

ZEBRA MUSSEL

Prevention, Early Detection
and Rapid Response Plan

Chisago
Lakes Lake
Improvement
District
August 10,
2016

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Zebra Mussel

Prevention, Early Detection and Rapid Response Plan

Chisago Lakes Lake Improvement District

OVERVIEW

The Chisago Lakes Lake Improvement District (LID) 2016 Water Resource Management Plan includes the goal: Promote the reduction of non-native aquatic invasive species.

The Chisago County Local Water Management Plan includes the Priority Concern: The introduction or spread of aquatic invasive species and the negative effect on water quality, navigation, recreation, or fisheries.

In 2014 the Minnesota State Legislature passed Minnesota Statute 477A.19 AIS Prevention Aid that provides funding to Minnesota Counties to conduct AIS prevention efforts to include watercraft inspections, public awareness, signage and enforcement.

Inspection and prevention programs are the foundation for Aquatic Invasive Species (AIS) comprehensive management programs and represent the most important component of an AIS management program. Additional components include AIS early detection, rapid response and long term management. Once zebra mussels have been introduced into a lake there has never been a successful attempt to eradicate them from a lake. Managing an established population of zebra mussels is often unsuccessful.

At the end of 2015 there were no reports of zebra mussels in any Chisago County lake. However, reproducing populations of zebra mussels have been found in Forest Lake, White Bear Lake, Mille Lacs Lake and the St. Croix River. If zebra mussels are detected in Chisago County lakes, water quality and lake biota changes will likely occur.

The DNR [zebra mussel fact sheet \(Attachment A\)](#) provides an overview of the mussel and related best management practices.

Portions of this document are adapted from “Zebra Mussel Early Detection, Rapid Response, and Control Plan for Forest Lake, Washington County, Minnesota” prepared by Steve McComas, Blue Water Science, April 9, 2015.

PREVENTION

Watercraft Inspections

In 2010, the Chisago Lakes Lake Improvement District (LID) began a partnership with the Minnesota Department of Natural Resources (DNR) to conduct watercraft inspections at area boat launches. The purpose of the program is to change behavior, create new habits and ensure boaters are in compliance with AIS rules and regulations. Watercraft Inspectors inspect boats coming into and out of lakes to minimize the likelihood of transporting AIS from one lake to another. In addition, watercraft inspectors have the opportunity to explain to boaters how important it is for each boater to take responsibility to make sure the boat has been Cleaned, Drained and Dried, whether or not a Watercraft Inspector is present.

In 2013 the Watercraft Inspection Program expanded with a partnership with the Comfort Lake Forest Lake Watershed District to include 24 public water accesses in Chisago and Northern Washington Counties. In 2015, Watercraft Inspectors worked over 7,000 hours to complete over 10,000 watercraft inspections. Prevention of spread remains the most important step in the zebra mussel prevention, early detection and rapid response plan.

The [2015 Watercraft Inspection Program factsheet](#) (Attachment B) provides an overview of the program.

The [2015 Aquatic Invasive Species Prevention Annual Report](#) (Attachment C) provides a comprehensive summary of the program.

Decontamination

In 2015 Chisago County purchased a Lambda EOS decontamination unit. The decontamination unit is used to apply hot water to watercraft to kill zebra mussels. The decontamination unit rotates among the 10 most heavily used public water access in Chisago and northern Washington Counties. These accesses include Chisago/South Lindstrom, East Rush, Forest 1, Forest 3, Green, Little Green, North Center, Osceola, South Center and Taylors Falls Lions Club landing.



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Education/Outreach

Chisago County has hired a ¼ time AIS Education Specialist. The primary objective of this position is to develop and implement a county wide AIS communications, education and marketing plan.

One of the first projects is to update the AIS signage at public water accesses. At the accesses throughout the County the AIS signage is at varying degrees of accuracy. The signs will be updated to provide a consistent and accurate message.



Information on zebra mussels will be added to the LID website. <http://www.chisagocounty.us/300/Lake-Improvement-District>

As part of this process educational banners were developed in cooperation with the St. Croix River Association and the National Park Service.



Enforcement

Chisago County Sheriff's Water Patrol staff periodically conducts watercraft inspections at public water accesses. Sheriff's staff have the authority to issue warnings, citations and possible arrests for violations of AIS rules and regulations.

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Regional Coordination

The St. Croix River Association is coordinating the development and implementation of an AIS Strategic Work plan for the counties within the St. Croix River Basin of which Chisago County is an active participant. Components of the work plan include:

- a. Coordinate with St. Croix River Basin stakeholders in achieving prevention, containment, and control when possible of AIS and their impacts,
- b. Inventory existing AIS programs and identify gaps where work is needed,
- c. Identify threats within the St. Croix River Basin, and
- d. Develop a plan with strategies specific to river systems to direct AIS prevention, detection, and rapid response activities.

Boat lifts, docks, swim rafts or associated equipment

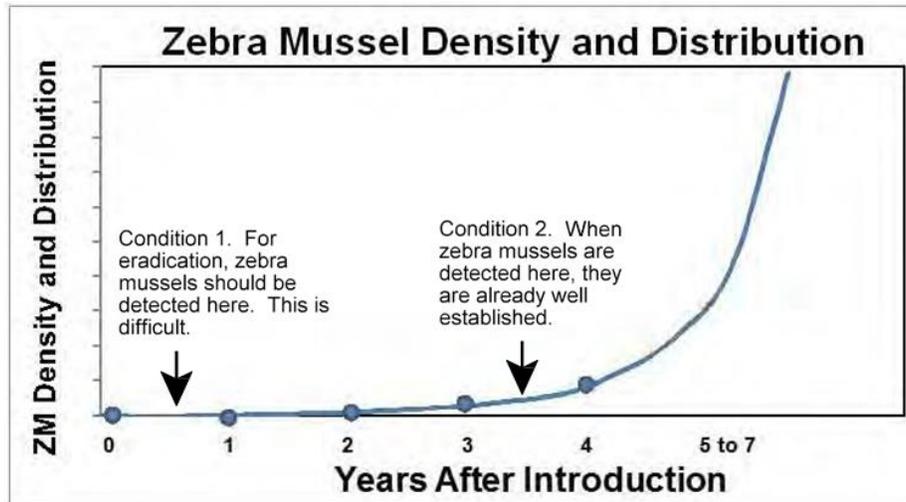
Boat lifts, docks, swim rafts or associated equipment that stay submersed in the water for an extended period of time have a high risk of contamination by AIS. The equipment is complex, having many nooks and crannies where invasives can hide and those areas can stay damp for days after the equipment is removed from the water; therefore it is difficult to fully decontaminate. This is especially true for zebra mussels which attach to hard surfaces, typically in shaded/dark areas. That is why Minnesota has the mandatory 21-day dry time, to be certain all attached invasive species, seen or unseen, are dead (due to drying out). A boat lift, dock, swim raft, or associated equipment that has been removed from any water body may not be placed in another water body until a minimum of 21 days has passed. More information can be found at www.dnr.state.mn.us/invasives/shoreland_owners.html

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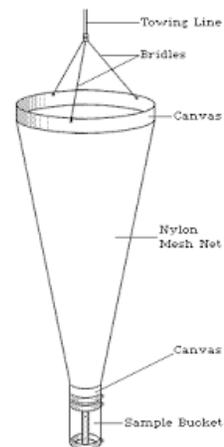
EARLY DETECTION

Zebra Mussel Settlement Samplers

Since 2010, when zebra mussels were first detected in Lake Minnetonka, methods of early zebra mussel detection have been improving. It is now recognized that finding zebra mussels at an early stage of introduction is challenging. Based on what has been learned from Minnesota experiences, an early detection approach has been formulated.



Zebra mussel samplers will be placed in various locations near shores throughout the lakes. Lake associations will be provided with up to 4 zebra mussel samplers per lake. Samplers will be distributed throughout the lake with preference to locations near public water accesses (likely first point of entry into the lake). The LID will provide samplers and training. Volunteers are asked to inspect samplers at least every other week during the open water season. In addition, volunteers will be asked to inspect docks and boat lifts, especially at the time they are removed from the lake. In the event zebra mussels are detected (or suspected) volunteers are to contact the LID and Minnesota Department of Natural Resources AIS staff.



All actions from this point forward will be coordinated with, and under the direction of the Minnesota Department of Natural Resources, Central Region, St. Cloud AIS specialists. www.dnr.state.mn.us/invasives/ais/contacts.html. Christine Jurek, DNR AIS specialist is currently the primary contact at christine.jurek@state.mn.us or (330) 223-7847.

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In addition, potential detections of zebra mussels can be reported to the Minnesota Aquatic Invasive Species Research Center – AIS Detectors and Trackers Network. The Network is currently in development and will be utilized when it is officially up and running.

[AIS Detectors and Trackers: Wanted!](#) (Attachment D)



The following three fact sheets provide information on monitoring for zebra mussel, building and inspecting settlement samplers.

[Monitoring for zebra mussels](#) (Attachment E)

[Zebra mussel settlement samplers](#) (Attachment F)

[How to inspect a zebra mussel plate sampler](#) (Attachment G)

Reports of zebra mussels can be submitted using the EDDMapS Midwest online/mobile reporting application: www.eddmaps.org/midwest/report

RAPID RESPONSE

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Once zebra mussels have been introduced into a lake there has never been a successful attempt to eradicate them from a lake. Managing an established population is often unsuccessful.

Rapid Response Assessment

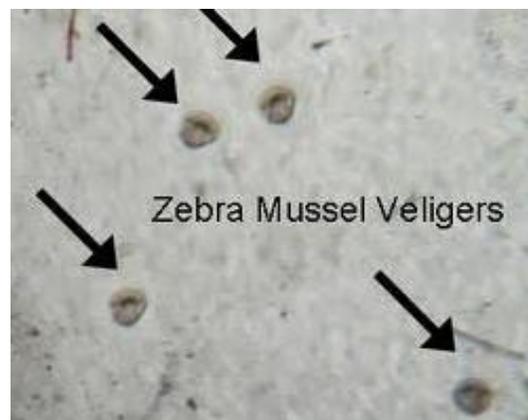
Zebra mussel detection (or suspected) in a lake will trigger a rapid response assessment under the direction of the Minnesota Department of Natural Resources AIS Specialists. The first action will be to verify that a suspect mussel is actually a zebra mussel. There are other mussels in Chisago County lakes that mimic zebra mussels.

Upon verification of zebra mussels in a lake, a rapid response assessment will take place. The assessment includes an initial search of the most probable locations to determine the density and distribution of zebra mussels. The search may include different techniques including divers. All zebra mussel locations will be mapped.



Figure S1. Rapid response assessment in Christmas Lake in 2014.

Typically, new zebra mussel introductions have come in at a public access or on lake equipment such as boat docks or lifts. The most efficient search effort is inspecting boat landing areas. Shoreline searches should be conducted at random sites around the lake, including but not limited to public access areas. Unless a lake resident observes an attached zebra mussel on a piece of lake equipment as it goes in, there is little chance of finding this zebra mussel on a random lake wide search of lake equipment. Therefore a search effort should be concentrated in the public access area.



In early summer cold temperature water, zebra mussel spawning has not yet started, so new veligers (larval stage) would not have settled in

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areas and developed into juveniles. However, from the previous year, adults may have detached and re-attached on hard substrates in shallow water. Finding new juveniles on hard substrates produced from spawning adults during the growing season might not be detected until July or August when they would be large enough to be observed.

As water temperatures warm, monitoring for veligers is a possible method to detect the presence of zebra mussels, but there is a low probability of detecting rare populations when there is a low density of spawning adults. Veligers, which are functionally acting like zooplankton, have a low probability of detection. Veliger monitoring is widely used in the western states and is a technique to be considered.

Zebra Mussel Eradication Index

As a component in the rapid response assessment, to help evaluate the zebra mussel status and make a determination if an eradication attempt should be implemented, a semi-quantitative approach can be considered using a zebra mussel Eradication Index (McComas, unpublished). The Index has been used for a number of lakes. The highest score recorded to date was for Christmas Lake where an Index score of 730 out of a possible 1,000 points was calculated. This has been the best candidate for a zebra mussel eradication attempt as of October 2015. However, zebra mussels were found in October 2015 in Christmas Lake three months after the final eradication attempt. Eradication was not successful in Christmas Lake. This indicates that for a successful eradication, an Index score above 730 may be required.

Eradication Index (McComas unpublished)

Criteria	Poor 0-30	Fair 30-60	Excellent 60-100
Minimum of 30 hours and 7,000 objects checked monthly in early detection surveys. Plate or tube samplers should be deployed and checked monthly			
Monthly early detection inspections indicate zebra mussels came into the lake within a month. Alternatively, there is specific knowledge of a recent introduction on an object (for example recent installation of a used boatlift with zebra mussels).			
Rapid response assessment involves up to 90 hours of additional searching and 20,000 objects should be checked.			
Zebra mussels are found at 1 or 2 sites. If three sites or more are found the probability of eradication decreases. Low numbers of zebra mussels should be present at the site of occurrence. If zebra mussel densities are high, the odds increase that they have detached and drifted to			

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other locations. If two sites with zebra mussels are found in different areas of the lake, it is highly unlikely that any pilot projects for control would be approved as scattered distribution is suggestive of lakewide dispersal.			
Zebra mussels should be immature. It has to be assumed immature zebra mussels were introduced on objects detached and reattached to new objects. Presence of mature zebra mussels indicates the probability of ongoing spawning.			
Individual mature zebra mussels should be separated by distance. If two or more mature zebra mussels are found in close proximity successful spawning is likely to have occurred and dispersal of veligers and juveniles may be widespread but undetected.			
Wave action on containment barriers along open stretches of shoreline causes leakage of treatment water and dilution by lake water reducing the chemical concentration of the toxic agent within the containment area. It is best if the containment area is in a secluded location such as a bay or a cove.			
Treatment area should be at least 3 times larger than known area of distribution at a site. A total area greater than 10 acres will be difficult to administer. Treatment should occur as soon as possible after the rapid response assessment.			
The probability of reintroduction should be low. Is the public access gated, are inspectors present from sunup to sundown, etc? Also do nearby lakes have zebra mussels?			
The smaller the lake the better. The odds of a successful eradication for lakes greater than 300 acres in size is low.			
Total Score			

Rapid Response Action

If only 1 or 2 zebra mussel sites are found after the rapid response assessment then eradication may be attempted. The feasibility of a successful eradication will be evaluated by comparing conditions to other lakes that have attempted eradication treatments. DNR, Chisago County, Lake Associations and consultants will coordinate decision making to determine if a rapid response action will go forward.

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If the results of the rapid response assessment indicate that all zebra mussels are found in a small area and the zebra mussel Eradication Index score is suitably high, an eradication attempt may be considered. If zebra mussels are found in 2 or more areas, and there is a low Index score, the odds of successful eradication are low and going forward with a rapid response action should be carefully considered and probably should not occur. A list of rapid response actions is shown below. It should be noted that once zebra mussels have been discovered in a lake, they have never been eradicated in the Midwest.

If rapid response action is considered, containment barriers may be installed to attempt to contain the population until controls can be implemented.

Rapid Response Action Options (McComas unpublished)

Rapid Response Action	Pros	Cons	Costs for 0.5 acre Treatment (22,000 square feet)
EarthTec (copper sulfate compound)	Used in Christmas and Independence and results indicated lethal concentrations can be achieved. Registered for zebra mussel control.	In some cases, less than 100% mortality of zebra mussels. Other organisms will be killed. Public access will be closed for a month.	Installation of a containment barrier up to 8 applications of CuSO ₄ over a 4-5 day period. Total: \$10,000
Potash (potassium chloride, a molluscicide)	Proven technique in a Virginia quarry and in Lake Winnipeg harbors. Can achieve 100% mortality.	Not a registered pesticide. Need special permission to use it. Public access will be closed for a month.	Containment barrier and single treatment: Total: \$8,000
Zequanox (biopesticide)	Proven technique. Used in Christmas Lake. Registered to use for zebra mussel control.	Less than 100% mortality of zebra mussels. Public access will be closed for a month.	Containment barrier and product: Total: \$44,400
Tarp or Pond Liners	Used in Lake Waco, Texas and Lake Tahoe, Nevada (Asian	Need to remove tarps after a month. Need special permits.	\$1/sf x 22,000 sf = \$22,000 + labor Total: \$22,000

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	clams). Access remains open.	Organisms under the tarp will be killed.	
Drawdown (dewater the infested area using a water dam)	Can completely dewater and dry out an infested area for a theoretical 100% mortality.	Other organisms will be killed in dewatered area as well.	Rental for 441 feet of a water dam for a containment area: Total: \$46,000 + labor Purchase of 441 ft of a water dam Total: \$113,000 + labor

Current Minnesota rules and regulations will determine which method(s) of treatment will be allowed during a response effort. The DNR AIS specialist will help determine which actions can be taken. At this point in time zebra mussel control efforts are reviewed on a case by case basis and must meet specific requirements in order to be considered. More information on pilot projects to control zebra mussels can be found at:

www.dnr.state.mn.us/invasives/aquaticanimals/zebramussel/pilot_project.html

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LONG TERM MANAGEMENT:

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If eradication actions are not feasible or unsuccessful, zebra mussels may spread through connected lakes in a few years. For some situations, small-scale control for small areas may be an option to suppress zebra mussel heavy growth. Currently there are several small scale zebra mussel removal devices that may work to remove zebra mussels from swimming areas, boat accesses and sandy fish spawning areas. It will likely take 3 or more years before zebra mussels reach high clumping densities in a lake where removal activities are needed.

Zebra mussels have few natural controls and large or lake wide treatments are not economically or ecologically ready to implement at this time.

In 2012, the Minnesota legislature appropriated funds to create an Aquatic Invasive Species Cooperative Research Center at the University of Minnesota, in collaboration with the Commissioner of Natural Resources. The Center's mission is to develop research-based solutions that can reduce the impacts of aquatic invasive species in Minnesota by preventing spread, controlling populations, and managing ecosystems; and to advance knowledge to inspire action by others. The Center's vision is to be a vibrant and durable research enterprise that advances the knowledge and builds the capacity that Minnesota needs in order to reduce the impacts of aquatic invasive species on our cherished lakes, rivers, and wetlands.

The Center has identified spiny waterflea, zebra mussels, quagga mussels and faucet snail as high priority species with known high risk of spread and high impact.

Possible Lake Changes if zebra mussel Become Established

Ecological and recreational impacts that can result from zebra mussel infestations and are summarized below.

Ecological Impacts of zebra mussels: With the filtering action of a large population of zebra mussels, water clarity will improve, but there can be changes as a result of this clearer water.

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Sunlight will penetrate into deeper water and aquatic plants may grow denser and into deeper depths.

Another consideration is that energy flow will be shunted off into a zebra mussel - algal loop and the 'energy' may not flow up to fish. The result could be a lower number of fish. The 'energy' in this case, is the flow of nutrients through the food chain. In lakes without zebra mussels, phosphorus is taken up by algae and algae are grazed by zooplankton, which in turn are eaten by small fish. Gamefish, like bass and walleyes, eat the small fish. Therefore phosphorus has made its way into the gamefish or piscivores (carnivorous animals eat primarily fish). However, when high densities of zebra mussels are present in a lake, they feed on algae as well. Because predation on zebra mussels by fish is low, the phosphorus 'energy' does not go up the food chain. Instead of transferring energy up to fish, zebra mussel excretion products deposit nutrients into the sediments. Released nutrients from the sediments will go back into algal growth, which in turn, is filtered by zebra mussels, forming the zebra mussel-algal loop. Fish do not get the full benefit of the phosphorus 'energy' component and the result can be lower fish biomass in the long term.

Small scale zebra mussel control techniques

Zebra mussels have few natural controls and large scale or lake wide treatments are not economically or ecologically available at this time. The alternative is to control zebra mussels in small areas. Currently there are several small-scale removal devices that could work to remove zebra mussels from swimming areas, boat accesses and even sandy fish spawning areas. It will likely take 3 or more years before zebra mussels reach high clumping densities in a lake where removal activities are needed.

Long term monitoring after zebra mussel colonization

Currently, routine water quality sampling occurs for the major lakes in the LID. Water quality monitoring is scheduled to continue at these sites in the future. Monitoring zebra mussel densities should be considered as well at these water quality sampling locations. In the future, zebra mussel densities could be correlated with water quality results. In addition, plant assessments and fish surveys will continue and potential changes may be associated with zebra mussel densities.

The Chisago Lakes Lake Improvement District will continue to monitor zebra mussel prevention and management research and make changes to the plan as appropriate.