

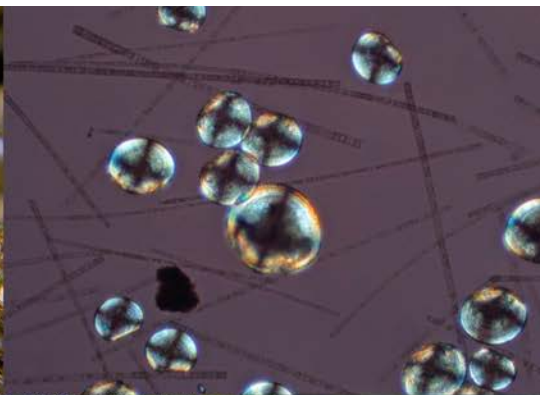


NEW YORK
STATE OF
OPPORTUNITY.

**Department of
Environmental
Conservation**

New York State
**AQUATIC INVASIVE SPECIES
MANAGEMENT PLAN**

July 2015



Cover photos (clockwise from upper-left):

Round goby, Eric Engbretson, US Fish and Wildlife Service, Bugwood.org

Dreissenid mussel veliger, Fred Henson, NYSDEC

Northern snakehead, Jim Gilmore, NYSDEC

Round gobies and Dreissenid mussels, Geof Eckerlin, NYSDEC

Floating primrose willow removal, Chart Guthrie, NYSDEC

I. EXECUTIVE SUMMARY

In 1994 the Aquatic Nuisance Species Task Force, a multi-agency federal body co-chaired by the US Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, approved New York's *Nonindigenous Aquatic Species Comprehensive Management Plan*. That plan identified goals and supporting actions aimed at reducing the potential for the introduction and spread of nonindigenous aquatic species, hereafter referred to as aquatic invasive species (AIS) into New York waters, minimizing harmful impacts from those organisms, and educating the public on the importance of preventing future introductions. In addition, that plan recommended creation of a Nonindigenous Aquatic Species Prevention and Control Unit to implement selected actions identified in the plan. While some elements of the 1994 plan have been enacted, it was not possible to implement all of them, and the introduction and spread of AIS continue to be serious concerns. Thus, an updated plan has been developed to further address the AIS issue, with a focus on the state's fresh waters and recommend actions.

New York is a water-rich state with an abundance of lakes, ponds, rivers, and marine waters. The construction of numerous canals created artificial waterway connections which increased the opportunity for AIS to be transported into and from New York. Historically, AIS of particular concern included zebra and quagga mussels, sea lamprey, Eurasian watermilfoil, water chestnut, and hydrilla. More recently, extensive efforts are underway to prevent the spread of one or more species of Asian carp from the Mississippi River watershed to the Great Lakes Basin.

There is no single law or regulation that can be broadly used to prevent AIS from entering waters in New York or from being spread once present. New York State enacted two pieces of legislation and adopted regulations in 2014 intended to prevent the spread of AIS through recreational watercraft use. Environmental Conservation Law (ECL) was amended to add a new ECL § 9-1710 that requires operators of watercraft launching in a public waterbody to take "reasonable precautions" to prevent the spread of AIS. NYSDEC is drafting regulations prescribing a suite of reasonable precautions that may be taken. Article 3 of Navigation Law was amended to add a new § 35-d requiring NYSDEC to develop a universal, downloadable AIS spread-prevention sign and requiring all owners of public boat launches to conspicuously display the sign. In 2014, NYSDEC adopted regulations requiring watercraft launched at or retrieved from its access sites to be drained, and the watercraft, trailer, and associated equipment to be free of visible plant or animal matter (6 NYCRR §§ 59.4 & 190.24). The New York State Office of Parks, Recreation, & Historic Preservation adopted a similar regulation at its sites, recorded in New York Codes Rules and Regulations (9 NYCRR § 377.1 (i)).

In 2013, NYSDEC adopted regulations intended to slow the spread of invasive species through commerce by establishing the state's first lists of prohibited and regulated species (6 NYCRR § 575). Other NYSDEC regulations that help prevent the spread of AIS require authorization via permit for fish to be stocked into waters of the state (ECL § 11-0507), and for such fish to be free of specified fish pathogens. NYSDEC also regulates the use of baitfish (6 NYCRR § 19.2) and requires that they be certified as pathogen free (6 NYCRR §§ 188.1 & 188.2).

The updated *AIS Plan* was initially drafted by staff from DEC before being provided to outside reviewers for additional input. It is focused on the state's fresh waters although, if implemented, the plan has elements that will aid efforts to limit the proliferation of AIS in marine and coastal portions of the state. To support the overall goal of stopping the introduction and spread of AIS into and within New York State's waters, four objectives were identified: Prevention, Detection, Response, and Capacity. For the first three objectives, strategies incorporating actions to foster attainment were further categorized as Education and Outreach, Leadership and Coordination, Research and Information, and Regulatory and Legislative. The Capacity objective was focused solely on securing adequate funding and resources to support AIS programs in New York; thus, it did not lend itself to the categories described above.

A suite of more than 50 actions needed to fully implement the plan was identified, and these actions are summarized in an implementation table. Recognizing the challenge in implementing all of the plan's recommendations within the five-year span of this plan, ten high-priority actions were identified and briefly described below. All are considered to be very important; thus, they do not appear in priority order. The codes preceding each action link to the Implementation Table (pp. 37) and the text of this plan.

- **1A1.** Expand the boat launch steward program and ensure consistency of these programs statewide
- **3B1.** Develop an AIS response framework to guide decision making when AIS are detected, and communicate the reasoning for the response selected
- **4X1.** Within available resources, NYSDEC will implement and maintain a statewide, coordinated AIS management program.
- **1A2.** Implement an AIS public awareness campaign and evaluate its effectiveness in reaching target audiences
- **1B1.** Provide Department of Environmental Conservation (Department) leadership for the AIS program to achieve productive and coordinated actions
- **3D1.** Identify legal, regulatory, and institutional barriers that could impede a rapid response to an AIS introduction
- **1A3.** Expand the use of AIS disposal stations at waterway access sites
- **3B2.** Create regional "first responder" AIS teams to incorporate local expertise in planning and implementing appropriate responses to AIS

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- **1B2.** Continue to coordinate NYSDEC activities within the New York Invasive Species Council
 - **1C1.** Identify and evaluate risks associated with pathways for AIS introduction to and movement within New York

Annual evaluation and monitoring will be used to gauge progress toward meeting the objectives of the plan. Pending the outcome of efforts to secure adequate resources to implement elements of the plan, progress will be measured and reported by either the *AIS Plan* team or by personnel assigned to work on the overall AIS management program.

CONTENTS

I. EXECUTIVE SUMMARY.....	i
CONTENTS	iv
II. INTRODUCTION.....	1
Historical AIS problems.....	11
Recent AIS problems	12
Adverse Economic Effects Associated with AIS.....	13
IV. GOAL.....	15
V. EXISTING AUTHORITIES AND PROGRAMS.....	15
VI. OBJECTIVES, STRATEGIES, and ACTIONS	16
Prevention objective	16
Detection Objective.....	22
Response Objective.....	26
Capacity Objective.....	30
VII. PRIORITIES FOR ACTION	31
VIII. IMPLEMENTATION TABLE 2015-2020.....	33
IX. PROGRAM MONITORING AND EVALUATION.....	43
X. ACRONYMS AND DEFINITIONS	44
XI. REFERENCES	48
APPENDIX A. Detailed Description of Existing Authorities and Programs.....	51
Existing Authorities	51
State Programs.....	52
Other State Agencies, Councils and Committees.....	54
Federal Programs	56
International Agreements.....	61
APPENDIX B - Aquatic Invasive Species Ranking Very Highly Invasive in New York State.....	63
APPENDIX C – Responsiveness Summary for Public Comments.....	64
Background:	65
Introduction:.....	65
General Comments.....	66

A. Resources and Funding.....	66
B. Enforcement	66
C. Proposals for Detailed, Specific Actions	67
List of Commenters.....	67
Comments and Responses	69
Notice of the Draft Aquatic Invasive Species Management Plan	124

II. INTRODUCTION

Aquatic invasive species (AIS) are organisms that are not native to our aquatic ecosystems and can threaten New York State's aquatic ecology, economy, and even human health. New York State's legal definition of invasive species is consistent with the federal definition and is "*a species that is nonnative to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. ...the harm must significantly outweigh any benefits*" (ECL § 9-1703).

The introduction and spread of aquatic invasive species are major problems in the United States. New York State is particularly vulnerable to AIS introduction given its abundant marine and fresh water resources, major commercial ports, and the easy access that ocean-going vessels have to the Great Lakes via the St. Lawrence Seaway and the state's canal system. These connections also allow for the rapid spread of AIS once introduced to the Great Lakes or other interconnected waterways. AIS such as water chestnut (*Trapa natans*) and Eurasian watermilfoil (*Myriophyllum spicatum*) were first introduced to the country more than 70 years ago and were allowed to spread largely unchecked because, at the time the introductions occurred, the AIS issue was not widely recognized. It was not until the zebra mussel (*Dreissena polymorpha*) was introduced to North America in the 1980s and had impacts on water quality and the recreational and commercial use of many high-profile waters that the importance of AIS was widely recognized.

Economic losses associated with invasive species are enormous and have been calculated at nearly \$120 billion per year in the United States (Pimentel, et al. 2005). Maintenance costs at water intakes due to dreissenid mussels (zebra mussel and quagga mussel, *D. bugensis*) alone are an estimated \$267 million in North America (Pimentel, 2005). Commercial and recreational fishing are severely impacted by invasive species. In New York State canals and the Hudson River system, an estimated \$500 million in economic losses occur each year from at least 154 non-native species; 80% of that loss is in commercial and sport fishing.

AIS usually arrive without the predators and diseases that control their numbers in their native range. The resulting unchecked potential for rapid population growth can disrupt aquatic ecosystems. Northern snakehead (*Channa argus*), sea lamprey (*Petromyzon marinus*), round goby (*Neogobius melanostomus*), hydrilla (*Hydrilla verticillata*), and the New Zealand mudsnail (*Potamopyrgus antipodarum*), all present in some New York State waters, can prey upon or displace native species, alter habitat, or otherwise harm native species. Aquatic invasive species can also negatively impact human health. For example, Chinese mitten crabs (*Eriocheir sinensis*) are carriers of Asian lung fluke (*Paragonimus spp.*). Dreissenid mussels selectively graze on green algae, reducing competition for blue-green algae, which can, in turn, pose risks to human health by affecting the taste and quality of drinking water and cause harmful toxic algal blooms.

Invasive species are almost entirely spread by humans, and global trade and

travel have greatly increased the rate of invasion. AIS arrive by many pathways, including direct introduction, live animal trade, the nursery and landscape trade, recreational boating, cargo transport, and shipping ballast. Approximately 67% of the invasive species found in the Great Lakes and St. Lawrence River were reportedly introduced in ship ballast water (Grigorovich, et al. 2003).

Aquatic invasive species are pervasive throughout New York State. The largest waterbodies possess many AIS. As of 2012, more than 180 nonnative and invasive aquatic species have been verified in the Great Lakes (National Oceanographic and Atmospheric Administration, [NOAA] 2014); 122 have been found in the Hudson River; 87 have been documented in the St. Lawrence River; and 49 have been reported in Lake Champlain (Lake Champlain Basin Program, [LCBP] 2012). Inland waterbodies have not been spared, although it is likely that smaller waterbodies do not have as many AIS as these larger, mostly international border waterways. AIS plants have been found in close to 500 waterbodies in New York State, with Eurasian watermilfoil found in about 2/3rds of these, in nearly every county in the state. Dreissenid mussels have been found in at least 60 waterbodies (New York Natural Heritage Program [NHP] iMapInvasives© 2014). It is likely that the actual frequency of AIS occurrences in the state is substantially larger because AIS surveillance has not been conducted on the majority of the nearly 20,000 lakes, ponds, and reservoirs (NYSDEC, unpublished data) and 87,000 miles of rivers and streams (NYSDEC, 2012). By 2013, in what is probably the least invaded but most extensively surveyed portion of the state, the Adirondack Park Invasive Plant Program (APIPP) surveyed 311 lakes since the program's inception (ca. 2000), and 94 (30%) of those are known to harbor AIS. More importantly, more than 200 lakes widely distributed throughout the park are reportedly still free of AIS (H. Smith, APIPP, personal communication).

It is important to note, however, that not all nonnative species are invasive. Some introduced nonnative aquatic species don't survive, and others that do may integrate into New York State ecosystems without causing significant harm to natural aquatic resources, the economy, or human health. Examples include brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). In addition, some waters that have been widely colonized by nonnative species, including AIS, still support aquatic ecosystem functions and are capable of sustaining economically important recreational activities such as sport fishing. For example, Lake Ontario has an abundance of AIS and is New York State's most heavily fished body of water, with angler expenditures exceeding \$155M per year (Connelly and Brown, 2009).

Ecological conditions and processes dictating the potential for the introduction and establishment of AIS are inextricably linked to the climate and, therefore, climate change. Volatile weather patterns, altered water levels and overall climate shifts will favor the introduction and ultimate success of certain invaders, while reducing or eliminating threats from others. Similarly, food webs and energy flows within existing aquatic ecosystems will no doubt be altered. Ranges of specific AIS (and native species) will shift, and overwintering potential will increase as thermal barriers are removed (Pagnucco, et al. 2015). These consequences add to the importance of reviewing and adapting an effective aquatic invasive species management program

(Bierwagen, et al. 2008)—in our case, at least every five years.

While it is clearly important to take active measures to limit the introduction and spread of AIS, it is also important to do so without unduly affecting the use and enjoyment of New York State waters. In 1991, the Aquatic Nuisance Species Task Force (ANSTF) was established to help focus attention and action on issues relating to AIS. One of the specific tasks of the ANSTF was to foster the development of AIS management plans by states and provide some funding for implementation by states with approved plans. New York State prepared a plan to address aquatic nuisance species in 1993, and that plan was approved by the ANSTF in 1994 and implemented to varying degrees in the intervening years. In the more than 20 years since New York State's first plan was developed, new populations of AIS have been discovered, a comprehensive framework to address all taxa of invasive species has been implemented, and stakeholder interest and demand for action by the state have increased dramatically.

This plan updates and revises New York State's prior plan and is intended to guide AIS prevention and control efforts over the next five years. It describes an AIS management program (AISMP), including our goals, objectives, and actions to prevent, detect, and respond to AIS using a comprehensive approach to protect New York State aquatic resources from the adverse impacts of AIS. The focus of the plan is directed at the state's fresh waters, although many of the strategies called for in the plan will be beneficial in addressing this issue for marine and coastal portions of the state as well. The plan emphasizes pathways or the means by which AIS are spread, rather than focusing on specific invasive species. This approach recognizes that many different species can be spread by a single pathway. Applying effective management to address a particular pathway will slow the spread of all AIS transported through that pathway.

III. DEFINING THE PROBLEM IN NEW YORK STATE

Geographic Applicability

As a major point of entry for travelers, cargo, and mail entering the United States, New York State is highly vulnerable to introduction of AIS. The state has a total of 27 ports, including a very large deepwater seaport in New York City and smaller ports on Lake Erie, Lake Ontario, the St. Lawrence River, the Hudson River and Long Island Sound. Global trade in live nonnative species for the pet, food, and landscape and nursery trades, and organisms transported in ship ballast arrive through these ports, presenting a risk of AIS introduction. Abundant water resources ranging from the Great Lakes to tidal rivers to mountain ponds support diverse recreational boating, from cruise ships to white water rafting to wilderness travel in kayaks and canoes. Each activity poses some level of risk of introducing or spreading AIS.

New York State occupies an important position regionally, and its aquatic resources can be broken down into 17 major drainage basins (Figure 1). This plan is applicable to waters of the state as defined in ECL § 17-0105. As a member of the Great Lakes community, New York State can be impacted by any AIS introductions in the Great Lakes region. Conversely, the Great Lakes are vulnerable to AIS introductions that might originate in New York State, as demonstrated by the alewife (*Alosa pseudoharengus*) and sea lamprey. Rivers originating in or flowing into the state also provide multiple aquatic connections. The Susquehanna River is the headwater for the Chesapeake Bay watershed. The Chemung River also drains into the Susquehanna. In western New York State, Chautauqua Lake and the Allegheny River link New York State to the Mississippi watershed. The Delaware River watershed is another major multi-state, regional watershed that, like the Susquehanna, has its origin in New York State. However, many of these have significant barriers that impact the upstream migration of AIS into New York State. New York State shares the Lake Champlain watershed with Vermont and Canada, and there are several smaller waterbodies connecting New York State to Pennsylvania, New Jersey, Connecticut, Massachusetts, and Vermont. Finally, New York State is coastal. The marine waters of Long Island Sound share shoreline with Connecticut, Rhode Island, and Massachusetts, and New York Harbor is bordered both by New York State and New Jersey. All of these waters represent portals to AIS introductions.

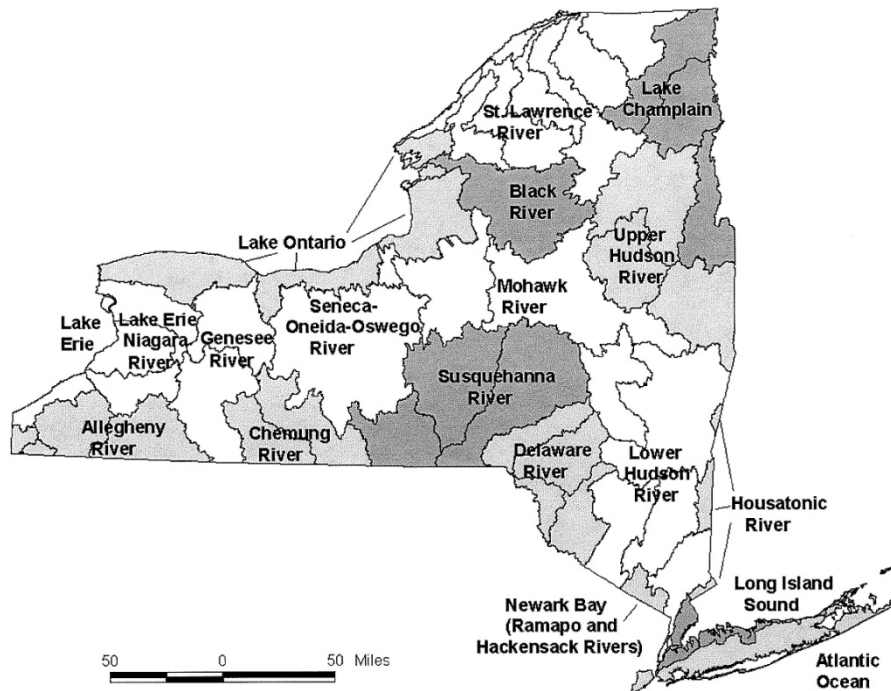


Figure 1. Major watersheds of New York State. From *Inland Fishes of New York State*

The problem of AIS in New York State has been exacerbated by the presence of numerous canals, both historical as well as those still in current use because they artificially connect watersheds. The current New York State Canal System consists of four canals: Erie, Champlain, Oswego, and Seneca-Cayuga. The Erie Canal was opened in 1825 and remains in use today. It links the Hudson and Mohawk rivers to the Great Lakes as well as to many other inland waters. The Champlain Canal links the Hudson River to Lake Champlain. The Oswego Canal links the Erie Canal to Lake Ontario near Syracuse. Finally, the Seneca-Cayuga Canal links the Erie Canal to Seneca Lake and Cayuga Lake, two of the Finger Lakes in central New York State. Historically, the Chenango Canal linked the Erie Canal system to the Susquehanna and Chenango rivers from 1838 to 1878, and the Black River Canal connected the Erie Canal system to Lake Ontario via the Black River from 1840 to 1926. The Allegheny River was also connected briefly (1856 to 1878) to the Erie Canal by the Genesee Valley Canal. The Delaware Hudson Canal was a privately funded canal that linked the Hudson and Delaware rivers from the 1840s until 1913. A good discussion of the canals of New York State and their possible influence on fish distribution can be found in Smith (1985). Canals served an important role in the economic development of New York State and westward migration. However, they also made many New York State watersheds highly vulnerable to AIS colonization. Dreissenid mussels spread more rapidly into the Finger Lakes and Oneida Lake through the canals than by the eastward flow of water through the Great Lakes and the St. Lawrence River. The Erie Canal may also have opened the door for invasive species that originated in marine water, such as

sea lamprey¹ and alewife, allowing them to penetrate not only into New York State inland waters, but into the Great Lakes as well. Highly invasive Asian carp, especially bighead carp (*Hypophthalmichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*), both present in the Mississippi River Basin, are of particular concern. Spread of these species from the Mississippi River Basin into the Great Lakes through interconnected waters and throughout much of New York via the canal system and Hudson River would severely disrupt aquatic ecosystems and threaten recreational fishing and other water-based recreation. Further, silver carp often leap out of the water at the vibrations of boat engines, potentially harming people.

¹Disagreement exists as to whether or not the sea lamprey was native to Lake Ontario, or whether it gained access through the opening of the Erie Canal (Smith, 1985). There is clear agreement that the sea lamprey gained access to Lake Erie and the other Great Lakes in the 1920s through the Welland Canal, which bypasses the Niagara River and allows direct access to Lake Erie from Lake Ontario.

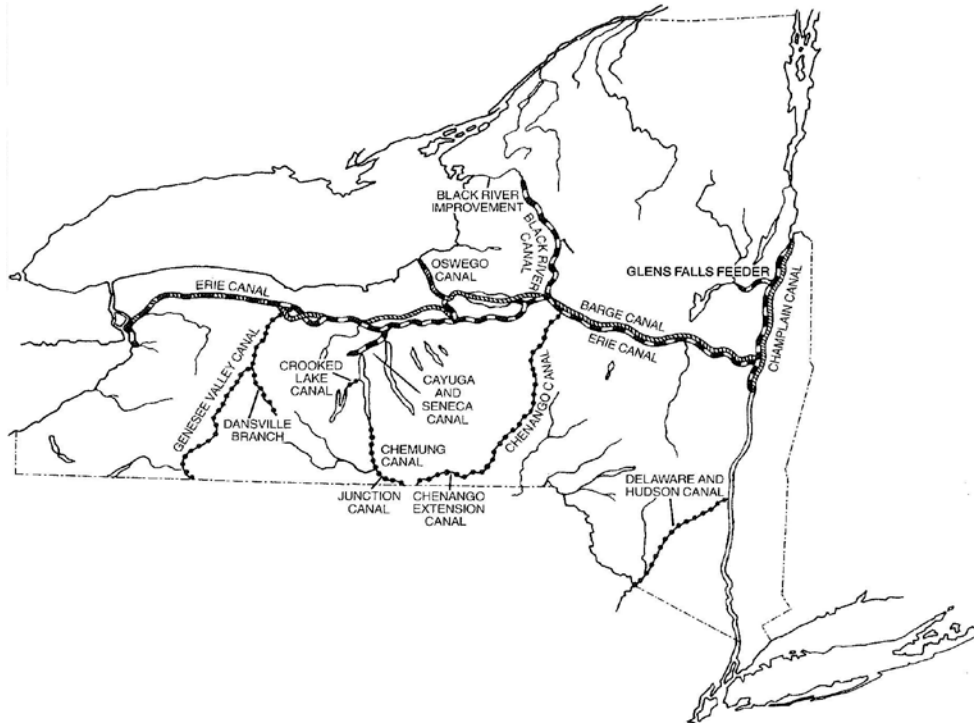


Figure 2. Past and present canals in New York State. From *Inland Fishes of New York State*

Because of New York State's geographic position and hydrological connection to the Great Lakes watershed, the Delaware and Chesapeake watersheds, and the Mississippi watershed via the Allegheny River, New York State's AIS programs and policies have the potential to impact many other states throughout the Northeast, the Midwest, the Mid-Atlantic, and even the Central Plains. Likewise, AIS introductions, activities, and plans in these other regions have the potential to affect New York State. The extensive use of New York State ports in Lake Erie, Lake Ontario, the St. Lawrence Seaway, the Hudson River, the Atlantic Ocean, and Long Island Sound makes New York State waterways particularly vulnerable to AIS introductions. Internet trade and increasing global commerce, bringing goods to New York State from locales around the world, create additional vulnerability.

New York State lies within the bounds of three ANSTF regional panels established by the National ANS Task Force: the Northeast ANS Panel (MA, ME, NH, NY, RI, VT), the Great Lakes ANS Panel (IN, MI, MN, NY, PA, OH, WI), and the Mid-Atlantic Regional AIS Panel (DC, MD, NC, NJ, NY, PA, VA, WV). Regular communication and cooperation among the states is facilitated through these panels.

New York State shares waters and watersheds with adjoining states and Canadian provinces. Such overlaps include Great Lakes Erie and Ontario and Lake

Champlain. Interstate communications and cooperation are essential to successful AIS management. One example is the LCBP, a partnership established in federal statute to restore and protect Lake Champlain and its watershed, and supported by New York, Vermont, Quebec, and the US Environmental Protection Agency (USEPA). The LCBP has an ANSTF-approved AIS management plan jointly coordinated by NYSDEC and the Vermont Department of Environmental Conservation. Adjoining states with ANSTF-approved AIS management plans are Pennsylvania, Massachusetts, and Connecticut. The Authors reviewed these states' plans as well as others during the writing of this plan. New York participated in scoping the Great Lakes and Mississippi River Interbasin Study by the US Army Corps of Engineers. This study investigated the linkages between the Great Lakes and Mississippi River basins, and the risk of movement of AIS between the basins, and presents a range of options and technologies to prevent aquatic nuisance species (ANS—an outdated synonym to AIS) movement between the basins through aquatic connections.

Pathways

There are numerous potential pathways of introduction for AIS into and throughout New York State. Not all introductions of AIS to the state or individual waterbodies from existing in-state AIS can be attributed to a specific pathway. However, there is strong evidence that each of the vectors identified below represent a potential pathway for moving AIS into the waters of New York State, and these vectors must be addressed to reduce continuing and future movement of these species into and within the state.

- **Commercial shipping vessels:** It is highly probable that many of the animal AIS introduced in recent years, such as dreissenid mussels, round goby, ruffe (*Gymnocephalus cernuus*) and fishhook waterfleas (*Cercopagis pengoi*), were brought into the United States in the ballast water of transoceanic ships. This pathway is less likely to be implicated in the movement of AIS within the state, given the inability of these larger vessels to travel outside boundary waters of the state. However, once introduced to the Great Lakes system, these species may spread by other pathways to inland waterbodies.
- **Recreational watercraft:** Recreational watercraft, both powered and not, can contribute significantly to movement of AIS from sources outside the state and between waterbodies within the state. This process has occurred for as long as powered and trailered boats have been commonplace in New York State waterways, but has likely accelerated with the construction of the New York State Thruway in 1954 and the Adirondack Northway in 1962. Recreational watercraft can move aquatic plants and animals as hitchhikers on boat propellers, trailers, hulls, sailboat keels, centerboard and dagger-board trunks, and rudders, and fishing and anchor lines, as well as within motors, live wells, and bilge water. It is likely that many of the aquatic invasive plants and small-bodied organisms moving within the state have been transported by recreational watercraft.

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- **Interconnected waterways:** As noted above, canals effectively move watercraft and any hitchhiking AIS throughout the state by connecting Lake Champlain to the Hudson-Mohawk watershed, to the Great Lakes and the Finger Lakes drainage basins by the Erie and Champlain canal systems. AIS can also move easily from upstream to downstream through outlets of infested waterbodies to inlets of uninfested sites, whether as fragments of plants or larval forms of animals.
 - **Aquaria releases:** Numerous aquatic invasive plant and animal species such as Brazilian elodea (*Egeria densa*) and Asian clam (*Corbicula fluminea*) have been sold in pet stores, through the aquaria trade, or via the Internet. The regulation of this practice is challenging, given the historic lack of regulatory and enforcement authority. In addition, these species can be difficult to distinguish from native species. The release of aquatic species from aquaria often occurs because the owner does not want them anymore, but does not want to kill them either.
 - **Intentional introductions:** New York State requires a permit and a fish health inspection for the intentional introduction or release of fish or fish eggs into waters of the state. The public might not be fully aware of these requirements even for those species that have been evaluated and approved for biocontrol, such as triploid grass carp. Occasionally, stories circulate in the media that certain species are effective biocontrols of AIS, and the public can be easily misled into releasing what they perceive to be a biocontrol species. Any biocontrol species approved by the US Department of Agriculture's Animal and Plant Health Inspection Service for release in the US must be further evaluated for use in New York State before it is released, and such an intentional introduction can only occur with a state permit.

Anglers may also release fish caught in one part of the state into a water body in another part of the state, possibly to establish what they perceive as a desirable fishery closer to home. Even if the introduced fish is native to New York State, it might be nonindigenous to the new region, watershed, or water body, and it can become an AIS. In the Adirondacks, many ponds are fragile ecosystems inhabited by unique original Adirondack strains of brook trout (*Salvelinus fontinalis*). If a locally nonindigenous fish species is introduced, it can out-compete the native brook trout and possibly lead to the extinction of a unique genetic strain. Fish should not be released, intentionally or unintentionally, in waters from which they did not originate, except under NYSDEC permit.

- **Nursery plantings:** The water garden trade can unintentionally move AIS species into and within the state, either through the sale and transport of mislabeled or misidentified AIS commonly mistaken for desirable aquatic plants, or as contaminants attached to the transported plants or in the planting material, including soils or water. The pioneering introduction of monoecious hydrilla in California has been attributed to contamination of a (legal) water lily stock

supplied from Maryland (California Department of Food and Agriculture, 2001).

- **Cultural:** Several AIS serve as important symbols for some ethnic populations living in New York State. The northern snakehead is native to China, Russia, North Korea, and South Korea. This fish is a common part of the Asian food market, although the United States Fish and Wildlife Service (USFWS) has prohibited its importation and interstate transport under the Lacey Act (18 US Code § 42). Certain cultures believe the fish has healing and medicinal powers. Large-scale ceremonial releases of live snakehead are thought by some ethnic groups to be a prayer to deities (Severinghaus and Chi, 1999). Other species may also be released as part of a religious ceremony.
- **Live food trade:** Markets offering live food represent an important source of fresh food for many New York State residents but are particularly important for immigrant cultures seeking foods that form a core cuisine from their native lands. AIS fish that are sold in these markets represent a significant threat to New York State waterways, such as the Asian swamp eel (*Monopterus albus*). Other species that commonly occurred in ethnic food markets, such as the Chinese mitten crab, bighead carp (*Hypophthalmichthys nobilis*) and northern snakehead, have already been prohibited from importation. It is believed that some of these species have been intentionally stocked to provide a continuing food source for these markets. Asian clam is popular with certain ethnic groups and may have been introduced in an effort to develop a food supply in certain New York State waters.
- **Bait:** Bait buckets may also serve as a source of aquatic invaders. The rusty crayfish (*Orconectes rusticus*) has spread to New York State from the central and midwestern US, most likely through bait buckets. The size and aggressive behavior of rusty crayfish allow it to out-compete native crayfish and minimize predation from other fish. Rusty crayfish can also alter aquatic plant habitat and prey on fish eggs, further impacting native crayfish and fish populations (Horns and Magnuson, 1981). The bait bucket water may also contain AIS such as larval dreissenid mussels (veligers), invasive macroinvertebrates like waterfleas, fish, bacterial and viral pathogens, or other parasites.
- **Waterfowl:** Plant parts can also attach to fur, feathers, or feet and can also be spread by animals in undigested feces. The movement of AIS, such as water chestnut, may be associated with waterfowl migration, because many infested waterbodies have no public access, no private recreational use, and are isolated from other infested waterbodies. However, each of these waterbodies, and those in neighboring states, are regularly visited by or are in the flight path of migratory waterfowl.
- **Unknown pathways:** The actual transport vector for AIS introductions may be difficult to determine, even if only a subset of the potential pathways is relevant for that AIS species, and even if the “parent” population within a specific

waterbody can be surmised from its size and location. For example, the source of the Asian clam infestation in Lake George cannot be explicitly linked to any of the pathways described above, even if the pioneering location could be definitively identified and dated. This is consistent with the challenges in implicating a pathway for most invaders.

Historical AIS problems

New York State has experienced numerous AIS problems, some going back hundreds of years. As such, a brief synopsis is presented in this document. Because the presence of sea lamprey in Lake Ontario was not noted until 1831, several years after the opening of the Erie Canal (Smith, 1985), it has been speculated that the opening of the Erie Canal allowed them into Lake Ontario, where they ultimately gained access to the upper Great Lakes and devastated indigenous lake trout (*Salvelinus namaycush*) populations.

The alewife is a migratory fish, historically known to spawn in the Hudson River, which is believed to have gained access to Lake Ontario through the Erie Canal (Smith, 1985)². Smith (1985) suggests that the alewife entered Lake Ontario in the early 1800s but did not become abundant until the populations of large predators such as walleye (*Sander vitreus*), sauger (*Sander canadensis*), and lake trout were drastically reduced through overfishing. With the loss of large predators that would otherwise have kept it in check, alewives eventually out-competed other forage species and caused aesthetic and human health problems when massive die-offs occurred, filling beaches and harbors with tons of dead, decaying fish.

AIS plant introductions can be documented from as far back as the 1880s, when water chestnut seeds brought from Europe were planted in Sanders Pond (now Collins Lake) in Scotia in eastern New York State, leading to extensive populations in the lake by 1884. Subsequent flooding of the neighboring Mohawk River (via locks and dams on the New York State Barge Canal) spread the plant and spawned widespread growth by the 1920s. Water chestnuts were reported in the Hudson River by 1930, reaching nuisance levels in the 1950s, and probably spread west through the Erie Barge Canal system, reaching Oneida Lake and the Finger Lakes region by the turn of the 21st century. The plants spread north into Lake Champlain through the Hudson-Champlain Canal. It was first reported in Maryland in the late 1910s and reached the Potomac River during the early 1920s, developing widespread populations in the 1940s (Kishbaugh, 2009).

² Some ichthyologists believe that like the sea lamprey, the alewife may have entered Lake Ontario through the St. Lawrence River, and they consider it a native species. Also like the sea lamprey, the alewife undoubtedly gained access to the upper Great Lakes through the Welland Canal.

Recent AIS problems

Herein we describe a selection of recent AIS issues pertinent to New York State, which by no means represent a complete nor real-time representation of our most-recent invasions. In the 1980s, zebra mussels entered the state through Lake Erie. A near-simultaneous introduction appears to have occurred in the Hudson River, either from recreational boating or a ballast water release. They rapidly spread eastward through the Erie Canal into the Finger Lakes region of central New York State. Quagga mussels were first reported in North America in 1988 and the Erie Canal in 1989 (May and Marsden, 1992) but were found in the Mohawk River in Crescent by 1995. Quagga mussels now dominate Lake Ontario substrates, where zebra mussels once did (Mills, et al. 1999), perhaps due to the species' preference for deeper, cooler waters as compared to zebra mussels (Mills, et al. 1996).

Round goby followed dreissenid mussels into Lake Ontario from Lake Erie, where they quickly became established. In localized areas, they can rapidly become the most abundant fish species present. Round goby can out-compete and replace native species such as the mottled sculpin (*Cottus bairdi* (Jude 1996) and prey upon the eggs of native species (Chotkowski and Marsden, 1999). Round goby have also been implicated as reservoirs of both avian botulism (Getchell, et al. 2006) and viral hemorrhagic septicemia virus (Eckerlin, et al. 2011) in Lake Ontario and the St. Lawrence River.

Both the spiny waterflea (*Bythotrephes cederstroemi*) and the fishhook waterflea have become established in Lake Ontario. In addition, the fishhook waterflea has colonized the Finger Lakes, and the spiny waterflea has recently been detected in several eastern Adirondack lakes, including Lake George, Great Sacandaga Lake, the Glens Falls feeder canal and Lake Champlain. Both species have been found to disrupt the zooplankton community and the associated fish communities where they've invaded (USEPA, 2008).

Northern snakehead populations were discovered in two NYSDEC regions in New York State in recent years. One population was found in two connected ponds in Flushing Meadows, Queens and another at a pond within the defunct Flushing Airport, but both were deemed to have little potential for spread due to salinity barriers. The capture of an individual northern snakehead from Harlem Meer in Central Park has prompted surveillance sampling which has recovered only one other individual in four years. Another population was found in Ridgebury Lake and Catlin Creek (Orange County), where the potential for spread to the Hudson River was deemed great. NYSDEC staff depopulated Ridgebury Lake and Catlin Creek using a fish toxicant in August 2008 and eradicated at least 220 northern snakehead. Following a second treatment in 2009, NYSDEC staff detected no surviving northern snakehead. Currently, the restored fishery is recovering.

The Chinese mitten crab, discovered in the Hudson River in 2009 (Benson and Fuller, 2014), is a migratory species that has the potential to impact both fresh and

marine waters of the Hudson River estuary. The species became established in the San Francisco Bay and freshwater rivers and canals that feed the bay in the early 1990s and impacted the ecosystem through competition with native crayfish species (California Department of Fish and Wildlife, 1998). Chinese mitten crabs have been illegally imported live into New York City, because the species is considered a delicacy in Asian markets.

New Zealand mud snail (*Potamopyrgus antipodarum*) is a small freshwater snail that was probably brought to this country by ballast water. It was introduced initially in the western part of the country, but in 1991, a small population was detected in Lake Ontario near Wilson, New York (Zaranko, et al. 1997). A more recent study found New Zealand mud snails in Fish Creek (Niagara County), approximately 25 miles east of the original site (Levri, et al. 2012). The snails have also been collected from the Welland Canal and northeastern Lake Ontario, Ontario, Canada. This species can survive passage through the digestive tract of fish, colonizes at high densities, and is salt-tolerant, all of which increase the potential for spread and effectiveness as a competitor and biofouler.

Hydrilla was first documented in 2008 in a small pond in Orange County, but has since been discovered in more than a dozen waterbodies throughout the state, including Lake Ronkonkoma, the inlet to Cayuga Lake, and the Erie Canal just outside Buffalo. The monoecious variety of hydrilla found north of the Potomac River does not appear to exhibit the dense canopies found with the dioecious genotype more commonly found in the southern US. However, monoecious hydrilla grows laterally along the bottom of the waterbody, and then expands upward, creating thick stands within the waterbody. Both biotypes can result in significant ecological and economic impacts.

Adverse Economic Effects Associated with AIS

It is difficult to put a cost on the full range of adverse impacts of AIS infestations to date in New York State. Many plant AIS are aesthetically undesirable and interfere with aquatic recreational activities, including swimming, boating, and fishing, and can significantly reduce property values. Lakefront property owners invest significant amounts of money in vegetation harvesting or repeated aquatic herbicide treatments. The power industry and municipalities have invested large sums of money and effort to keep water intakes free of dreissenid mussels. Data presented by O'Neill (1997) indicated the estimated dreissenid mussel-related expenditures by water-use facilities in New York State between 1989 and 1995 was a little more than \$9 million. Rate payers, municipalities, tax payers, and consumers shoulder this cost.

Commercial and recreational fishing are severely impacted by invasive species. In the New York State canals and Hudson River system, an estimated \$500 million in economic losses occur each year from at least 154 non-native species; 80% of that loss is in commercial and sport fishing (Pimentel, et al. 2005).

More than \$5 million was spent to control Eurasian watermilfoil in Lake George

between 1985 and 2012, as part of an expenditure of more than \$8 million for all AIS-related activities (Lake George Park Commission, [LGPC] 2013). In just a four-year period, New York State issued nearly \$1.3 million in “eradication grants,” and Boylen (C.Boylen, Rensselaer Polytechnic Institute, unpublished data) estimated between \$1.2 and \$2.2 million was spent each year from 2007 to 2010 by lake residents and local government at just 35 lakes (besides Lake George) in managing invasive plants. It is likely that this represents a significant underestimate of all expenses, particularly labor costs associated with hand harvesting and benthic matting, the most common techniques used. It is estimated that costs for the first year of controlling hydrilla from Cayuga Inlet exceeded \$500,000. Asian clam control costs in Lake George exceeded \$1.5 million over a two-year period (LGPC, 2013).

The potential return in terms of reduced adverse ecological, economic, and societal impacts on a state investment to implement an AIS program could be considerable. Often the significant benefits that can be realized from such an investment go unnoticed. The benefits accrued from an AIS prevention program are usually stated in terms of expenditures not made, as opposed to actual savings, although real economic benefits can sometimes be accurately determined. For example, businesses involved in aquatic recreation activities can realize increased profits after a successful aquatic vegetation control program. It must be acknowledged that no AIS program or effort implemented by the state could have prevented the spread of dreissenid mussels into New York State waters from western Lake Erie. However, a more aggressive control and mitigation program might have prevented the spread into waters not directly connected to the Great Lakes.

The complete scope of AIS problems in New York State is not fully understood. The number and extent of AIS invaders have not been fully documented, the relative importance of specific AIS pathways is not always known, and the ecological and socio-economic problems derived from AIS infestations have not been quantified. However, the impact of AIS is apparent to lake residents, recreational users, businesses, and those that rely on the ecological integrity of the waterbodies in New York State. The objectives and actions outlined in this plan have been proposed to detect and better document the extent and coverage of these AIS species, prevent their spread into and within the state, and respond to existing and future invasions.

IV. GOAL

Prevent the Introduction and Spread of Aquatic Invasive Species in New York State

This single goal encompasses the full scope of what the AISMP is intended to accomplish. Objectives (1. Prevention, 2. Detection, 3. Response, and 4. Capacity), as described and discussed in detail below, have been developed to serve as milestones for achievement of the goal. Actions designed to foster attainment of the objectives were organized into one of four strategies:

- A. Education and Outreach
- B. Leadership and Coordination
- C. Research and Information
- D. Regulatory and Legislative

The authors used this framework to structure recommended actions tailored to specific objectives in a transparent manner, but recognize alternative frameworks could also be used. Only by accomplishing the tasks and actions associated with the objectives can the plan's overarching goal be achieved. Recommended actions are identified and classified as either "immediate actions" or "additional actions." The ten highest priority actions were selected from the "immediate actions" and considered the highest priority without further ranking in their relative importance due to their all being critical to effective AIS management. Immediate actions are high-priority actions that should be implemented as soon as resources and capacity allow. "Additional actions" are medium priority actions. The plan authors did not identify "low priority" actions.

V. EXISTING AUTHORITIES AND PROGRAMS

NYSDEC acknowledges the existence of a relatively long history and the participation of *many* partners involved in efforts to address AIS issues in New York State. For the sake of brevity, only the pertinent state and federal entities are included. They are described in APPENDIX A.

VI. OBJECTIVES, STRATEGIES, and ACTIONS

Prevention Objective: Stop the introduction of AIS into and spread within New York State

Issue statement:

A key purpose of the AISMP is to prescribe how to stop AIS before they are introduced to the state, an ecological region, or waters of concern. AIS are difficult to detect and are often already established and distributed throughout a waterbody, and perhaps beyond, by the time they are discovered. An effective prevention strategy will be multi-faceted and will include education and outreach components as well as regulatory and voluntary tools. Prevention requires vigilance *and* an informed citizenry willing to act. Most AIS introductions are detected and reported by concerned citizens; therefore, a knowledgeable public is a critical element toward stopping the spread of invasive species. Public buy-in of prevention measures will prove elusive without heightened public awareness, which in turn encourages user groups to become stewards of resources important to their activities. The most effective educational efforts are crafted and delivered to target audiences and user groups that engage in specific activities such as boating, water gardening, and angling. Avid participants in such activities will generally act responsibly to prevent AIS spread if they believe AIS are a significant risk to their favorite activities. Some may naturally view risk to the environment, economy, and human health as secondary to risk to their favorite activities; thus, an effective AISMP must educate these stakeholders to the impact of AIS on issues of importance to them.

Education and outreach are delivered by various means, including multiple media and personal contact such as on-site signs, presentations, boat launch stewards, brochures, identification cards, stickers, websites, public service announcements, and social media. The Department delivers education and outreach using several of these means. It has also delivered education and outreach indirectly by coordinating the formation and funding of eight Partnerships for Regional Invasive Species Management (PRISMs, Figure 3) which deliver a full complement of invasive species management, including education and outreach, a statewide education and outreach framework, and an online clearinghouse for invasive species information in New York State. One example of a concerted education and outreach effort is the first New York State Invasive Species Awareness Week in July 2014, during which over 100 various public education events were held statewide. Most events were hosted by PRISMs. National outreach campaigns include “Stop Aquatic Hitchhikers,” aimed at recreational boaters and anglers, and “Habitatitude,” for educating owners of non-native pet species.

Many different AIS can invade through any single pathway, such as trade in live organisms or recreational boating. Effective prevention strategies and actions focus on primary pathways and specific vectors (such as recreational watercraft, trailers, anglers, retailers, landscapers, and water gardeners). Species that pose the greatest risks to our environment, economy, or human health should be identified for particular vigilance and

assessed for any specific spread-prevention measures required. Prevention requires a broad range of actions, including detecting and removing AIS “hitchhikers,” stemming commercial sales and intentional introductions of live AIS, stopping initial introductions through our many ports of entry, and halting the movement of existing AIS within the state. Activities in and around waterbodies conducted by private and public employees can spread AIS; employees need to take measures to avoid such introductions. This will require creating or updating existing standard operating procedures (SOPs) to guide field activities such as fish stocking, sampling activities, construction, and maintenance, that can be shared with other agencies working on New York State waters.

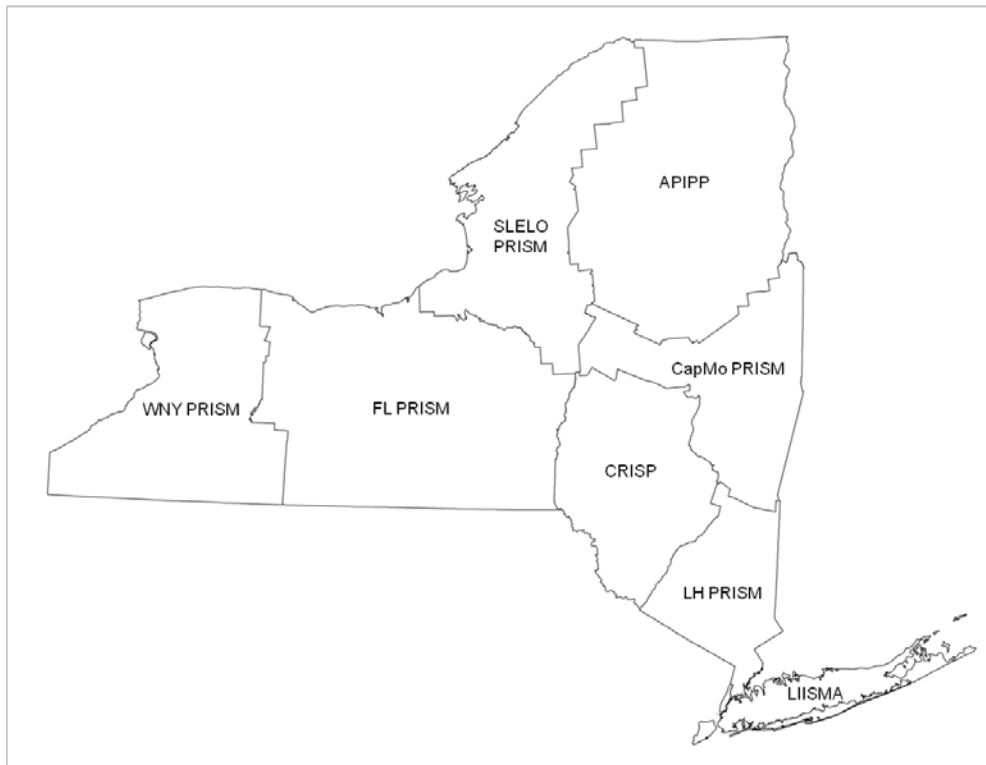


Figure 3. Partnership for Regional Invasive Species Management (PRISM) boundaries as of 2014. These PRISMs are: Western NY PRISM (WNY PRISM); Finger Lakes PRISM (FL PRISM); St. Lawrence – Eastern Lake Ontario PRISM (SLELO PRISM); Adirondack Park Invasive Plant Program (APIPP); Capital Mohawk PRISM (CapMo PRISM); Catskills Regional Invasive Species Partnership (CRISP); Lower Hudson PRISM (LH PRISM); and Long Island Invasive Species Management Area (LIISMA).

Effective spread prevention also requires current research; however, current research needs are not being met. The Department has very limited capacity to conduct invasive species research. The former Invasive Species Task Force (ISTF) recommended that the state establish a regional center for research to coordinate and collaborate with the New York Invasive Species Council (NYISC), New York Invasive Species Advisory Committee (ISAC) and partners. The New York Invasive Species

Research Institute (NYISRI), established in 2009 under contract with Cornell University and coordinated by the Invasive Species Coordination Unit (ISCU), conducts some research on potential biological control agents and provides coordination and guidance, including species white papers, identification of existing research efforts, identification of best providers for research services, assistance with identifying research priorities, and investigation of efficacy of treatments.

Historically, New York State laws and regulations regarding AIS have not been well organized or consistently effective. New York State has passed laws and adopted regulations to reduce the negative impacts of invasive species. Some environmental regulatory programs designed to protect against harm done by herbicides, physical disturbance, and other activities have posed a challenge to efforts to conduct treatment activities intended to prevent the spread of invasive species. Permitting and fiscal processes can significantly delay treatment. A patchwork of local laws has developed in recent years, as several municipalities in the Adirondacks and a few counties in the Adirondacks and Finger Lakes regions have enacted laws prohibiting the transport of AIS on recreational watercraft and trailers. The effectiveness of such laws may be reduced if the boating public, for example, must comply with regulations that vary widely among bodies of water and jurisdictions.

New York has addressed two priority pathways – the sale of invasive species and the transport of AIS by recreational boating activities. New York State enacted two pieces of legislation and adopted regulations in 2014 intended to prevent the spread of AIS through recreational watercraft use. Environmental Conservation Law (ECL) was amended to add a new ECL § 9-1710 that requires operators of watercraft launching in a public waterbody to take “reasonable precautions” to prevent the spread of AIS. NYSDEC is drafting regulations prescribing a suite of reasonable precautions that may be taken. Article 3 of Navigation Law was amended to add a new § 35-d requiring NYSDEC to develop a universal, downloadable AIS spread-prevention sign and requiring all owners of public boat launches to conspicuously display the sign. In 2014, NYSDEC adopted regulations requiring watercraft launched at or retrieved from its access sites to be drained and the watercraft, trailer, and associated equipment to be free of visible plant or animal matter (6 NYCRR §§ 59.4 & 190.24). New York State Office of Parks, Recreation, and Historic Preservation (OPRHP) adopted a similar regulation at its sites, recorded in New York Codes Rules and Regulations (9 NYCRR § 377.1 (i)). In 2014, NYSDEC adopted regulations intended to slow the spread of invasive species through commerce, that established the state’s first lists of prohibited and regulated species (6 NYCRR § 575).

Efforts are underway to streamline regulatory reviews and permit issuance for hand harvesting, suction harvesting, benthic mats to control select AIS in protected streams, protected freshwater wetlands, navigable waters, or designated Wild, Scenic, and Recreational Rivers.

Education and Outreach Strategy

Immediate actions

- **1A1.** Expand boat launch steward programs for public and private boat access sites, and ensure consistency of boat launch steward programs.
- **1A2.** Implement an effective AIS public awareness campaign that will target those likely to introduce AIS or be impacted by AIS introductions. Regularly evaluate these efforts to ensure their effectiveness in preventing the introduction and spread of AIS in New York State. Potential components of this campaign may include:
 - Seasonal contributions to *Conservationist* magazine, published by the Department
 - Public service announcements
 - Educational modules for summer campers
 - Tip strips
 - Watch cards
 - Kiosks at boat launch and other public access sites
 - Signs
 - Self-certification
 - Outreach through angling and hunting guides, boating directory, press releases
 - “Stop Aquatic Hitchhikers”
 - “Habitatitude”
- **1A3.** Expand the use of invasive species disposal stations.
- **1A4.** Identify, describe, and promote voluntary approaches to address prevention of AIS spread to and within New York State.

Additional actions

- Develop an education/outreach program for public/elected officials and state agency partners.
- Identify specific target audiences for prevention activities.
- Periodically survey target audiences and the public to gauge the success of AIS prevention activities, and revise activities as appropriate.

Leadership and Coordination Strategy

Immediate actions

- **1B1.** NYSDEC will provide leadership for the AISMP by establishing an AIS manager or supervisor charged with implementing the AIS plan.
- **1B2.** Coordinate Department activities with the New York State Invasive Species Council.
- **1B3.** Develop and implement statewide standard procedures (e.g., Hazard Analysis and Critical Control Point [HACCP]) to ensure state agency field activities do not transport AIS, and share guidance and protocols with others.
- **1B4.** Develop a close working relationship with NYISRI to ensure research needs are met.
- **1B5.** Participate in regional AIS panels, including the Northeast Aquatic Nuisance Species Panel (NEANS), Great Lakes, and Mid-Atlantic.

Additional actions

- Develop MOUs with other agencies to accomplish mutual/overlapping AIS prevention objectives.
- As appropriate technologies are developed, create and implement protocols for the treatment of contaminated cargo, packaging, hulls, and ballast water to eradicate AIS.

Research and Information Strategy

Immediate actions

- **1C1.** Identify and evaluate risks associated with pathways for AIS introduction into and movement within New York State.
- **1C2.** Identify AIS species most likely to be moved to and within New York State.
- **1C3.** Identify and evaluate mechanisms for preventing transport to and within New York State, including boat wash stations, and implement effective options.
- **1C4.** Identify and use additional providers to conduct AIS-related research.
- **1C5.** Incorporate potential impacts of climate change on AIS introductions to New York State over various time horizons.
- **1C6.** Research efficacy, safety, and utility of practical materials, equipment, and techniques for preventing AIS transport.
- **1C7.** Develop a means of identifying waters that are/are not high risk for AIS invasion and adverse impacts.
- **1C8.** Survey AIS prevention methods used by other states and provinces.

Additional actions

- Organize and conduct an annual professional conference to discuss AIS issues

with various stakeholders and/or constituents (AFS, NALMS/FOLA, NEAPMS, etc.).

- Research invasion forecasting techniques and technology.

Regulatory and Legislative Strategy

Immediate actions

- **1D1.** Conduct a review of existing laws and regulations that may be impediments to AIS prevention, and develop and propose consolidated, coordinated replacements.
- **1D2.** Promulgate state regulations at state launch sites (NYSDEC and OPRHP) aimed at AIS prevention.

Additional actions

- Develop and propose appropriate regulatory or legislative actions needed to address prevention of AIS migration to and within New York State to include, but not be limited to:
 - Drafting regulations pursuant to new 2014 state AIS transport law that requires operators of watercraft launching in a public waterbody to take “reasonable precautions” to prevent the spread of AIS
 - Assisting, as appropriate, in assessing non-native plant and animal species and in developing lists of non-native plant and animal invasive species, consistent with accepted protocols, that are classified as Prohibited or Regulated (ECL § 9-1709)
 - Bait regulations pertaining to allowable bait, disease-free certification, and disposal considerations
 - Regulations prohibiting the sale of live AIS for consumption
 - Technical guidance for potential implementation of an AIS Water Quality Standard

Detection Objective: Conduct and promote surveillance and monitoring activities to identify new invaders, and document the distribution and impacts of AIS throughout the state

Issue statement

Surveillance to detect new AIS plays a critical role in enabling a response to aquatic invasive species before they become established and lead to adverse impacts. Rapid response strategies conducted subsequent to early detections are much more likely to be technically feasible, logistically manageable, more likely to result in eradication or control, and will likely be less expensive. Surveillance activities are also important for identifying the geographic extent of waterbodies where AIS have been detected, providing an important context for developing a response plan and identifying waterbodies susceptible to invasion.

The extent of an infestation within a waterbody is documented and delineated through *monitoring*, an important element of a response plan. Monitoring results can be important in both choosing appropriate response strategies and determining the appropriate timing for the application of these strategies. Monitoring is also critical for documenting the success of AIS response efforts and for refining site-specific response plans. In addition, monitoring data within waterbodies and documenting the coverage and abundance of AIS are critical for identifying ecological, recreational, and economic impacts.

With over 17,000 lakes, ponds, and reservoirs, more than 70,000 miles of rivers and streams, and multiple ports of entry, the opportunities for AIS introduction and spread are plentiful, and the difficulties in assessing these waterbodies are extreme. These challenges are further compounded by the shortage of proficient monitoring staff, limited coordination of AIS monitoring activities ongoing in the state, and the need for remote technology to enhance surveillance and monitoring.

New York State does not have a sufficient number of trained personnel to conduct AIS surveillance activities. More complete surveillance to find AIS and more extensive monitoring to document the extent of infestations over time will need to rely heavily on the use of volunteers. Many AIS of concern in New York State are strong candidates for volunteer surveillance programs focusing on detecting new AIS infestations. They have unique characteristics that distinguish them from native plants and animals, although other AIS are not so easily distinguished and warrant training and expert verification. These surveillance programs, and less formal surveillance activities, require informative, consistent materials and a focus on specific high-priority AIS to better direct volunteer efforts.

Some areas of the state, particularly those for which a PRISM has implemented a volunteer monitoring program or another regionally directed framework, have stronger surveillance and monitoring programs than others. Opportunities should be pursued to promote coordination, data sharing, and site selection, including a focus on specific

susceptible waterbodies, to institute:

- Early detection of AIS;
- Explicit coordination of regional surveillance or waterbody-specific monitoring;
- Linking of surveillance findings to a regional rapid response framework.

Additional easy-to-use tools are needed for monitoring and surveillance of plant and animal AIS and to evaluate impacts associated with them. Existing surveillance and monitoring largely consists of visual observation, netting, electroshocking, sampling with two-sided rakes, and deploying divers for early AIS detection in what is akin to searching for a needle in a haystack. In fact, many initial AIS findings are accidental, “stumbled” upon by those fortunate enough to know what they have found. Finding these AIS with the existing crude surveillance tools is not efficient. Better tools are needed to systematically survey larger areas, on site and remotely, and to significantly reduce the labor costs associated with regular monitoring of existing infestations.

Regulatory, legislative, and logistical obstacles exist which could limit the ability to conduct surveillance and collect monitoring data and other information needed to evaluate AIS impacts and response actions. These include the following:

- Delays or prohibitions to securing access to AIS sites through private property or collection permits at waterbodies owned by local or county government
- The need for genetic tests to verify some AIS
- Rapid procurement processes to recruit and fund PRISM monitoring teams
- Limited staff and expertise for conducting AIS surveillance and field identification of AIS

AIS surveillance and monitoring are not routinely performed by NYSDEC. Fiscal obstacles also exist. For example, monitoring costs were explicitly excluded from a prior grant program (Invasive Species Eradication Grant) that limited expenditures to response strategies. With only limited resources available for AIS response, monitoring to document the effectiveness of an AIS response action is often neglected. Without a monitoring requirement, AIS response projects cannot be well evaluated.

Education and Outreach Strategy

Immediate actions

- **2A1.** Develop generic and specific AIS early detection content—simple identification keys, tip sheets, image galleries—for agency staff, professionals, volunteers, PRISMs, and the public, including web content for AIS surveyors.
- **2A2.** Recruit and train volunteers from organizations such as lake associations and environmental, conservation and fishing organizations for AIS surveillance and monitoring activities.
- **2A3.** Conduct invasive species ID workshops for interested stakeholders to promote citizen science-related activities, using and expanding the APIPP model.

-
- **2A4.** Use the iMapInvasives tools to establish a primary source location for AIS occurrence records to establish and maintain databases of primary source locations (and within lake distributions) of priority invasive and “watch” species, and to facilitate intrastate sharing of invasive species sightings/presence data.
 - **2A5.** Use the New York State invasive species ranking assessment system described in *A Regulatory System for Non-native Species* (NYISC, 2010) as the basis for the selection of priority species.
 - **2A6.** Distribute educational information targeted at specific groups who are especially affected by introductions of AIS.

Additional actions

- Identify appropriate roles for the public to conduct early detection surveillance and develop a surveillance module to recruit and use the public in this capacity.
- Link AIS surveillance to intra- and inter-agency “outreach” programs.

Leadership and Coordination Strategy

Immediate actions

In coordination with PRISM coordinators:

- **2B1.** Develop AIS and AIS-specific surveillance programs.
- **2B2.** Develop standardized monitoring protocol for conducting AIS surveillance and delineating AIS infestations.
- **2B3.** Recruit surveillance and monitoring coordinators to oversee AIS-related activities on the ground.
- **2B4.** Identify AIS species and waterbodies that would be good candidates for targeted surveillance.
- **2B5.** Establish PRISM-level AIS monitoring teams to delineate new AIS infestations found through surveillance programs.

Additional actions

- Identify and coordinate existing AIS surveillance and monitoring programs conducted by both agency and non-agency staff.
- Encourage PRISMs to host AIS training workshops.
- Incorporate AIS surveillance into field activities and existing (non-AIS) monitoring programs.
- Encourage private landowners and organizations to assist early detection efforts on private lands.
- Recruit professional monitors for sustained monitoring efforts associated with AIS eradication/response projects.

Research and Information Strategy

Immediate actions

- **2C1.** Identify a common set of monitoring “metrics” to be used in AIS impact assessments addressing ecological, health, water quality, recreational, economic, and public perception.
- **2C2.** Conduct AIS impact assessments.
- **2C3.** Support long-term monitoring of AIS response project waterbodies.

Additional actions

- Conduct studies that evaluate ecological impacts of AIS, including both introduction and removal.
- Investigate any human health or ecosystem perturbations resulting from AIS.
- Develop and improve approaches and technology to aid in the detection of AIS.
- Develop and conduct a questionnaire that surveys both individuals and businesses regarding the impact of specific invasive species (lakefront property owners, marinas, industries with water intakes, municipalities).
- Identify and seek technology for identification of invasive species, including environmental DNA (eDNA) and remote sensing.
- Evaluate better procedures to mark AIS infestations in the field and report the location.

Regulatory and Legislative Strategy

Immediate actions

- **2D1.** Identify and correct regulatory, logistical, and legislative hurdles to early detection.

Additional actions

- Require monitoring as part of New York State AIS grants and permits.

Response Objective: Identify and implement the appropriate response to aquatic invasive species introductions

Issue statement

Numerous AIS introductions have already occurred in New York State waters, and despite the best efforts at prevention, more AIS introductions will occur. An effective management program for addressing the impacts of AIS introductions requires appropriate and timely responses. In addition to responding to new AIS introductions, it is important to evaluate the effectiveness of responding to introductions that have already occurred. The range of responses can include (but are not limited to):

- Eradication - total destruction and removal of the infestation
- Control - active measures to suppress AIS
- Containment - specific actions taken to prevent AIS from leaving the waterbody
- Monitoring – observation of AIS, its spread, and the occurrence of adverse impacts resulting from the introduction
- Mitigation – actions taken to minimize or offset the adverse impacts caused by AIS infestation
- Restoration – returning environmental conditions to what existed before AIS infestation occurred, e.g., replanting native wetland vegetation after removing a *Phragmites* infestation
- No action –response limited to education and outreach rather than implementing specific activities directly against the AIS

To be effective and efficient, a process is needed to guide the selection of AIS responses. The process needs to provide for the systematic, comprehensive, and centralized assessment of an AIS introduction and the resources available to formulate an effective response. Otherwise, response actions could be ineffective and resources wasted. Response efforts also will be more effective by including both agency personnel and local stakeholders that reflect local knowledge and considerations.

Adaptive management is critical in a response program, because how effective a given response will be is often unknown. An internal and external communication plan about the desired action and its selection is also important so that partners and stakeholders are well informed. A procedure to provide feedback to the AIS Program after the response is undertaken will help to identify any problems encountered and document significant successes so that they can be integrated into future responses.

Because an AIS could be completely new to North America, information on the biology and effective controls for a new AIS might be limited or absent. How a new species responds to a new habitat is unpredictable. An introduction could be benign in one region/waterbody and extremely problematic in another. The effectiveness of different control treatments could be unknown. If not carefully documented and shared, the success or failure of past actions could be lost and mistakes repeated.

Environmental regulations have been developed for the purpose of minimizing adverse environmental impacts. However, experience in different states has shown that implementing a timely, effective response to a new AIS introduction can be impeded by regulations that put limits on the range and extent of some potential response actions. This is particularly true when a response must happen immediately to prevent the spread of a new AIS. Such regulations were promulgated for a specific purpose, so a means must be determined not to *circumvent* laws, regulations, and administrative procedures, but to work *through* regulatory and statutory requirements in an expedited fashion to achieve the goal of the regulation while still allowing for a timely response. Laws and regulations that serve as the basis for AIS response actions are generally scattered throughout different ECL articles and sections and were developed for specific purposes besides a broad-based AISMP. Finally, the laws and regulations to provide the necessary authority to support/justify a particular response action might be lacking, and new laws or regulations need to be proposed. For example, 6 NYCRR § 327.6(c) only allows the aquatic herbicide 2,4-D to be used for the control of *emergent* plants having a large part of their leafy growth projecting above or lying flat on the water surface. That regulation would prevent the use of 2,4-D to control a *submerged* aquatic invasive species, even if it was the most efficacious herbicide available. This and similar regulations should be revised or repealed.

An effective suite of responses to AIS introductions must be carefully planned, timely, knowledge based, and consistent. Detailed assessments of response efforts should be made, and good records must be maintained, so that other response actions can be initiated against a background of knowing what worked and what did not. That knowledge can also be gleaned from response actions undertaken by other AIS management entities, such as other state, federal, multi-state, regional, or watershed-based AIS programs. Communication is a major component of any AIS response. The public needs to be informed about the introduction, the possible adverse impacts and what they can do to help in managing the introduction.

Responses must be developed not only for new, or relatively new AIS problems, but for AIS problems that have persisted for decades as well. For example, aquatic plant species such as water chestnut, Eurasian watermilfoil, and curly-leaf pondweed have caused significant adverse impacts to both the ecology and recreational enjoyment of New York State waterbodies for over 50 years. Despite the widespread and persistent nature of these AIS infestations, they should not be disregarded. AIS management strategies should be developed for containing the spread of these persistent problems and rolling them back when possible. There may be times, however, when no action is appropriate because past efforts have proved to be ineffective and costly.

Education and outreach strategy

Immediate actions

- **3A1.** Develop a series of fact sheets explaining the advantages and disadvantages of different response actions, such as eradication, control, no action, etc., that could be used to guide the decision-making process by outlining procedures and expectations associated with each.
- **3A2.** Develop and implement specific communication plans for outreach associated with response actions to inform and educate the public, stakeholders, and elected officials.

Additional actions

- Train volunteers to hand harvest aquatic invasive plants.
- Develop a reporting protocol for responders to document lessons learned from response actions in a consistent, timely, and uniform manner.
- Train stakeholders in the use of the HACCP process to identify risks, structured decision-making tools (SDM) and incident command system (ICS) principles to facilitate effective response.

Leadership and Coordination Strategy

Immediate actions

- **3B1.** Develop an (or adopt a pre-existing) AIS response framework.
- **3B2.** Create regional AIS response teams that serve as “first responders” for AIS introductions within a NYSDEC region. These teams would: develop specific operational AIS response plans using SDM, conduct training exercises to test abilities and identify problems, and review response plans and identify obstacles to implementation.

Additional actions

- Develop and foster cooperative relationships with stakeholders and partners.
- Develop a systematic process for evaluating response actions as implemented.
- Conduct training and AIS drills that use the ICS and integrate HACCP procedures.

Research and Information Strategy

Immediate actions

- **3C1.** Assemble a web-based catalog of ongoing research pertaining to AIS being conducted in New York State (and elsewhere), including points of contact.

Additional actions

- Conduct risk assessments of the potential for specific AIS to be introduced into New York State waterbodies and similarly, assess the potential for specific waterbodies, watersheds, or waterbody types to experience damaging AIS introductions. Identify knowledge gaps with respect to potential AIS response actions.
- Characterize the extent to which adverse ecological, economic, and social impacts are likely to be experienced by specific waterbodies and watersheds from various potential AIS introductions.
- Evaluate past actions in New York State and other states to set appropriate timetables and expectations for proposed projects.
- Explore innovative control strategies, including biological control and integrated pest management.
- Investigate potential beneficial uses for harvested AIS.
- Develop and implement restoration plans for aquatic ecosystems to provide conditions more suitable for native species.

Regulatory and Legislative Strategy

Immediate actions

- **3D1.** Identify legal, regulatory, and institutional barriers that could impede a rapid response to an AIS introduction.
- **3D2.** Develop general permits to control certain invasive species by employing specified techniques, including hand harvesting, suction harvesting, benthic matting, and pesticides.
- **3D3.** Implement corrective measures to minimize impacts of such barriers to specific response options.
- **3D4.** Develop specific regulations to enable rapid response actions (declaration of AIS emergency) to new introductions of specific AIS into either New York State or to uninfested waterbodies.

Additional actions

- Identify and establish long-term regulatory frameworks for high-priority eradication projects.
- Streamline statewide regulatory processes for management in state regulated wetlands and streams by developing a general permit for invasive species control.

Capacity Objective: Secure adequate long-term funding for AIS programs in New York State.

Issue statement

AIS management is a full-time program, and staff and resources for a new program effort are not currently available. Existing staff lack the available time to undertake a new responsibility such as the AISMP. Staff required for such a program would need specialized training and expertise to conduct all prevention, detection, and response actions laid out in this plan. Our proposed organization builds upon the existing Invasive Species Coordination Unit, but adds leadership and implementation elements as well. An effective AIS program could be very resource intensive. There are limited federal funds available for states with approved ANS plans. New York received \$20,000 in 2014. To help build an effective AISMP, the following actions are recommended:

Immediate actions

- **4X1.** Within available resources, NYSDEC will implement and maintain a statewide, coordinated AISMP.
- **4X2.** Develop budgets for new AISMP and request additional state and federal funding to support these programs.
- **4X3.** Identify staff in each region that would constitute regional response teams.
- **4X4.** Develop expert capacity for timely AIS verification.
- **4X5.** Procure a standby service contract (or other mechanism) for rapid response actions for newly discovered infestations of AIS.
- **4x6.** Provide resources to support research toward approaches and technology to aid in the detection of AIS.

Additional actions

- Institute an invasive species prevention grant/cost-sharing program.

VII. PRIORITIES FOR ACTION

The actions associated with the four objectives described in Section VI are all essential to achievement of each individual objective, as well as the overall goal of preventing the introduction and spread of Aquatic Invasive Species in New York State. However, several actions should be recognized as having a higher priority. These high-priority actions are foundational; that is, accomplishing them is necessary to move on to other actions. Another rationale for prioritizing actions is that they have already been initiated and demonstrated significant success in preventing AIS introductions. The list of high-priority actions includes:

- **1A1. Expand boat launch steward programs for public and private boat launch sites, and ensure consistency of boat launch steward programs.** This is an important program that has already demonstrated public acceptance and success in reducing the movement of AIS into and out of boat launch sites. It has only been implemented so far at a limited number of boat launch sites and needs to be expanded.
- **3B1. Develop an (or adopt a pre-existing) AIS response framework.** To achieve an effective AIS management program and maximize the use of limited resources, a systematic process for evaluating AIS introductions and formulating appropriate responses consistently is required. AIS response frameworks have been developed by other entities that could be adopted and/or modified for use in New York State without having to create an entirely new framework.
- **4X1. Within available resources, NYSDEC will implement and maintain a statewide, coordinated AISMP.** A viable AIS management program requires a commitment of staff and resources.
- **1A2. Implement an effective AIS public awareness campaign that will target those likely to introduce AIS or be impacted by AIS introductions. Regularly evaluate these efforts to ensure their effectiveness in preventing the introduction and spread of AIS in New York State.** AIS cannot be managed solely by a state agency. An informed, involved citizenry is required.
- **1B1. Provide Department of Environmental Conservation (Department) leadership for the AIS program to achieve productive and coordinated actions.** Numerous government and non-governmental organizations (NGOs) have expressed interest and concern in the AIS problem. Focused, coordinated actions are needed for an effective program. Leadership is needed to achieve productive, coordinated actions. Establishing an AIS program would be a first step in providing such leadership.

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- **3D1. Identify legal, regulatory, and institutional barriers that could impede a rapid response to an AIS introduction.** Before an effective rapid response program can be established, the barriers to rapid implementation must be identified and planned for.
 - **1A3. Expand the use of invasive species disposal stations.** Disposal stations at boat launch sites provide both a dedicated location for disposal of AIS and also serve as a billboard promoting the cleaning and draining of boats. Deployment of these tools has been limited and should be rapidly expanded at public boat launches, particularly those at waters known to harbor AIS.
 - **3B2. Create regional AIS response teams that serve as “first responders” for AIS introductions within a NYSDEC region. These teams would: develop specific operational AIS response plans using SDM, conduct training exercises to test abilities and identify problems, and review response plans and identify obstacles to implementation.** A new introduction requires local expertise to plan and implement the appropriate response.
 - **1B2. Coordinate Department activities with the New York State Invasive Species Council and the Invasive Species Advisory Committee.** The Invasive Species Council represents AIS stakeholders that have been empowered by legislation to set the direction for addressing AIS problems across the state. Continued coordination with the council and advisory committee is essential for achieving an effective AIS management program.
 - **1C1. Identify and evaluate risks associated with all pathways for aquatic invasive species introduction into and movement within New York State.** In AIS management, it is frequently easy to focus on organisms and lose track of the pathways that move organisms into and throughout the state. For a successful prevention program, it is essential to keep the focus on pathways.