Michigan's Terrestrial Invasive Species State Management Plan

A Cooperative Effort of the
Michigan Department of Agriculture and Rural Development
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Department of Transportation
In Consultation and Partnership with Other Interested Parties

Executive Summary

Terrestrial invasive species (TIS) — non-native plants, insects, animals and diseases that harm the environment, economy and human health — are taking a toll on Michigan. Michigan's Terrestrial Invasive Species State Management Plan provides a strategy for preventing introductions of invasive species on land and reducing impacts from those that have arrived.

TIS cause billions of dollars in damage annually, are extremely costly to control and often have irreversible ecological effects. A coordinated, statewide, strategic effort will more effectively limit the economic and environmental impacts of TIS.

Michigan's Terrestrial Invasive Species State Management Plan complements the Aquatic Invasive Species State Management Plan completed in 2013 by providing guidance to the State of Michigan and its broad network of invasive species partners for TIS management. The program is cooperatively implemented by the Michigan Departments of Agriculture & Rural Development, Environmental Quality and Natural Resources.

The State Management Plan outlines a statewide strategy to reduce the environmental and economic damages caused by TIS. The plan has four goals:

- Prevention
- Early detection and response
- Control and restoration
- Collaboration

These goals are achieved by work in six activity areas:

- Risk analysis
- Management practices
- Monitoring and research
- Outreach and education
- Regulation and policy
- Leadership and coordination

Each activity area contains objectives and strategic actions outlined in an implementation table found in Appendix D of this document.

Recommendations:

The following are terrestrial invasive species priorities for Michigan, including ongoing activities as well as those that require attention:

- Implement and enforce appropriate regulations.
- Implement species-specific risk assessments when updating regulated and watch list species.
- Promote partnerships to develop needed surveillance technologies.
- Implement risk analysis – the process of identifying optimal management approaches for species in various stages of invasion.
- Develop and use dispersal and other forecasting models to be most efficient in surveillance, prevention, eradication and control.
- Advance collaboration within networks of public, private and nonprofit organizations to ensure resources get where and when they are needed most.
- Identify and focus on critical priorities, ensuring there are precise objectives, sufficient resources and realistic expectations.

Contents

Introduction

Terrestrial invasive species (TIS) are damaging Michigan's forest, dune, grassland, agricultural and urban environments. They include non-native plants, insects, animals and diseases that harm Michigan's environment, economy and human health. Emerald ash borer, feral pigs, Japanese knotweed, oak wilt and beech bark disease are a few examples of TIS that are currently affecting Michigan. TIS cause billions of dollars in damage annually, are extremely costly to control and often have irreversible ecological effects. Throughout the state of Michigan, invasive species programs exist at various organizational levels. These efforts are often fragmented and insufficient to control the growing problem of TIS. A coordinated, statewide, strategic effort will more effectively limit the economic and environmental impacts of TIS.

Heath Snail
Photo- Brian Sullivan,
USDA/APHIS/PPQ - MI PHSS

What are Terrestrial Invasive Species?

Any terrestrial invasive species covered under the scope of this plan is defined as:

"A species that is not native AND whose introduction causes or is likely to cause economic or environmental harm or harm to human health."*

A "non-native" organism is one that historically did not occur in an ecosystem under consideration.

Most non-native species are not invasive and support human livelihoods or a preferred quality of life. Some non-native species provide valuable benefits including most agricultural and horticultural species.

Direct human health issues resulting from invasive species are rare but of great concern. The spread of human-related illnesses is considered by epidemiologists and studied separately from invasive pathogens that harm non-human hosts; therefore, invasive species that only present threats as human pathogens are not considered within the scope of this plan. The invasive species program works closely with human health agencies and professionals to address crossover of invasive species and diseases impacting both humans and animals.

*Derived from Executive Order 13112 – Invasive Species (Feb. 3, 1999).

Michigan's Invasive Species Program

Michigan's Invasive Species Program is cooperatively implemented by the Michigan Departments of Agriculture and Rural Development, Environmental Quality and Natural Resources. This unique inter-agency collaboration stems from their shared responsibility for invasive species policy, legislation, regulation, education, monitoring, assessment, management and control of both terrestrial and aquatic invasive species. The program is governed by the Invasive Species Steering Committee which provides oversight and guidance. The Terrestrial and Aquatic Invasive Species Core Teams and the associated working groups ensure communication and collaboration within the state agencies (Appendix A) and with a wide range of partners. The TIS State Management Plan (SMP), along with the Aquatic Invasive Species State Management Plan completed in 2013, provides guidance to the State of Michigan and its broad network of invasive species partners. The TIS SMP emphasizes invasive plants, animals and tree diseases, filling a void not addressed by other programs and funding sources, such as those available for wildlife and most agricultural diseases. This current focus ensures the program has the greatest possible impact where it is most needed.

Cause for Concern

Michigan provides diverse recreational opportunities, supports a growing natural resource-based economy and offers a unique quality of life. There are over 3,200 miles of shoreline, 20 million acres of forest, 10 million acres of farmland and 6.5 million acres of wetlands, all of which are threatened by invasive species. The following examples illustrate the cause for concern:

- Michigan's 36 million acres of land provide habitat for over 500 species of terrestrial wildlife, of which 73 are listed as species of greatest conservation need; TIS are recognized as a significant threat to recovery for over half of these species (Derosier et al. 2015).
- Visitors spent over $22 billion dollars in Michigan in 2014, supporting nearly 327,000 jobs (Tourism Economics 2014). Invasive species impact the use and beauty of Michigan's shorelines, trails and parks, which may result in a reduction in visitor spending and citizen enjoyment.
- Michigan's Forest Products Industry supports 96,000 jobs and contributes more than $20 billion to the state's economy each year (Michigan DNR 2015). Invasive forest pests including emerald ash borer, oak wilt and beech bark disease kill trees and significantly impact the value of urban properties, forests and timber resources. The estimated cost of treating or removing dead ash within developed land in Michigan's communities due to emerald ash borer was $230 million in 2009 (Kovacs et al. 2010).

Hemlock Woolly Adelgid

- Michigan's farm commodities contribute $13 billion annually to the state's economy (Knudson and Peterson 2012) and Michigan boasts the second highest crop diversity in the United States (Michigan Department of Agriculture and Rural Development 2012). The U. S. Department of Agriculture has identified 19 invasive agricultural pests of concern threatening crop production in Michigan (Pest Tracker 2015).
- There was $5.7 billion in economic activity related to Michigan's nursery, perennial plant, Christmas tree, sod, landscaping and lawn care industries in 2010. The economic impact of the landscape services and retail sectors was $4.5 billion. Together, all segments of the Green Industry accounted for a total of 33,393 individuals employed (Knudson and Peterson 2012).
- According to the U.S. Fish and Wildlife Service, hunters and wildlife watchers in Michigan spent over $3.5 billion in 2011 (U.S. Dept. of Interior and U.S. Dept. of Commerce 2011).

Environmental Effects of Terrestrial Invasive Species: Shoreline Erosion

The shorelines of the Great Lakes are a dynamic and ever-changing environment. Natural forces shape the beaches, dunes and bluffs, contributing to the natural process of erosion under which many specialized plants and animals thrive. However, invasive species such as lyme grass, Japanese knotweed and baby's breath permanently change how erosion occurs and replace the many species with only a few. The globally unique features of the Great Lakes shorelines are threatened by these invasive species.

Before and after management
Baby's breath
Gypsophila paniculata
infestation
Zetterberg Preserve, 2006 and 2010
Photo- Laura Rainbolt

A Statewide Strategy

The SMP outlines a statewide strategy to reduce the environmental and economic damages caused by TIS. The plan's four goals are: prevention; early detection and response; control and restoration; and collaboration. These goals are achieved by work in six activity areas (Figure 1). Each activity area contains objectives and strategic actions outlined in an implementation table (Appendix D). These activities will assess risk, provide guidance for management, support targeted monitoring and research, develop outreach programs, inform regulation and policy and strengthen leadership and coordination.

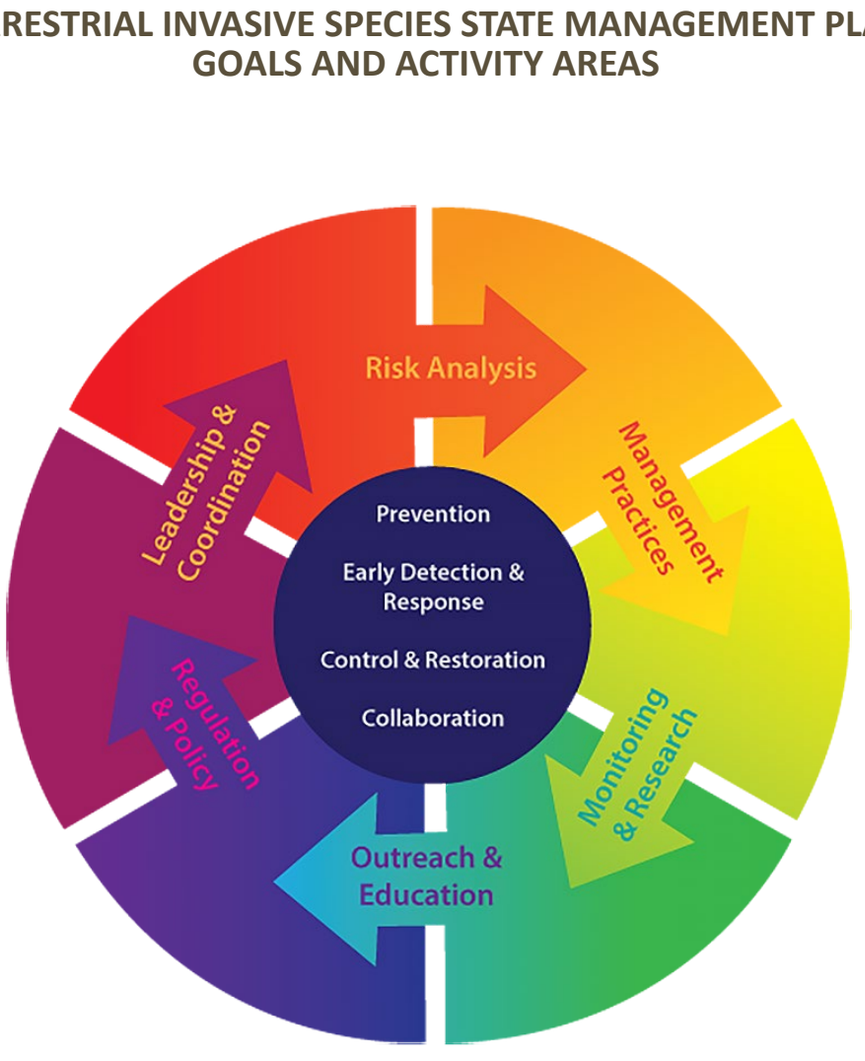


Figure 1. The four major goals of the TIS Plan will be met through efforts in six activity areas.

Goals

1. Prevention

Prevent the introduction of new terrestrial invasive species into Michigan.

Preventing the introduction of TIS before they arrive in Michigan is the most cost-effective invasive species strategy (Leung et al. 2002; Lodge et al. 2016). The species that pose the greatest risk must be identified through risk assessment and their pathways to introduction monitored and blocked. Species with the most potential to harm the environment, economy or human health must be regulated by inclusion in state legislation (Part 413, Transgenic and Nonnative Organisms, of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, as amended [NREPA]) that prohibits or restricts their import, sale, and possession. High priority species not yet regulated will be included in the State's Watch List.

Risk assessment is a tool used to identify species that pose the greatest risk. These assessments evaluate the likelihood of a species' introduction, establishment, spread and the severity of its impact on the environment and economy (Lodge et al. 2016). This includes the species' biology, history of invasiveness and invasion potential, impacts, ease of eradication, pathways of spread and climate-matching between native and introduced ranges. This information provides a science-based approach to evaluating potential inclusions to prohibited and restricted lists and prioritizing prevention efforts. Risk analysis takes this information a step further by developing the most cost-effective management interventions.

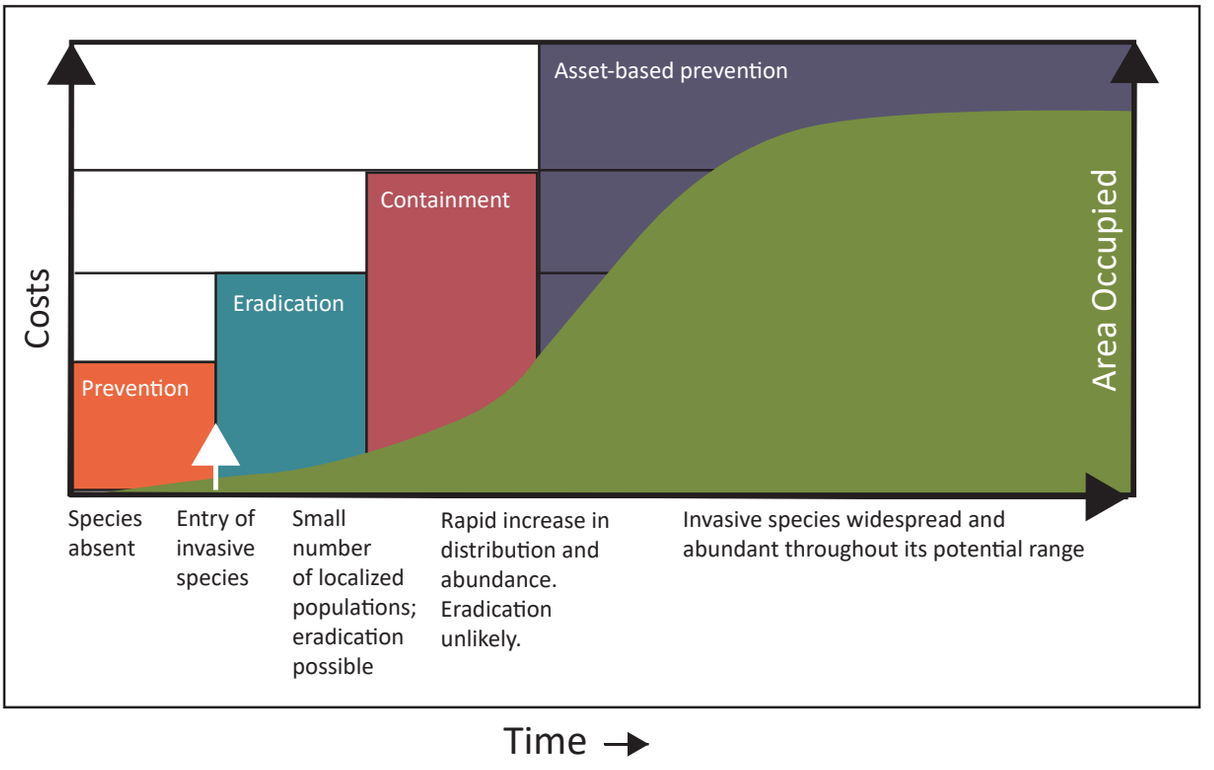


Figure 2. The Invasion Curve demonstrates that there is a cost to prevention and eradication, although it is orders of magnitude less than long-term management of an invasive species.

Prevention Spotlight: Asian Longhorned Beetle (*Anoplophora glabripennis*)

Preventing the Asian longhorned beetle (ALB) from entering Michigan requires addressing risk from infested wood. "Don't Move Firewood!" is a prevention campaign aimed at keeping our forests safe. Maple trees are the ALB's favorite host (Hu et al. 2009). More than 1 billion maple trees grow in Michigan (Leatherberry and Spencer 1996). ALB can attack and destroy many other tree species, including birch, buckeye, elm, horse-chestnut and willow. Larvae feed in tunnels in the wood of tree branches and trunks. These tunnels cause branches to break and will eventually kill the tree. ALB populations are known to be present in areas of southern Ohio, Massachusetts, New York and Ontario (MISIN 2015).

Asian Longhorned Beetle
Photo- Daniel Herms,
The Ohio StateUniversity
Bugwood.org

Climate Change and Invasive Species – An Emerging Threat

Michigan's climate is warming, with more precipitation falling in extreme storms. Continued change will increase the potential for new invaders in Michigan (Hoving et al. 2013). From mammals to birds, snakes to butterflies, widespread range shifts in Michigan have already been documented. With continued climate disruption, we will see more and greater impacts. Mobile species, such as animals, are shifting, whereas stationary species, such as plants, are declining or stressed. This is creating opportunities for new invasive species, including forest pests and diseases. Strategic actions are needed that support monitoring, research and response to new threats as they arise in the wake of a changing climate.

Japanese Stiltgrass
Photo- Andrea Matthies

Identify and survey most likely pathways of introduction.

For those species that warrant prevention in Michigan, the most effective means is through interruption of their most likely pathways before they are introduced (Leung et al. 2002). Pathways and their subsequent "sub-pathways" vary for each species (Table 1). Understanding the various methods that physically transport TIS and the modes or pathways of introduction provides a starting point for prevention measures.

TIS are often introduced unintentionally through human-assisted means such as moving firewood, "hitchhikers" attached to clothing or boot soles, hauling soil or fill materials from infested areas or using pest-ridden wooden packaging for shipping (Michigan DNR 2008). Other invasive plants have been intentionally introduced as ornamentals or for some derived benefit such as erosion control or as a resource for wildlife (Michigan DNR and MNFI 2012a, 2012b). Likewise, some invasive species have been purposely imported as pets, food or as controls for other nuisance species.

Prevention can occur by informing all stakeholders through updated watch lists and increasing public participation in cleaning vehicles and gear, buying local firewood, choosing noninvasive ornamental plants and not releasing pets.

Table 1: Common Pathways and Sub-pathways of Introduction

Pathways	Sub-pathways
Firewood or wood	**Residential use** **Commercial use**
Habitat modification and restoration	**Mowing** **Land clearing/development** **Logging** **Revegetation**
Hitchhikers	**Travelers** **Baggage and gear** **Shipped materials** **Pets and animals**
Organisms in trade	**Landscaping and plant nursery trade** **Pet trade** **Food and game animals**
Recreation	**Trail users** **Hunters and anglers** **Wildlife viewers**
Research and monitoring	**Equipment and sampling gear**
Wood products	**Solid wood packing materials** **Mulch** **Commercial wood products**
Transportation	**Cars, trucks, buses** **Construction and maintenance equipment** **Helicopters, planes, trains**

2. Early Detection and Response

Detect terrestrial invasive species as they arrive and respond to prevent their establishment and spread in Michigan.

Preparation is the key to a successful early detection and response program. The State must continually update the Watch List (see box below) and communicate and coordinate the most effective surveillance strategies to combat TIS. While new occurrences are inevitable, preparation prior to an early detection will increase the probability of eradication. Therefore, it is important to prepare an overarching TIS Response Plan to establish a process of funding, communication, action and evaluation before a new detection of a high threat species.

Invasive Species Watch List:

Michigan's Invasive Species Watch List (Appendix B) provides an up-to-date listing of organisms identified by the State's Invasive Species Core Teams as being immediate and significant threats to Michigan's economy, agriculture and/or natural resources. These species either have never been confirmed in the wild in Michigan or are known to be in limited areas only. Early detection and timely reporting can keep these species from spreading throughout Michigan.

Himalayan Balsam
Photo- Barbara Tokarska-Guzik,
University of Silesia,
Bugwood.org

Species-specific response plans will be developed for invasive species that are most likely to arrive in Michigan. Risk analysis provides optimal management approaches for species in various stages of invasion and the costs and benefits of each. However, some species will arrive and may establish before a risk assessment has even been conducted. Therefore, the list of species evaluated by risk assessment should reflect the most immediate information needs.

Effective early detection of new occurrences followed by appropriate response efforts reduces the likelihood of establishment and the cost of long-term management. A system of on-the-ground continuous surveillance and reporting at the most high-risk pathways should be pursued using the best available technology. Such a system will be built through collaboration with and training of, federal, tribal, state and local agencies, industries, research organizations, Cooperative Invasive Species Management Areas and volunteer groups.

Once the presence of a watch list species or one that may be a potential threat has been verified by an expert, a response plan will be implemented if available. Otherwise, a risk analysis and response plan will be completed in a timely manner. The risk analysis allows decision-makers to choose management alternatives that consider both the potential damages and cost of each response to achieve the best possible outcomes.

3. Control and Restoration

Control terrestrial invasive species to minimize the harmful environmental, economic and public health effects resulting from established populations. Restore habitats as appropriate.

If an invasive species becomes established or widespread at a scale in which the potential for eradication is severely diminished, effective control is more difficult and requires more resources (Lodge et al. 2006). Invasions that are spreading or already causing significant impacts require different strategies than those for which early detection and eradication is still possible. Managers must have the necessary information to forecast long-term impacts and weigh the benefits and costs of various management alternatives.

Managing established TIS requires developing additional technologies (e.g., chemical, bio-control, mechanical, genetic) or enhancing species-specific comprehensive management strategies, best control practices and restoration techniques to mitigate negative impacts. If treatments are pursued, the progress of treatment generally follows the method of prioritization by density of infestation (i.e., least to most infested, followed by restoration where necessary).

Control Practices – Oak Wilt

Oak wilt is an invasive fungus threatening Michigan's red oak trees. Infected trees die quickly, often within a few weeks of the appearance of symptoms (O'Brien et al. 2011). Beetles that have visited infected oaks carry the spores of the fungus long distances to healthy oaks. The disease, which occurs across much of the state in both urban and forest settings, moves rapidly to neighboring healthy oak trees through root systems that have grafted with diseased trees (O'Brien et al. 2011). While oak wilt-infected trees cannot be saved, healthy trees can be protected by breaking root grafts before the disease can spread. A 5-foot-long steel blade mounted on a vibratory plow is used to sever the root systems below ground. Red oak trees growing inside the treatment lines are then cut and chipped, burned or sawed into lumber to help prevent overland spread of the disease.

Treatment of oak wilt areas will:

- *Protect timber value in forests with high-value oak;*
- *Control small, isolated areas of oak wilt to minimize the risk of spreading;*
- *Preserve recreational value in and around state and federal recreation areas; and*
- *Protect residential property values.*

It is recommended to buy firewood when you reach your destination and burn it all on-site. Do not prune oak trees between April 15 and July 15 to prohibit spores from colonizing tree wounds.

Oak Wilt

4. Collaboration

Encourage collaboration to optimize solutions and share resources, knowledge and skills.

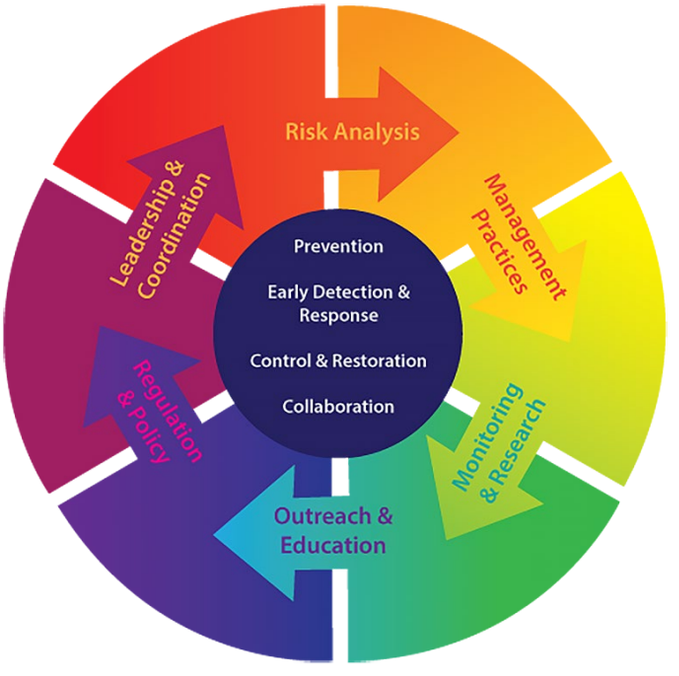
Managing TIS requires the knowledge and expertise of individuals from many disciplines and organizations including universities, government agencies, NGOs and the private sector. The program will commit to seeking the input of experts and support research. Significant work is needed in the development and implementation of risk assessment, risk analysis, blocking pathways across boundaries and borders, species-specific response plans and control and management options. Just as resource experts are needed to conceptualize and test strategies, partners are needed to assist in implementing the SMP throughout the state from prevention to detection to control and restoration. Local resources such as conservation districts and Cooperative Invasive Species Management Areas (CISMAs) provide citizens with information on invasive species and treatment options and manage on-the-ground control activities. Citizens and private sector partners in areas such as agriculture, forest products, construction and transportation can contribute in important ways to prevention and detection efforts.

Cooperative Invasive Species Management Areas (CISMAs)

CISMAs are regional, collaborative organizations that address invasive species across their geographic area. Local, state, federal and tribal governments, private and non-profit partners joined together in various geographic areas to form CISMAs for their communities. CISMAs provide outreach and information, encourage resource sharing and facilitate strategic management of priority invasive species. CISMAs facilitate cooperation and coordination across jurisdictional boundaries. A map of current Cooperative Invasive Species Management Areas in Michigan can be found in Appendix C.

Activity Areas

To meet the four goals of the TIS SMP, activities have been categorized into six areas: Risk Analysis, Management Practices, Monitoring and Research, Outreach and Education, Regulation and Policy and Leadership and Coordination. Aspects of each of these activity areas support the plan's four goals. Objectives and strategic actions are defined for each activity area. Details for these objectives and actions, including example tasks, measures of success, lead state agencies and cooperating agencies or organizations are expressed in the implementation table in Appendix D. The Implementation Table will be used as a guide for implementing the SMP, tracking progress, assigning roles and contributing to program evaluation. Partners can consult the implementation table to find how their organization's efforts can assist the plan.



I. Risk Analysis

Develop and implement a methodology to assess the risk of new invasive species based on their potential to cause harm to the environment, economy and human health.

Potential threats must be assessed through risk analysis; first, species must be evaluated by a risk assessment to determine the likelihood of a species introduction, establishment, spread and the severity of the impact. Risk analysis will aid in determining the most cost-effective management interventions, possibly including a deliberate, but justified "do nothing" approach. Risk assessment requires understanding the biology of the species such as lifecycle, habitat requirements and various aspects of its reproduction. It also requires understanding how receptive Michigan's various urban, suburban and rural environments are and how severely they could be impacted by the invasive organism.

OB = Objective, SA = Strategic Action

OB I.A. Identify and prioritize ecosystems vulnerable to TIS.
SA I.A.1. Implement a science-based risk-assessment process to analyze the level of ecosystem susceptibility and vulnerability to TIS.
SA I.A.2. Define high-value ecosystems to facilitate prioritization of detection, response and management efforts.
OB I.B. Identify and prioritize current and potential high-threat TIS.
SA I.B.1. Implement a science-based risk assessment process to analyze the level of risk of potential TIS and the likelihood of introduction.
SA I.B.2. Develop a prioritization process for prevention, detection and control of TIS.
OB I.C. Analyze the impacts of landscape level factors.
SA I.C.1. Identify potential and high-threat TIS, impacts and pathway changes under various climate change scenarios.
SA I.C.2. Identify contributing factors that inhibit management of TIS including non-point source pollution, urbanization, fragmentation and ownership patterns.
OB I.D. Analyze pathways of TIS introduction and spread.
SA I.D.1. Further refine and prioritize current list of TIS pathways and associated subpathways.
SA I.D.2. Periodically review TIS pathways and identify emerging TIS pathways.


Japanese Stiltgrass


Black Swallow-wort

II. Management Practices

Develop and disseminate protocols and strategies for effective TIS management and ecosystem restoration.

Successful management, including prevention, early detection and control of TIS requires a suite of tools to implement management actions. These include methods to identify the most important pathways to prevent new introductions and the most effective detection technologies. Once invasive species begin spreading, dispersal models are needed to determine how to best limit their spread. For those species that are well-established, managers need information on costs and benefits of various management alternatives, including streamlined processes for obtaining certifications and permits if necessary. Finally, restoration can be considered for some environments where invasive species have been sufficiently reduced and where consistent with land management goals.

OB = Objective, SA = Strategic Action

OB II.A. Minimize impacts of TIS through control activities.
SA II.A.1. Prioritize and strategically implement control at state, regional and local scales.
SA II.A.2. Ensure control activities have expected outcomes and measures of success.
SA II.A.3. Evaluate treatments and actions.
OB II.B. Decrease likelihood of new TIS establishing and spreading in Michigan.
SA II.B.1. Build partnerships and recruit partners in response efforts.
SA II.B.2. Respond to reports of new TIS through implementation of actions outlined in the TIS Response Plan.
SA II.B.3. Control or address pathways of introduction or spread.
OB II.C. Incorporate TIS prevention, detection and control into land management plans and activities.
SA II.C.1. Assess goals of management activities and identify TIS that may impact management.
SA II.C.2. Ensure permits address known TIS threats and best management practices for prevention and control.
SA II.C.3. Identify and mitigate land management activities that facilitate introduction and spread of TIS through known pathways.
SA II.C.4. Increase the number of management activities that contribute to a reduction in TIS.
OB II.D. Prevent future TIS invasions and restore ecosystem integrity through enhanced restoration and rehabilitation strategies.
SA II.D.1. Support programs conducting restoration and rehabilitation work.
SA II.D.2. Develop and implement prioritization techniques for restoration and rehabilitation projects.
SA II.D.3. Assess effectiveness of restoration and rehabilitation efforts.
SA II.D.4. Develop new and improve existing restoration and rehabilitation techniques based on local management objectives and feasibility.

III. Monitoring and Research

Coordinate monitoring efforts and direct research efforts to improve the effectiveness of TIS management strategies.

Knowledge about invasive species prevention, detection and treatment practices is incomplete and frequently outdated. Emphasizing the use of applied science will ensure that managers are implementing the most effective technologies for invasive species management. Communicating this information effectively through best management practices will ensure all partners are using the most effective tools.

A framework is also needed to measure progress in accomplishing the four goals of this plan: prevention, early detection and response, control and restoration and collaboration. For instance, monitoring the number of acres treated for invasive species measures an output but fails to show how well the plan achieves control and restoration. A variety of appropriate metrics tied to precise objectives are needed to help managers evaluate progress and identify ways to continually improve.

OB = Objective, SA = Strategic Action

OB III.A. Improve surveillance, reporting and data management with a focus on pathways, risk analysis and early detection.
SA III.A.1. Expand and improve existing information-gathering and data-sharing networks.
SA III.A.2. Develop, distribute and implement standardized monitoring and reporting protocols for use by multiple agencies and partners.
SA III.A.3. Monitor vulnerable ecosystems in rural and urban terrestrial environments.
SA III.A.4. Enhance and implement detection efforts at strategic points of entry and high-risk pathways.
SA III.A.5. Build a knowledge base of the distribution and abundance of existing key terrestrial invasive species.
OB III.B. Expand research on TIS.
SA III.B.1. Quantify economic, ecologic, social and landscape-level impacts of TIS.
SA III.B.2. Support research priorities with a focus on prevention, detection, control and restoration.
SA III.B.3. Identify and develop technology including bio-control for key invasive species.
OB III.C. Track implementation and assess effectiveness of the SMP.
SA III.C.1. Develop a system for tracking activities and accomplishments by agencies and partners.
SA III.C.2. Evaluate actions implemented under this plan.
SA III.C.3. Monitor accomplishments and provide an annual update to decision-makers and stakeholders.

IV. Outreach and Education

Provide TIS program managers and stakeholders with information and training to increase local involvement in prevention, detection and control efforts.

Invasive species draw interest from a wide range of stakeholders, many of whom are well-informed and want to be involved in solutions. Others are impacted by invasive species but may not be well-informed about TIS and efforts will be made to inform these individuals as part of the public awareness strategies listed below. These diverse stakeholder groups are assets providing the needed capacity to solve complex invasive species problems. Their potential can be realized when they are engaged in all aspects of invasive species management, from identification of the most important problems to the development of management strategies. As strategies are implemented, these stakeholders are critical in conducting quality training and promotion of best management and prevention practices in their communities.

OB = Objective, SA = Strategic Action

OB IV.A. Increase public awareness of TIS impacts and threats using public and private partnerships.
SA IV.A.1. Develop or use existing outreach campaigns tailored to specific audiences, integrating the use of social media, videos, printed and web-based materials.
SA IV.A.2. Provide education and outreach through symposia and workshops for landowners, local government officials, resource management professionals and retailers.
SA IV.A.3. Incorporate TIS into educational programming for youth and adults.
SA IV.A.4. Assess changes in attitudes and behavior through surveys of target audiences.
OB IV.B. Prevent the introduction and limit the spread of TIS through public outreach, staff training and information sharing
SA IV.B.1. Enhance existing and develop additional training resources on identification of TIS.
SA IV.B.2. Improve and simplify access to resources for training and reporting.
SA IV.B.3. Engage partners and the public in identification of high threat TIS and reporting to a centralized database.
SA IV.B.4. Develop pathway-oriented outreach materials to distribute to target audiences at strategic locations.
SA IV.B.5. Provide education on decontamination and Best Management Practices (BMPs) to limit the spread of TIS.
SA IV.B.6. Provide education on TIS regulations, policies, laws and quarantines.
OB IV.C. Improve the effectiveness of TIS control through education and training on control measures.
SA IV.C.1. Provide training opportunities on BMPs, control methodology and treatment monitoring.
SA IV.C.2. Develop outreach materials informing the public about TIS, management, control and outcomes.
SA IV.C.3. Promote protective measures and BMPs through communication and coordination with partners.

V. Regulation and Policy

Use current research and data to develop and revise state policies and regulations for management of TIS.

Appropriate regulations are necessary to keep invasive species out of Michigan and minimize the spread of existing ones. Regulators need to provide clear and concise information on laws and policies and streamline processes to promote compliance among industries, recreational users and other partners.

OB = Objective, SA = Strategic Action

OB V.A. Improve regulatory and policy frameworks for invasive species management.
SA V.A.1. Use risk assessments to conduct annual reviews and update the lists of prohibited and restricted species in Part 413 of Michigan's Natural Resources and Environmental Protection Act (NREPA).
SA V.A.2. Identify and address gaps and inconsistencies in state policies, procedures, permits, land use orders, quarantines and legislation.
SA V.A.3. Enhance the capacity to enforce TIS legislation and policies.
OB V.B. Secure resources for high-priority invasive species projects.
SA V.B.1. Identify resource needs and funding gaps for implementation of invasive species projects.
SA V.B.2. Leverage existing resources and develop incentives to maximize management capacity.
SA V.B.3. Create stable funding sources for TIS management.

The Law in Michigan:

In 2003, the state legislature passed a law regulating the introduction and further spread of invasive species in Michigan. Part 413, Transgenic and Nonnative Organisms, of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, as amended, was written as a preventative measure to stop invasive species with the potential to harm human health or natural, agricultural or silvicultural resources. Included in the legislation is a list of prohibited or restricted species. Annually, species may be added, deleted or re-classified by the legislature based on recommendations from the Natural Resources Commission or the Commission of Agriculture and Rural Development in consultation with the departments of Natural Resources and Agriculture and Rural Development. This list acts as a first line of prevention and awareness, with other supporting activities strengthening this effort. A link to the current list of Part 413 terrestrial species is included in Appendix E.

VI. Leadership and Coordination

Provide leadership and coordination for statewide efforts to prevent, detect, manage and control terrestrial invasive species.

TIS prevention, detection and management occur at multiple levels of government among numerous partners and within various frameworks across the state. To enhance the ability to prevent introductions, limit dispersal and improve effectiveness of long-term management measures, it is essential to put forth a cohesive and comprehensive interagency effort, provide support for external partners and facilitate informed decision-making. These strategic actions aim to enhance coordination among state agencies and build leadership capacity to advance TIS management at all levels across the state.

OB = Objective, SA = Strategic Action

OB I.A. Improve capacity to detect and respond to high-threat and emerging TIS.
SA VI.A.1. Develop an interagency TIS response plan.
SA VI.A.2. Develop and support a first detector network of trained personnel at strategic locations.
SA VI.A.3. Develop and implement species-specific response plans.
SA VI.A.4. Test and evaluate response plans through mock detections or exercises.
OB I.B. Increase technical expertise available for TIS information and identification.
SA VI.B.1. Establish a network of local, state and regional experts to inform TIS planning and action.
SA V I.B.2. Create and maintain list of taxa-specific TIS verification experts.
OB I.C. Prevent and manage TIS through coordination and collaboration with partners at multiple levels.
SA VI.C.1. Find common approaches to harmonize cross-jurisdictional action with federal and state agencies and local municipalities.
SA VI.C.2. Develop and support vital partnerships to increase understanding of impacts, available resources and needed capacity.
SA VI.C.3. Work collaboratively with industry to address pathways of introduction through prevention, detection and control.
SA VI.C.4. Foster partnerships that increase the likelihood of management and research success and eliminate duplicative efforts and expenditures.

Putting the Plan into Action: Next Steps

The Terrestrial Invasive Species State Management Plan outlines the actions necessary to advance the prevention, management and control of Michigan's terrestrial invasive species. The highest priorities are those that prevent new invasions such as implementing a risk assessment process for updating the various prohibited, restricted and watch lists (V.A.1). Similarly important is analyzing the cost and benefits of various pathway surveillance efforts (I.D.I) and implementing detection efforts at strategic points-of-entry and high risk pathways (III.A.4).

While a higher priority will be placed on activities supporting prevention, the State and its partners are responsible for addressing invasive species that have arrived and are spreading or already well established. Priority will be given to identifying the optimal management alternatives to eradicate invasive species. Secondarily, those species that are beyond eradication will be addressed through the development of control technology, including biocontrol (III.B.3.), prioritizing ecosystems that are most vulnerable to TIS (I.A.1), identifying contributing factors that inhibit control (I.C.2.) and evaluating treatments and actions (II.A.3.). Activities should rely on the most advanced science and technology and contribute to the development of best management practices.

Finally, every action should further the development of necessary tools to enable the State of Michigan and its partners to continually improve invasive species management. This will require partnerships with researchers and managers to evaluate and publish the lessons learned and improve information exchange (III.A.1.).

Michigan has a citizenry that is willing to be engaged in invasive species management; that power can be harnessed through partnerships such as Cooperative Invasive Species Management Areas. Implementing this plan is an exciting opportunity to advance these collaborations involving public, private, nonprofit organizations, researchers and others to collectively address the most important invasive species challenges.

Emerald Ash Borer survey and tree removal Delta Township

Emerald Ash Borer survey and tree removal Delta Township

A DNR parks employee spraying pesticide to fight the Hemlock Woolly Adelgid

Invasives workshop viewing Japanese Knotweed

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Japanese Knotweed

Oak Wilt

Glossary of Terms

BMP
Best management practices (BMPs) are a set of guidelines for preventing or controlling the spread of invasive species based on generally accepted or tested methods.

Bio-control
Bio-control or biological control is the reduction of pest populations by natural enemies and typically involves an active human role.

CISMA
Cooperative Invasive Species Management Areas (CISMAs) are local organizations that facilitate collaboration across jurisdictional boundaries for more effective invasive species management.

Control
Limiting the spread, reducing or eradicating an already established invasive species population.

Detection
Discovering the occurrence of an invasive species at a new or previously unconfirmed location.

Ecosystem
A community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (air, water and mineral soil), interacting as a system.

Establishment
An invasive species is considered established once its population is reproducing and self-sustaining.

Eradication
Completely removing an invasive species population from a location.

Introduction
The release or transport of a non-native species to a new location or environment. There are many modes of introduction.

Management
Actions taken to prevent the establishment of new invasive species, limit the dispersal or minimize negative impacts of established invasive species populations.

Mitigate
Taking measures to lessen the severity of impacts.

Monitoring
Systematic surveillance of invasive species to collect information regarding status and spread to evaluate progress and effectiveness of activities.

NREPA
In 1994, the Michigan legislature codified the many natural resource and environmental protection laws under the Natural Resources and Environmental Protection Act, 1994 Public Act 451, as amended. (NREPA). Part 413, Transgenic and Nonnative Organisms, was added to NREPA in 2003 and refers specifically to the regulation of invasive species.

Pathways
How invasive species are transported from one location to another. There are natural, animal and human-assisted pathways (e.g. hitchhikers, shipping, transportation).

Prioritization
Determining the relative importance of controlling invasive species based on potential negative impacts to Michigan's environment, economy and the health of its citizens.

Rehabilitation
A process of returning desirable elements (i.e., processes, species, services) to an ecosystem, often requiring the removal of certain invasive species, but not emphasizing a return to former plant and animal communities or even to an ecosystem primarily consisting of native species.

Response
Actions taken in reaction to detection of an invasive species. Response options vary but may include confirming the detection, evaluating the detection, communication and applying mechanical, chemical or physical control.

Restoration
A process of returning desirable elements (i.e., processes, species, services) to an ecosystem, including re-establishing former plant and animal communities and native species to the greatest extent possible based on reference ecosystems.

Risk analysis
A process of identifying optimal management approaches for species in various stages of invasion and the costs and benefits of each.

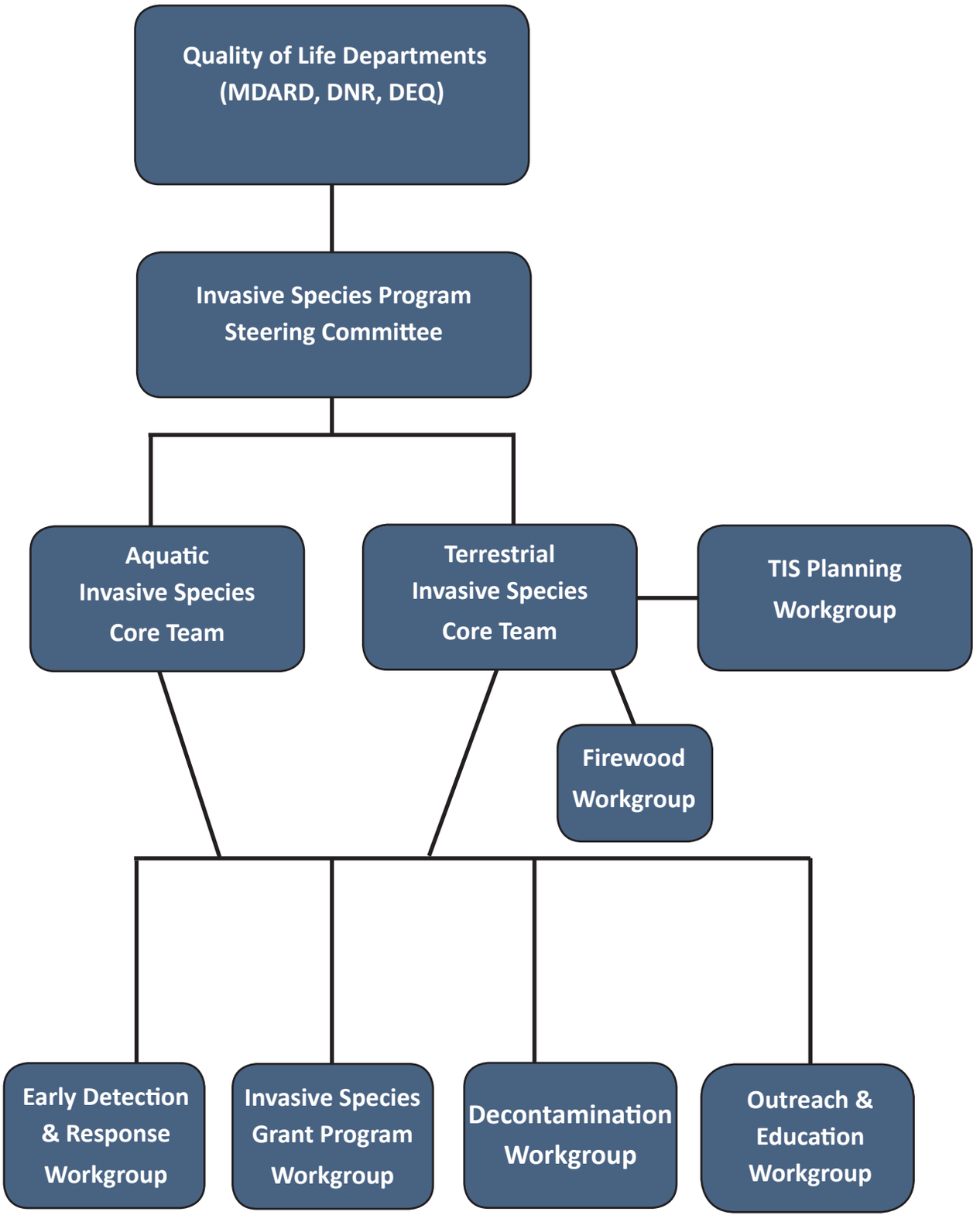
Risk assessment
Evaluation of the likelihood of a species introduction, establishment, spread and the severity of the impact.

Survey
Systematic examination of a pre-determined area to detect and record invasive species on the landscape. Surveys provide data on new detections, existing populations and species distribution.

Terrestrial
A plant or animal living on land as opposed to water. Terrestrial animals are those that live on or in the ground; terrestrial plants grow in soil versus in water.

Appendix A. Invasive Species Program Governance

The Invasive Species Program governance structure within the Michigan Quality of Life Departments of Agricultural and Rural Development (MDARD), Natural Resources (DNR) and Environmental Quality (DEQ).



Appendix B. List of Priority Terrestrial Invasive Species

Terrestrial Invasive Species Watch List

The invasive species included on the watch list are priority species that have been identified as posing an immediate and significant threat to Michigan's natural resources. These species have either not been confirmed in Michigan, have very limited distribution or are localized. Early detection and timely reporting of occurrences of these species is crucial for increasing the likelihood of stopping an invasion and limiting negative ecological and economic impacts. This list is reviewed and updated periodically, and the most current list is available at www.michigan.gov/invasives.

Terrestrial Watch List Species		
Common Name	**Scientific Name**	**Category**
Asian longhorned beetle	*Anoplophora glabripenni*	Insect
Asiatic sand sedge	*Carex kobomugi*	Plant
Balsam woolly adelgid	*Adelges piceae*	Insect
Chinese yam*	*Dioscorea oppositifolia*	Plant
Hemlock woolly adelgid*	*Adelges tsugae*	Insect
Himalayan balsam*	*Impatiens glandulifera*	Plant
Japanese stiltgrass*	*Microstegium vimineum*	Plant
Kudzu*	*Pueraria montana*	Plant
Mile-a-minute weed	*Persicaria perfoliata*	Plant
Nutria	*Myocastor coypus*	Mammal
Thousand Cankers Disease	*Geosmithia morbida* *Pityophthorus juglandis*	Tree Disease

** denotes known presence in Michigan.*

Prohibited or Restricted Terrestrial Invasive Species

Some invasive species are legally designated by the State of Michigan as either "prohibited" or "restricted." If a species is prohibited or restricted, it is unlawful to possess, introduce, import, sell or offer that species for sale as a live organism, except under certain circumstances.

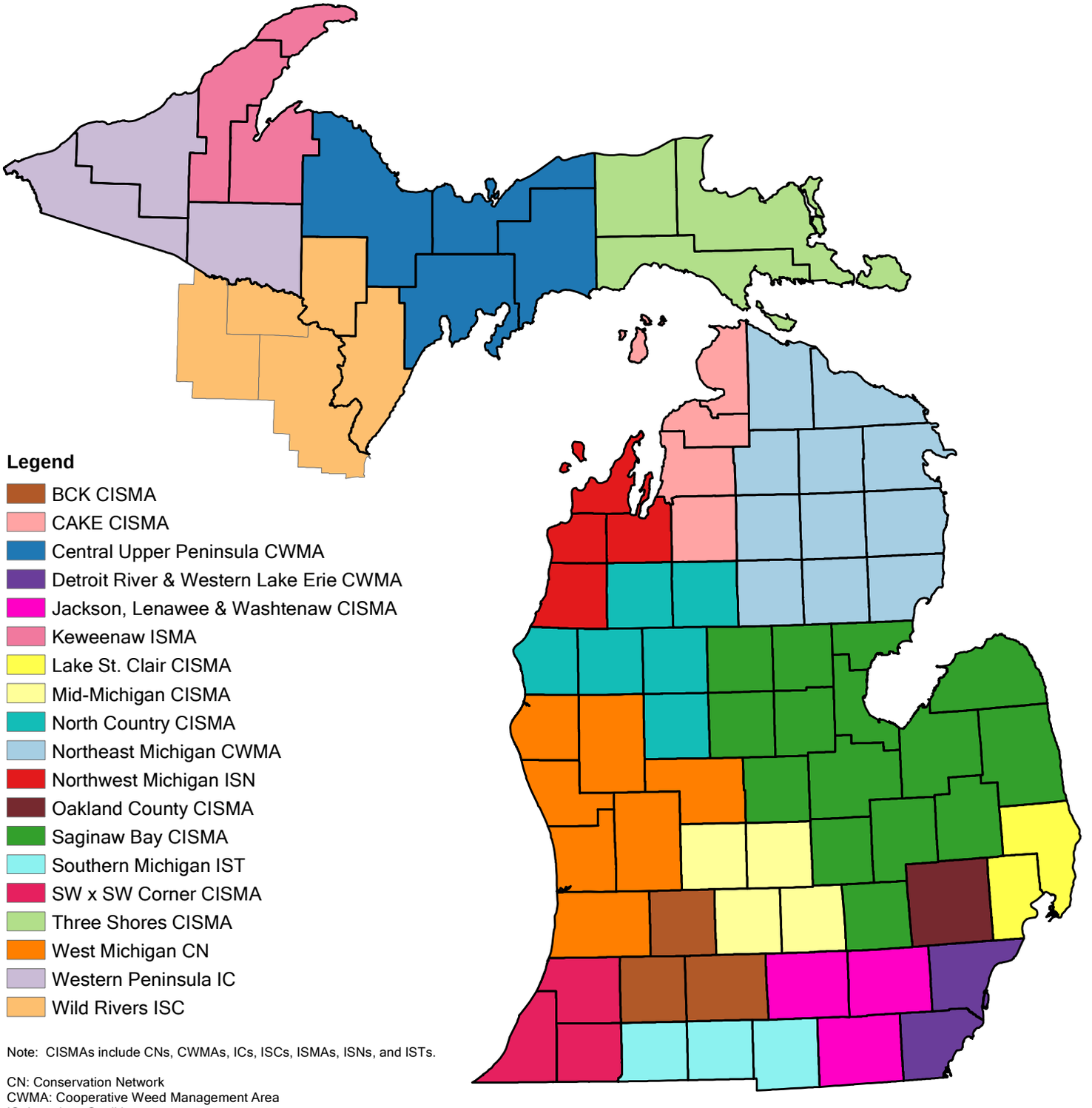
The term "prohibited" is used for species that are not widely distributed in the state. Often, management or control techniques for prohibited species are not available.

The term "restricted" is applied to species that are established in the state. Management and control practices are usually available for restricted species. Autumn olive is currently the only terrestrial invasive species designated as restricted.

Part 413 of Michigan's Natural Resources and Environmental Protection Act (NREPA) established the list of prohibited and restricted species, which is regularly amended by Invasive Species Orders. This list is reviewed and updated periodically. The most current list is available at www.michigan.gov/invasives.

Terrestrial Prohibited and Restricted Species		
Common Name (P = Prohibited; R = Restricted Species)	**Scientific Name**	**Category**
Asian longhorned beetle (P)	*Anoplophora glabripennis*	Insect
Autumn olive (R)	*Elaeagnus umbellata*	Shrub
Brown garden snail (P)	*Helix aspersa*	Mollusk
Carthusian snail (P)	*Monacha cartusiana*	Mollusk
Emerald ash borer (P)	*Agrilus planipennis*	Insect
Eurasian collared dove (P)	*Streptopelia decaocto*	Bird
Feral swine (P)	*Sus scrofa linnaeus*	Mammal
Giant African snail (P)	*Achatina fulica*	Mollusk
Giant hogweed (P)	*Heracleum mantegazzianum*	Plant
Girdled snail (P)	*Hygromia cinctella*	Mollusk
Heath snail (P)	*Xerolenta obvia*	Mollusk
Japanese knotweed (P)	*Fallopia japonica*	Plant
Nutria (P)	*Myocastor coypus*	Mammal
Wrinkled dune snail (P)	*Candidula intersecta*	Mollusk

Appendix C. Michigan Cooperative Invasive Species Management Areas (CISMAs)



Note: CISMAs include CNs, CWMAs, ICs, ISCs, ISMAs, ISNs, and ISTs.

CN: Conservation Network
CWMA: Cooperative Weed Management Area
IC: Invasives Coalition
ISC: Invasive Species Coalition
ISMA: Invasive Species Management Area
ISN: Invasive Species Network
IST: Invasive Species Team

For more information on your local CISMA, visit the Michigan Invasive Species Coalition's website at www.michiganinvasives.org

Updated March 1, 2018
Michigan Invasive Species Coalition

Updated at http://www.michiganinvasives.org/managementareas/

Appendix D.

Michigan Terrestrial Invasive Species State Management Plan Implementation Table									
Activity Area I: Risk Analysis									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	E	R	C		
I.A. Identify and prioritize ecosystems vulnerable to TIS.	I.A.1. Implement a science-based risk assessment process to analyze the level of ecosystem susceptibility and vulnerability to TIS.	Identify and evaluate existing risk assessment processes. Refine and adapt processes for use by state agencies and partners.	Risk assessment process in place.	X	X	X	X	DARD DEQ DNR	Academia, Industries, NGOs, Federal agencies
	I.A.2. Define high value ecosystems to facilitate prioritization of detection, response and management efforts.	Gather information on high-value ecosystems within plans and among partners.	High-value ecosystems identified.	X	X	X		TIS Core Team	Academia, NGOs, Federal agencies
I.B. Identify and prioritize current and potential high-threat TIS.	I.B.1. Implement a science-based risk assessment process to analyze the level of risk of potential TIS and likelihood of introduction.	Identify and evaluate existing risk assessment processes. Refine and adapt processes for use by state agencies and partners.	Risk-assessment process in place.	X	X		X	DARD DEQ DNR	Academia, Industries, NGOs, Federal and Tribal governments
	I.B.2. Develop prioritization process for prevention, detection and control of TIS.	Create or adapt from existing processes, and distribute for use by partners, agencies, NGOs.	Prioritization process developed, documented and implemented.	X	X	X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal governments
I.C. Analyze the impacts of landscape level factors.	I.C.1. Identify potential and high-threat TIS impacts and pathway changes under various climate change scenarios.	Support or conduct scientific inquiry on effects of different climate change scenarios on TIS. Identify potential risks posed by changing climates.	Results are disseminated.	X	X			DARD DEQ DNR	Industries, NGOs, Academia, local, state, federal and tribal governments
	I.C.2 Identify contributing factors that inhibit management of TIS including non-point source pollution, urbanization, fragmentation and ownership patterns.	Support or conduct scientific inquiry on effects of contributing factors on TIS. Identify potential risks posed.	Results are disseminated.		X	X		DARD DEQ DNR	Industries, NGOs, Academia, local, state, federal and tribal governments

* Goals (PERC); P=Prevention, E=Early Detection and Response, R=Control and Restoration, C=Collaboration

Activity Area I: Risk Analysis (Cont'd)

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
I.D. Analyze pathways of TIS introduction and spread.	I.D.1 Further refine and prioritize current list of TIS pathways and associated subpathways.	Support or conduct scientific inquiry on pathways and subpathways. Conduct pathway analysis.	Results of analysis distributed.	X	X			DARD DEQ DNR	Industries, Academia, NGOs
	I.D.2 Periodically review known and identify emerging TIS pathways.	Conduct periodic review of pathways.	Periodic review conducted.	X	X			DARD DEQ DNR	Industries, Academia, NGOs

Activity Area II: Management Practices

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
II.A. Minimize impacts of TIS through control activities.	II.A.1. Prioritize and strategically implement control at state, regional, and local scales.	Maintain Michigan Invasive Species Coalition and State disperses grant funding to CISMAs.	Priority species and projects are defined and aligned with each other.		X	X	X	DARD DNR	Industries, NGOs, Academia, local, state, federal and tribal governments
	II.A.2. Ensure control actions have expected outcomes and measures of success.	Provide staff and partners with training on developing outcomes and measures of success.	Number of projects with outcomes and measures of success.	X		X		TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal governments
	II.A.3. Evaluate treatments and actions.	Use common indicators to measure level of control success.	Number of actions met or exceeded target level of control.			X	X	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal governments
II.B. Decrease likelihood of new TIS establishing and spreading in Michigan.	II.B.1. Build partnerships and recruit partners in response efforts.	Outreach to potential partners.	List of partners.			X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal governments
	II.B.2. Respond to reports of new TIS through implementation of actions outlined in the TIS Response Plan.	Increase capacity and apply resources according to level of infestation.	Number of responses.			X		DARD DNR	CISMAs, NGOs, Academia, local, state, federal and tribal governments
	II.B.3. Control or eliminate pathways of introduction or spread.	Identify target pathway and interrupt or control pathway.	Number of pathways interrupted or controlled.	X		X		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal governments

Activity Area II: Management Measures (Cont'd)

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
II.C. Incorporate TIS prevention, detection and control into land management plans and activities.	II.C.1. Assess goals of management activities and identify TIS that may impact management.	TIS surveys and databases are consulted during development of management plans.	Information on presence and abundance of TIS included in management plans. Management goals are achievable.	X	X	X		Land Managers and Planners	TIS Core Team
	II.C.2. Ensure permits address known TIS threats and best management practices for prevention and control.	Draft standard permit conditions for use by review staff and partners addressing TIS.	Standard permit conditions available for staff and other governments.	X	X	X	X	TIS Core Team	Local, state and tribal agencies
	II.C.3. Identify and mitigate land management activities that facilitate introduction and spread of TIS through known pathways.	Identify target species, pathways and BMPs.	Number of management plans including BMPs to prevent the spread of invasive species.	X	X	X		Land Managers and Planners	TIS Core Team
	II.C.4. Increase the number of management activities that contribute to a reduction in TIS.	Document target species for control. Identify management actions that help control TIS.	Number of control activities increasing.			X	X	Land Managers and Planners	TIS Core Team
II.D. Prevent future TIS invasions and restore ecosystem integrity through enhanced restoration and rehabilitation strategies.	II.D.1. Support programs conducting restoration and rehabilitation work.	Identify resources for restoration work and highlight successes and accomplishments.	Resources identified. Number of success stories.			X	X	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies
	II.D.2. Develop and implement prioritization techniques for restoration and rehabilitation projects.	Work with agencies and partners to identify restoration priorities. Develop and distribute prioritization guidelines.	Guidelines created and made available.			X		TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies
	II.D.3. Assess effectiveness of restoration and rehabilitation efforts.	Engage in pre-and post-restoration monitoring. Communicate results of restoration activities.	Monitoring results documented and shared.	X	X	X		TIS Core Team	Land managers
	II.D.4. Develop new and improve existing restoration and rehabilitation techniques.	Evaluate, coordinate and improve existing techniques. Provide staff and partners with training on new techniques.	Number of trainings offered.			X	X	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies

Activity Area III: Monitoring and Research

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
III.A. Improve surveillance, reporting and data management with a focus on pathways, risk analysis and early detection.	III.A.1. Expand and improve existing information gathering and data sharing networks.	Develop additional functionality and improve accessibility of centralized data sharing networks. Promote centralized network through multimedia outreach efforts.	Number of users reporting added; # reportable species added; # reports received.	X	X		X	TIS Core Team	MISIN, Industries, Academia, NGOs
	III.A.2. Develop, distribute and implement standardized monitoring and reporting protocols for use by multiple agencies and partners.	Evaluate, coordinate and streamline existing protocols and procedures. Provide staff and partners with training on protocols. Conduct routine monitoring and report data to centralized database.	Protocols developed; number of trainings or training resources provided.		X		X	DARD DEQ DNR	MISIN, Industries, Academia, NGOs, local, state, federal and tribal agencies
	III.A.3. Monitor vulnerable ecosystems in rural and urban terrestrial environments.	Conduct or support routine monitoring using standardized protocol.	Number of sites monitored		X			TIS Core Team	Academia, Industries, NGOs, local, state, federal and tribal agencies
	III.A.4. Enhance and implement detection efforts at strategic points of entry and high-risk pathways.	Identify strategic points of entry. Train and deploy staff to conduct targeted surveillance.	Detection efforts enhanced at strategic locations.		X			DARD DNR	Academia, Industries, NGOs
	III.A.5. Build a knowledge base of the distribution and abundance of existing key terrestrial invasive species.	Collect, analyze, summarize and distribute data on TIS detections. Provide maps, briefings and other informational materials on species distribution to public, partners and staff.	Data analyzed and results distributed via websites, published results, etc.		X		X	DARD DNR	Academia, Industries, NGOs

Activity Area III: Monitoring and Research (Cont'd)

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
III.B. Expand research on TIS.	III.B.1. Quantify economic, ecologic, social and landscape level impacts of TIS.	Support and track research.	Number of new studies on TIS impacts.	X	X	X		TIS Core Team	Academia, Industries, NGOs
	III.B.2. Support research priorities with a focus on prevention, detection, control and restoration.	Support and track research.	Number of new research projects on TIS prevention, detection and restoration.	X	X	X	X	TIS Core Team	Academia, Industries, NGOs
	III.B.3. Identify and develop promising control technology, including biocontrol, for key invasive species.	Support and track research.	Number of new technologies developed. Number of bio-control introduced.		X	X		TIS Core Team	Academia, Industries, NGOs
III.C. Track implementation and assess effectiveness of the SMP.	III.C.1. Develop a system for tracking activities and accomplishments by agencies and partners.	Identify tracking requirements and mechanisms. Create database for documenting activity. Promote easy access of database for reporting.	Database developed.	X	X		X	TIS Core Team	CISMAs, Academia, Industries, NGOs, local, state, federal and tribal agencies
	III.C.2. Evaluate actions implemented under this plan	Determine if outcomes meet measures of success.	Progress on actions documented.	X	X	X		TIS Core Team	Academia, Industries, NGOs
	III.C.3. Monitor accomplishments and provide annual update to decision-makers and stakeholders.	Compile information on accomplishments. Determine method of reporting and end users. Provide written or oral updates.	Report of accomplishments provided	X	X	X	X	TIS Core Team	Academia, NGOs

Activity Area IV: Outreach and Education									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	E	R	C		
IV.A. Increase public awareness of TIS impacts and threats utilizing public and private partnerships.	IV.A.1. Develop or use existing outreach campaigns tailored to specific audiences, integrating the use of social media, videos, printed and web-based materials.	Identify audiences, identify and evaluate existing efforts and determine the need for new efforts. Make recommendations and develop materials.	Audiences identified, recommendations made, materials developed and distributed.	X		X		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.A.2. Provide education and outreach through symposia and workshops for landowners, local government officials, resource management professionals and retail trade.	Present information regarding TIS through oral presentations. Distribute printed materials at conferences, meetings, etc. Hold workshops for landowners, professionals and partners.	Number of presentations given; number of workshops held; number of conferences attended.	X		X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.A.3. Incorporate TIS into educational programming for youth and adults.	Evaluate existing educational programming for k-12 and adults. Identify needs and potential partners for enhanced programming. Develop resources for teachers and extension offices.	TIS in the curriculum.	X		X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.A.4. Assess changes in attitudes and behavior through surveys of target audiences.	Develop and distribute stakeholder survey.	Survey developed. Results analyzed.	X	X	X		TIS Core Team	Academia, NGOs

Activity Area IV: Outreach and Education (Cont'd)									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	E	R	C		
IV.B. Prevent the introduction and limit the spread of TIS through public outreach, staff training and information sharing.	IV.B.1. Enhance existing and develop additional training resources on identification of TIS.	Develop TIS identification course.	Trained staff and volunteers in TIS.	X	X	X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.2. Improve and simplify access to resources for training and reporting.	Identify resources available.	List of resources available with access information.	X	X	X		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.3. Engage partners and the public in identification of high threat TIS and reporting to a centralized database.	Outreach on MISIN.	Number of new users MISIN. Number of reports increasing.	X	X	X	X	TIS Core Team	CISMAs, MISIN, Industries, NGOs, Academia
	IV.B.4. Develop pathway-oriented outreach materials to distribute to target audiences at strategic locations.	Identify target species and develop pathway-oriented materials.	List of distribution points. Outreach materials developed and made available.	X	X	X		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.5. Provide education on decontamination and Best Management Practices (BMPs) to limit the spread of TIS.	Evaluate existing BMPs and develop additional ones.Provide electronic access to BMPs and resources on decontamination. Develop videos and instructional materials for decontamination.	Electronic materials developed and made available.	X	X	X		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.6. Provide education on TIS regulations, policies, laws and quarantines.	Evaluate existing materials and develop additional ones. Update websites with new and relevant information.	Materials available for outreach.	X	X	X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies

Activity Area IV: Outreach and Education (Cont'd)									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	E	R	C		
IV.C. Improve the effectiveness of TIS control through education and training on control measures.	IV.C.1. Provide training opportunities on BMPs, control methodology and treatment monitoring.	Schedule and host trainings for partners, staff and the public. Create web-based training resources.	Number of trainings hosted; number of online modules developed.	X	X		X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.C.2. Develop outreach materials informing public about TIS, management, control, and outcomes.	Develop materials. Update websites with new and relevant information.	Materials available for outreach.	X	X		X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.C.3. Promote protective measures and BMPs through communication and coordination with partners.	Use partner group meetings, conferences and events to promote BMPs and distribute information.	Number of events.	X	X		X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies

Activity Area V: Regulation and Policy

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
V.A. Improve regulatory and policy frameworks for invasive species management.	V.A.1. Use risk assessments to conduct annual reviews and update the lists of prohibited and restricted species in Part 413 of Michigan's Natural Resources and Environmental Protection Act (NREPA).	Review existing and emerging TIS threats. Provide recommendations for adding or removing species from Part 413 of the NREPA list.	Trained staff and volunteers in TIS.	X			X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	V.A.2. Identify and address gaps and inconsistencies in state policies, procedures, permits, land use orders, quarantines and legislation.	Evaluate existing legislation and regulations that affect TIS management goals and SMP implementation. Provide briefing on current status.	List of resources available with access information.	X	X		X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	V.A.3. Enhance the capacity to enforce TIS legislation and policies.	Evaluate enforcement and compliance mechanisms. Make recommendations on the need for enhanced measures. Initiate enforcement action on violators.	Recommendations submitted, violations documented and enforcement action taken.	X	X		X	DARD-PPPM DNR-LED	State police, Attorney General's office, local prosecutors
V.B. Secure resources for high-priority invasive species projects.	V.B.1. Identify resource needs and funding gaps for implementation of invasive species projects.	Conduct an inventory of existing resources and projects. Determine where program gaps and needs exist.	Inventory list; gap list.	X	X	X	X	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies
	V.B.2. Leverage existing resources and develop incentives to maximize management capacity.	Evaluate existing grant programs and improve processes. Identify potential projects for collaboration or match. Explore incentives to manage invasive species.	Identify potential funding sources to address program gaps. Develop and submit funding proposals.	X	X	X	X	DARD DEQ DNR	Industries, NGOs, Academia, Federal agencies
	V.B.3. Create stable funding sources for TIS management.	Identify potential funding sources to address program gaps. Develop and submit funding proposals.	Proposals submitted.	X	X	X	X	TIS Core Team	Industries, NGOs, Academia, Tribes; Federal, state and provincial agencies

Activity Area VI: Leadership and Coordination

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
VI.A. Improve capacity to detect early and respond to high-threat and emerging TIS.	VI.A.1. Develop an interagency TIS response plan.	Adapt existing AIS Early Detection and Response Plan and Policy to include TIS.	Invasive Species Response Plan and Policy adapted.		X		X	DARD-PPPM & AID, DNR-WLD & FRD	USDA, USFS, Tribal agencies, CISMAs
	VI.A.2. Develop and support a first detector network of trained personnel at strategic locations.	Example tasks. Identify key detection locations; train field personnel on identification; provide detectors with ID, reporting and outreach resources	First detector network in place.	X	X		X	DARD-PPPM & AID DNR- WLD & FRD	NGOs, Academia, Industries, local, state, federal, and tribal agencies
	VI.A.3. Develop and implement species-specific response plans	Identify barriers for detection and response. Identify key actions and personnel for response implementation.	Response plans developed for all watch list species. 90% of barriers addressed or removed.	X	X	X	X	DARD DNR	NGOs, Academia, Industries, local, state, federal and tribal agencies
	VI.A.4. Test and evaluate response plans through mock detections or exercises.	Conduct species-specific response exercises to test response plans for high threat species. Involve interactions of all agencies and define roles, authorities and resources. Develop After Action Reports to evaluate mock responses.	Number of mock exercises conducted. Number of After Action Report items addressed.	X	X		X	DARD-PPPM & AID DNR-WLD & FRD	USDA, USFS, Tribal agencies, CISMAs
VI.B. Increase technical expertise available for TIS information and identification.	VI.B.1. Establish a network of experts to provide updated facts, figures and details to inform TIS planning.	Determine extra-agency experts on TIS and solicit involvement in Core Team activities.	List of experts created.	X	X	X	X	TIS Core Team	NGOs, Academia, Industries, CISMAs, local, state, federal and tribal agencies
	VI.B.2. Create and maintain list of taxa-specific TIS verification experts.	Identify experts on specific TIS taxa and resources for verification of specimens. Document and address gaps.	List of experts created. Gaps in expertise identified and filled.	X	X	X	X	TIS Core Team	NGOs, Academia, Industries, CISMAs, local, state, federal and tribal agencies

Activity Area VI: Leadership and Coordination (Cont'd)

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
VI.C. Prevent and manage TIS through coordination and collaboration with partners at multiple levels.	VI.C.1. Find common approaches to harmonize cross-jurisdictional action with federal and state agencies and local municipalities.	Strengthen and support regional partnerships and initiatives. Identify and address barriers to action and collaboration. Increase coordinated efforts with local government.	50% of barriers removed. # Coordinated efforts and actions.	X	X	X	X	TIS Core Team	Federal, state, provincial, tribal and local agencies, CISMAs
	VI.C.2. Develop and support vital partnerships to increase understanding of impacts, available resources and needed capacity.	Compile list of existing TIS partnerships. Evaluate effectiveness and identify gaps.	Vital partnerships are in place and active through MOUs, plans, proposals or other collaborative opportunities.	X	X	X	X	TIS Core Team	CISMAs, MISC, Industries, IFIC, NGOs, Academia, local, state, federal and tribal agencies
	VI.C.3. Work collaboratively with industry to address pathways of introduction through prevention, detection and control.	Work with potential industry partners. Identify potential actions to mitigate TIS introduction and spread via industry related pathways.	75% of mutually agreed actions to prevent TIS through firewood, wood products and organisms in trade pathways are implemented. 50% of land managing industries are equipped to identify invasive species and take action on lands they manage.	X	X	X	X	DARD DNR	Industries, Academia, NGOs
	VI.C.4. Foster partnerships that increase the likelihood of management and research success to eliminate duplicative efforts and expenditures.	Work with agencies and organizations conducting TIS management and/or research to evaluate efforts and identify potential cross-over.	Number of coordinated efforts and actions.	X	X	X	X	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies

Appendix E. Laws and Regulations

Law or Regulation	Agency/Agencies	Summary
Animal Industry Act, 1998 P.A. 466 as amended	MDARD	The Animal Industry Act includes measures "to protect the human food chain and the livestock and aquaculture industries of the state through prevention, control, and eradication of infectious, contagious, or toxicological diseases of livestock and other animals; to prevent the importation of certain nonindigenous animals under certain circumstances."
Certification of Seed (1959 P.A. 221)	MDARD	Certification of Seed defines certified and certain other classes of seed and authorizes the Director to develop rules, regulations and standards regarding certification and seed classes.
Cooperative Forestry Assistance Act of 1978, as amended (16 U.S.C. 41)	USDA - USFS	The Cooperative Forestry Assistance Act (16 U.S.C. 41) includes provisions for the prevention and control of insects and diseases affecting trees and forests and for broadening existing forest management, fire protection, insect and disease protection programs on non-Federal forest lands.
Federal Noxious Weed List		The Federal Noxious Weed List is the list of noxious weeds prohibited or restricted by the Plant Protection Act of 2000 as amended.
Federal Seed Act (7 C.F.R. part 201)	USDA - AMS	The Federal Seed Act establishes standards for records, maintenance, labeling and oversight for agricultural and vegetable seeds.
Field Seed Certification - DARD Regulation No. 623	MDARD	The Field Seed Certification Regulation defines and establishes standards and processes for seed certification for field crop and turf grass seeds.
Food Security Act of 1985 (16 U.S.C. 3801-3862)	USDA - NRCS	The Food Security Act of 1985, also referenced as the 1985 Farm Bill, allows lower commodity prices and income supports, and also established the Conservation Reserve Program (CRP), sodbuster and swampbuster regulations.
Forest Service Organic Administration Act of 1897 (16 U.S.C. 2)	USDA - USFS	The Organic Administration Act authorizes the establishment and administration of national forests.
Insect Pests and Plant Diseases 1945 P.A. 72)	MDARD	The Insect Pest and Plant Disease Act of 1945 authorizes measures to "prevent the importation from other states, and the spread within this state, of all serious insect pests and contagious plant diseases and to provide for their repression and control, imposing certain powers and duties on the commissioner of agriculture."

Law or Regulation	Agency/Agencies	Summary
Lacey Act (18 U.S.C. 42)	USFWS	Under the Lacey Act (18 U.S.C. 42), 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 U.S. These injurious species may not be imported into or transported between states, districts or territories of the U.S. without a permit issued by the U. S. Fish and Wildlife Service. The 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008), amended the Lacey Act by expanding its protection to a broader range of plants and plant products. The Lacey Act now also makes it unlawful to import certain plants and plant products without an import declaration.
Large Carnivore Act (2000 P.A. 274)	MDARD	The Large Carnivore Act regulates the ownership, possession and care of certain large carnivores.
List of Prohibited and Restricted Species in Michigan	MDARD, DNR, DEQ	The Prohibited and Restricted Species List indicates currently prohibited and restricted species in Michigan as expressed in Part 413 of NREPA and invasive species orders.
Michigan Seed Law (1965 P.A. 329)	MDARD	The Michigan Seed Law includes regulation of the labeling, coloration, advertising, sale, offering, exposing, or transporting for sale of agricultural, vegetable, lawn, flower, and forest tree seeds and authorizes the director of agriculture to adopt rules for the enforcement of this act.
National Environmental Policy Act (NEPA) 42 U.S.C. 4321 et seq. (1969)	USDA - USFS	The National Environmental Policy Act provides for the proper consideration to the environment prior to undertaking any major Federal action that significantly affects the environment and establishes requirements for environmental assessments and/or environmental impact statements.
Natural Resources and Environmental Protection Act 1994 P.A. 451 as amended (NREPA)	DNR, NRC, DEQ, MDARD	NREPA's purpose is to "protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to protect the people's right to hunt and fish; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, assessments, and donations; to provide certain appropriations; to prescribe penalties and provide remedies; and to repeal acts and parts of acts."

Law or Regulation	Agency/Agencies	Summary
Noxious Weeds Act - 1941 P.A.359	MDARD	The Noxious Weeds Act provides for the control and eradication of noxious weeds by outlining powers of municipal and local governments.
Part 413, Transgenic and Non-native Organisms, of NREPA	MDARD, DNR, MDEQ	Part 413 of NREPA defines prohibited and restricted species in Michigan and limits the possession, import or sale of such species.
Plant Protection Act (7 U.S.C. 7701)	USFWS	The Plant Protection Act of 2000, (7 U.S.C. 7701 et seq.) which includes the Noxious Weed Control and Eradication Act of 2004, regulates the movement of plants, plant products, biological control organisms, and noxious weeds and authorizes the Secretary of Agriculture to "publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or that are subject to restrictions on interstate movement within the United States."
Presidential Executive Order 13112	DEQ, USFWS, USDA - APHIS, USDA - NRCS, USFS	Presidential Executive Order 13112 (1999) requires that the National Invasive Species Council be created to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.
Privately Owned Cervidae Producers Marketing Act - 2000 P.A. 190.	MDARD	The Privately Owned Cervidae Producers Marketing Act defines, develops, and regulates privately owned cervidae as an agricultural enterprise in Michigan and provides relevant power and duties to certain state agencies and departments.
Seed Law Implementation - Regulation 715	MDARD	The Seed Law Implementation Regulation provides the state list of prohibited and restricted noxious weeds
Seed Potato Certification - DARD Regulation No. 628	MDARD	The Seed Potato Certification Regulation defines and establishes standards and processes for potato seed certification.
Soil and Water Resources Conservation Act of 1977 (16 U.S.C. 40)	USDA - NRCS	The Soil and Water Resources Conservation Act of 1977, as amended provides the United States Department of Agriculture broad strategic assessment and planning authority for the conservation, protection, and enhancement of soil, water, and related natural resources.
Soil Conservation and Domestic Allotment Act of 1935 (16 U.S.C. 590 et seq. as amended)	USDA - NRCS	The Soil Conservation and Domestic Allotment Act authorizes Secretary of Agriculture to conduct soil erosion surveys and prevention measures and to provide funds for soil erosion reduction.

Law or Regulation	Agency/Agencies	Summary
Species Injurious to Wildlife as defined by the Lacey Act	USFWS	A comprehensive list of species defined as injurious to wildlife through the Lacey Act.
The Insect Pest and Plant Disease Act - 1931 P.A. 189.	MDARD	The Insect Pest and Plant Disease Act of 1931 regulates the sale and distribution of plant materials to prevent the introduction and spread of plant pests and diseases.
The Natural Resources Commission Prohibited and Restricted Aquatic Invasive Species Order Amendment 1 of 2014	MDARD, DNR, DEQ	The Natural Resources Commission Prohibited and Restricted Aquatic Invasive Species Order Amendment 1 of 2014 adds to the list of prohibited and restricted species in Michigan outlined in Part 413 of NREPA.
White Pine Blister Rust Act - 1929 P.A. 313.	MDARD	The White Pine Blister Rust Act provides for control and eradication of white pine blister rust and declares certain plants and bushes a public nuisance.
Wildlife Conservation Orders	DNR - WLD	Michigan's Wildlife Conservation Orders regulate hunting, trapping and game species and include regulation, restrictions and permitting for importation of animals, nuisance animal control regulations and disease control permits.

DNR = Michigan Department of Natural Resources; DNR - WLD = DNR Wildlife Division; MDARD = Michigan Department of Agriculture and Rural Development; USDA - USFS = United States Department of Agriculture - United States Forest Service; USDA - NRCS = USDA - Natural Resources Conservation Service; USDA - AMS = Agricultural Marketing Service; USFWS = Unites States Fish and Wildlife Service; MDEQ = Michigan Department of Environmental Quality.

Invasive shrubs- Photo- Leslie J. Mehrhoff University of Connecticut, Bugwood.org

Chinese Yam infestation- Photo- Chris Evans, University of Illinois, Bugwood.org

Michigan's Terrestrial Invasive Species State Management Plan

Michigan Department of Agriculture & Rural Development

DEQ

Department of Natural Resources DNR Michigan

MDOT