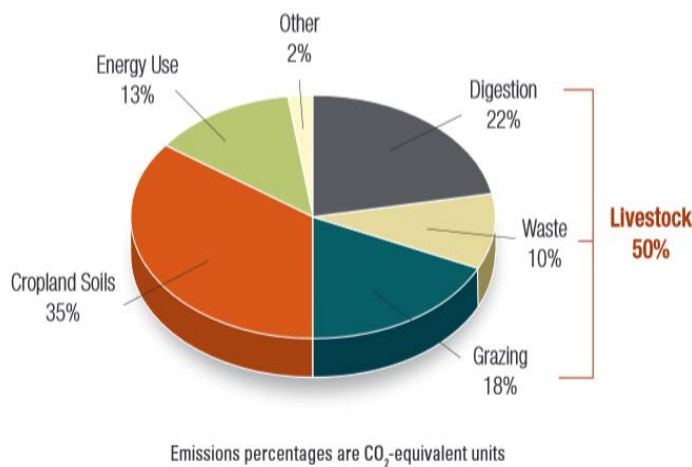


Figure 1. Michigan CO<sub>2</sub> inputs (Union of Concerned Scientist 2009).

- Crop production will be inhibited by changing rain patterns such as wetter springs (which delays planting and increases flood risk), and almost 10 percent less rain during the increasingly hot summers (Union of Concerned Scientist, 2009).

## Climate Change Effects on the Great Lakes, Inland Lakes and Streams

- Lake levels are predicted to continue to decline.
- Declines in the duration of winter ice are expected to continue.
- The distribution of many fish and other organisms in Great Lakes, as well as inland lakes and streams, will change. Valuable cold-water fish that are significant to the Great Lakes Region Tribes will decrease in numbers while warm-water species are likely to increase.
- Stratification will increase in all lakes, increasing oxygen depletion and the formation of “dead zones” for fish and other vital organisms.

## Gun Lake Tribe Climate Change Effects

The Gun Lake Tribe currently holds over 838 acres of agricultural, forested, commercial, and residential properties. Many valuable cultural and natural resources exist within these properties. The Gun Lake Tribe realizes that these impacts are not solely within Tribal properties, but that these impacts will affect the entire Great Lakes Region and Mother Earth.

The Gun Lake Tribe acknowledges the importance of actions to mitigate the causes of climate change. With this understanding, the Gun Lake Tribe has assessed the vulnerability and effects climate change will have on the following culturally significant natural resources.

## Vulnerability Assessment Tools

Numerous tools have been utilized to assess the climate change effects on Tribal resources within this document. The Climate Change Vulnerability Index (CCVI), developed by NatureServe, has been utilized as well as the Michigan Department of Natural Resources, Vulnerability Assessment of 400 Species of Greatest Conservation Need and Game Species in Michigan document. Where applicable climate tools were not available, staff quantified vulnerability scores through research and conversations with Tribal elders.

## Kalamazoo River/Kekamzoo Zibe:

- a. Vulnerability- High
- b. The Village of Match-e-be-nash-she-wish was once located where the City of Kalamazoo is situated in present day. The Village of Match-e-be-nash-wish was known as the “Village at Kekamzoo” and was described as being the “head of the Kalamazoo River”. The 1821 Treaty of Chicago ceded many lands south of Grand River; within this treaty, a nine mile square area of land was given to Chief Match-e-be-nash-she-wish and his people. This reservation was known as the Match-e-be-nash-she-wish Reservation and was located northeast of the present Michigan Avenue bridge in the City of Kalamazoo on the banks of the Kalamazoo River. The Kalamazoo

River was utilized by the Gun Lake Tribe for sucker harvests, lake sturgeon harvests, and wild rice harvests. The Kekamzoo Zibe was known as the lifeblood of Mother Earth. The Kalamazoo River continues to play a vital role to the Gun Lake Tribe through the lake sturgeon rehabilitation projects, hunting and trapping, and historical mound burial sites.

- c. Climate change will impact the Kalamazoo River, like many water bodies in the Michigan, by displacing cold-water species, creating dead zones, increasing flood events, and increasing non-point source and point source pollution. Climate change threatens the re-introduction of wild rice to the Kalamazoo River as well as the ongoing lake sturgeon restoration efforts by the Gun Lake Tribe.

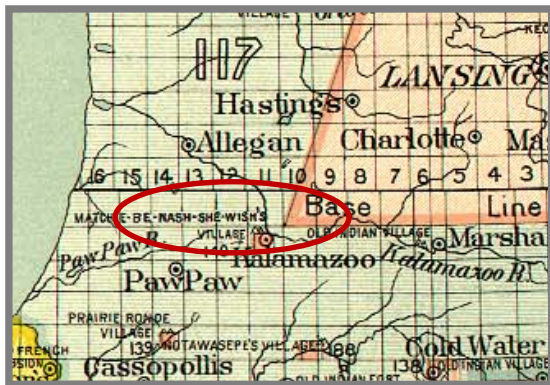


Figure 2. Match-e-be-nash-she-wish Village on the Kalamazoo River

*Punkin Shananaquet, Gun Lake Tribe citizen.....*

*The Kalamazoo River has always been and remains today a source of spiritual power for the Potawatomi of Southwest Michigan. The water is one of four main spirits that we acknowledge when offering prayers and medicine bundles for healing. The Kalamazoo River was one of the main sources for sustenance for the Potawatomi people in earlier times. We recognize the sacred balance the rivers, lakes, and streams provide by referring to them as the lifeblood of Mother Earth. One of our moons is referred to as Namebini Giizis or “Sucker Moon”, known in the English language as February. Suckers would move upstream to spawn and our people would gather to harvest the fish as they moved inland. Entire families would gather and reconnect at various times throughout the year when we depended on one another to assist by means of spearing, cleaning, or preserving and smoking the fish. Sturgeon were another source of subsistence for native people in the watershed as they moved from the big lake up the river. It was at one of these camps that my great-great grandfather became ill and died while spearing sturgeon. The people wrapped him in birch bark and placed him in a cliff along the Kalamazoo River so that his final resting place would not be disturbed by the Whiteman.*



*This story has been handed down in oral tradition from one generation to another. My mother told it to me as part of the reason why I would be fasting at this particular place along the Kalamazoo River. My four-day “berry fast” occurred when I was fourteen years of age in 1975. I offer this story as but one example among many within the history of my people an example of the spiritual significance along with oral traditions that ties me and my people to the land and Kalamazoo River forever.*

### **American Basswood/Wigbemesh:**

- a. Vulnerability- Moderate
- b. The basswood tree is a significant cultural resource for the Gun Lake Tribe to be used as cordage for baskets, fish traps, wigwam construction, and other cordage practices. Basswood trees are also used for medicinal purposes; the inner bark of the basswood tree is used to treat dysentery, the twigs for lung ailments, and the leaves to help treat burns. Basswood tree sap is even utilized to make syrup.
- c. Climate change will threaten the basswood tree, like many other forestry species, by changing current habitat ranges, changing/extending growth periods, and increasing large-scale blow-downs. The United States Department of Agriculture (USDA) Forest Service modeling framework for climate change predicts that the American basswood will migrate north from its current habitat in Michigan. Utilizing the Hadley-high habitat prediction method the American basswood tree will become non-existent in southwest Michigan by the year 2100 (Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007). The Hadley-high method assumes climate change continues at its current rate with no change.



Figure 3. Basswood cordage  
Photo: Grove, K.

### **Black Ash/Wisgak:**

- a. Vulnerability-High

- b. The Gun Lake Tribe is known for its black ash basketry makers across the country. The effects of the emerald ash borer have decimated black ash trees throughout the region over the past seven years. With the increase in climate change stressors, the future of black ash basketry making is unknown.
- c. Climate change will likely increase stressors on existing black ash swamps located within Tribal properties. Climate change will increase temperatures and cause drier conditions in the growing season, relative humidity will increase in the summer months, and increased wind and thunder storms will cause more large scale blow-down effects (Lee Frelich, University Minnesota). Utilizing the Hadley-high habitat climate change prediction method (climate change continues with no change), the USDA Forestry Service predicts the black ash tree will become non-existent in Michigan by the year 2100 (Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007).



Figure 4. Black ash baskets, Gun Lake Tribal Citizens  
Photo: Pigeon, A

### Whitetail Deer/Wawashkesi:

- a. Vulnerability-Moderate
- b. The whitetail deer is a traditional food source as well as a source for raw hide that is utilized in hand drum construction for the Gun Lake Tribe. The whitetail deer or “wawashkesi” is also the second traditional clan animal in the Anishinaabe clan system.
- c. Climate change stressors include habitat changes and winter deer “yard” alterations, which offer safety areas for deer in the winter. Climate change will affect the location and range of these deer “yards”. Warmer summer days will also increase heat exhaustion and death rates. Michigan’s whitetail deer population is extremely vulnerable to hemorrhagic disease which is spread by infected biting midges. These biting midges are killed by extended hard frost days; because the midges are killed by a hard frost, the disease subsides shortly after the first hard autumn frost. With climate change extending autumn frost, Tribal deer populations will be more susceptible to this disease. Longer summers can also lead to the proliferation of stronger and more persistent strains of Lyme disease bacteria with greater severity to both deer and humans. Climate change could also expand the distribution of deer ticks

by 70% by later this century (NWF, Big Game Wildlife in a Warming World, 2013). This could lead to an increase in other less commonly known tick-borne diseases such as: Powassan virus, anaplasmosis, and babesiosis (CDC, Tickborne Diseases of the United States, 2014).

### **Sugar Maple/Shenamesh:**

- a. Vulnerability-Moderate
- b. Spring maple sap harvesting is a long standing tradition for the Gun Lake Tribe and many Great Lakes Pottawatomi Tribes. Traditionally, maple tapping occurred between February-April as a large multi-family unit. The Gun Lake Tribe still practices this tradition at the Jijak Property and Boot Lake Property for its annual maple syrup harvest. This annual event brings over 10 Tribal families and community members together to share oral history and sugar maple tapping traditions. Maple saplings are also used to construct the framework of sweat lodges and wigwams.
- c. Climate change will affect the timing of maple syrup production by pushing the production period earlier in the spring and possibly changing flavors and the viscosity of the sap. Forest Service studies have also shown that climate change will likely reduce the amount of suitable habitat for sugar maple trees over the next 100 years (Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007).



**Figure 5. Jijak Property, Maple Syrup Processing Building**  
Photo: McKenney, S.

### **White Cedar/Gizhkey:**

- a. Vulnerability: Moderate
- b. There are four sacred medicinal plants that grow in this world according to Anishinaabe culture. They are used for spiritual cleansing, protection of family members, and healing of the soul. These four medical plants include: white sage, tobacco, sweet grass, and white cedar. White cedar is used as a protection medicine. It protects a person when they are connected to the spiritual session of the mind, when

traveling through the gateway to the other side of this earth. White cedar is hung above a doorway or entrance to a home to keep wandering or unwanted entities from entering the premises. White cedar is also used for canoe building and ceremonial smudging. The white cedar tree has many medicinal qualities from the roots, bark, branches and sap. It is said in oral traditions that the white cedar tree was the first tree to be created. It represents the southern direction, the middle of the day, and the second season “Niiben” or summer.

- c. Climate change threatens white cedar, like many other forestry species, by changing current habitat ranges, changing/extending growth periods, and increasing large-scale blow-downs. The USDA Forest Service modeling framework for climate change predicts the white cedar to migrate north from its current habitat in Michigan. Utilizing the Hadley-high habitat prediction method (climate change continues with no change) the white cedar tree will become non-existent in southwest Michigan by the year 2100 (Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007).



Figure 6. Carving canoe a thwart utilizing white cedar.  
Photo: Finney K., Great Lakes Lifeway Institute

### Wild Rice/Mnomen:

- a. Vulnerability: Extremely
- b. The Gun Lake Tribe is currently implementing a wild rice restoration project to restore historic rice beds within southwest Michigan. The Tribe has located six wild rice beds within the ancestral territory of the Tribe. The Tribe is working to restore wild rice to these local water bodies utilizing rice from existing beds throughout the State of Michigan. Wild rice processing camps have been held annually by the Tribe since 2011 in order to bring the ricing traditions back to Tribal citizens. Gun Lake Tribal citizens are very excited to see the “good berry” being re-introduced to southwest Michigan. In 2014, over 300 lbs. of wild rice was seeded within Tribal lakes.

Wild rice plays a vital role in the traditions of Anishinaabe people. The first oral and written occurrences of rice are found in the Migration story of the Anishinaabe people to the Great Lakes Region.

*Anishinaabe, Wild Rice “Mnomen” Migration Story.....*

*Over one thousand years ago, the Anishinaabe people lived along the Atlantic coastline of Turtle Island (North America). They were visited by eight Prophets and given seven Prophecies to follow, the third of which directed them to travel westward until they found the place where “food grows on water”. When they arrived in the Great Lakes region they discovered vast beds of wild rice, or Mnomen (pronounced Ma-nō-min). As the story is told, Nanaboozhoo, the cultural hero of the Anishinaabek was introduced to rice by fortune, and by a duck. One evening Nanaboozhoo returned from hunting, but he had no game. As he came towards his fire, there was a duck sitting on the edge of his kettle of boiling water. After the duck flew away, Nanaboozhoo, looked into the kettle and found wild rice floating upon the water, but he did not know what it was. He ate his supper from the kettle, and it was the best soup he had ever tasted. Later, he followed in the direction that the duck had taken, and came to a lake full of mnomen. He saw all kinds of duck and geese and mud hens, and all the other water birds eating the grain. After that, when Nanaboozhoo did not kill a deer, he knew where to find food to eat.*

*Mnomen is a gift given to the Anishinaabe from the Creator, and is a centerpiece of the nutrition and sustenance for our community. In the earliest of teachings of Anishinaabe history, there is a reference to wild rice, known as the food which grows upon the water, the food, the ancestors were told to find, then we would know when to end our migration to the west. It is this profound and historic relationship which is remembered in the wild rice harvest on the White Earth and other reservations-a food which is uniquely ours, and a food, which is used in our daily lives, our ceremonies, and our thanksgiving feasts.” (T. Vennum, Jr., Minnesota Historical Press, 1988).*

These strong ties to wild rice make this plant species a vital cultural and natural resource to the Gun Lake Tribe and the Anishinaabe people.

- c. Climate change threatens existing wild rice beds and future restoration efforts. Fluctuations in water levels, caused by climate change, can flood or drain existing mnomen beds. Intense rainfall events can uproot plants or entire beds when they are in the critical “floating leaf” stage of their development. Brown spot disease within these beds also appears to be increasing across the Great Lake Region. Brown spot disease favors warm humid conditions that promote fungal diseases. This disease can decimate yearly wild rice harvest. Anishinaabe citizens have also reported an increase in rice worms. Rice worms are a pest that feed on rice. These rice worms favor warmer

summers and mild winters. Once infested with rice worms, wild rice seed production can drop as much as 50%.

High water quality is essential for wild rice health. Climate change will affect many of the existing beds through hydrological changes, water quality changes, and temperature changes. Loss of extended ice cover could also decrease protection from winter storm events.

With these climate change threats in mind, wild rice preservation is a high priority for the Gun Lake Tribe. Rice harvesting, ricing camps, and community gatherings are essential to provide connections to the past and future for the Gun Lake Tribe.



**Figure 7. Wild rice “mnomen” harvest Gun Lake Tribe, 2014**  
Photo: Finney, K., Jijak Foundation

**Paper Birch/Wigwas:**

- a. Vulnerability: High
- b. The paper birch tree is utilized by the Gun Lake Tribe to make traditional canoes, wild rice winnowing baskets, containers, ornamental goods, and cough syrup.
- c. Climate change models predict that the paper birch tree will experience large declines in its current range. Temperature increases are expected to have a large impact on this tree because of its effects on soil moisture and the ability of the birch tree to get both water and nutrients. Michigan and Wisconsin are already seeing declines due to these drier habitats.



Figure 8. Birch bark winnowing basket with mnomen  
Photo: GLT Environmental Department

**Lake Sturgeon/Name':**

- a. Vulnerability: Moderate
- b. The Gun Lake Tribe is currently implementing a lake sturgeon “name” restoration project on the Kalamazoo River in partnership with the United States Fish and Wildlife Service and Michigan Department of Natural Resources. The restoration project conducts adult drift surveys, larval drift surveys, and egg matt collections to assist the lake sturgeon with reproduction. A lake sturgeon release celebration is held in the fall to celebrate the release of wild sturgeon back into the Kalamazoo River. The name' has a rich history with the Gun Lake Tribe.

History of Name' and the Gun Lake Tribe, *Punkin Shananaquet Gun Lake Tribal Citizen*.....

*The “Name” or Sturgeon Clan is referred to as the Ogema or Chief Clan of the fish pantheon, with Turtle also holding the title of Chief or “King”. The Fish Clan people, or Water Clans as they are often referred, are considered the philosophers and spiritualists, those who interpret and provide spiritual knowledge and guidance. Colors for the clan are animate meaning they move and provide life is Blue, Green and Silver. Fish Clan*

*people are often regarded as mediators in tribal disputes with their word and/or decisions being final. We observed upon thousands of generations the existence of the fish and how important of a role they have with the water, the lakes, the creeks and streams. The survival of water is critical with the inhabitants of those who live within that environment.*

*Like the life of the fish, Sturgeon Clan people often survive to an old age and before the arrival of the European the life span of our people easily reached 130 years.*

*Our connection and restoration of the Sturgeon is our ability to survive. Like our ancestors, the Sturgeon was taken almost to the point of extinction. There are accounts of the Sturgeon being stacked like lumber – the meat left to rot because the effort was only to take the eggs “caviar” for use in rich 16<sup>th</sup> – 20<sup>th</sup> century diets. Whereas our philosophy is to use all parts and respect the life it is about to provide for you and your family, your community and your Nations. This is a critical point in our history not only for restoration but to reclaim the connection for sacred life. Our Tribe is very proud of the fact that through cooperation – our environmental knowledge, our teachings and the spiritual sense of “jak ge’ go” – all things in creation are sacred, is being looked upon as viable for all nations of color.”*

- c. Lake sturgeon were once abundant within the Kalamazoo River and Lake Michigan systems until overfishing in the 1800's and early 1900's decimated their populations. In Michigan, lake sturgeon have been protected since 1994 when they were designated as a threatened species. The Kalamazoo River/Lake Michigan system currently holds approximately 90 spawning age lake sturgeon. In the mid-1990's, only 30 spawning age lake sturgeon were known to exist. It is anticipated that climate change will negatively affect these breeding Kalamazoo River lake sturgeon. The continued rising water temperatures in both the Kalamazoo River and Lake Michigan will decrease the quality and quantity of limited spawning and nursery habitats. Climatic vulnerability could disrupt the timing of sturgeon reproduction and the length of optimal fish growth periods as environmental cues shift and warming waters affect ecosystem health. Lake sturgeon are also vulnerable to stream sediment loads and storm water run-off that are associated with more extreme weather conditions and flood events associated with climate change (National Wildlife Foundation, Sturgeon, 2007).

The Gun Lake Tribe considers the restorations efforts of Name', as well as the climate change threats to them, to be of the highest regard. Currently the Gun Lake Tribe is partnering with the Michigan Department of Natural Resources to improve spawning habits sites within the Kalamazoo River and work with the Allegan Dam ownership concerning dam releases that are affecting the Name'. The Tribe will continue to research and explore climate change adaptation strategies for the Name'.





Figure 9. Lake Sturgeon release, Kalamazoo River  
Photo: GLT Environmental Department

### Timber Wolf/Me'ingan:

- a. Vulnerability: Moderate
- b. The wolf and Anishinaabe people have very close ties. Both the Anishinaabe original man and the wolf walked the Earth together in the Creation Story. The original man and the wolf became brothers as they journeyed together. The Creator said both creatures are brothers and what happens to one will happen to the other. He said: each of you will be feared, respected and misunderstood by the people that will join you later on Earth. Anishinaabe people believe the return of the wolf to the Great Lakes Region reflects a return of the Anishinaabe people beginning to come back to traditional ways and natural living (Benton-Banai, E., Mishomis Book, 1988). The wolves of Isle Royal have recently seen the impact of climate change by the recent reduction in ice cover on Lake Superior. The ice bridge from mainland Wisconsin and Michigan would normally bring new wolves to the island on a yearly basis. Because of the lack of full ice coverage the wolves of Isle Royal have begun to inbreed which is causing genetic deformities and high death rates. The Isle Royale wolf population has dropped to six wolves verses the 1990 population of 38.
- c. Climate change stressors include prey reductions and stressors to local ecosystems. Wolf prey reductions are occurring from herbivores spending less time foraging due to high temperature extremes which then causes these herbivores to be more susceptible to winter kills. Warmer temperature extremes will also increase tick outbreaks on these herbivores.



Figure 10. Isle Royale wolves  
Photo: National Parks Service

### Sandhill Crane/Jijak:

- a. Vulnerability: Moderate
- b. The Gun Lake Tribe is known within the Anishinaabe culture as the Crane Clan. The sandhill crane is one of the seven original clan animals. The crane is considered a great leader and is one full of wisdom and knowledge. The Creator organized the Clan System to provide order and government to the Anishinaabe people. The Gun Lake Tribe's Boot Lake property has been utilized annually as a summer rookery for ten pairs of sandhill cranes. Tribal properties are also utilized as part the annual Midwest sandhill crane count.
- c. The sandhill crane is threatened by climate change through increased drought, heat increases in summer months, and changes in winter snow tracks that are trending farther north. Evaporation from small potholes and inland lakes will also decrease summer breeding and staging migration grounds.

*Anishinaabe Crane Story, Simone McLeod.....*

*Many moons ago, Gichi-Manidoo sent a jijaak (a sandhill crane) to earth on a mission. While the spirit-bird was descending, he uttered loud and far sounding cries heard by ininiwag (humans) and manidoog (spirits) alike. Some say the cries must even have startled Makadeshigan, the spirit of the Underworld. Slowly circling down above Gichigamiin, the Great Fresh Water Lakes, sending forth his echoing cry, pleased with the numerous whitefish that glanced and swam in the clear waters and sparkling foam of the rapids, crane finally chose a resting place (known as the fifth stopping place) on a hill overlooking beautiful Baawiting. Again the crane sent forth his solitary cry and the clans of Makwa (bear), Awaasii (catfish), A'aawaa (loon) and Moozoonii-Waabizhesh (combined clans of little moose and marten) gathered at his call. They soon congregated a large town near the Rapids and a Ceremonial Lodge of the Midewiwin (Grand Medicine Society) was erected there, and for the second time since the*

*People had left the Dawn Land the sound of the Midewiwin Grandfather Drum reverberated across the land and the waters. Since then the crane, who is sometimes called Baswenaazhi (the Echo Maker) and regarded as a symbol of eloquence and leadership, presides over all councils."*

### **Bald Eagle/Megizi:**

- a. Vulnerability: Moderate
- b. The bald eagle is utilized within Anishinaabe culture for eagle staffs, fans, broaches, spiritual whistles, and talking sticks. The bald eagle is revered as the leader of the Bird Clan. Those who hold the eagle as their clan animal are thought to be spiritual leaders within Anishinaabe communities and close to the Creator. Within oral traditions the eagle saved the Anishinaabe people from destruction by telling the Creator he would watch over the Anishinaabe people and make sure the Waterdrum was heard and that tobacco was offered. The eagle was to fly over the Earth every day and report back to the Creator. The eagle saved the Anishinaabe from destruction by contacting the Creator and speaking on behalf of the Anishinaabe people. He promised to watch over them and report back to the Creator.
- c. Bald eagles are recovering from sever population declines in Michigan. Slowly, bald eagle sightings are becoming more common in southwest Michigan. The Audubon Society has projected only 26% of existing bald eagle summer ranges to remain in the United States by the year 2080 due to climate change effects on habitat. These effects and the effects on the prey species of the bald eagle will have unknown long-term impacts on the bald eagle.

### **Turtle/Mishike:**

- a. Vulnerability: High
- b. Many turtles exist within Tribal properties including: Common Map turtle, Eastern Box turtle, Painted turtle, Common Snapping turtle, Spiny Soft-shell Turtle and the Red-eared slider. Turtles are very important to the Anishinaabe people. In the Anishinaabe creation story there was a great flood, afterwards a small speck of soil was placed on the turtle's back, which grew to become North America or "Turtle Island." The turtle is also the leader of the fish clan, one of the original seven clans of the Anishinaabe. This clan is looked to for truth and wisdom. Turtles continue to play a key role within traditional storytelling and shells are still being used to create turtle rattles.
- c. Impacts from climate change on Michigan turtles include altered surface water temperatures and changes in water quality affecting prey kills. Freshwater turtles nesting and mating seasons are determined by ambient air temperatures and rain fall events. Changes in these temperatures and rainfall events will affect the breeding times and sex determination of fresh water turtles (Bowen, Spencer, Janzen, A comparative study of environmental factors that affect nesting freshwater turtles, 2005). The Gun Lake Tribe is currently seeking grant funding to research the effects climate change is having on local turtle populations through Great Lakes Restoration funding.



Figure 11 Painted turtle  
Photo: GLT Environmental Department

### Gun Lake Tribal Garden and Traditional Foods:

- a. Vulnerability: Moderate
- b. The Gun Lake Tribe's non-profit, the Jijak Foundation, has recently started to grow and harvest traditional Anishinaabe foods from historical seed banks. The Tribal Garden's traditional foods are threatened by climate change due to the pests that were not in existence before Europeans came to North America. Many of these traditional crops are threatened by modern pests. Climate change effects on large agricultural crops can be directly related to small gardens such as the Jijak garden. In the US, between 1988-1990, the top eight major crops had over 90 billion dollars in crop losses associated with pests (Rosenzweig, Climate Change and Extreme Weather Events, 2001). Climate change affects the amount of pesticides used to control and/or prevent pest outbreaks on crops. The intensity and timing of rainfall events influences pesticide persistence and efficiency, while temperature and light affect pesticide persistence through chemical alterations. Most climate change models show a large increase in pest's habitat ranges, resulting in an increased use in agricultural chemicals with accompanying health and environmental costs.



Figure 12. Flint Corn  
Photo: Jijak Foundation

The beginning of our Mother Earth occurred when a Sky Woman fell from a hole near the Tree of Life. When she was falling from her world, she grabbed the sides of the ground near the tree and took the seeds of various plant life. It is these seeds that began to grow into the plants and herbal life needed for survival. Plants grown from these seeds included corn, beans, and squash and became the Three Sisters of the Anishinaabe People.  
~Author unknown

**Existing Jijak Foundation Seed Bank:**

- Bear Island Chippewa Flint corn
- Seneca Blue Bear Dance Flint corn
- Shawnee Flour corn
- Delaware Blue Flour corn
- Potawatomi White Flint corn
- Potawatomi Cranberry Pole Bean
- Potawatomi Lime Pole Bean
- Numerous varieties of tobacco

In addition, the Jijak Foundation is growing heirloom squash, watermelon, beans and many other crops. These crops are threatened by climate change through temperature changes, increases in the amount of carbon dioxide in the air, and the frequency of extreme weather patterns. Many grain crops are susceptible to warming weather patterns by reducing the amount of time the seeds have to mature and grow. This change in seed growth can reduce yields for small gardens, such as the Jijak garden, as well as on large agricultural farms in the Great Lakes Region. Climate change also affects the transportation of fungal diseases to crops. The increase in severe weather plays a key role to the spread of fungal diseases. Large storm events may also catalyze the spread of disease across continents or oceans (Rosenzweig, Climate Change and Extreme Weather Events, 2001).

**Medicinal Plants:**

- a. Vulnerability: Moderate-High
- b. Many medicinal plants are and will be threatened by climate change. Important Anishinaabe medicinal plants include: Common Burdock, New England Aster, Bull Thistle, Horseweed, Joe-Pye Weed, Black-eyed Susan, Goldenrod, Blue-flag Iris, Wild Mint, Wild Bergamot, Varieties of Dogwood, Varieties of the Mustard family and many other native and non-native plants in Michigan. The medicinal plants are used for making teas for colds, anti-spasmodic medicines, healing burns and blisters, blood purifiers, laxative treatments, healing sores and many other medical treatments.
- c. Climate change will expand ranges for some of these medical plants and well as reduce habitat ranges for others. While scientific research is lacking on many of the specific effects climate change will have on these individual plants, it is expected that many of these plants will see habitat expansion/reduction changes due to climate change impacts.

**Gun Lake Tribe Infrastructure Impacts:**

- a. Vulnerability: Moderate

- b. The Gun Lake Tribe has seen large increases in land purchases over the past 5 years and plans to develop many of these properties in the near future.
- c. It is well known that climate change is beginning to and will continue to have negative impacts on infrastructure issues across the United States. The Gun Tribe will also be affected by these infrastructure strains. Some of these infrastructure threats include:
  - 1. Impacts from riverine flooding events.
  - 2. Increased electricity demands in summer months.
  - 3. Increased power outages to above ground transmission lines from increased storm frequencies and durations.
  - 4. Water supply and water quality issues. Dealing with less dissolved oxygen, more non-point source pollution sources and warmer water.
  - 5. Transportation threats from storm damage to bridges roads, and railway movements.
  - 6. Building infrastructure threats from the degradation and failure of foundations and materials from increased storm and flooding events.
  - 7. An increase in extreme daily rainfall events which will affect the maintenance of existing stormwater, drainage, and sewer infrastructures.

**Gun Lake Tribe Health Impacts:**

Human health concerns related to climate change result from a complex set of interacting human and environmental factors. Most vulnerable to these concerns are the elderly, very young, and those whose health is already at risk. Climate change projections continue to suggest extreme heat periods and sever storm events that will impact Tribal health. Air and water quality will decrease alongside these events. The Gun Lake Tribe realizes these effects will have a large impact on the Tribe due to current population demographics (200 citizens under the age of 18). Figure 10 visualizes many of these health concerns related to climate change.

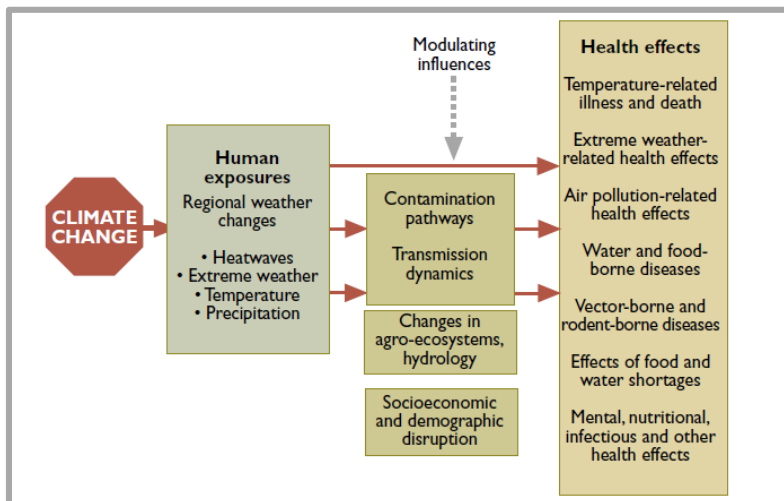


Figure 12. Pathways by which climate change affects human health  
Credit: World Health Organization

**Heat Related Illness:**

- a. Vulnerability: Moderate
- b. Climate change will lead to more severe and longer heat waves in summer months. These changes will increase electrical supplies and atmospheric pollution. Urbanized areas will escalate in temperatures in both length and degree. Demand on air conditioning will also increase with associated cost to air quality.

**Increased Risk of Respiratory Disease:**

- a. Vulnerability: High
- b. Weather conditions conducive to high ozone levels will occur more often over the next decade, and high heat days may lead to decreased air quality and an increased rate of respiratory disease and issues. The ground-level ozone is produced by a complex series of chemical reactions involving sunlight, oxygen, water vapor, and oxides of nitrogen. The rates of these reactions increase with higher temperatures. As the Great Lake Region grows warmer the ground-level ozone will hold these air pollutants at a constant causing those with respiratory issues to struggle and succumb to increased breathing issues.

**Increase in Tick and Mosquito Populations:**

- a. Vulnerability: High
- b. Milder winters and warmer summers will increase mosquito and tick numbers. This in turn, will increase the spread of disease such as Lyme and West Nile virus within the Great Lakes Region. Mosquito populations can grow tenfold with a two degree change in weather. Iowa saw a 40% increase in tick populations in 2014, which was attributed to warm summer events (Kirsten, Adair, Daily News, 2012).

**Increase in Solar Radiation Exposure:**

- a. Vulnerability: Moderate
- b. Epidemiological studies have implicated solar radiation as a cause of skin cancer. Recent assessments by the United Nations Environment Program have projected increases in skin cancer and sunburn severity due to stratospheric ozone depletion. Other depletion effects on the skin could include: Malignant melanoma, and chronic sun damage.

**Invasive Species:**

- a. Vulnerability: Moderate
- b. The Gun Lake Tribe is currently implementing an invasive species control project on fee and trust parcels on tribally held land. Invasive species eradication is priority for the

Gun Lake Tribe Environmental Department. Changes in invasive species distribution threaten culturally significant plants and animals to the Gun Lake Tribe.

- c. Changes in temperatures brought on by climate change often favor the spread of invasive species and pests. Native ecosystems on tribal lands are likely to suffer from these relatively abrupt changes in climate change. Climate change will almost certainly lead to changes in distribution of both native and non-native species of plants and animals. Changes in temperature and moisture constraints will allow species to move into and successfully invade new areas. Both native and non-native species will move out of their current distribution areas, becoming more common or more rare dependent upon their climatic preferences. Temperature and moisture changes will also create the potential for species that are not currently considered invasive to become invasive in new environments (Hellman, Consequences of climate change for invasive species, 2008).

### **Gun Lake Tribe Existing Climate Change Adaptations:**

The Gun Lake Tribe has implemented the following adaptations strategies to address climate change. As development grows within the Tribe's reservation, these efforts shall continue:

- a. Installation of a 5.88kw photovoltaic system to offset the carbon footprint of the Luella Collins Community Center.
- b. Installation of .50kw photovoltaic system to power lighting for the Luella Collins Community Center Park.
- c. Installation of a 4.55kw photovoltaic system to offset the carbon footprint at the Tribe's Settlement Park facilities.
- d. Installation of a geothermal heating and cooling system at the Gun Lake Tribe's Government Campus. The campus also includes numerous rain gardens to reduce water quality impacts to local water bodies.
- e. Purchase of the Gun Lake Tribe's first hybrid vehicle.
- f. The Gun Lake Casino has retrofitted all interior and exterior iridescent lighting to LED lighting. The Casino is also exploring photovoltaic systems within future Casino expansions.
- g. The Gun Lake Tribe Environmental Department has developed the Conservation Incentive Program (CIP) which provides rebate incentives to Tribal citizens who engage in energy reduction retrofits in their homes. The CIP Program also provides rebates for the purchase of hybrid vehicles and the installation of high efficiency furnaces and water heaters.





**Figure 13. Gun Lake Tribe solar panel maintenance LCCC**  
Photo: McKenney, S.

### **Gun Lake Tribe Adaptation Strategy and Actions:**

The Gun Lake Tribe realizes that climate change is having an impact within Michigan as well as our entire planet. The Tribe understands that the time is now to begin to make changes in order to reduce the effects climate change will have across the planet. The Tribe will address these changes through the following steps:

1. Establish and maintain a Climate Change Advisory Group which will coordinate future funding request and collaborate with other regional climate change groups and relevant entities.
2. Increase educational efforts to disseminate climate change information to Tribal citizens and staff.
  - a. Publish four climate change articles per year within the Gun Lake Tribe Tribune newsletter.
  - b. Distribute four climate change articles per year via the Gun Lake Casino e-blast program for Casino employees.
  - c. Publish up to date climate change education on the Tribe's website
3. Increase the energy efficiency of Tribally owned buildings/industries and residences of Tribal citizens.
  - a. Educate Tribal citizens concerning home energy savings and provide funding assistance for retrofits through the Conservation Incentive Program.
  - b. Provide ambient and indoor air quality education and adaptation tools to address air quality concerns.
  - c. Require estimates for the installation of LEED certified practices in all future developments.
4. Improve governmental car fleet through the purchase of fuel efficient, hybrid, and low emission vehicles.

- a. Develop a vehicle purchasing policy which includes the requirement of a price quote for a comparable hybrid or low emission vehicle during vehicle selections. The policy shall also require the purchase of the comparable hybrid/low emission vehicle when the price quote is within 10% of the conventional vehicle price
5. Assess and improve tillage and herbicide practices on all rented farmland.
  - a. Contact and meet with agricultural renters to implement conservation tillage practices.
  - b. Assist renters with USDA/NRCS conservation planning applications.
  - c. Require conservation tillage and riparian buffers in all new leases of agricultural land when feasible.
6. Inventory all existing culturally significant resources for vulnerability assessments.
7. Increase carbon sequestration
  - a. Manage forested parcels for wildlife management and air quality/carbon sequestration benefits.
  - b. Establish native plantings and natural areas.

## Appendix 1

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