Wachusett Reservoir

Aquatic Invasive Species Summary

Historical Update and Ongoing Actions

Spring 2016

Massachusetts Department of Conservation and Recreation
Division of Water Supply Protection
Office of Watershed Management

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Acknowledgements

This report was prepared by the MA Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management. The principal authors are Joy Trahan-Liptak and Jamie Carr, Aquatic Biologists. Cover photo by Joy Trahan-Liptak: Eurasian Milfoil (*Myriophyllum spicatum*) in Muddy Pond, Sterling.

Introduction

An "Aquatic Invasive Species Assessment and Management Plan" was produced by the Division of Water Supply Protection (DWSP) in October 2010. This plan documented the presence of non-native aquatic species in the reservoir system (including Sudbury Reservoir, a backup water supply), provided a history of management for those species considered invasive, and presented the basic strategy for protecting the reservoirs from additional non-native aquatic species. Due to the expansion of the non-native aquatic species populations within and encroaching on Wachusett Reservoir and its watershed, it was determined that an updated document specific to this reservoir and surrounding area should be developed.

1. History of AIS in Wachusett Reservoir / Watershed

Non-native species (also referred to as aquatic invasive species or AIS) have likely been present in or around Wachusett Reservoir for many decades; however, in the past 25-30 years, awareness and concern regarding the effect of these species has increased as these and additional non-native species increase their distribution within and around the reservoir and watershed. Of primary concern for managers of the Wachusett system are those species which have the potential to impact water quality. The following is a brief history of non-native species in Wachusett Reservoir and monitoring efforts that have been conducted as a result of the rise of specific non-native species in the region. More extensive discussion and data regarding specific management activities may be found in the Annual Water Quality Reports, as cited below.

Figure 1: Map of Wachusett Reservoir highlighting AIS management areas.

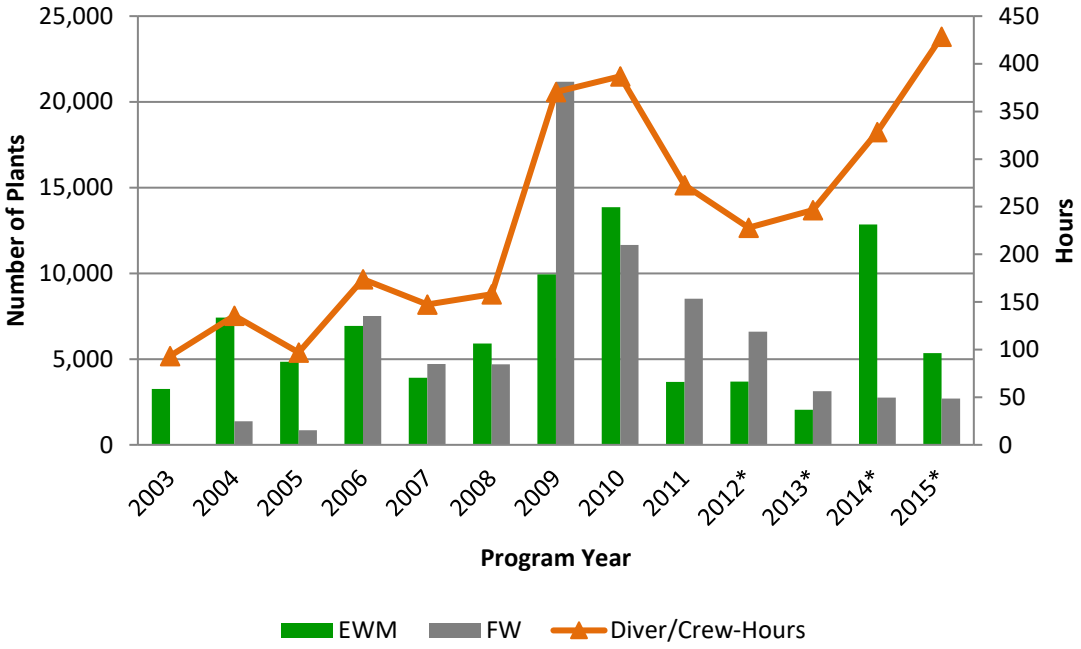
1.1 Reservoir Non-Native Aquatic Vegetation (through 2015)

Since the mid to late 1990s, several non-native species of aquatic vegetation have become well established in certain portions of the reservoir. Some, including *Myriophyllum heterophyllum* (variable milfoil) have likely been present since the 1970s or before, since they were documented in nearby areas in the 1960s. Field notes for sampling conducted in Quinapoxet Basin in 1989 reference "lots of milfoil" in that area. An evaluation of reservoir vegetation conducted by MA DEP staff in 1996 documented *M. heterophyllum* as established in several basins and coves; however, *Myriophyllum spicatum* (Eurasian milfoil), *Cabomba caroliniana* (fanwort), nor any other AIS were noted (McVoy & Brank, 1996).

In 1999, MDC (The predecessor to the DCR Division of Water Supply Protection was referred to as the Metropolitan District Commission until 2003) Aquatic Biologist David Worden initiated an aquatic vegetation evaluation and discovered both *M. spicatum* and *C. caroliniana* in northern portions of Stillwater Basin. These populations were small and characterized as "pioneers." Surveys of water bodies in the Stillwater Basin watershed documented no *M. spicatum* or *C. caroliniana*, leading biologists to conclude that the infestation originated from direct introductions to the Stillwater Basin or the river itself. By 2001, *M. spicatum* distribution had increased and was beginning to colonize the northern portion of Oakdale Basin. At this point, managers from MDC and MWRA (Massachusetts Water Resource Authority) decided that management of *M. spicatum* and *C. caroliniana* should be initiated in order to preclude these species from establishing in the main basin of the reservoir where their presence could be detrimental to water quality. Although other management methods were evaluated, physical removal via diver hand-pulling was selected as the primary strategy. Installation of benthic barriers and floating fragment curtains supplemented the hand-pulling operations. By the end of the first year of management, two acres of benthic barrier had been installed in Oakdale Basin and between 78,000 and 97,900 *M. spicatum* plants had been removed, primarily from Oakdale Basin, but as far south as Powerline Cove in the main basin.

These management efforts have been ongoing since their inception in 2002 and are currently enhanced by diver assisted suction harvesting (DASH) which has been used to target large dense patches of target vegetation since 2012. More extensive discussion on these annual efforts may be found in annual water quality reports (http://www.mass.gov/eea/agencies/dcr/water-res-protection/water-quality-monitoring/water-quality.html).

Figure 2: AIS Removal in Thomas, Oakdale, and Main Basin 2003 – 2015
* includes hours for DASH



Despite these measures and an average effort of 235 diver-hours per year since 2002, the target plants continued to proliferate and extend their distribution closer and into the main basin. In the early stages of the project, management of the invasive species in Stillwater Basin was deemed unfeasible due to the physical characteristics of this basin, the areal extent of the infestation, and their distribution among dense beds of native plants. Regardless of isolation of this basin by fragment barriers (Figure 3), fragments continued to move downstream, especially at times of high flow, and it was determined that management in this area would be required to preclude further infestation downstream. Therefore, an intensive vegetation removal program was implemented in 2013 utilizing Diver Assisted Suction Harvesting. The program was continued in 2014 and 2015 and is anticipated to be ongoing. Removal efforts have resulted in a significant decrease of AIS biomass and EQ biologists have observed reestablishment of native plant species as work continues.

Figure 3: Locations of Fragment Barriers

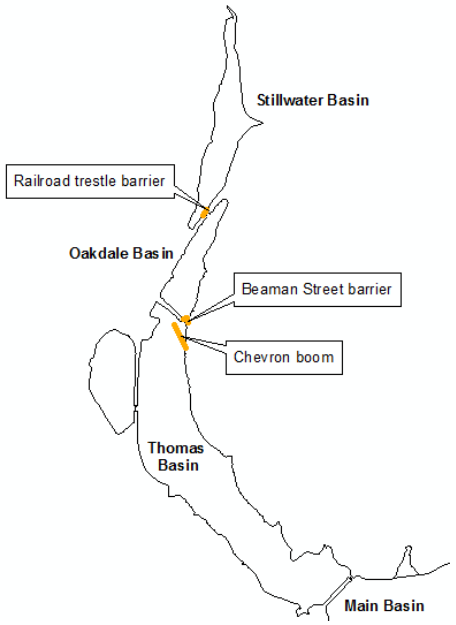
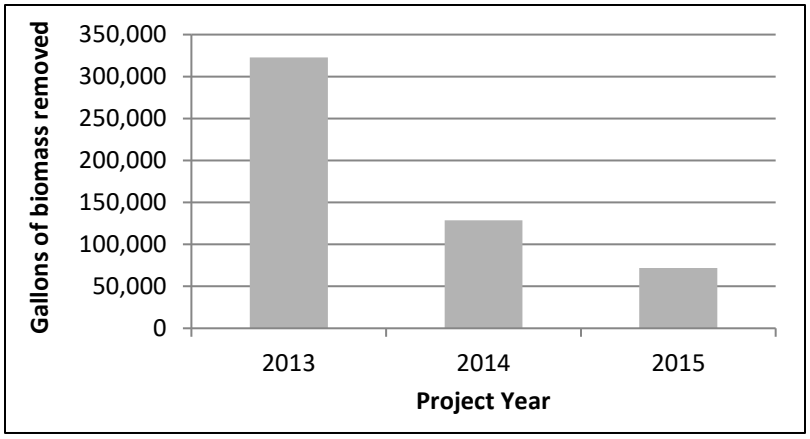


Figure 4: Stillwater DASH AIS Removal Totals



As part of routine investigations in 2014, DCR aquatic biologists and MWRA contractors discovered two new non-native species of aquatic vegetation; *Glossostigma cleistanthum* (mudmat) and *Elatine ambigua* (Asian waterwort) in the reservoir. At the time of discovery, these plants were well established at various locations throughout the reservoir and had therefore likely been present undetected for some time due to their diminutive stature. As a result of this characteristic and their habit of low growth along the sediment, these species are unlikely to impact water quality. However, the discovery of these well-established organisms highlights the vulnerability of the reservoir to introductions of novel non-native species and the necessity for continued monitoring. As monitoring continues, occasional isolated occurrences of invasive species are to be expected. Further discussion of new AIS occurrences such as this is provided in Section 2.

1.2 Reservoir Non-Native Aquatic Fauna

Although several non-native animals (i.e., Chinese mystery snail, virile crayfish, largemouth bass, etc.) have been present within Wachusett Reservoir for many years, these species have not historically been considered a threat to water quality.

As with most water bodies in the region, there are several species of non-native fish present within the reservoir. Introductions of fish to Massachusetts were made as early as the mid-1700s from intentional efforts to improve game fisheries or unintentional releases via bait buckets or aquarium releases. Although 76 water bodies in Massachusetts were treated chemically between 1952 and 1968 with the intent of improving trout fisheries, little effort has been made to manage non-native populations, and many are supported via stocking activities (e.g., Rainbow Trout). As of 2002, as much as 48% of the state's primary fishery is composed of non-native fish and 27 species are actively reproducing (Hartel, Halliwell, & Launer, 2002). The table below lists non-native fish species known to inhabit Wachusett Reservoir and/or its tributaries.

Comparing historical angler creel surveys for Wachusett Reservoir with recent angler creel surveys conducted in 2011 and 2012 shows that the fish species most frequently caught by anglers have changed over the past 30 years, and that this likely reflects changes in the fish community composition over this time period (Carr, 2015). As of the most recent survey lake trout and smallmouth bass comprised nearly two-thirds of total angler catch and greater than half of the total harvest reported.

Table 1: Non-native Aquatic Fauna of Wachusett Reservoir

Species	**Year Introduced to MA** (from Hartel *et. al.*)	Wachusett Reservoir MA DFW Stocking Status	Management Action Taken
Fish			
Yellow Bullhead (*Ameiurus natalis*)	1917		None
Rainbow Smelt (*Osmerus mordax*)	1700s	Unknown, stocked in Quabbin Reservoir	None
Landlocked Salmon (*Salmo salar*)	1965	Currently stocked periodically	None
Rainbow Trout (*Oncorhynchus mykiss*)	1883	Currently stocked annually	None
Brown Trout (*Salmo trutta*)	1887	Previously stocked	None
Lake Trout (S*alvelinus namaycush*)	1952	Unknown, stocked in Quabbin Reservoir	None
Rock Bass (*Ambloplites rupestris*)	1934		None
Bluegill (*Lepomis macrochirus*)	1917		None
Smallmouth Bass (*Micropterus dolomieu*)	1850		None
Largemouth Bass (*Micropterus salmoides*)	< 1862		None
Black Crappie (*Pomoxis nigromaculatus*)	1910		None
Invertebrates			
Chinese mystery snail (*Cipangopaludina chinensis*)	ca. 1914		None
Virile crayfish (*Orconectes virilis*)	< 1917		None

2. New Introductions and Expansion of Non-native Species

Introductions of non-native species are expected to be an on-going issue on a global, national, and regional scale as anthropogenic activity continues to facilitate distribution and climate change alters habitats and growth patterns. The following outlines several factors that must be considered when addressing AIS in the reservoir and watershed:

- Recent discoveries of well established non-native species within the reservoir highlight the continued vulnerability of the water supply to new introductions. As an easily publically accessible water body in close proximity to urban areas, Wachusett Reservoir is under many direct human pressures. The proximity of the reservoir to the many other water bodies in the region that are infested provides added risk from both human and natural transport vectors such as transport on fishing gear, waterfowl movement, downstream flow, and even wind currents. As discussed in the sections above, the risk of fragments moving into new areas of the water body via water currents has already been observed in the reservoir. In the case of both Gates Brook Cove and Malagasco Brook Cove, EWM was found behind sediment curtains which should have precluded infestation via water flow. It is possible that fragments were transported to these areas by beavers, waterfowl, or anglers.

- It is important to consider that the increase in the number of AIS now reported within the reservoir is not due solely to recent introductions. At least in part, several of the recent species discoveries such as *Glossostigma cleistanthum* (mudmat) and *Elatine ambigua* (Asian waterwort) were discovered due to the amount of effort expended to survey the littoral areas of the water body, the more recent concentration on identifying the smallest aquatic plants species, and the still developing field of using DNA analysis to identify aquatic plants to species level. These factors will likely be in play in the future as well.

- Zooplankton net samples are periodically scanned for known zooplankton invaders such as spiny water flea (*Bythotrephes longimanus*), which would be easily recognizable if captured. However, it is possible that small organisms such as zooplankton, sponges, and bryozoans present within the reservoir that have largely not been keyed out may include non-native species. Other organisms may also be present, but remain undetected due to their life histories. An example of such a species is the non-native freshwater jellyfish which was discovered by DCR biologists during its medusa stage in a small pond adjacent to the reservoir in 2015.

- Climate change is also likely to contribute to increases in non-native species and their viability in the reservoir, as outlined in the following excerpt from the Aquatic Macrophyte Surveys of MWRA/DCR Source and Emergency Reservoirs 2015 report by ESS (ESS Group, Inc., 2016).

5.0 CLIMATE CHANGE AND FUTURE AQUATIC INVADERS

Since the late nineteenth century, temperatures in southern New England have warmed consistently, with winter temperatures rising more than summer temperatures (Blue Hill Observatory 2015, NOAA 2015). Average snow cover has also decreased, ice over on lakes and ponds tends to arrive later and ice-out tends to arrive earlier. Additionally, precipitation has increased approximately 25 percent during the same period. Climate change models suggest that these trends will continue and may intensify through the twenty-first century (New England Regional Assessment 2002).

Climate change may increase the likelihood of invasion by new aquatic macrophyte species. Climate change may also spur some of the species that are already present to become more aggressive. Although the reasons for this are complex, the following list presents some of the most direct causes:

1. Lengthened growing season for aquatic macrophytes, which provides a wider seasonal window for introduction, growth and reproduction
2. Warmer water temperatures during the growing season, increasing the growth rate of some species
3. Extended season of active in-water use by principal vectors (humans and wildlife)
4. Increased frequency and magnitude of weather-related ecosystem disturbances
5. More intense precipitation events, which would be expected to increase the mobilization of soils and nutrients into aquatic ecosystems

3. Addressing AIS in the Future: Objectives, Strategies, Actions

The overarching goals for aquatic invasive species management in Wachusett Reservoir are **to prevent new introductions of non-native species** and **to limit the spread of introductions that have already occurred**. In general, the strategies to meet these goals fall under four general categories: public outreach and education, exclusion/decontamination, detection, and response. These efforts are generally overseen by the aquatic biologists in the Wachusett EQ Section with a large portion of public education/outreach and enforcement undertaken by the DCR Watershed Rangers. Each category is discussed in the sections that follow.

3.1 Public Education/Outreach

While the Division has much control over potential introductions of non-native species to the reservoir from equipment such as boats and trailers, there is a greater challenge in preventing introductions from anglers fishing from shore, as well as introductions to water bodies in the watersheds. The approach to providing public outreach on the threats from non-native species must be multifaceted to reach the general public as well as user groups.

DCR Watershed Rangers are the primary source of public interface in the immediate vicinity of the reservoir. They are regularly updated (annual training and as needed) on the latest non-native species concerns and thus they are well equipped to educate the reservoir users they encounter as part of their daily patrol duties and in educational settings. A law against transportation of aquatic nuisance species (M.G.L. c. 21, § 37B) was passed in 2013. The implementing regulations (302 CMR 18.00) give DCR Rangers (as well as other designated law enforcement officials) authority to issue citations for "Knowingly or intentionally placing, or causing to be placed, an ANS [aquatic nuisance species] in or upon Inland Waters," and other related violations of the law on all properties owned or managed by DCR.

Educational brochures and signage are a key element in any public outreach and DCR has developed both to highlight threats from non-native species and the steps needed to protect against

them. Entities targeted for distribution of brochures/signage include the following: bait shops, libraries, sportsman clubs, boat ramps, water access areas, anglers, etc.

3.2 Exclusion and Decontamination

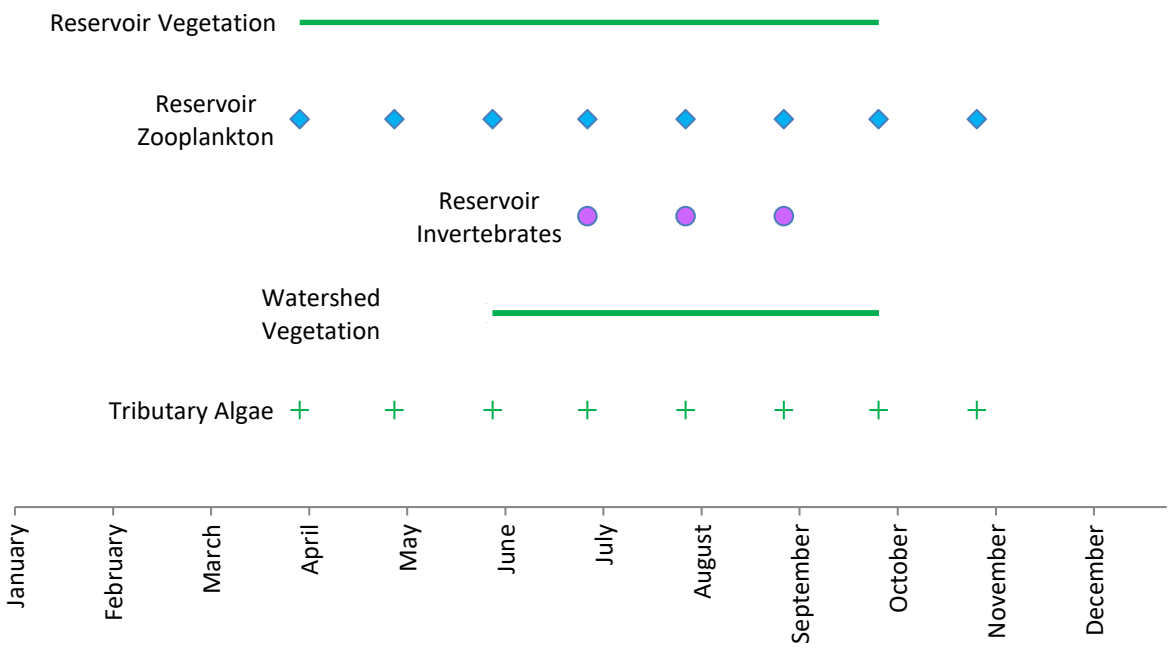
Public boating is not allowed on Wachusett Reservoir. Certain situations require that contractors, law enforcement agencies, and staff from Division of Fisheries and Wildlife use their agency's vessels on the reservoir. These vessels and any equipment utilized on or in the reservoir must comply with the 'Aquatic Invasive Species Decontamination Protocol for MWRA/DCR Reservoirs' included in the Appendix. This requirement will be included in all RFPs and agreements with other agencies. DCR Aquatic Biologists or MWRA personnel are present on site to perform a visual inspection of each vessel and associated equipment before it enters the reservoir. In addition to the inspection, completed decontamination certifications forms are collected and approved/denied at that time. Recognizing that procedures for decontamination may change based on the introduction of new non-native species, this document will be updated as needed.

3.3 Detection/Monitoring

Monitoring of the aquatic communities within a water body is an essential component to any program that strives to reduce the risk for establishment of non-native species. Knowledge of baseline conditions facilitates early detection of new introductions and provides for future assessments of how these introductions affect the native community over time. Early detection of introductions allows for response measures that are often successful in eradication or control at a lower cost and effort due to the limited extent of the initial infestation.

Wachusett Reservoir, including all five basins, is the first priority for monitoring. Additional water bodies are added and prioritized based on several criteria, including: connection and proximity to the reservoir, use by the public, and proximity to known populations of non-native species. Specific monitored parameters, timing, and protocols will vary depending on the water body. The following graphic presents the expected time-frames for monitoring programs.

Figure 5: Wachusett Reservoir and Watershed Expected Annual Monitoring Schedule



Standard protocols for these monitoring activities will be developed as needed and appended to this document. Results will be catalogued electronically in a standardized format and brief reports will be developed for each water body/area as assessments are completed.

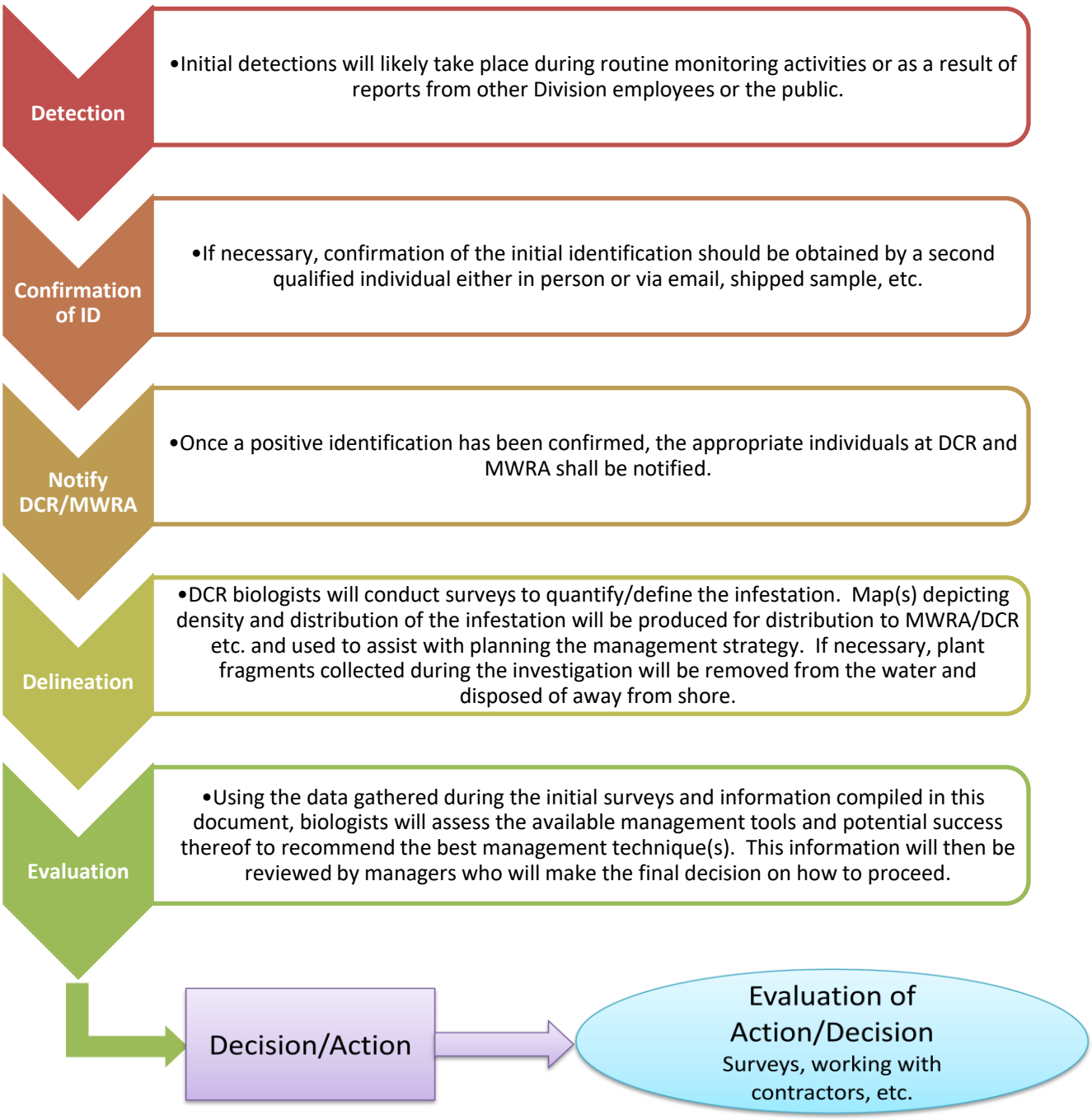
3.4 Response

As discussed above (see Section 2), the number of non-native aquatic species and the viability of species currently present in the region is expected to increase. It is expected that the number of non-native species present within the reservoir and its watershed could show a corresponding increase. The detection of these species will most likely correspond with the level of effort allocated toward monitoring activities.

Due to the wide-ranging nature of invasive species, the water quality and/or ecologic impacts these species may have on the reservoir will be evaluated and responded to on an individual basis. Some species, such as Water Chestnut (*Trapa natans*) may have clear negative impacts on both water quality and ecologic function as well as a straightforward and accepted approach to management (physical removal). The impacts and management of others, such as the mudmat and Asian waterwort discovered in the reservoir in 2014, may be less clear and require additional monitoring or research in order to determine if management is necessary upon discovery or becomes necessary in the future.

The following graphic provides an example of the progression of response activities.

Figure 6: AIS Response Example



4. Appendices

AIS Watch List

This list will be updated as necessary – last updated 09/2023

Vegetation/Algae			
Scientific Name	**Common Name(s)**	**Type of Organism**	**Closest known occurrence**
Myriophyllum spicatum	Eurasian milfoil	Macrophyte	Wachusett Reservoir
Cabomba caroliniana	Fanwort	Macrophyte	Wachusett Reservoir
Myriophyllum heterophyllum	Variable milfoil	Macrophyte	Wachusett Reservoir
Trapa natans	Water chestnut	Macrophyte	Clamshell Pond (Clinton, MA)
Glossostigma cleistanthum	Mudmat	Macrophyte	Wachusett Reservoir
Elatine ambigua	Asian waterwort	Macrophyte	Wachusett Reservoir
Hydrilla verticillata	Hydrilla	Macrophyte	South Meadow Ponds (Clinton, MA)
Egeria densa	Brazilian waterweed	Macrophyte	Clamshell Pond (Clinton, MA)
Najas minor	Brittle / European naiad	Macrophyte	Lily Ponds (W. Boylston, MA)
Potamogeton crispus	Curly-leaf Pondweed	Macrophyte	South Meadow Ponds (Clinton, MA)
Didymosphenia geminata	Didymo / "rock snot"	Diatom Alga	West Branch of the Westfield River (Chester, MA)
Aldrovanda vesiculosa	Waterwheel	Macrophyte	Pelham, NH[1]
Nymphoides peltata	Yellow floating heart	Macrophyte	South Meadow Ponds (Clinton, MA)
Marsilea quadrifolia	European water-clover	Macrophyte	Sudbury River (Framingham, MA)
Myriophyllum aquaticum	Parrot feather	Macrophyte	Unnamed Pond (SW intersection of Chestnut Street and South Street, Needham, MA)
Nitellopsis obtusa	Starry stonewort	Macroalgae	Otsego Lake, Blackbird Bay (Cooperstown , NY)
Emergent Vegetation			
Phragmites australis	Common Reed	Wetland Plant	Wachusett Reservoir
Lythrum salicaria	Purple Loosestrife	Wetland Plant	Wachusett Reservoir
Nelumbo lutea	American lotus	Wetland Plant	Sudbury Reservoir (Southborough, MA)
Pistia stratiotes	Water lettuce	Emergent Plant	Stillwater River (Sterling, MA)
Fauna			
Corbicula fluminea	Asian clam	Bivalve Mollusk	Fort Meadow Reservoir (Marlborough, MA)
Dreissena polymorpha	Zebra mussel	Bivalve Mollusk	Laurel Lake and Housatonic River (Lee and Lenox, MA)
Bythotrephes longimanus	Spiny water flea	Micro-crustacean	[Feeder canal] Hudson River (Glens Falls, NY)
Cipangopaludina chinensis malleata	Chinese mystery snail	Gastropod	Wachusett Reservoir
Orconectes virilis	Virile crayfish	Crustacean	Wachusett Reservoir
Channa argus	Snakehead	Fish	Newton Pond (Boylston/Shrewsbury, MA)
Tilapia	Tilapia	Fish	Wachusett Reservoir

[1] Nov 18, 2019. Via email. M. P. Charpentier, Field Botanist, Oxbow Associates Inc.

Aquatic Invasive Species Decontamination Protocol for MWRA/DCR Reservoirs

Please complete and submit this checklist before deploying a boat/equipment to MWRA/DCR reservoirs (For Quabbin Reservoir, including O'Loughlin Pond and Pottapaug Pond, please comply with the Quabbin Boat Seal Program requirements):

1. ☐ **CLEAN**: **Carefully inspect boat, trailer, and equipment** for any possible contamination (this includes all interior and exterior boat surfaces, engines, anchors, lines, downriggers, fishing gear, boots, clothing, wetsuits, dive gear, nets, buckets, tools, and any other items exposed to water). **Remove all plant fragments (even those that are native), mud, and debris**. Dispose of these materials in an upland area well away from open water and catch basins or watercourses that might discharge into a water body. If a boat or motor were used in a water body that contains zebra mussels, feel the surface for any rough spots. Any rough areas should be thoroughly cleaned until smooth to the touch (see below).

2. ☐ **DRAIN**: **Drain all water** from boat, bilge, engines, jet drives, live wells, and other equipment, and remove standing water from every nook and cranny that cannot be drained. Water should be released in an area that is "high and dry" just as with disposal of removed plant fragments, mud, and debris.

3. ☐ EACH piece of equipment to be utilized must be subjected to one of the following, depending on the equipment to be used and time available.

DRY *OR* **DECONTAMINATE**

If time permits, impose downtime for boat, trailer, and all equipment so that they are FULLY DRY for the time periods listed below:

Time of Year	Duration
July and August	1 week
June and September	2 weeks
Before and after these dates	4 weeks
Winter Exposure to freezing temperatures over the winter is considered to be sufficient for decontamination*	

If drying downtime is not practicable and a visit to another water body is planned, use one, or a combination of the following methods:

Disinfectant	Concentration	Contact Time
Steam/scalding hot water*	>140°F	10 seconds
Chlorine/Bleach Solution	1 oz. per gallon water	10 minutes
Lysol	1% solution	10 minutes
Vinegar	As sold – 100%	20 minutes
Freezing	<32°F	24 hours

* preferred method

4. ☐ Please fill out and submit following checklist for each set of equipment to be utilized for the duration of the project.

Decontamination Certification

Last water body visited: _____

name, town, state

The following pieces of equipment that will be utilized in/on _____ have been decontaminated as follows:

name of MWRA/DCR reservoir

Please check each decontamination method used. Note 'n/a' if listed equipment will not be used.		Dry __/__/__ to __/__/__	Frozen __/__/__ to __/__/__	Steam/scalding water >140°F*	Chlorine/Bleach Solution	Lysol	Vinegar
Boat	Hull / engine housing						
	Deck						
	Bilge and live well						
	Transom well						
	Rope, anchors						
	Engine cooling system						
	Plant collection equipment						
Trailer	Frame						
	Wheels						
	Bunks/rollers						
Survey Equipment	Throw rake including rope						
	Secchi disk including rope						
	Boots						
	Nets						
	Water samplers						
Dive Gear	Wetsuit						
	Weights						
	BCD						
	Mask, fins, snorkel						
	Air hoses and tanks						
	Plant collection bags/tools						
Other	Please list:						

* preferred method

I hereby certify that the water craft and all other equipment to be utilized on this MWRA/DCR reservoir have been decontaminated as listed above.

_____	_____	_____
Print name	*Company/Position*	*Signature*

5. ☐

DCR Personnel

Project/Contract: _____

☐ Pass

Inspection: Reason:

5. Works Cited

Carr, J. (2015). *Wachusett Reservoir Creel Survey Report: Survey Years 2011 and 2012.* Massachusetts Department of Conservation and Recreation, Division of Watershed Management.

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