Keweenaw Bay Indian Community

Aquatic Invasive Species Adaptive Management Plan

October 2015

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The following motion is from the 10-08-15 Tribal Council Meeting-
(Minutes approved on 11/09/15)

Aquatic Invasive Species (AIS) Adaptive Management Plan -

MOTION MADE BY EDDY EDWARDS TO APPROVE THE AQUATIC INVASIVE SPECIES ADAPTIVE MANAGEMENT PLAN. SUPPORTED BY ROBERT R.D. CURTIS, JR. ALL IN FAVOR (Jennifer Misegan, Toni J. Minton, Susan J. LaFernier, Doreen G. Blaker, Robert R.D. Curtis, Jr., Eddy Edwards, Randall R. Haataja, Michael F. LaFernier, Sr., Gary F. Loonsfoot, Sr., Don Messer, Jr., Donald Shalifoe, Sr.), OPPOSED - 0, ABSTAINING - 0, ABSENT - 0, MOTION CARRIED.

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List of Acronyms

AAWV	American Association of Wildlife Veterinarians
ACHP	Advisory Council on Historic Preservation
AIS	Aquatic Invasive Species
AISAMP	Aquatic Invasive Species Adaptive Management Plan
ANA	Administration for Native Americans
ANS	Aquatic Nuisance Species
BIA	Bureau of Indian Affairs
CD	Conservation District
CWMA	Cooperative Weed Management Area
eDNA	Environmental DNA
EMS	Early Mortality Syndrome
EWM	Eurasian watermilfoil
GISIN	Global Invasive Species Information Network
GLFC	Great Lakes Fisheries Commission
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
GLIN	Great Lakes Information Network
GLNPO	Great Lakes National Program Office
HACCP	Hazard Analysis and Critical Control Point
IRMP	Integrated Resource Management Plan
KBIC	Keweenaw Bay Indian Community
KBIC NRD	Keweenaw Bay Indian Community Natural Resources Department
KISMA	Keweenaw Invasive Species Management Area
MDARD	Michigan Department of Agriculture and Rural Development
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MISC	Michigan Invasive Species Coalition
MISN	Midwest Invasive Species Network
MNDNR	Minnesota Department of Natural Resources
MNFI	Michigan Natural Features Inventory
MSUE	Michigan State University-Extension
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act
NISA	National Invasive Species Act

NISC	National Invasive Species Council
NOAA	National Oceanic and Atmospheric Administration
OISC	Ontario Invasive Species Centre
ONAA	Office of Native American Affairs
OTR	Office of Tribal Relations
PWR	Partnership for Watershed Restoration
SCUBA	Self-Contained Underwater Breathing Apparatus
TEK	Traditional Ecological Knowledge
UCANR	University of California Agriculture & Natural Resources
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USFWS-SLC	United States Fish and Wildlife Service- Sea Lamprey Control
USGS	United States Geological Survey
UWEX	University of Wisconsin-Extension
VHS	Viral Hemorrhagic Septicemia
WDATCP	Wisconsin Department of Agriculture, Trade and Consumer Protection
WDNR	Wisconsin Department of Natural Resources
WePIC	Western Peninsula Invasive Coalition
WisDOT	Wisconsin Department of Transportation
WRISC	Wild Rivers Invasive Species Coalition
WSP	Wildlife Stewardship Plan

1.0 Introduction

Keweenaw Bay Indian Community
Aquatic Invasive Species Adaptive Management Plan
Vision Statement

"While holding great respect for all species, the vision of this Aquatic Invasive Species Adaptive Management Plan is to promote and protect the health and existence of native plants and animals of ecological, cultural, or subsistence significance upon which the Keweenaw Bay Indian Community depends by preventing, monitoring, and managing aquatic invasive species and educating the community about these plants and animals."

1.1 Purpose of the Aquatic Invasive Species Adaptive Management Plan

As our world becomes more connected, the potential for species to move from one location to another is increasing. Through intentional or non-intentional means, humans have been responsible for translocation of many species globally, enabling non-native species to colonize terrestrial and aquatic environments far away from their origins. While there are many terms and definitions related to invasive species, all of them focus on the concept that species that are non-native to an ecosystem may cause significant ecological and economic harm.

Invasive species are those "species that [are] non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm to human health" (MDNR et al 2009). Thus, aquatic invasive species (AIS) are aquatic organisms that invade ecosystems beyond their natural, historic range. Their presence may harm native ecosystems and the cultural, subsistence, commercial, agricultural, or recreational activities that depend upon the native community (USFWS 2013b).

From a biodiversity perspective, invasive species may threaten the genetic integrity of a native species with its unique connection to the local population's life history, geographic diversity, and diversity of habitats. Each of these native populations of plants and animals is one thread in the fabric of the land and water landscape, of the environment, of life on earth and warrants protection.

Some non-native, introduced, or hybrid species (for example, some fish species like Coho salmon) are utilized for their food value when they are abundant, accessible, or exhibit higher growth rates, and are not necessarily considered "invasive" by those who value them.

The Keweenaw Bay Indian Community (KBIC) is dedicated to the protection of its resources and preservation of the culture and traditions of its community. In developing and re-developing guidance documents, the KBIC places great emphasis on Traditional Ecological Knowledge (TEK). The core of the cultural fabric originates from the people's relationship with the environment and all its resources, all things living and non-living, all things physical and spiritual, all things mutually respected and dignified; this lifeway represents the cultural continuity from the past to the present (Gagnon 2011). Centuries of environmental knowledge, beliefs, and values have become the foundation for protecting homelands, expressions of sovereignty, and affirming treaty rights. TEK can guide, complement and supplement

biological science and management of natural resources (Menzies and Butler 2006). The following quote from Edward Benton-Banai's *The Mishomis Book* (1988) depicts the belief that culture is the number one priority:

> *As he walked, Original Man talked with the animals and plants. He named them as he went. He noted that some were good for we-sin'-ni-win' (food) and medicine. He noticed that each had its own individual kind of wisdom. He did not know that all of these plant and animals would play an important part for all the people that would be coming to live on the earth at a later time. There was not one plant, animal, or place that was not touched by him. These plants and animals are nations and have certain rights and we have to live together and support one another.*

While holding great respect for and recognition of the value of all species, there are some species that threaten the health and existence of plants and animals of ecological, cultural, or subsistence significance. While culture is the number one priority, part of that is protecting native plants and ecosystems and acknowledging the role of invasive species control in that process. Recognizing that some invasive non-native species can stress key native species populations, reduce forage availability, or degrade habitat and water quality, this Aquatic Invasive Species Adaptive Management Plan (AISAMP) will focus on those invasive species that diminish the availability of culturally significant species upon which tribal members depend.

The AISAMP will provide specific information and actions to better prevent, monitor, assess, and control aquatic invasive species in water bodies of interest to the KBIC (see section 1.3). This plan will serve as a guiding document and resource for the Keweenaw Bay Indian Community's Natural Resources Department (KBIC NRD) and for the broader community, regarding education, inspection and sanitization, monitoring, rapid response, management, laws and regulations, coordination among agencies, continued research and updating this AISAMP.

1.2 KBIC Overview

This Aquatic Invasive Species Adaptive Management Plan will parallel the Integrated Resource Management Plan (IRMP) and Wildlife Stewardship Plan (WSP) which are already in place at the KBIC NRD. A future Terrestrial Invasive Species Plan will align with the overall goals and objectives of this AISAMP.

The vision statement of the Integrated Resource Management Plan is "To live in harmony while enhancing and sustaining the resources of the Keweenaw Bay Indian Community for the Seventh Generation" (KBIC 2002). "Anishinaabe people have traditionally harvested plants for food, ceremony, medicines, dyes, tools, construction, and basketry. KBIC's IRMP sets forth goals of protecting and expanding stands of culturally significant native plants (i.e. wild rice) and identifying and controlling invasive species on the Reservation that threaten the existence of our native plants" (KBIC 2002). The IRMP incorporates subsistence and natural resources, social, cultural, environmental, and economic aspects of importance to KBIC into management decisions.

The vision of the Wildlife Stewardship Plan is "To support, and respect mutual relationships between thriving native fish, wildlife, plant, and human communities by maintaining, enhancing, or restoring ecologically diverse networks of healthy wildlife populations and habitat" (Nankervis and Hindelang

2014). Similar to the IRMP, the WSP has incorporated many goals aiming to increase coordination with groups and departments to manage AIS in the region, continue inventory and monitoring of lakes, streams and ponds for new populations of AIS, continue monitoring and control of expanding populations of AIS, and most importantly, promote and support native plants and wildlife in the community (Nankervis and Hindelang 2014).

This AISAMP is written in conjunction with the IRMP and WSP which will serve as a guide for the effective management of aquatic invasive species in the Keweenaw Bay Indian Community for future generations.

To date, KBIC has managed and controlled four invasive plant species on Reservation lands: purple loosestrife, Japanese barberry, spotted knapweed, and Eurasian watermilfoil. Active control as well as locating and mapping locations of invasive plants for future control has been a high priority for plant program staff. KBIC NRD prefers to use manual, mechanical and biological control whenever possible. Chemical control is only used when other control methods have not been successful. Historical aquatic invasive species data collection can be viewed in Appendix B.

Similarly, the KBIC NRD is already making strong efforts in monitoring and managing AIS. These efforts have included (but are not limited to) sea lamprey control, fish forage base and diet work, and documentation of by-caught AIS. This plan is intended to build on the KBIC NRD's existing work.

KBIC is also working in collaboration with a number of groups and agencies on invasive control efforts and native seed collection and propagation, including Great Lakes Indian Fish and Wildlife Commission (GLIFWC), US Forest Service (USFS), Midwest Invasive Plant Network, Baraga County Conservation District, and others.

This AISAMP is aligned with the KBIC Subsistence Resources Fisheries Goal Statement: "To maintain and perpetuate comprehensive, pro-active and, when warranted, responsive fisheries stocking, research, conservation, and management activities for local and regional fisheries."

> *DESCRIPTION OF SUBSISTENCE FISHERIES RESOURCE: Our traditional territory is composed of several hundred inland lakes and thousands of miles of rivers, streams, and creeks. The area is also adjacent to Lake Superior and encompasses hundreds of miles of coastal and shoreline habitats. KBIC licenses approximately 20 tribal members to commercially fish Lake Superior, with a typical annual fish extraction of approximately 200,000 pounds. In addition, over 700 Tribal members are annually licensed to harvest fish through subsistence and sport fishing avenues in the western Upper Peninsula.*
>
> *Focal native fisheries management species for KBIC include (but are not limited to) brook trout, lake trout, lake whitefish, cisco (a.k.a. lake herring), lake sturgeon and walleye. Hosts of additional species are considered in many aspects of KBIC fisheries management, with many non-native species recognized as important components of regional fisheries dynamics. KBIC utilizes its Natural Resources Department to manage both cold water and cool water aquaculture operations. Focal species for fish production include brook trout (both stream and coaster strain varieties), lake trout and walleye.*

KBIC NRD has utilized standardized fisheries survey procedures to provide appropriate fishery recommendations to KBIC Leadership. These efforts are supported by the Great Lakes Fishery Commission, Great Lakes Indian Fish and Wildlife Commission, U.S. Fish and Wildlife Service, Ottawa National Forest, and Michigan Department of Natural Resources. Major objectives for standardized surveys include assessing and monitoring extraction response to commercially valuable fish species (lake trout and lake whitefish, cisco, etc.), evaluating fish stocking success as evidenced by marked hatchery fish survival and contribution to collected data-sets, monitoring and assessing abundance of ecologically and culturally important species such as the imperiled lake sturgeon, stream habitat and biota monitoring, etc. (KBIC 2002).

1.3 Geographic Reference Area

KBIC is a signatory to the Treaty of 1842 and the Treaty of 1854. The Treaty of 1854 established Reservation land bases which include the L'Anse and Ontonagon Indian Reservations. The primary land base is the L'Anse Indian Reservation, located in the western Upper Peninsula of Michigan along the shores of the Keweenaw Bay of Lake Superior (Figure 1).

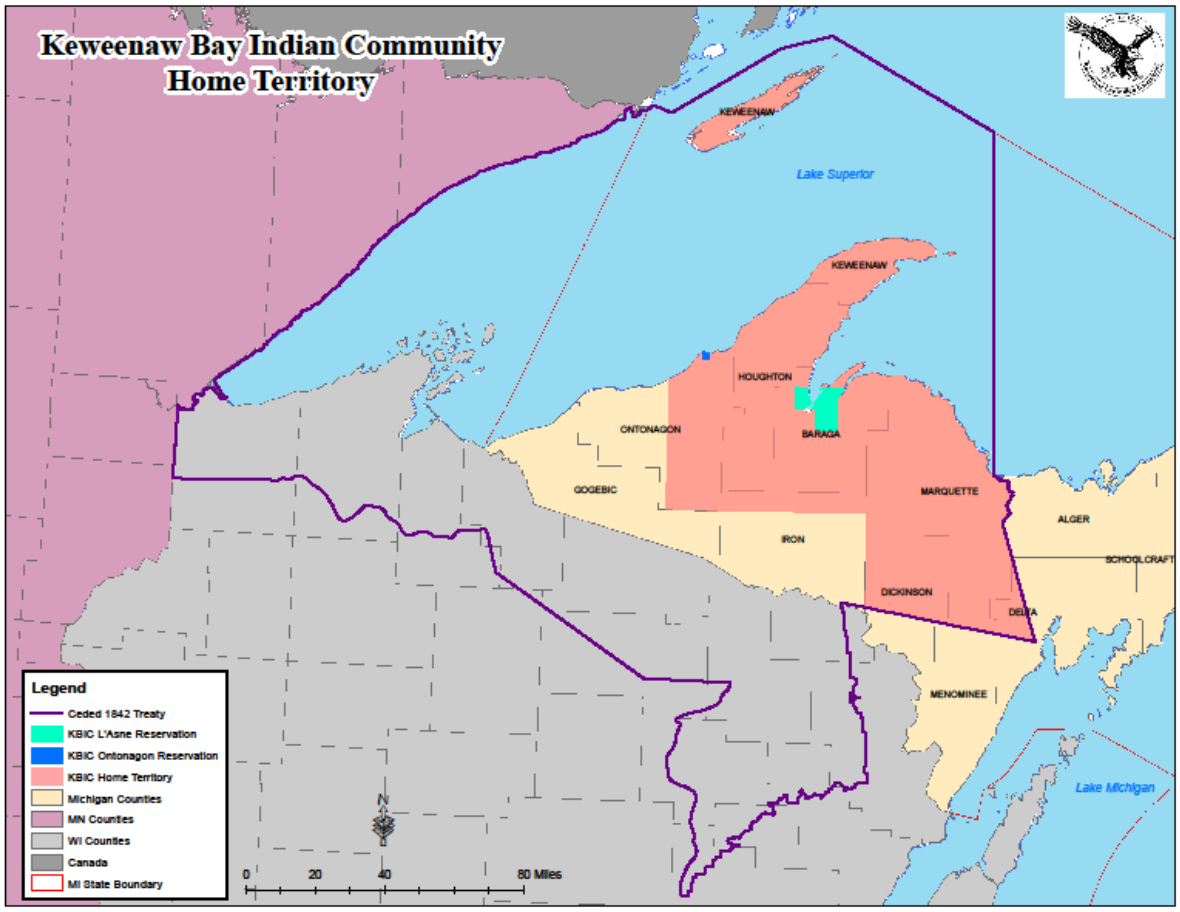

Figure 1. Keweenaw Bay Indian Community and 1842 Ceded Territory.

The L'Anse Indian Reservation consists of approximately 75,000 acres, 54,000 of which are land, and 21,000 of which is Lake Superior. There are approximately 19 miles of Lake Superior shoreline, 3,000 acres of wetlands, 120 acres of inland lakes, and 80 miles of rivers within five watersheds that are either wholly or partially within the L'Anse Reservation boundaries. The Village of Baraga and community of Zeba both lie entirely within the Reservation boundaries, while the Village of L'Anse lies partially within the Reservation.

The Ontonagon Indian Reservation is located in Ontonagon County along the Lake Superior shoreline, is approximately 3,000 acres in size, has about 2 miles of Lake Superior shoreline, and includes three watersheds partially within Reservation boundaries. KBIC also administers approximately 200 acres of land holdings and housing in Marquette County. The L'Anse Indian Reservation and the Ontonagon Reservation exterior boundaries are formally recognized by the Bureau of Indian Affairs (BIA).

The KBIC Home Territory (shown in peach in Figure 1) encompasses all of Houghton, Keweenaw, Baraga and Marquette counties and portions of Ontonagon, Iron, Dickinson, Delta and Menominee counties. It also includes the waters and islands of Lake Superior as described in the Treaty of 1842. The Home Territory is the traditional hunting, fishing, and gathering grounds that historically were observed out of respect for other Lake Superior Chippewa bands during lean times. KBIC continues to observe Home Territory out of respect to other Bands and their management of resources close to their reservations.

Ceded territories covering the western Upper Peninsula of Michigan and northern portions of Wisconsin and Minnesota were defined by the Treaties of 1842 and 1854. KBIC retains hunting, fishing, gathering, and other usufructuary rights within these ceded territories, and tribal members and government staff exercise these rights for subsistence, spiritual, cultural, management, and recreational purposes.

While the above sections define land boundaries, emphasis of the AISAMP is on the aquatic resources of the KBIC; more specifically Lake Superior and its tributaries (Figure 2). The quality of Lake Superior is of utmost importance and AIS are considered to be a top threat to that resource.

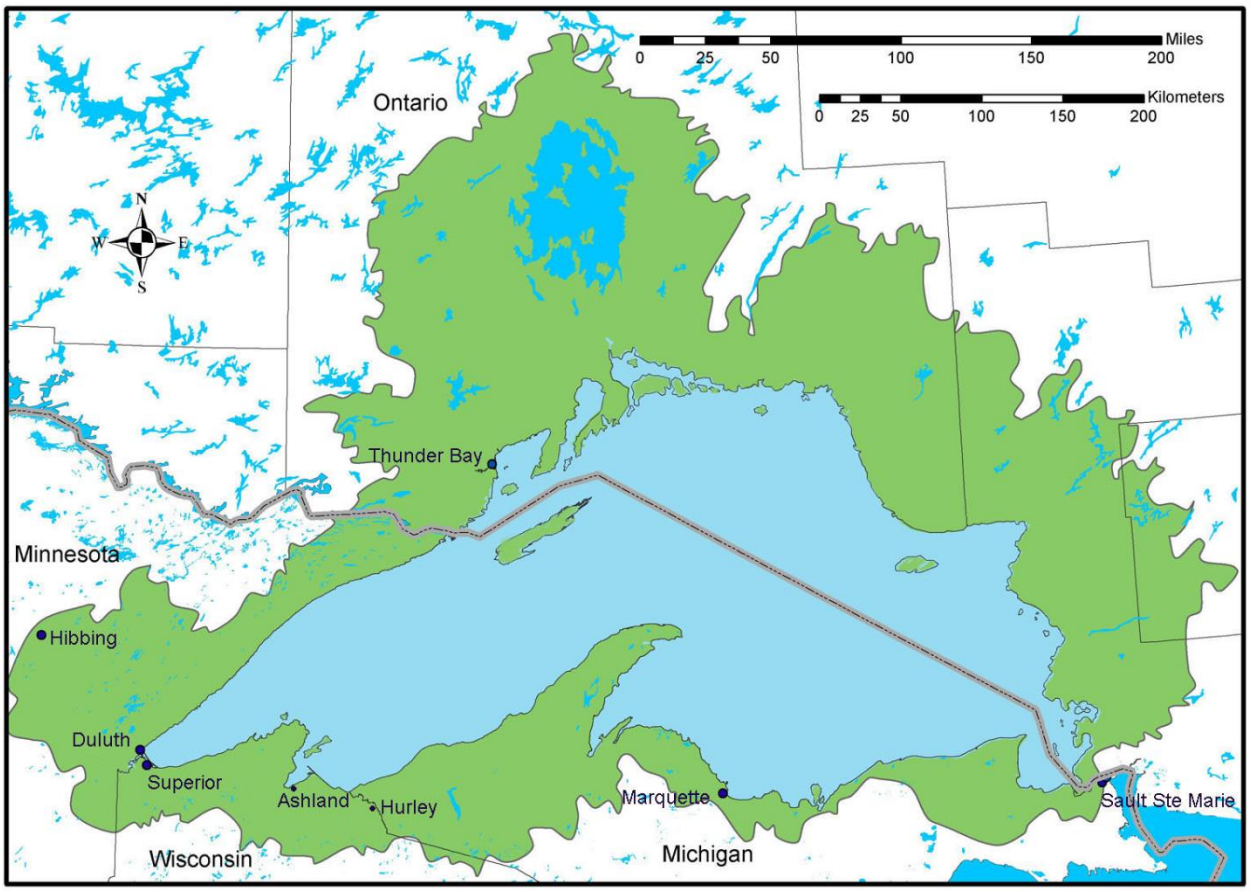

Figure 2. Lake Superior Drainage Basin. Photo credit: capacitycenter.org

2.0 Authorities and Enforcement

The primary purpose of this plan is to guide efforts to prevent the introduction, to reduce the spread, and to promote appropriate management of aquatic invasive species populations. Because invasive species disperse widely across the landscape and administrative boundaries, it is advantageous to work cooperatively towards management and control objectives. In addition, the number of new exotics being introduced into local ecosystems continues to out-pace control activities and is too much for any one agency to manage alone. This plan is designed with consideration of tribal, federal, state, regional, and local authorities and laws to focus on minimizing the negative impacts caused by invasive species to natural ecosystems and native plants and animals (including humans). Many invasive species plans are currently in place or being developed at the national, tribal, state, regional, and local levels and this plan is intended to work in conjunction with other plans and cooperating agencies.

All recommendations for monitoring and actions within this plan will carefully and conscientiously protect species and lands of sacred and cultural significance to KBIC and will follow guidelines in place for the Protection of Indian Sacred Sites, Traditional Cultural Landscapes, National Historic Preservation Act Section 106, the Office of Native American Affairs (ONAA), Advisory Council on Historic Preservation's (ACHP's) Native American initiatives, as well as the Memorandum of Understanding

Regarding Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites with the Departments of Defense, the Interior, Agriculture, and Energy and the Advisory Council on Historic Preservation to improve the protection of and tribal access to Indian sacred sites through enhanced and improved interdepartmental coordination and collaboration.

Tribal – This AISAMP is developed in compliance with all relevant KBIC tribal documents, plans, and goals, with foremost consideration of the KBIC NRD Environmental Quality Water Resources – Surface Water Goal Statement: "To ensure that all Reservation surface waters are fishable, swimmable, and drinkable in accordance with the USEPA Clean Water Act and Tribal Water Quality Standards, and to protect the quality and quantity of groundwater resources for tribal members." Surface waters for which KBIC intends to establish water quality standards include all waters within the Reservation boundaries which consist of approximately 80 miles of streams and rivers, 49 miles of intermittent streams, 164 small lakes and ponds totaling approximately 259 surface acres, and approximately 3000 acres of wetlands (KBIC 2002).

National Historic Preservation Act Section 106 process requires consultation with Indian tribes to ensure historic properties that may be of religious and cultural significance to them are both identified and appropriately considered in the Section 106 review process. In fact, the Section 106 regulations at Section 800.4(c) (1) acknowledge the special expertise of Indian tribes in assessing the eligibility of historic properties that may be of religious and cultural significance to them.

Additional relevant documents include:

Protecting Historic Properties: http://www.achp.gov/docs/CitizenGuide.pdf
United Nations Declaration on Rights of Indigenous Peoples: http://www.achp.gov/UNdeclaration.html
The Protection of Indian Sacred Sites: http://www.achp.gov/sacredsiteprotection.html
Traditional Cultural Landscapes: http://www.achp.gov/na_culturallandscapes.html
Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites: http://www.achp.gov/docs/SacredSites-MOU_121205.pdf

GLIFWC – The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) is an organization exercising delegated authority from 11 federally recognized tribes in Minnesota, Wisconsin, and Michigan, including KBIC. These tribes retain hunting, fishing, and gathering rights in the territories ceded to the United States through various treaties. Healthy aquatic plant and animal communities provide a foundation for the exercise of treaty rights by providing food and habitat for culturally important game species, as well as subsistence foods and medicines for tribal members. Non-native invasive aquatic plants and animals threaten the health of native ecosystems and the resources harvested and utilized by tribal members by altering aquatic ecosystems and adversely affecting native species. Since the early 1800s, at least 162 species of fish, plants, invertebrates, algae, and pathogens have been introduced into the riparian and aquatic habitats of the Great Lakes. Many of these organisms have since invaded inland lakes and rivers in the Ceded Territory, and others are now poised to do so (GLIFWC 2014b).

Much of GLIFWC's work on aquatic invasive species education and outreach as well as prevention and control efforts is a result of funding from cooperating agencies including: Bureau of Indian Affairs

(BIA)—Noxious Weed Program; Annual funding from the BIA's Noxious Weed Program provides a foundation for GLIFWC to develop new partnerships and bring additional resources to bear on noxious weed management within the treaty ceded territories; Environmental Protection Agency (EPA)— Great Lakes National Program Office (GLNPO); and Administration for Native Americans (ANA). Funding from ANA has enabled GLIFWC to build its capacity to inventory and track the distribution and abundance of AIS in the treaty ceded territories, and implement educational outreach activities. GLIFWC routinely shares information and coordinates management activities with several cooperating agencies and organizations including: Great Lakes Indian Fish & Wildlife Commission member tribes; Invasive Plant Association of Wisconsin; Michigan Department of Natural Resources; Minnesota Department of Agriculture; Minnesota Department of Natural Resources; Sea Grant; The Nature Conservancy; USDA–Natural Resources Conservation Service; USDA–Forest Service and professional consultants.

Federal – The Aquatic Nuisance Species (ANS) Task Force was created by the passage of the federal *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990* (NANPCA). The Task Force has since served as an oversight organization, coordinating national ANS activities and implementing NANPCA. The NANPCA mandates were expanded with the passage of the *National Invasive Species Act* (NISA) in 1996. The ANS Task Force is chaired by the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration, and consists of 7 federal agency representatives and 11 ex officio members. Task Force committees focus on a variety of broad issues, including risk assessment and management, monitoring, research protocol and coordination, communication, education, and outreach. The following are brief descriptions of a few Federal laws enacted to improve the prevention and response of aquatic invasive species.

Federal Laws

The *Lacey Act of 1900* states that the Secretary of the Interior is authorized to regulate the importation and transport of species, including offspring and eggs, determined to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the US (USFWS 2004).

Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 was created to prevent and control infestations of the coastal inland waters of the United States by the zebra mussel and other nonindigenous aquatic nuisance species (US Congress 1990).

National Invasive Species Act of 1996 (NISA) is the U.S. federal bill to reauthorize and expand the 1990 federal nonindigenous species legislation. A key element of the legislation is that it provides for ballast water management to prevent the introduction and further spread of nonindigenous species in U.S. waters (US Congress 1996).

Part of the *Water Resources Development Act* states that "the Great Lakes navigation system has been instrumental in the spread of sea lamprey and the associated impacts on its fisher; and…control of sea lamprey at any Great Lakes basin location is appropriate" (US Congress 1999).

The *Great Lakes Fish and Wildlife Restoration Act of 2006* aims to amend the *Great Lakes Fish and Wildlife Restoration Act of 1990* in order to protect and effectively manage the fish and wildlife resources, and the habitats of which the resources depend, in the Great Lakes Basin (US Congress 2006).

Regional – Regional ANS panels also exist throughout the country, and their role, as established by Congress, is to advise and support the federal ANS Task Force in carrying out its responsibilities in their region. The coordinators of each panel report to the Task Force. Michigan is represented on the Great Lakes Panel on ANS where working on a regional level brings in expertise from a number of states and has led to numerous regional and even national collaborative projects, ranging from publication development to full-scale outreach and control initiatives (GLIN 2012).

The ANS Task Force also supports implementation of ANS prevention and control strategies at the state level. States submit management plans, and if approved by the Task Force, the states then receive federal funding for ANS activities.

State – Michigan AIS Program Overview: The effects of AIS in the State of Michigan are vast and complicated - something that cannot be managed alone by one agency. In the Great Lakes Region, the Michigan Departments of Environmental Quality (MDEQ), Natural Resources (MDNR), and Agriculture and Rural Development (MDARD) are working together as a unified AIS Core Team to address AIS issues that range from prevention, monitoring, inspection, and control. The AIS Core Team demonstrates a commitment to coordinating the implementation of Michigan's AIS State Management Plan and continues to gain momentum in the battle of AIS within the Great Lakes Region.

The State of Michigan recently updated its *Aquatic Invasive Species State Management Plan* (2013), which is a cooperative effort of the MDEQ, MDNR, MDOT, and MDARD. This comprehensive plan outlines new actions for implementation as well as maintaining and enhancing existing efforts to prevent the introduction of new AIS, prevent the dispersal of AIS, detect and respond to new invaders, and minimize the harmful effects of AIS in Michigan waters.

Similar to Michigan, Wisconsin has many state government agencies that help manage the effects of AIS. Some of these agencies include: Wisconsin Department of Natural Resources (WDNR), Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP), Wisconsin Department of Transportation (WisDOT). Together these agencies have developed *Wisconsin's Comprehensive Management Plan To Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species.*

Local – A number of local, county, and municipal noxious weed ordinances and laws also exist throughout the state. Outside of state

The United States Environmental Protection Agency (USEPA) defines ***Integrated Pest Management*** *as: an effective and environmentally sensitive approach to pest management that relies on a combination of commonsense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interactions with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. IPM programs take advantage of all pest management options possibly including, but not limited to, the judicious use of pesticides* (USEPA 2014).

agencies, there is significant effort being exerted by local and private partners in Michigan to manage AIS in various targeted efforts. The Michigan Invasive Species Coalition (MISC) seeks to facilitate cooperation and information sharing among various groups. MISC addresses both terrestrial and aquatic invasive species. Stewardship Network Clusters and Cooperative Weed Management Areas (as described in next section) are very active in many areas of the state and serve a critical role not only in the management and control of AIS, but also in AIS prevention.

In summer 2014, Keweenaw Bay Indian Community Natural Resources Department received funding through the United States Forest Service (USFS) to hire an Aquatic Invasive Species Educator/Boat Washer to assist with efforts to address AIS in local waters on the home territories. This position provides boat washing services and education opportunities to boat owners and fishers on the importance of helping prevent the spread of aquatic invasive species.

3.0 Programs

The agencies and organizations listed in this section are just a few of the programs that have a keen interest in preventing, monitoring, controlling and educating others about invasive species. Each of these groups listed below follows the approach of Integrated Pest Management (IPM) (see sidebar).

The programs described below range from tribal groups, to federal and state government agencies, to regional and county organizations, and to local and college groups. While each of these programs provides information about preventing, monitoring, controlling and educating others about *all* types of invasive species, the following descriptions are focused mainly on their efforts with aquatic invasive species (AIS).

KBIC – The Keweenaw Bay Indian Community's Natural Resource Department (KBIC NRD) is dedicated to preventing, monitoring, controlling and educating others about invasive species. The KBIC NRD biologists and technicians collect spatial data regarding the locations and densities of observed invasive species. An example of this AIS data collection can be seen in Appendix B.

KBIC NRD biologists and technicians work in cooperation with other organizations such as GLIFWC, USFS, USFWS, and county Conservation Districts to control threatening invasive species, and collect native seeds for future propagation.

As mentioned previously, the KBIC NRD has already begun monitoring and managing AIS. Examples include sea lamprey control, fish forage base and diet work, and documenting observed AIS. It should be noted that the KBIC NRD prefers the use of manual, mechanical and biological control methods over the use of chemicals. This Aquatic Invasive Species Adaptive Management Plan will help the KBIC NRD continue with current AIS efforts and develop goals for the prevention, monitoring, and control of aquatic invasive species in the 1842 Ceded Territory. The KBIC partners and cooperates with many of the organizations described in the following paragraphs.

GLIFWC – The Great Lakes Indian Fish & Wildlife Commission (GLIFWC) was formed in 1984, and comprises eleven Ojibwe tribes in Michigan, Wisconsin and Minnesota (GLIFWC 2014a). These tribes include: Mille Lacs (Misi-zaaga'iganiing), Danbury (Bikoganoogan St. Croix), Bad River (Mashkiigong-

ziibiing), Lac du Flambeau (Waaswaaganing), Mole Lake/Sokaogon (Zaka'aaganing), Fond du Lac (Nagaajiwanaang), Red Cliff (Gaa-miskwaabikaang), Bay Mills (Ginoozhekaaning), Lac Vieux Desert (Gete-gitigaaning), Lac Courte Oreilles (Odaawaa-zaaga'iganiing) and Keweenaw Bay (Gakiiwe 'onaning). These tribes are located across four ceded territories (1836, 1837, 1842 and 1854 treaties) for which GLIFWC provides natural resource expertise, conservation enforcement, legal and policy analysis, and public information services. Because of GLIFWC's connection with the tribes of these northern states, they are aware of and have experience with the detrimental impacts aquatic invasive species can have on native species, such as wild rice, lake trout, whitefish and herring, which are significant to the tribes' culture.

GLIFWC biologists monitor the ceded territories in a variety of ways. In search of aquatic invasive plant species, biologists conduct shoreline and littoral zone surveys via boats. In larger lakes, select spots are chosen based on their likelihood or probability of infestation. For invasive invertebrates, varieties of plankton tows are used to look for zebra mussel veligers, spiny water fleas and fishhook water fleas. In search of sea lamprey, GLIFWC has worked in conjunction with the US Fish and Wildlife Service Sea Lamprey Control Station (USFWS-SLC) in Marquette, MI. These surveys are done in order to monitor the upstream spawning movements of sea lamprey, estimate the number of lamprey spawning in each tributary and to reduce the spawning potential of sea lamprey (Mattes 2012). Shoreline and wetland surveys are conducted on foot. All invasive species monitoring is collected in conjunction with spatial data. Once these data are collected, varieties of maps are created. Some monitoring sites are selected based on risk assessments and prioritization models.

GLIFWC has created a number of educational booklets, brochures and posters to inform the general public about important tribal topics. From information about treaty rights, to fisheries management, to wild rice, to aquatic invasive species, these media are essential to educating people about the importance of preventing and monitoring for invasive species. These educational materials are available in electronic form on their website, or as a hardcopy. Available on their website is an interactive mapping program for viewing where invasive species (among other species) are located. To find more information about GLIFWC, visit their website at www.glifwc.org.

One of the GLIFWC research projects in the Ceded Territories that has implications for AIS management is the *Manoomin* (Wild Rice) Enhancement Project. *Manoomin* has been a staple in the diet of native people in the upper Great Lakes region for over 1000 years. It has been an important component of the diet and the culture of the Ojibwe people since their migration from the eastern seaboard into the heart of wild rice range at the west end of Lake Superior. With the arrival of Europeans, wild rice also became an important economic commodity, providing critical nutrition to the fur-trappers and traders moving into the area. Today, *manoomin* retains extraordinary significance to the Ojibwe, and is considered sacred food. The August moon is still referred to as *Manoominike Giizis* (the Rice Making Moon), and the harvest season is celebrated with traditional pow-wows. In addition to its value to Native Americans, wild rice provides a valuable food source for wildlife, and its presence increases the biological diversity of wetlands. Stands of wild rice offer important structural habitats to aquatic invertebrates and fishes. *Manoomin* can also improve water quality by tying up nutrients and by decreasing the wind action across lakes that can suspend sediment particles and lead to water clarity and quality problems. Unfortunately, wild rice is much less abundant than it was historically. The reaffirmation of off-reservation treaty rights has restored the tribes' opportunity to cooperatively manage wild rice in the ceded territories. The general

objective for the Enhancement Project is to increase the amount of wild rice in the ceded territories through the reestablishment of historic beds, the development of new beds, and monitoring for negative impacts from AIS such as displacement and degradation of water quality (David 2013).

USFWS – The United States Fish and Wildlife Service (USFWS) is an agency within the Federal Government's Department of the Interior. Within the US Fish and Wildlife Service, the Office of the Native American Liaison was created to focus on areas where federal and tribal conservation efforts intersect. *The Native American Policy of the U.S. Fish and Wildlife Service* states that "The [U.S. Fish and Wildlife] Service will work directly with Native American governments and observe legislative mandates, trust responsibilities and respect Native American cultural values when planning and implementing programs" (USFWS 1994). For more information about the Office of Native American Liaisons, visit www.fws.gov/nativeamerican.

The Branch of Aquatic Invasive Species, which is part of the USFWS's Fisheries Program, leads the Aquatic Invasive Species Program. This program, organized into regions, works with the public and private sector to develop and implement invasive species projects. The AIS Program uses a hazard analysis and critical control point management tool to identify high risk pathways of AIS introductions (USFWS 2013a). They are also a fundamental part of the 100th Meridian Initiative (http://www.100thmeridian.org), which strives to prevent the westward spread of zebra mussels and other AIS by boats and other watercraft. The Program not only participates in preventing AIS, but conducts early detection and rapid response searches. This proactive monitoring allows for prompt responses to new invasions before they become established. One way they are doing this is by collecting samples from the Great Lakes and testing the environmental DNA (eDNA). Analyzing these samples for eDNA confirms the presence of organisms (such as AIS) that may otherwise be overlooked in traditional surveying methods. The AIS Program provides outreach and awareness by developing informational websites, conducting workshops, creating pamphlets, AIS identification cards, and videos. For more information about the USFWS's AIS Program, visit www.fws.gov/fisheries/ANS.

The nearest USFWS station is located in Marquette, Michigan. This Biological Station works largely in monitoring for the aquatic invasive sea lamprey. Their work involves assessing presence, distribution, abundance and size structure of sea lampreys in Great Lakes tributaries. These efforts include: trapping and netting lamprey, maintaining sea lamprey barriers, and chemically controlling lamprey populations. The Biological Station provides educational outreach by involving volunteers in their lamprey monitoring. For more information about the Marquette Biological Station and their efforts with sea lampreys, visit www.fws.gov/midwest/marquette.

USFS – The United States Forest Service (USFS) is an agency within the Federal Government's Department of Agriculture (USDA). The Forest Service is dedicated "to achieve quality land management under the sustainable multiple-use management concept to meet the diverse needs of people" (USDA 2014b). The USFS achieves these goals by encouraging landowners to practice good stewardship, develop and provide scientific knowledge to protect, manage our lands, and advocate a conservation ethic in promoting the health, productivity, diversity and beauty of forests and associated lands (USDA 2014a).

Within the US Forest Service is the Office of Tribal Relations (OTR). The OTR provides oversight of Forest Service programs and policy that may affect Tribes, prepares and implements new and existing

policy and direction outlining the legal requirements existing to Tribes, clarifies the Agency's responsibilities regarding Tribal trust and reserved rights, and develops and supports education and training for employees of the Forest Service, helping them work more effectively with tribal governments and other partners (USDA 2013). For more information about the Office of Tribal Relations, visit www.fs.fed.us/spf/tribalrelations.

The USFS has implemented an Invasive Species Program which strives to "reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of invasive species across all landscapes and ownerships" (USDA 2014b). They are working in conjunction with Wildlife Forever, a national non-profit conservation branch of the North American Hunting Club and North American Fishing Club, to educate the hunting and fishing community and encourage their efforts to prevent the spread of AIS, report new finds, and help eradicate AIS (USDA 2014a). The USFS Invasive Species Program's website has many educational materials including: maps of current invasive species infestations, videos, flyers, reports and links to helpful resources. For more information about the USFS Invasive Species Program, visit www.fs.fed.us/invasivespecies.

MDNR – The Michigan Department of Natural Resources (MDNR) plays a significant role in preventing, monitoring, controlling and providing outreach on aquatic invasive species. Equipped with four offices in the Ceded Territory, many staff, and volunteers, the MDNR is effective in preventing and monitoring for aquatic invasive species. To prevent further spread of AIS, the MDNR conducts early detection surveys, assigns and staffs boat washes at landings, collects and analyzes samples for AIS eDNA, and works with the Michigan Department of Environmental Quality to ensure boats and other vessels are abiding by the Code of Best Management Practices for Ballast Water Management.

With a large part of the Ceded Territory located in Michigan, monitoring efforts for AIS is crucial. The MDNR has taken strong efforts to manage and control AIS populations in the state. By assessing the current and potential abundance and distribution of the AIS, they determine which control technique is best suited to the location and species. As part of these assessments, the MDNR also includes restoration treatments as part of their management goals. This helps safeguard against future invasions and/or mitigate effects from the current situation (MDEQ et al 2013). As part of their educational outreach, the MDNR engages volunteers, landowners and partner groups. They also have available many maps, brochures, identification cards, videos and workshops. To find more about the MDNR's efforts with AIS, visit www.michigan.gov/invasivespecies.

WDNR – The Wisconsin Department of Natural Resources (WDNR) also plays a major role in preventing, monitoring, controlling and providing outreach on aquatic invasive species. Similar to the MDNR, the WDNR is well-furnished with local offices, staff, and volunteers within the Ceded Territory. WDNR biologists contribute efforts to prevent AIS introductions by purchasing and staffing boat washes at landings, conducting early detection surveys, installing signage at boat landings, and leading events like the 2014 Landing Blitz, which encourages boaters and riparian owners to prevent the spread of AIS.

WDNR biologists depend on citizen volunteers to help collect AIS data, and support their efforts in monitoring lakes, streams and the Great Lakes basin. WDNR biologists are also part of a multi-year statewide baseline monitoring effort to collect previously unknown data about lakes across the state. This effort will help establish Wisconsin AIS distribution information, and help track the rate of AIS spread

across the state (WDNR 2014) As part of their educational outreach, the WDNR interacts with volunteers, landowners, and partner groups. They also help educate bait dealers, informing them about AIS and state laws and regulations. They also have available many maps, brochures, identification cards, videos and workshops. To find more about the WDNR's efforts, visit http://dnr.wi.gov/topic/invasives.

KISMA – The Keweenaw Invasive Species Management Area (KISMA) is a Cooperative Weed Management Area, CWMA* that was developed in March, 2011. Its geographic area consists of Houghton, Keweenaw and Baraga Counties in Michigan. KISMA's mission statement is as follows: The Keweenaw Invasive Species Management Area's mission is to facilitate cooperation and education among federal, state, tribal, and local groups and landowners in prevention and management of invasive species across land ownership boundaries within Baraga, Houghton, and Keweenaw Counties (KISMA 2014).

Because of KISMA's partnership with many organizations, monitoring for aquatic invasive species is conducted by a variety of helpers. Much of KISMA's monitoring involves on-the-ground field work—surveying infested areas or suspected AIS areas and manually or chemically controlling the AIS. Volunteer and citizen efforts help identify, monitor, and control AIS infestations.

KISMA provides numerous resources on their website. Reports of previous year's accomplishments and work completed are provided. Flyers, brochures, and maps are available for downloading and reviewing. KISMA also offers workshops which involve the public in learning more about the native and non-native species in their area. For more information about KISMA, visit their website at www.kisma.org.

WePIC – The Western Peninsula Invasive Coalition (WePIC) is a CWMA[1] that started in 2006 and covers 2.6 million acres, and includes 700 lakes, and 150 public access points. Its geographic extent consists of Gogebic, Iron and Ontonagon Counties and the Ottawa National Forest. WePIC's mission statement is as follows: The Western Peninsula Invasives Coalition's mission is to facilitate cooperation and education among federal, state, tribal, and local groups and landowners in prevention and management of invasive species across land ownership boundaries within Gogebic, Iron, and Ontonagon Counties and additional areas within the Ottawa National Forest (WePIC 2014).

WePIC has dedicated efforts to preventing AIS from infesting their relatively non-invaded local ecosystems. These efforts include: creating AIS signage for boat landings, designing and distributing AIS identification flyers/brochures, posting billboards on frequently-used roads, purchasing and staffing pressure washers to clean boats and landings, and conducting surveys on lakes in search of new AIS infestations. Their efforts also including monitoring and controlling already established populations of AIS. Examples of this are: chemical treatments of AIS species, monitoring biological control on AIS populations, and collecting spatial data regarding AIS areas and densities. Volunteer and citizen efforts help identify, monitor, and control AIS infestations. Educational resources provided by WePIC include

*A Cooperative Weed Management Area (CWMA) is a local organization that brings together landowners and land managers to coordinate action and share expertise and resources to manage common weed species. CWMAs often function under the authority of a mutually developed Memorandum of Understanding and are governed by a steering committee. Together, CWMA partners develop a comprehensive weed management plan for their area. At the least, CWMA plans include survey and mapping components as well as plans for integrated weed management. The three CWMAs located nearest the Keweenaw Bay Indian Community are: KISMA, WePIC, and WRISC. Other CWMAs found within the 1842 Ceded Territory include: Northwoods CWMA (Ashland, Bayfield, Douglas and Iron Counties, WI), Wisconsin Headwaters Invasives Partnership (Vilas and Oneida County, WI), and Central UP CWMA (Marquette, Alger, Delta and Schoolcraft, MI).

detailed maps of AIS present in the area, flyers, brochures, billboards, yearly reports, and links to helpful resources. For more information about WePIC, visit their website at www.wepic.org.

WRISC – The Wild Rivers Invasive Species Coalition (WRISC) is a CWMA that was created in 2010. Its geographic region consists of Florence, Forest, and Marinette Counties in Wisconsin, and Dickinson, and Menominee Counties in Michigan. WRISC's mission statement is as follows: The Wild Rivers Invasive Species Coalition (WRISC) is a multi-partner organization representing five counties and two states. WRISC is dedicated to the management of invasive species on our lands and waters through cooperation, education, prevention and control (WRISC 2011).

WRISC has a dedicated monitoring team that collects spatial data of AIS throughout the area. Much of WRISC's monitoring involves on-the-ground field work—surveying infested areas or suspected AIS areas and manually or chemically controlling the AIS. Volunteer and citizen efforts help identify, monitor, and control AIS infestations. WRISC provides educational resources, including: maps of AIS present by county, brochures, reports, and links to helpful resources. For more information about WRISC, visit their website at www.wrisc.org.

County-Based AIS Coordinators – County-based AIS Coordinators are responsible for developing partnerships, and creating and implementing countywide plans to prevent and control the spread of aquatic invasive species. The County-Based AIS Coordinator generally sits on the county's Land and Water Conservation Department (or version thereof) board and works with a variety of professionals to meet the county's AIS goals. To find Wisconsin counties' AIS Coordinators, visit http://dnr.wi.gov/lakes/contacts. For Michigan AIS Coordinators, visit https://www.michigan.gov/documents/dnr/Invasive_Species_Contact_Table_411161_7.pdf.

Conservation Districts (Michigan) – The Michigan Association of Conservation Districts comprises 78 Conservation Districts (CD). Their goal is to take an ecosystem approach to conservation and protection. Organized geographically by county, they work in partnership with other conservationists to set local priorities, develop action plans and solve natural resource problems.

Sea Grant (Michigan and Wisconsin) – The Sea Grant is partnership between universities and the Federal Government's National Oceanic and Atmospheric Administration (NOAA). With 33 programs based at universities in every coastal and Great Lakes state, Puerto Rico, and Guam, the Sea Grant program aims to prevent new introductions of AIS, develop ways to control spread of AIS, evaluate the effects of AIS, and educate the public on impacts from AIS. In short, each Sea Grant program has three components: research, education and outreach.

The Michigan Sea Grant program is based out of the University of Michigan and Michigan State University. Because Michigan is surrounded by four of the five Great Lakes, Michigan Sea Grant is dedicated to the protection and sustainable use of the Great Lakes and coastal resources (MI Sea Grant 2014a). Some research project topics completed by the Michigan Sea Grant program include: zebra mussels and why they attach so tightly to hard surfaces, ID of diseases in zebra mussels, how the round goby was able to spread so rapidly throughout the Great Lakes, understanding the influence of zebra mussels on toxic cyanobacterial blooms, the economic and policy options for controlling the introduction

and spread of AIS in the Great Lakes, and the potential economic damage of ruffe in the Great Lakes, to name a few (MI Sea Grant 2014b).

The Wisconsin Sea Grant program is based out of the University of Wisconsin-Madison. Wisconsin Sea Grant's missions statement is stated as, "UW Sea Grant supports scientific research, education and outreach to foster the wise use, conservation and sustainable development of Great Lakes and coastal resources…" (WI Sea Grant 2013b). Research project topics the Wisconsin Sea Grant programs include: round gobies' effect on Great Lakes streams, ballast water and harboring AIS, changes in Great Lakes fisheries, and the role of quagga mussels in regulating organic carbon (WI Sea Grant 2013a).

Education is a central focus for all Sea Grant programs. In both Michigan and Wisconsin Sea Grant programs, educational outreach is made by hosting camps and workshops, communication with anglers, creating publications and online resources, and taking a focus on helping educators by creating ready-to-use lessons and methods that support students to learn about science and aquatic invasive species.

Extension Services (Michigan and Wisconsin) – Extension services are part of a university and work in cooperation with other university systems, counties, tribal governments and other public and private organizations.

The Michigan State University-Extension (MSUE) partners with volunteer organizations on preventing the introduction of new species, developing rapid response programs, controlling the spread of established species, and mitigating invasive species' ecological and socioeconomic impacts (MSU 2014). The Michigan State University-Extension is a principal partner of the Michigan Inland Lakes Partnership, which aims to support efforts to research, monitor, evaluate and regulate ecosystem impact sources, such as AIS. MSUE is also responsible for generating and maintaining the Michigan Natural Features Inventory. This inventory is a statewide biological database for rare plants and animals, exemplary natural communities, and other significant natural features. This collection of biological information helps land and water managers know where populations of endangered, threatened or special concern species are and consider the effects invasive species may have on them.

Similarly, the University of Wisconsin-Extension (UWEX) aims to prevent the introduction of new invasive species, contain the spread of invasives already established in the state, and control these established populations when possible (UW-Madison 2011). The University of Wisconsin-Extension is a primary partner in supporting educational materials for the Wisconsin Lakes Partnership, of which preventing, monitoring and controlling AIS is a large focus.

4.0 Aquatic Invasive Species

4.1 Definitions

The Great Lakes region is full of life and rich with native species well-adapted to survival. Since the early 1800s, however, many non-native plants, animals and microscopic organisms have been introduced into the Great Lakes, either accidentally or intentionally (MI Sea Grant 2014c). With its close ties to the Great Lakes, the KBIC has been affected by these intrusions.

Aquatic invasive species (AIS) (also referred to as nuisance or noxious) are aquatic organisms that invade ecosystems beyond their natural, historic range. Their presence may harm native ecosystems and the cultural, subsistence, commercial, agricultural, or recreational activities that depend upon the native community of species (USFWS 2013b).

There is a great variety in terms and definitions when it comes to AIS. The following are a few related terms and their definitions.

Native (or indigenous) species is defined as native to a given region or ecosystem if its presence in that region is the result of only natural processes, with no human intervention. Every natural organism has its own natural range of distribution in which it is regarded as native (US Legal 2014).

Non-native (or nonindigenous) species is defined as a species living outside its native distributional range, which has arrived by human activity, either deliberate or accidental. Non-native species can have various effects on the local ecosystem. Introduced species that have a negative effect on a local ecosystem are also known as invasive species. Not all non-native species are considered invasive. Some have no known negative effect and can, in fact, be beneficial (MBL 2013).

Invasive species is defined as a plant or animal that is not native to a specific location (an introduced species); and has a tendency to spread, which is believed to cause damage to the environment, human economy and/or human health (NISC 2006).

Noxious species is defined as a species that has been officially declared by a federal, state, tribal, or county government entity to be injurious to native ecosystems and wildlife habitats, cropland, and rangeland agriculture, and/or humans, livestock, and wildlife, and to be the target of recommended or mandatory management efforts (BIA 2014).

Naturalized species is defined as a process by which a non-native organism spreads into the wild and its reproduction is sufficient to maintain its population (UCANR 2014).

Desired (native and non-native) species are those species that are preferred and are used in a beneficial manner (cultural or subsistence significance) – to be determined by KBIC.

Undesired (native and non-native) species can be native or non-native, but are ultimately unwanted – to be determined by KBIC.

Among these terms, the major difference is between nonindigenous and invasive. A "nonindigenous" species is an organism (plant, animal, and microbe) found living beyond its historic native range, which is usually taken as the area where it evolved to its present form (NOAA). Executive Order 13112 of February 3, 1999, defined "alien" species as "any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not "native" to the particular ecosystem in which it is found. Thus, alien can be used interchangeably with nonindigenous (NOAA). The terms exotic and non-native are both synonyms for nonindigenous. So nonindigenous=alien=exotic=non-native (NOAA).

In general, invasive species can be algae, plants, animals, or microbes (i.e. disease) and can be aquatic (in the water) or terrestrial (on the land) living outside their native range. Non-native species may not always cause harm but many invasive species are more aggressive and quickly out-compete native species for space and resources, as they are free from natural predators, reproduce rapidly and aggressively compete with native species (KBIC NRD 2014).

The *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990* defines an aquatic nuisance species as "a nonindigenous species that threatens the diversity of abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquaculture or recreational activities dependent on such waters" (US Congress 1990). Similarly, Executive Order 13112 (1999) defined invasive species as an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Thus, invasive and nuisance species are synonymous and can be used interchangeably (NOAA).

An invasive species is also, by definition, nonindigenous, but not all nonindigenous species are considered invasive. For example, Coho, Chinook, and pink salmon are favored nonindigenous sport fish in the Great Lakes, and are not considered by many to be invasive or a nuisance (NOAA). These salmon could also be called alien or exotic with respect to the Great Lakes (NOAA). Salmon, rainbow trout, and brown trout were deliberately introduced and have invaded the habitat, food sources, and other parts of native fishes' environment and from this perspective can be considered invasive. The zebra mussel is an invasive (or nuisance) species, as well as nonindigenous (NOAA). As a result, an area once covered or occupied by native species can quickly become a monoculture of invasive species (KBIC 2014). Perspectives on whether a nonindigenous species is invasive can shift over time or be controversial among sports people, scientists and others. For example, the alewife, a nonindigenous fish that was first reported in the Great Lakes in 1973 was considered a costly nuisance species in the mid-20th century. Today, some consider alewife a valuable (but still nonindigenous) food source for salmon and lake trout, which support a multi-billion dollar sport fishery (NOAA). In contrast, some ecologists view the alewife as having had many detrimental effects on the environment such as competing for food sources, preying on native fish eggs, and possibly contributing to Early Mortality Syndrome (EMS) (see alewife factsheet).

4.2 AIS in the Target Area

An important step to an AISAMP is to know which AIS are already established and which AIS are on the horizon. Table 1 lists the aquatic invasive species known to be present within the KBIC 1842 Ceded Territory. A list of AIS on the horizon is available in the following section (4.3). For more detailed species accounts, refer to specific factsheets in Appendix A.

Table 1. Aquatic Invasive Species Present in the 1842 Ceded Territory.			
	Common Name (ONF Ranking)	**Scientific Name**	**Ojibwe Name**
Fish	Alewife	*Alosa pseudoharengus*	*Gitchigami giigoohn*
	Eurasian ruffe	*Gymnocephalus cernuus*	
	Rainbow smelt	*Osmerus mordax*	*Biijimaagazehns*
	Round goby	*Neogobius melanostomus*	
	Sea Lamprey	*Petromyzon marinus*	*Bimiizii*
	Threespine stickleback	*Gasterosteus aculeatus*	
Mollusks	Asian clam	*Corbicula fluminea*	
	Banded mystery snail	*Viviparus georgianus*	
	Chinese mystery snail	*Cipangopaludina chinensis*	
	Faucet snail	*Bithynia tentaculata*	
	Japanese mystery snail	*Cipangopaludina japonica*	
	Quagga mussel	*Dreissena bugensis*	
	Zebra mussel	*Dreissena polymorpha*	
Plants	Curly-leaf pondweed	*Potamogeton crispus*	
	Eurasian watermilfoil	*Myriophyllum spicatum*	
	Flowering rush	*Butomus umbellatus*	
	Narrow-leaved cattail	*Typha angustifolia*	
	Purple loosestrife	*Lythrum salicaria*	
	Reed mannagrass	*Glyceria maxima*	
	Yellow floating heart	*Nymphoides peltata*	
	Yellow iris	*Iris pseudocorus*	
Crustaceans	Rusty crayfish	*Orconectes rusticus*	
	Spiny water flea	*Bythotrephes longimanus*	
Pathogen	Viral Hemorrhagic Septicemia (VHS)	*Novirhabdovirus* sp.	

Various agencies map aquatic invasive species in the United States. Some of the agencies within the Ceded Territory include: GLIFWC, KISMA, MISN, USDA, and USGS. Appendix C is a table compilation of these agencies' mapped AIS distributions specific to the KBIC 1842 Ceded Territory. Also included in the appendix is data from a research study conducted by Dr. Charles Kerfoot et al (2011), which studied the presence/absence of the spiny water flea in Michigan's Upper Peninsula and northern Wisconsin. The table is a comprehensive, but not exhaustive list of AIS that that are currently established in the KBIC 1842 Ceded Territory. An "X" was placed where AIS have been documented in Lake Superior, the 1842 Ceded Territory, the KBIC Home Territory, the L'Anse Reservation, the Ontonagon Reservation, or if the AIS is considered "On the Horizon."

KBIC's proximity to Lake Superior and Lake Michigan poses a significant threat to the inland lakes and streams for new introductions of AIS. This AISAMP will implement best management strategies to help prevent new introductions, reduce the spread of, and educate stakeholders about injurious AIS.

Links are provided for reference because AIS inventories frequently change:

- Lake Superior AIS: http://www.seagrant.umn.edu/ais/superior_nonnatives

- GLIFWC AIS database and Global Invasive Species Information Network: http://invasives.glifwc.org/ais/ and also by species, county, state: http://gisin.glifwc.org/
- Keweenaw Invasive Species Management Area (KISMA) AIS: www.kisma.org and http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5426434.pdf
- Western Peninsula Invasives Coalition (WePIC) AIS: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5246593.pdf
- Midwest Invasive Species Information Network (MISIN): http://www.misin.msu.edu/
- USGS Nonindigenous Aquatic Species: http://nas.er.usgs.gov/

4.3 AIS on the Horizon

As indicated earlier, the number of aquatic invasive species found in the Great Lakes basin and the KBIC Ceded Territory is vast. As conservationists, we must also focus our efforts on AIS that are currently not in the area, and have the potential to invade. These "AIS on the horizon" generally need the following criteria to infiltrate a new area: a source of the colonizing AIS is available, a vector and pathway available for their transport and they can tolerate transportation by said vector, and the introduced area is suitable for their survival (WDNR 2012). The species below have made this list because they are currently found in or near the Lake Superior Basin. These species are also listed here because of their aggressiveness as invasive species and because they could cause significant ecosystem, cultural and economic impacts to the KBIC. For more information about vectors and pathways, see section 4.8. For more detailed species accounts, refer to specific factsheets in Appendix A.

Table 2. Aquatic Invasive Species On the Horizon.

	Common Name	**Scientific Name**
Fish	Bighead carp	*Hypophthalmichthys nobilis*
	Silver carp	*Hypophthalmichthys molitrix*
	Black carp	*Mylopharyngodon piceus*
	Grass carp	*Ctenopharyngodon idella*
	Northern snakehead	*Channa argus*
Mollusks	New Zealand mudsnail	*Potamopyrgus antipodarum*
Plants	Brazilian waterweed	*Egeria densa*
	Brittle water nymph	*Najas minor*
	European frogbit	*Hydrocharis morsus-ranae*
	Hydrilla	*Hydrilla verticillata*
	Parrot feather	*Myriophyllum aquaticum*
	Starry stonewort	*Nitellopsis obtuse*
	Water chestnut	*Trapa natans*
	Water hyacinth	*Eichhornia crassipes*
	Water lettuce	*Pistia stratiotes*
Crustaceans	Bloody red shrimp	*Hemimysis anomala*
	Chinese mitten crab	*Eriocheir sinensis*
	Fishhook water flea	*Cercopagis pengoi*
	Red swamp crayfish	*Procambarus clarkii*

4.4 Ecosystem Impacts

As indicated by names such as "invasive," "alien," "non-native," and "nonindigenous," we are well aware that aquatic invasive species are not meant to be a part of our local ecosystems. These species can cause a huge detriment to the native plant and animal communities by way of: loss or destruction of habitat and consequent loss of native and sometimes rare species, disrupting food webs and fisheries, causing water quality issues, inhibiting water flows, and introducing new diseases. The following are examples of how aquatic invasive species affect KBIC ecosystems.

Zebra mussels' fecundity is so prolific that over 40,000 eggs can be laid in a single reproductive cycle (Benson et al 2014). With numbers like this, and the ability to attach themselves to rocks, wood, plants, and other animals, zebra mussels are capable of eliminating available habitat for other aquatic species. In Lake Erie, zebra mussel densities reach between 30,000 and 70,000 individuals per square meter eliminating all available habitats for native species (MN Sea Grant 2009). Similarly, purple loosestrife, which can produce up to 300,000 seeds per year, can establish itself in an area, and outcompete other plants for habitat. Invasive plants, like purple loosestrife, have the potential to grow so dense that other plants do not have access to light and cannot grow. These opportunistic and aggressive aquatic invasive species, can also contribute to the loss of endangered, threatened, special concern and culturally important species via competition for habitat. The most well-known example of this is the loss of habitat for wild rice stands in Michigan, Wisconsin and Minnesota. For information about how AIS impact wild rice stands in the KBIC, see section 4.5 (Cultural Impacts).

The dynamic of an ecosystem's food web is a careful balance of predator-prey relationships, and with the introduction of aquatic invasive species this balance can be easily disrupted. Species such as alewife, Eurasian ruffe and round goby eat the same food as native fish species (perch, pike, bass, walleye), but are much more aggressive and effective at catching their prey. In some cases, they have reduced native fish numbers by depleting the shared food source. Other AIS disturb the food web by eating the fish eggs of native fish species. For example, the round goby preys on darters, other small fish and lake trout eggs (Fuller et al 2014). When populations of these types of AIS are introduced and/or increase in size, it is possible that native fish species and the overall aquatic food chain can be impacted.

The sea lamprey has been a well-known nuisance species in the Great Lakes. During its lifetime, a sea lamprey can kill 40 or more pounds of fish (GLFC 2000). Sea lamprey harm many species of fish, including (1) native species that are vastly important in KBIC commercial and subsistence fisheries management (lean and Siscowet forms of lake trout, whitefish and cisco to name a few), (2) culturally important species such as lake sturgeon, and (3) non-native species that have become an integral part of KBIC Natural Resources Management (rainbow trout, Pacific salmon species, etc.) (Mensch per. comm.). For more information about the cultural impacts of sea lamprey, see section 4.5 and AIS factsheet (Appendix A).

Aquatic invasive species can also pose water quality issues. Asian carp uproot vegetation which in turn increases the water's turbidity. On the other hand, zebra mussels contribute to increases in water clarity levels. Zebra mussels are filter feeders and can filter one liter of water per day. Nearly all particulate matter, including phytoplankton and small zooplankton are removed (MN Sea Grant 2009). This increased clarity allows for vegetation (native or non-native) to grow at deeper depths. In some cases, AIS

(including the majority of aquatic invasive plant species) can grow to such high densities that they slow or stop water flow.

While some aquatic invasive species are in fact pathogenic (disease causing), some AIS are also vectors of diseases. The disease known as viral hemorrhagic septicemia (VHS) is a highly contagious fish disease and is transmitted to juvenile and adult fish by urine and other bodily fluids that enter a fish through their gills. It causes bleeding throughout the fish's body, inevitably leading to death. In this Aquatic Invasive Species Adaptive Management Plan, VHS is considered an aquatic invasive species due to its threat to the Great Lakes fishery. Invasive snails can be the intermediate host to a variety of flukes. The faucet snail is the intermediate host to flukes that can harm or kill waterfowl. In their native area (Asia), Chinese and banded mystery snails can transmit human intestinal flukes, but no cases have been documented in the United States (MNDNR 2014).

4.5 Cultural Impacts

In *The Mishomis Book*, Edward Benton-Banai chronicles accounts of the prophets of the seven fires who told the Anishinaabe what the future would bring. The Anishinaabe were led to a place where fish were abundant and where food grows on water and where their traditional ways would be a source of much strength. But over time, the predictions cautioned, intruders would threaten the Anishinaabe culture and the waters would become poisoned and the fish would become unfit to eat, speaking of the changes that would threaten the traditional ways and foods of the Anishinaabe. Many believe that time is at hand. Benton-Banai goes on to say that in the seventh fire there would come a critical point wherein all of Earth's people could come together to protect and care for the natural earth and all living beings. "If we natural people of the Earth could just wear the face of brotherhood, we might be able to deliver our society from the road to destruction" (Benton-Banai 1988).

At a KBIC talking circle event, comments of participants reflected their deep connection with harvesting traditions and concern for the changes experienced in recent years. Comments voiced include: "Fish are an all-year-round source of food for subsistence, and commercial and recreational activity; different fish come with different seasons." Importance is also marked by opening day of specific harvesting and fishing seasons. Families, tribal and non-tribal, from within and beyond the region, engage in these seasonal activities—these experiences are all traditions. People are physically together during seasonal harvests, contributing to and strengthening their social bonds and these harvests become experiences for sharing stories and learning from each other. The spring season is associated with ideas of "abundance and renewal" which contribute to a traditional significance of the spring season. With both the spring and fall seasons, there are cultural ceremonies and stories specific to each season. "These ceremonies are especially important for reinforcing, reaffirming, and keeping our identity, as a tribe, and as a fishing people" (Gagnon 2014).

Over the past several decades, the waters and wetlands of Great Lakes region have been threatened by toxins, pollutants, parasites, pathogens, and a variety of invasive species, which have impacted tribal and commercial fishing and foods of cultural and subsistence significance. In a 2013 KBIC community survey, respondents indicated the importance of fish and wild rice as subsistence and culturally valued foods, and their support of efforts to protect and enhance the traditional harvest of fish and wild rice (KBIC NRD 2013c). Recognizing this value, KBIC NRD set forth goals of protecting and expanding

stands of culturally significant native plants (i.e. wild rice) and identifying and controlling invasive species on the Reservation that threaten the existence of native plants and fish.

The species composition of the Great Lakes has changed, dramatically altering the fishery since the mid-1940s as species such as sea lamprey, smelt, alewives, and aquatic invasive plants have arrived. For example, Lake Superior has only a fraction of the forage base that it had prior to the sea lamprey invasion. Many other new exotic species threaten the fishery including the Eurasian ruffe, a small perch; the spiny water flea, a large predatory zooplankton; and the zebra mussel, a small biofouling clam which have all developed reproducing populations in the Lake Superior Basin. Aquatic invasive species populations have developed rapidly and may be capable of inflicting great ecological changes in Lake Superior (MN Sea Grant 2014).

As a result of the increased fishing pressure and the introduction of many exotic fish, native fish populations on KBIC tribal lands were drastically reduced and populations of many species remain low today. Particularly devastating to the Lake Superior fishery was the introduction of the parasitic sea lamprey in the early 1950's. Tribal fishermen who fished both commercially and for subsistence suffered from the decreased populations of fish. Treaty harvest in Lake Superior is regulated by the tribes, and tribal fishermen adhere to restricted quotas in order to provide opportunity for non-Indian fishing as well. The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) assists its members in the regulation of the treaty commercial fishery in Lake Superior. The GLIFWC Great Lakes Section focuses much of its time on *chinamekos* (lake trout), *adikameg* (whitefish), and *kewis* (cisco, a.k.a. lake herring), which are a culturally and nutritionally important source of low fat, high protein food. Some of KBIC's fish hatchery efforts include rearing and stocking of lake trout, brook trout and walleye. The KBIC also helps control the invasive *bimiizii* (sea lamprey), which is important in protecting the fishes of Lake Superior.

Another culturally important aquatic species is wild rice (*Zizania* spp.) Wild rice has declined in abundance from historic levels. Nevertheless, there is hope that this trend may be reversed. A growing interagency effort is underway to manage and restore wild rice throughout the western Great Lakes region through the reestablishment of historic beds, the development of new beds, and monitoring for negative impacts from AIS. Wild rice can be damaged by pollution, large boat wakes, changes in water levels, and exotic plant species such as Eurasian watermilfoil and curly-leaf pondweed which compete with it for shallow water habitat and degrade water quality. For the Anishinaabe, *manoomin* is the "food that grows on water," foretold in the migration story and is the "spirit food" that has been a central component of the culture for hundreds of years. Its ecological importance is not only as a nutritional and healthy food for humans, but it also benefits the muskrat that feeds on tender spring shoots, invertebrates that live on it, and a wide range of fish and wildlife species that use it for food, cover and physical structure in wetland communities (GLIFWC Wild Rice).

This AISAMP focuses on practical strategies and actions that will help to reduce the impact of aquatic invasive species on culturally important fish and plants. Working with other tribal, state, federal, and interested individuals, it is time to come together to protect and care for the natural earth.

4.6 Economic Impacts

As discussed in the previous sections, aquatic invasive species can be a detriment to the ecosystem in which they live in and to culturally significant species. Although those impairments are troublesome, AIS

also negatively impact the local economy. Billions of dollars are spent each year in the United States on invasive species prevention, early detection and rapid response, control and management, research, outreach, international cooperation and habitat restoration. These costs hit home to the KBIC in the form of: loss of commercial fishing production, loss of recreational fishing, boating and swimming, loss of property values and aesthetics, increased costs of monitoring and detecting of AIS, and increased costs for control, eradication and restoration of AIS invaded areas.

As mentioned in the previous section, aquatic invasive species like the sea lamprey have caused a significant decrease in the commercial fishing production in the Great Lakes. For example, before sea lamprey entered the Great Lakes, Canada and the United States harvested about 7 million kg (15 million lbs.) of lake trout in lakes Huron and Superior annually. By the early 1960s, the catch was only about 136,000 kg (300,000 lbs.) (GLFC 2006).

Recreational fishermen are faced with the same AIS dilemmas as commercial fishermen. Aquatic invasive species such as the sea lamprey, ruffe, alewife, and round goby have caused or have potential to cause decreased numbers of sport fish. Spiny and fishhook water fleas also affect the fisheries in similar ways. Their diet consists of the same zooplankton preferred by young bass, walleye and perch. And due to the water fleas' ability to reproduce sexually and asexually, their numbers (and demand for food) can increase rapidly. Spiny and fishhook water fleas' tail spines get caught on fishing equipment, making it difficult to reel in lines, and clogging commercial nets and trawl lines (OISC 2012).

Ironically, aquatic invasive species can also negatively impact what occurs on land. In a study conducted by Horsch and Lewis (2008), lakes located in the northern forest region of Wisconsin that have been invaded by Eurasian watermilfoil have seen an average 13% decrease in land property values after invasion. This general observation can be made with other aquatic invasive plant species that grow in high densities. While we expect that lakes invaded with AIS reflect lower property values, some studies indicate that lakes invaded by zebra mussels have actually increased home values (Johnson and Meder 2013). However, this correlation may be drawn from the relationship of the property value and the water clarity of the lake instead of the invasive mussel itself (Johnson and Meder 2013; and Krysel et al 2003).

Monitoring and detecting for AIS can be a costly job. At United States industrial and water treatment facilities, anywhere from $144,000-$685,000 is spent annually to monitor for zebra mussels (Rosaen et al 2012). Individual power plants can spend up to $3 million annually for monitoring and researching better control methods for zebra mussels. AIS control and eradication efforts make up the largest part of the annual AIS bill. The Great Lakes Fishery Commission spends nearly $20 million on sea lamprey control and lampricide treatments each year (Rosaen et al 2012). Another $21.6 million is spent on AIS control in the St. Lawrence Seaway (Rosaen et al 2012). The Great Lakes Restoration Initiative dedicates billions of dollars to help combat invasive species and restoring habitats destructed by such AIS.

4.7 Climate Change and AIS

Climate change refers to shifts in the long-term pattern of weather conditions for a region. These shifts can be due to natural phenomena and human-caused forces (such as burning fossil fuels). Climates have always changed, but in recent decades measurements have indicated climate is changing at increased rates. The KBIC NRD (2013a) lists the following predicted climate changes for our area based on scientific models:

- more mild winters;
- hotter, drier summers;
- more rain, less snow (especially during winter months);
- more frequent and intense rain events;
- longer growing season;
- change in migration timing and patterns of wildlife;
- ice on lakes will form later in the winter (if at all) and breakup earlier in the spring;
- change in abundance and distribution of coastal wetlands; and
- loss of native plant species; increase in non-native species.

Climate change and invasive species both influence environmental change in significant ways. Often thought of as independent forces, it is clear that these two factors can interact in causing environmental change. Rahel and Olden (2008) reviewed the effects of climate change on aquatic invasive species. The United States Environmental Protection Agency (USEPA) reviewed available literature on climate change influences on aquatic invasive species and examined state-level AIS management activities (USEPA 2008). The USEPA report also analyzed state and regional AIS management plans to determine their capacity to incorporate information on climate change. We have found these reviews particularly helpful in the preparation of this section.

In the Great Lakes area, climate change will influence freshwater systems by warming water temperatures, reducing ice cover, altering stream flow, and increasing storm events which in turn will affect both native and non-native species. These effects can interact with aquatic invasive species by (1) changing the paths by which species are introduced, (2) influencing establishment of non-native species, (3) mediating impacts of non-native species, and (4) requiring initiation or alteration of AIS control strategies (Rahel and Olden 2008).

Warmer climate means that warmwater aquaculture, tropical fish culture, and outdoor water gardens will expand into new areas. Since species in these settings often escape and enter natural ecosystems as invasives, this increases the numbers and enhances the proximity of potential AIS invaders to natural systems.

Various fish species and other aquatic organisms have specific water temperature ranges under which they thrive. Warmwater species cannot do well in coldwater environments. These environments tend to be occupied by coldwater species (for example, brook trout). As waters warm, however, some of these species may find it easier to establish breeding populations and thus expand their ranges. For example, Rahel and Olden (2008), state that eight warmwater fish species currently present in the lower Great Lakes could invade Lake Superior and Lake Huron as water temperatures continue to warm. These fish bring with them parasites that may be new to the ecosystem as well.
Warmer water could enhance the impacts of established AIS on native species by affecting competitive abilities, increasing consumption of native prey species by predatory AIS, or increasing effects of non-native parasites on native species. For example, brown trout (a non-native) out-competes brook trout at warmer temperatures, but the reverse is true at cooler temperatures. Brown trout may increase their range as water temperatures increase (Taniguchi et al 1998). In the Rocky Mountains, native bull trout out-compete the non-native brook trout in the coldest streams, but brook trout are likely to displace the bull trout as streams warm over time.

In some cases, warmer water may discourage AIS or make their establishment less successful. The spiny water flea colonized all of the Great Lakes in the 1980s and is spreading from coastal waters into northern inland lakes including several in Michigan's Upper Peninsula. This AISAMP prefers relatively cool water and does not seem to occur in lakes where surface temperatures reach 26-30 C° in mid to late summer (Kerfoot et al 2011).

Climate change will reduce the extent of ice cover on northern lakes which may affect the process of species invasions by increasing light for aquatic plants, reducing occurrence of low dissolved oxygen conditions in winter, and exposing aquatic organisms to a longer season of predation from terrestrial predators (Rahel and Olden 2008). Lakes with low dissolved oxygen under ice are not typically managed for sport fisheries and therefore have communities of native fishes and invertebrates. If dissolved oxygen increases because of a shorter period of ice cover, these lakes may be managed for sport fisheries and thus increase the kinds of non-native fish that may be introduced into these lakes. The amount of light that penetrates the lake will increase under reduced ice cover and perhaps allow new plant species to establish (some of which might be AIS). Fish are protected from bird and mammal predators when the aquatic ecosystem is under ice cover. Shorter periods of ice will likely influence each species in distinct ways.

Climate change will modify patterns of precipitation, evapotranspiration, and runoff (Frederick and Gleick 1999). This will cause changes in aquatic ecosystems such as longer periods of low flows, stream drying in late summer, increased intensity of spring runoff, and increased magnitude and frequency of floods. Events such as floods can cause non-native fishes to escape aquaculture or water garden ponds. Greater flows due to floods may facilitate movement of AIS organisms such as larval zebra mussels downstream to suitable habitat. In some environments, increased drought conditions and associated low stream flows seem to favor non-native fish species in streams. A change in the timing of greatest stream flow (e.g., from spring to late winter) could influence spawning success. Prolonged periods of desiccation in streams and rivers might favor some non-native species. For example, the New Zealand mud snail (an invader of North America) is tolerant of desiccation. In specific situations, AIS management strategies may need to accommodate altered flow regimes. The sea lamprey provides an appropriate example of this possibility. Low head dams have been effectively used to block upstream passage of spawning sea lampreys. With increasing magnitude and/or frequency of flood events, the effectiveness of these barriers may diminish.

Water scarcity for human uses may encourage increased water development projects such as reservoirs. Increased flooding may be answered with more flood control structures. Transporting water from one area to another may require more canals and aqueducts. All these activities are likely to enhance the opportunities for AIS to become established. Reservoirs tend to draw people from far and wide for recreation. Along with this recreational traffic come AIS. Replacing flowing water with standing water (as in reservoirs) favors some AIS. Asian carp and zebra mussels tend not to do well in streams with flowing water, but can dominate in standing water of reservoirs (Havel et al 2005). The parasite that causes "whirling disease" in fishes does very well in silty reservoirs because its intermediate host (Tubifex worms) thrives in these conditions (Nehring et al 2003).

Rahel and Olden (2008) conclude their review paper by stating that climate change may require a redefinition of the term "invasive species." They argue that current definitions address species that are not indigenous and are transferred among continents or across major river drainages. Climate change allows

species that are indigenous to expand their range with possible detrimental effects on other native species. Although the invasion is a more local one, the effects on other organisms are real. Currently in northern Wisconsin, a native aquatic plant called the southern naiad is increasing its population size in lakes to the point of reducing the diversity of the plant community and hindering human recreation.

As macroscopic organisms colonize and establish in new geographic areas they bring with them a host of pathogenic parasites. Some of these parasites will be new to the environment and may infect immunologically naïve organisms and cause large-scale outbreaks. Examples for this kind of phenomenon are prevalent enough in wildlife organisms that the American Association of Wildlife Veterinarians (AAWV) has published a "Position Statement on Climate Change, Wildlife Diseases, and Wildlife Health" which in part states: "It is anticipated that continuing changes to the climate will have serious negative impacts on public, animal and ecosystem health due to extreme weather events, changing disease transmission dynamics, emerging and re-emerging diseases, and alterations to habitat and ecological systems that are essential to wildlife conservation. Furthermore, there is increasing recognition of the inter-relationships of human, domestic animal, wildlife, and ecosystem health as illustrated by the fact the majority of recent emerging diseases have a wildlife origin" (AAWV 2009).

There is considerable uncertainty about how climate change will manifest in specific regions of the country and how climate changes will influence the abundance and distribution of aquatic organisms (native and non-native). Nevertheless, scientific understanding is increasing in both areas and examples of how climate change is influencing AIS are accumulating.

At the time of the USEPA (2008) review, most states had not begun to incorporate climate change information into their ongoing AIS programs, activities, or plans (at the time, there was no specific guidance directing the inclusion of climate change considerations). Given the potential interactions of climate change and AIS, it is strategic for the KBIC AIS Adaptive Management Plan to embrace this subject. The adaptive nature of the plan lends itself to the extremely dynamic nature of climate change and AIS.

This adaptive approach is not new to the KBIC NRD. The KBIC has been addressing climate change issues in a variety of ways. Each year, KBIC participates in many meetings with other committees such as the Great Lakes Fishery Commission, Great Lakes Indian Fish and Wildlife Commission, Lake Superior Bi-National Program, Lake Superior Technical Committee, various inter-tribal and inter-agency groups, and others. These meetings create discussion around climate change and help all organizations, including KBIC, incorporate and develop best management practices related to climate change. In so doing, the KBIC has added certain efforts into their baseline fisheries data collection efforts (for example, continuous temperature data logging, ice coverage estimates, and closer and more frequent comparative discussions with regional fisheries managers to gauge more widespread trends in fish behavior) to attempt to better manage the fisheries resources of the region. The KBIC has also begun to develop fisheries management models for various fishes with fish harvest recommendations as the climate change effects become more unpredictable and intensified.

The USEPA's 2008 review argues that incorporating climate-change information when planning and implementing AIS prevention, control, and eradication activities will help maintain the manager's ability to successfully carry out these activities. Adopting an adaptive management framework for AIS

management practices allows better prevention and control of AIS invasions under changing conditions and maximizes the effectiveness and efficiency of AIS programs (USEPA 2008). The KBIC AIS Adaptive Management Plan includes these attributes and incorporates measures to periodically review and update the AISAMP and strategies in light of climate change and new information on AIS.

Several attributes typify the KBIC AIS Adaptive Management Plan:

- an acknowledgement and understanding of potential impacts resulting from climate change;
- a capacity to adapt goals and activities;
- an adoption of monitoring strategies for tracking changing environmental conditions (including climate);
- a provision for regular plan updates to accommodate changes in information or the environment; and
- a vision of dedicated funding source(s) for implementation of the plan.

The KBIC AIS Adaptive Management Plan implementers will need to know:

- how environmental conditions (including climate) may change;
- which species may become threats under projected future conditions (including temperature tolerances of species);
- which systems may become vulnerable to invasion due to changes in temperature, nutrient availability, water quality or quantity, and/or changes in ecological community composition;
- how vectors and pathways will be influenced by changes in climate;
- how management actions, such a control methods, may be affected by changes in the environment; and
- what research is needed to better inform management strategies.

4.8 Sources, Vectors, and Pathways

As stated earlier, there are multiple elements necessary for an aquatic invasive species to invade a new area. A "source" of the colonizing AIS must be available. Originally, the source was the body of water in which the species was native. As new colonies are formed outside of the native range, these AIS populations become new sources. Other sources include aquaria, aquaculture facilities, fish hatcheries, aquatic plant venders, bait dealers, pet trade, and so on. Second, a vector and pathway is available for its transport and the AIS can tolerate transportation by said vector. The list of vectors is very long since many things can serve the purpose. Vectors can be natural things, like a rock, aquatic plant, fish, duck, and so on. Most vectors, however, have been made by humans and include many kinds of recreational gear, commercial fishing gear, minnow buckets, ships, and boats. Table 3 contains a list of some examples of vectors. Pathways can be natural (such as a river or air) or human-made such as highways and railroads. Large lakes (like Lake Superior) and oceans are also pathways. In fact, Lake Superior can act both as a source and a pathway.

Table 3. Potential vectors for AIS into KBIC high priority water.		
Boats	SCUBA & snorkeling equipment	Plant nursery stocks
Trailers	Wake boats	Aquaria
Anchors	Ballast water	Float planes
Live wells	Commercial fishing nets	Waders
Bait containers	Water sampling equipment	PFDs
Ropes	Aquatic plants	Bilge water

Although it is conceivable that an AIS introduction happens through all natural vectors and pathways, in most cases, humans are involved along every step of the way. Humans have developed sources, vectors, and pathways that make AIS introductions possible. Human modes of transportation combined with commercial and recreational traffic act as mechanisms by which an AIS-occupied vectors can move along a pathway fast enough to arrive at a new environment with the AIS still in a viable state. Human influence in this process is so pervasive that a map of AIS colonies is also a map of where humans visit. Table 4 lists various AIS along with some possible vectors and pathway.

Another criterion is whether the AIS can become successful at colonizing in its new environment. Habitat conditions, water chemistry, natural predators, competition with native organisms and other factors will influence whether new AIS can survive and thrive in its newly invaded water.

Table 4. Example AIS, possible vectors, and pathways.		
AIS	**Vector(s)**	**Pathway(s)**
Zebra mussel	Ballast water, aquatic plant material, bait container, bilge water, mud on anchor, live well, drift wood, fyke net, SCUBA & snorkeling equipment, carpet on bunk trailer, float plane	Road, stream/rivers, large lakes or oceans
Hydrilla	Aquaria, plant nursery stock	Road, pond flooding
Spiny water flea	Ballast water, aquatic plant material, bait fish (ingest spiny water flea resting egg) and container, mud on anchor, anchor rope, carpet on bunk trailer, mud on waders or boots, fishing line	Road, stream/rivers, large lakes or oceans
Eurasian watermilfoil	Prop, boat trailer, fish net, fishing lures	Road, streams/rivers, large lakes
New Zealand mudsnail	Sampling equipment, waders, fishing net, anything used that is in contact with the sediment, stocking equipment, plants	Road, streams/rivers, lakes, trails

4.9 Management Priorities

How can limited resources be most effectively applied to address the spread of AIS? One way to address this practical question is for the KBIC to consider and prioritize several possible approaches. Each can, and will be applied, but the emphasis can be adjusted to the need. Since the conditions are ever-changing, the adaptive approach is useful (adapting the strategies and priorities as necessary). We outline nine general areas for consideration in this context: (1) education, (2) inspection and sanitation, (3) monitoring, (4) rapid response, (5) direct management, (6) laws and regulations, (7) coordination among agencies, (8) research, and (9) documentation of plan implementation.

Education and awareness actions can alert lay people, vendors, professionals, and law enforcement staff to sources, vectors, and pathways. Education can also inform people as to the best ways to avoid transporting AIS, and what laws and regulations cover transport. Inspection and clean-drain-dry behaviors at boat landings can interrupt transportation of AIS along various pathways. Monitoring lakes and streams for presence of AIS plays a role in identifying new populations and source waters. Systematic monitoring can provide early detection of AIS and, in some cases, provide opportunity for early control. A rapid response plan provides guidance for those involved with a new discovery of AIS. It can save valuable time and ensure that an appropriate and timely response and action is taken. Direct management of AIS where possible, feasible, and beneficial is a consideration to confront when an AIS has established in a water body. Laws and regulations are crucial tools and covered in Section 2 of this document (Authorities and Enforcement). There are many agencies and organizations that deal with AIS (see Section 3) and improved communication and coordination among these groups would improve our ability to address AIS issues. In many cases, our understanding of AIS is rudimentary. Our abilities to control the spread of AIS and manage existing populations will benefit by new and existing research. The library of publications and reports continually grows and keeping abreast of new information is a serious undertaking. Finally, in keeping with the spirit of adaptive management, it is important to monitor and document the implementation of the AIS Adaptive Management Plan. This will allow evaluation of its effectiveness and point the direction toward improvements that can be incorporated into future versions of the plan. In Section 5, we develop each of these areas with specific objectives and actions.

Answers to several questions will inform how best to prioritize the basic management approaches. What are the AIS source waters in the region? How frequently are these source waters used by humans? What is the proximity of the AIS source waters to possible recipient waters? How do recreationists, agencies, and others use the AIS source water bodies? After leaving a source water body, where do people go next and what do they do there? What is the basic understanding and commitment of recreationists, vendors, and professionals, and other surface water users regarding AIS? How do surface water users behave with respect to minimizing AIS transport? It should be a priority of the AIS Adaptive Management Plan implementation to seek answers to these questions.

Lake Superior itself is an important potential source of AIS. It harbors many AIS, has high human use, and is close to inland water bodies increasing the opportunities for transport of AIS from Lake Superior to an inland water body. A high-risk pathway for spreading AIS is the transportation of recreational boats between water bodies. This pathway can be interrupted by actively inspecting boats entering and leaving public water and checking boat owners for compliance with best practices and regulations.

5.0 Management Goals, Objectives, and Actions

We believe that the essence of the KBIC AIS Adaptive Management Plan can be distilled in two fundamental goals:

Goal 1 - Implement practices that prevent new AIS introductions and limit the spread of existing AIS populations.

Goal 2 - Mitigate or eliminate ecological, cultural, economic, and public health impacts of AIS.

To achieve these goals, we establish objectives based on the nine general areas outlined in the previous section: (1) education, (2) inspection and sanitation, (3) monitoring, (4) rapid response, (5) direct management, (6) laws and regulations, (7) coordination among agencies, (8) research, and (9) documentation of plan implementation. It goes without saying that adequate funding is necessary to accomplish the objectives and goals of the plan. The plan is an important first step in this process. The following subsections present the objectives and menus of supporting actions.

The actions are generally addressed toward the KBIC NRD staff. The NRD AIS Specialist or consulting professional could carry out specific actions. Some actions may require a more collective effort. In other cases, actions could be carried out by lay people or others who use surface water resources in the region.

The objectives and actions are far-reaching. This is a long-term plan. Some actions may be undertaken in 2015. Others will be taken up later (even by future generations of stewards). The availability of time and funding will guide when some actions are undertaken.

Objective 1: Education – Educate resource professionals (including NRD, policymakers and law enforcement staff), the KBIC community members (including, and especially, young people), recreationists (boaters, anglers, divers, float plane pilots, and others), and commercial enterprises (commercial fishermen, tourism industry, bait shops, SCUBA and outdoor sports shops, aquaculture, aquarium trade, nurseries, water garden suppliers, contractors, and others) about aquatic invasive species with emphasis on preventing new invasions and why this is important.

Educating others about aquatic invasive species and about the KBIC's AIS activities is essential to the prevention and spread of new species in the Ceded Territory. Although many professionals are aware of aquatic invasive species and damages they cause, most community members, recreationists, and commercial enterprises do not recognize specific AIS species or the threats they pose. Many outreach and education materials are available from other agencies, so communication with these organizations is important (Objective 7).

Action: Use Appendix A to become familiar with AIS and AIS on the horizon.

Action: Attend public outreach events that discuss AIS. Some of these events include the Michigan Inland Lakes Partnership Convention, the Wisconsin Lakes Partnership Convention, and the Upper Midwest Invasive Species Conference.

Action: Educate and encourage area wardens, sheriffs and police to enforce the current AIS prevention laws by issuing citations to those in non-compliance.

Action: Provide outreach at powwows, community gatherings, and other tribal events.

Action: Provide current information and updates regarding AIS in the KBIC and NRD newsletters and NRD website.

Action: Develop/maintain relationships with public and private schools to advance awareness. Organize a traveling workshop on AIS. Use opportunities such as Annual Kids Fishing Derby, Environmental Fair, and Wild Rice Camp to do AIS education.

Action: Inventory high priority boat landings to check for adequate AIS signage. Make sure the new DNR sign with the added line about a fine is placed.

Action: Identify strategic audiences within the watershed for education on the spread of AIS and how to protect our native ecosystems (for example, bait shops, bait dealers, marinas, dock sales businesses, sporting goods stores, boater safety education, offices that sell fishing and boating licenses, fishing organizations, lake associations and park attendants).

Action: Coordinate with agencies in charge of heavily used boat landings to create kiosks and place educational materials on AIS.

Action: Develop and distribute television and public service announcements about AIS and provide precautionary prevention tips to boaters.

Action: Create a brochure specific to the KBIC waters so watercraft users are aware of what waterbodies have what AIS already established. This brochure could also have images of those invasives with early detection and clean-drain-dry procedures.

Action: Distribute educational materials and regulations on AIS to commercial fisherman, resort owners and tournament fisherman.

Action: Educate bait harvesters about AIS.

Action: Place AIS posters at all bait shops on current AIS laws and procedures.

Action: Educate bait shop attendants on proper protocols for screening bait for aquatic invasive species and provide them with educational materials of AIS present in the area.

Action: Educate anglers on identification of AIS and the importance of not using it for bait. Species like the round goby and Eurasian ruffe could be used as bait by anglers from Lake Superior or the tributaries to the Great Lakes and accidentally released into other inland water bodies.

Action: Increase awareness of the proper procedures for disposal of unwanted aquatic pets by meeting with aquarium facilities and providing information to pet owners. Use existing publications for this action.

Action: Identify area aquarium and water garden suppliers and provide them with AIS information. Materials are available through Minnesota Sea Grant for water gardening:

Do not release plants and fish poster

Do not release plant tag
Aquarium Release Education

Objective 2: Inspect and Sanitize – Inspect and sanitize equipment (recreational and professional) that comes in contact with surface waters.

Inspecting and sanitizing equipment that comes into contact with surface waters is the first line of defense in preventing the spread of aquatic invasive species. It is the most cost effective and environmentally sensitive method of managing AIS. This objective aims to identify high priority vectors, improve decontamination methods, and seek funding for assistance in inspecting and sanitizing equipment.

Action: Increase the presence of watercraft inspectors at the KBIC boat launch sites to step up inspection efforts and to ensure compliance with state launching regulations. These inspections can also carry out education and outreach efforts to boaters. Useful information for Michigan and Wisconsin Clean Boats, Clean Waters programs is available at:

Michigan Clean Boats, Clean Waters Manual
Wisconsin Clean Boats, Clean Waters Website

Action: Continue to seek funding to operate the portable boat wash.

Action: Keep records of the volunteer and paid attendant's activity at the landings and use it to better place the volunteers and the boat wash for the following season.

Action: Seek input from the public on the placement of the boat wash. Make stakeholders aware that they could call and schedule the boat wash to be at specific events, such as a fishing tournament, fishing opener on a busy lake, and educational meetings on AIS. Create a schedule on the KBIC website stating where the boat wash will be placed so boaters will know where to find the boat wash. Place the boat wash at a busy gas station on the corner between major waterbodies with a sign stating FREE Boat Wash.

Action: Follow the KBIC NRD Decontamination Protocol (Appendix D). Adapt the protocols to suit specific circumstances and as new information warrants.

Action: Coordinate with KBIC Management Divisions, especially during times of collaborative effort, to ensure KBIC NRD Decontamination Protocols are being implemented.

Action: Educate boaters, anglers, and float plane users of how to sanitize gear. See Appendix D for recommended sanitation protocols.

Action: Investigate areas where a permanent boat wash may be warranted due to the high risk of AIS spreading to other KBIC waters.

Action: Consider the adoption of the Hazard Analysis and Critical Control Point (HACCP) approach for prevention planning and developing Containment Plans specific to particular NRD activities.

Action: Encourage bait handlers, fish farmers and aquaculture producers to take the Aquatic Nuisance Species HACCP training and implement in their bait marketing activities to help stop the spread of AIS.

Action: Work with local dive shops on the proper decontamination of SCUBA equipment and make them aware how easily AIS transport can occur. Use current educational materials to hand out to divers. SCUBA Decontamination Handout - Nevada

Action: Educate on the proper gear sanitation used for wild rice harvesting, commercial fishing, and subsistence fisherman.

Action: Identify area construction contractors to assess current practices and develop preventive measures if needed.

Action: Develop specific decontamination protocols for construction equipment, tools, and protective clothing when working near waterbodies in the KBIC.

Action: Work with MDOT and county road commissions to see if proper sanitation is being done in regard to AIS dispersal near water.

Action: Identify habitat restoration projects or landscaping projects and encourage the use of native species or noninvasive non-native species, and educate on the proper sanitation steps to help stop the transfer of AIS.

Objective 3: Monitor – Monitor lakes and streams of high priority to KBIC in cooperation with other management agencies for the purpose of early detection of new AIS populations and source waters.

It is important to understand the vulnerability of water bodies within KBIC to new AIS infestations. Certainly, the popularity of a lake influences its likelihood of exposure. Research has shown that the chemical and physical characteristics of a water body can also determine the risk for successful colonization of certain AIS. For the zebra mussel, important chemical/physical characteristics to consider include: calcium concentration, pH, conductivity, total hardness, and water velocity. Lakes with ideal characteristics for zebra mussel colonization might be given higher priority for monitoring efforts. As another example, spiny water fleas prefer well-oxygenated (>2.4mg/L), cool (10-24°C), and low-salinity (0.04-0.06g/L) conditions (Branstrator et al 2013). Similar to zebra mussels, lakes with characteristics ideal for spiny water flea colonization might be given higher priority for prevention and monitoring efforts. Spiny water flea adults are sensitive to exposure to air and sunlight, but resting eggs can survive through winter on lake bottoms. Resting eggs can be transported long distances by boats and equipment if they stay moist. In the study, A *Vulnerability Assessment of Wisconsin's Inland Lakes to the Invasive Aquatic Predator Bythotrephes*, it was found that lakes within 50 miles of an infected lake may be more vulnerable to the spiny water flea than others due to their proximity.

Monitoring lakes and streams for early detection of aquatic invasive species is critical in keeping populations of AIS contained. Researching lakes and streams that are vulnerable to certain AIS (Objective 8) will help determine which bodies of water should be a priority for monitoring. Because AIS control in a waterbody can be expensive or impossible, detecting aquatic invasive species early should be a priority in the KBIC AIS effort.

Action: Prioritize lakes based on vulnerability to AIS and concentrate efforts for early detection monitoring. Conduct research reviews for any new literature on susceptibility (see sidebar).

Action: Work with coordinating agencies to document when and what water bodies have been monitored for AIS, what invasive they were looking for, and presence/absence.

Action: Become familiar with identifying AIS of concern and continue to educate staff on AIS on the horizon. Fact sheets are included in Appendix A describing how to identify species. There are many other resources online and I.D. cards available at various agencies.

Action: Develop standard field protocols for early detection monitoring.

Action: Expand early-detection monitoring programs.

Action: Frequent the AIS Smart Prevention website to see what lakes are susceptible to zebra mussels, round goby, rainbow smelt, and the rusty crayfish in the KBIC waters.

Action: Seek funding to monitor lakes for water quality parameters to determine their susceptibility AIS such as zebra mussels, round goby, rainbow smelt, and rusty crayfish. Add data to the Smart Prevention mapping tool.

Action: Monitor and document AIS while in the field.

Action: Survey high risk and culturally important areas for new AIS.

Action: Examine current sampling efforts and determine if additional monitoring for specific species is needed. Develop

a monitoring strategy that will identify which high priority species are to be sampled and what the frequency of the monitoring should be.

Action: Develop and distribute monitoring protocols for shoreline/wetland plant species of concern for which no state monitoring protocols have been developed.

Action: Investigate use of eDNA technology for monitoring AIS.

Action: Coordinate AIS reporting with an organization that has a well-maintained and up-to-date AIS database. Many databases have significant time lags between receiving an AIS report and posting.

Action: Maintain a link between the KBIC NRD website and the AIS database.

Objective 4: Rapid Response – Implement a rapid response plan that provides guidance to those who have discovered a new population of AIS.

If new populations of aquatic invasive species are discovered, a quick, coordinated response can eradicate or contain the AIS before it spreads. Rapid response to a new AIS introduction can also save on potential costs of long-term control. Implementing a rapid response plan is paramount for the KBIC. Coordinating and collaborating with other administrations (Objective 7) will help in creating the fastest response to new infestations of AIS.

Action: Adopt and follow the KBIC NRD AIS Rapid Response Strategy offered in Appendix E.

Action: Designate a Rapid Response Coordinator and a Rapid Response Team. Identify points of contact, including technical experts and lead agencies that could be called upon for early detection and rapid response efforts.

Action: Create a contact list of agencies and organizations that may be involved in the implementation of the KBIC AIS Adaptive Management Plan.

Action: Maintain and update Appendix G, Aquatic Invasive Species and Supplementary Management Resources.

Action: Adapt the Rapid Response Strategy as warranted.

Objective 5: Management – Manage (where possible) existing populations of AIS to prevent spread to other water bodies and minimize impacts.

While the following methods can work for a variety of aquatic invasive species, it is important to know that each management and treatment situation must be tailored to worker safety and consider site-specific objectives in order to be most effective. Some treatments are appropriate in some situations while not in

others. Appendix F provides a list of AIS and possible treatment methods. The following paragraphs provide a description of manual, mechanical, biological and chemical AIS management techniques.

Manual – Manual treatments are beneficial because they allow the manager to be selective in which species they intend to remove. Manual treatments involve any non-mechanized technique, which includes, but is not limited to: hand-pulling, lopping, and cutting. Manual treatments can be used in a variety of situations. Generally, this method is used to treat small infestations of AIS. This type of small population treatment is most commonly conducted where a new infestation of AIS has been discovered. Manual treatments can also be used as for spot-treatments of larger settings, or in cases when other methods are not accessible or applicable. For example, if a known native mussel population or known endangered species are in a location where aquatic invasive species are present, a manual treatment can be beneficial so not to disturb the rare species and/or native communities. Another advantage of manual treatments is that they can involve volunteers who have little or no experience treating invasive species. Limitations of manual treatment include: labor intensive, can be costly due to reoccurring treatments, and not ideal for every species.

Mechanical – Mechanical treatments are a less-common method of treatment. Some examples of mechanical treatment include: trapping, suction harvesting of aquatic invasive plants, dredging, scraping, brush-cutting, mowing and use of fire (by way of prescribed burns). This type of treatment is generally used in situations where the AIS is so widespread or dense that large amounts of the species need to be removed. Mechanical treatments are typically expensive, require equipment and knowledgeable operators, and can be dangerous to the managers and the surrounding ecosystem.

Biological – Biological treatments are a specialized type of treatment. Only AIS with a known biological host can be treated biologically. This method can be a preferred choice of treatment if the aquatic invasive species has a natural predator. One well-known terrestrial biological treatment used by the KBIC is the use of loosestrife beetles (*Galerucella calmariensis* and *G. pusilla*) on the invasive plant purple loosestrife. Another biological control commonly used is the milfoil weevil on Eurasian watermilfoil. The native milfoil weevil (*Euhrychiopsis lecontei*) feeds on the EWM plants, helping minimize and maintain the infestation. Disadvantages to biological controls including: purchasing the host predator can be expensive, the host predator must continue to live and survive near or on the AIS in order to control it, the predator can generally never completely eradicate a population, results may take multiple years before noticeable difference are observed.

Chemical – Chemical control methods can be very effective in controlling some aquatic invasive species, but generally at the cost of surrounding native species. Chemical treatments must be considered carefully and are not available for all aquatic invasive species. In the case of the Keweenaw Bay Indian Community, chemical treatments are considered a last resort due to the negative effects it can have on the ecological and cultural resources.

> **Action**: Determine which control strategies are most cost effective and environmentally and culturally sound. In cooperation with coordinating agencies, implement, if feasible, those strategies for problem AIS in the KBIC waters.

Action: Evaluate the effectiveness of control strategies that have been in place on the water of the KBIC and modify or discontinue implementation if evidence supports.

Action: Work with stakeholders to educate on containment plans where AIS are already established.

Action: Formulate a database of contacts for each waterbody in the KBIC Home Territory where AIS are documented.

Action: Establish baseline data on water chemistry, aquatic plants, and aquatic organisms on waterbodies within the KBIC Home Territory. This provides a baseline of ecological knowledge necessary to make good management decisions.

Action: Prioritize management efforts based on resource risk and resources available for control.

Action: Provide assistance to lake organizations, town lakes committees, waterfront property owners and other stakeholders with managing established populations of aquatic and shoreline invasive species.

Action: Maintain inventory and update species specific management tools to use.

Action: Pursue funding opportunities as available for AIS management efforts.

Action: Identify and evaluate available management options for eradication, control containment, or impact mitigation associated with specific aquatic invasive species or taxonomic groups.

Action: Identify and evaluate management options for containment and quarantine.

Action: Determine which management options to implement by assessing the characteristics and requirements for using various manual, mechanical, biological, or chemical tools approved for application during a rapid response to newly discovered invasions.

Action: Encourage research and development to expand the tool kit targeting AIS taxonomic groups where eradication and/or control measure have yet to be developed.

Action: Ensure that appropriate authorities engage in rapid response planning in order to provide the operational and legal support needed for evaluating, selecting and implementing management options.

Action: Participate in the development and implementation of a regional and/or national ballast water management program that will establish stringent interim standard with the long-term goal of eliminating AIS introductions into waters of the Great Lakes and the U.S. and reduce AIS dispersal between the lakes.

Action: Work with MDNR, GLIFWC, and the USFS to investigate trapping techniques and voluntary catch and release of predatory fish (smallmouth bass) used to control and contain rusty crayfish populations.

Objective 6: Laws & Regulations – Employ existing laws and regulations to minimize the spread of AIS.

Presently, many federal and state laws, regulations and policies apply to the introduction, distribution, importation, transportation, possession, propagation, planting, and sale and release of invasive plants and animals. These authorities are spread over several agencies (see part 2 of the KBIC AISAMP). This objective aims to review regulations for gaps and overlaps, and explore the need for new AIS laws and regulations.

Action: Educate and encourage area wardens, sheriffs and police to enforce the current AIS prevention laws by issuing citations to those in non-compliance.

Action: Introduce AIS volunteers and staff to area wardens, sheriffs, and police to gain support if someone is in non-compliance.

Action: Work with governing bodies on necessary AIS concerns.

Objective 7: Coordination – Coordinate with other agencies and organizations regarding AIS education, information, monitoring, and management to increase efficiency and economy in implementation of the KBIC AIS plan.

Aquatic invasive species management activities conducted by the KBIC will cross multiple jurisdictions. Types of jurisdictions could include, but are not limited to: federal and state government agencies, universities, Cooperative Weed Management Areas, volunteer organizations, local agencies, local vendors, stakeholders and consultants. These actions seek to increase coordination and collaboration with these administrations to allow for the comprehensive assessment of AIS activities and ensure action on high priority situations.

Action: Coordinate with KBIC Management Divisions, especially during times of collaborative effort, to ensure KBIC NRD Decontamination Protocols are being implemented.

Action: Work with coordinating agencies to best educate the stakeholders about AIS.

Action: Work with other agencies to create effective databases and GIS maps that are more compatible with, and responsive to, AIS management needs.

Action: Create a contact list of agencies and organizations that may be involved in the implementation of the KBIC AIS Adaptive Management Plan.

Action: Coordinate with other agencies, such as the Forest Service and KISMA on watercraft inspection efforts so you do not overlap. Share data to better understand the KBIC Home Territory boating efforts.

Action: Work with coordinating agencies on AIS monitoring efforts. Monitoring for AIS has been ongoing for many years by GLIFWC, the Ottawa National Forest Service, WRISC, WePIC, and KISMA. The wide variety of monitoring efforts by citizens, government agencies, and academics across the state and region contribute to successful AIS management.

Action: Consult with the Michigan and Wisconsin Aquaculture Association and the DNR to monitor actions taken by the industry to help stop the spread of AIS and disease.

Action: Continue to work with the Partnership for Watershed Restoration (PWR). Their mission is "To promote protection, restoration, and habitat improvement activities in watersheds that lie within the South-Central Lake Superior basin to achieve Coalition members and community needs through collaboration and partnerships."

Action: Create a Rapid Response Team with coordinating agencies to implement the plan when new AIS is found.

Action: Coordinate management of AIS with others to accomplish the same goal.

Action: Coordinate with others for funding and implementation of AIS management.

Objective 8: New Research – Review new research findings on specific AIS and participate in basic AIS research (as opportunities arise).

Increased knowledge of the biology of invasive species and connected early detection, rapid response and control methods will improve KBIC's aquatic invasive species management. For more information about aquatic invasive species on the horizon, see the factsheets in Appendix A. It is important to learn about and prepare for the potential economic, environmental, cultural, and human health and safety issues associated with those AIS.

Action: Compile a reference list of any past or present research done in regard to species specific AIS.

Action: Determine if there is a need for an Economic Impact Study on the effects of AIS, including the costs and benefits of pathway prevention.

Objective 9: Review and Update – Conduct periodic review of the KBIC AIS Adaptive Management Plan implementation including an analysis of progress and areas where adaptations are warranted.

This plan is based on the model of adaptive management. This means that when the plan is implemented, it comprises the best available information and well-defined goals and objectives. As time passes, new aquatic invasive species may be introduced, source waters may change, contacts at supporting agencies might differ, policies and regulations may be altered, objectives might be amended, and methods of prevention, early detection, rapid response, decontamination and control might be modified. This objective aims for a periodic review of the KBIC AISAMP in order to adapt to the ever-changing world of AIS management.

Action: Develop a system of tracking what actions have been completed.

Action: Update KBIC AIS Adaptive Management Plan periodically.

6.0 Conclusion

Over the course of six months, we (White Water Associates and the KBIC NRD) have completed the first version of the ***Keweenaw Bay Indian Community Aquatic Invasive Species Adaptive Management Plan***. At this point we realize that we are not at the end of a process, but at the beginning of one. The plan is intended not to be a long-term guide, but one intended to change (or more specifically, to be "adapted") in response to a changing environments, dynamic wildlife and plant communities, new scientific understanding, fresh insights from traditional ecological knowledge, additional sources of funds and human resources, evolving cultural needs, and new aquatic invaders.

Like the closely related ***Integrated Resource Management Plan*** and ***Wildlife Stewardship Plan***, the AIS Adaptive Management Plan provides priorities and describes actions. It can be considered a menu of opportunities to be undertaken as funding and human resources allow. The list of actions is not exhaustive and should be added to, modified, or deleted in future versions of the adaptive plan as warranted by prevailing conditions.

The KBIC AIS Adaptive Management Plan is an educational vehicle. We have attempted to review and provide the best information available at the present time. This is, however, a very dynamic field and new information becomes available every day. An important task of those implementing the plan is to stay apprised of current AIS science and management. The hands-on implementation of various actions will be an educational journey. What is learned from that process will provide valuable feedback for how the plan can be adapted in the future.

Finally, we provide our most emphatic management recommendation: ***Approach stewardship of aquatic ecosystems, including management of aquatic invasive species, with humility.*** Lake and stream ecosystems are enormously complex. Our understanding of how they work is not complete. Our ability to predict outcomes from specific actions is uncertain. New discoveries are made every day that have important implications for future management. The fact that ecosystems are inherently resilient is to our great fortune. In many cases, they rebound from disturbance and repair themselves from injury. We might glean wisdom from watershed managers who state that "...successful restoration usually has less to do with skillful manipulation of ecosystems than it does with staying out of nature's way" (Williams et al 1997). This plan is intended to accommodate and complement nature's own processes.

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Appendix A
Aquatic Invasive Species Factsheets