

Minnesota Department of Natural Resources

Department of Fish and Wildlife

Section of Fisheries

Completion Report

Southwest Minnesota Watershed Breaches and Invasive Carp Barriers

(Fall 2012 to Spring 2016)

By

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Executive Summary

Two species of Invasive carp (previously known in Minnesota as Asian Carp which include Silver Carp, Bighead Carp, Grass Carp, and Black Carp) were first reported in the Little Sioux River in Iowa in 2011. Confirmed specimens of Bighead (2 in 2011, 82 in 2012) and Silver (55 in 2012) Carp were collected in two of the Iowa Great Lakes (East Okoboji and Spirit Lake) by commercial seine hauls. An electric barrier has since been installed (Fall 2012) on the outlet of the Iowa Great Lakes (source of Milford Creek, tributary to Little Sioux River; Figure 1 site 5). Additional barrier locations as well as watershed breach locations were identified in Minnesota where Invasive Carp could be suspected of moving from the Little Sioux River watershed to adjacent watersheds. The additional barrier and breach locations were addressed with an earthen dyke, a modified outlet structure, a grated culvert, Hickenbottom tile caps, removal of culverts with a flowage easement, and an additional electrical barrier. Containment of Invasive Carp to within the Little Sioux River Watershed in SW MN is important to the states of Minnesota and Iowa due to connections to statewide waterways outside of the Little Sioux River Watershed leading to expansion of Invasive carp within Minnesota and Iowa. A sampling protocol has been implemented within the Little Sioux River Watershed since 2013 and no Invasive Carp have been sampled within the Minnesota waters of the Little Sioux River Watershed. This report gives the details of each barrier and breach project that was completed within the Little Sioux River Watershed from 2011 to 2015. Many relationships were created during this project and the projects implemented in southwestern Minnesota and northwestern Iowa. State and federal agencies, county and township governments, along with landowners came together to help find solutions to greatly reduce the uncertainty of possible Invasive Carp into watersheds and lakes of this region. An outcome of this effort as projects were completed, established long-term monitoring strategies and adopted maintenance protocols to insure the protection of aquatic resources from potential expansion of Invasive Carp from the Missouri River and its Minnesota tributaries.

Approved:

 6/20/2017

Regional Fisheries Manager

 6-20-17

Area Fisheries Supervisor

Introduction and Background Information

In 2011, the Iowa Department of Natural Resources (DNR) sampled two 15 to 16 inch Bighead Carp while assessing natural reproduction of native fish species on East Okoboji (Figure 1). The following spring (March 28, 2012) a commercial fisherman caught 82 Bighead Carp and 55 Silver Carp in a 6,000 foot seine while harvesting Bigmouth Buffalo and Common Carp in East Okoboji. The Invasive Carp (Silver and Bighead Carp) sampled ranged in length from 15 to 18 inches, but a single Silver Carp much larger than that weighing 15 pounds was captured. Additionally, in April 2012 the commercial fisherman also caught Silver Carp in Big Spirit Lake indicating upstream movement of the fish. The Invasive Carp captured in East Okoboji and Big Spirit Lake were suspected to be migrants from the Missouri River. During the spring of 2011, record high water levels in the Little Sioux River (LSR) triggered migration of Invasive Carp from the Missouri River (known infestation area) to the LSR, then into Mill Creek, and into the Iowa Great Lakes (Lower Gar, Minnewashta, Upper Gar, East Okoboji, West Okoboji, and Big Spirit Lakes). Connection of the Iowa Great Lakes to Minnesota lakes upstream was a concern as well as continued migration of Invasive Carp in the mainstem of the LSR, which originates in Jackson County Minnesota.

Direct connection of the Iowa Great Lakes to upstream bodies of water in Minnesota (Little Spirit Lake, Loon Lake, Pearl Lake, Rush Lake, and Clear Lake) was analyzed. During the fall and spring of 2012 and 2013 an electric barrier was installed at the outlet of the Iowa Great Lakes on Lower Gar Outlet to prevent further introductions of Invasive Carp. However, there was still a chance for further expansion of Invasive Carp in the LSR into Minnesota. Sampling was conducted on the LSR including tributaries and connected lakes and wetlands during the summer and fall of 2013 and 2014. No Invasive Carp were captured. Additionally, no Invasive Carp have been sampled in the Iowa Great Lakes since March 28, 2012 but they have been sampled in the LSR in Iowa. The LSR watershed was analyzed for potential placement of barriers to prevent expansion of Invasive Carp further north with the LSR. It was determined that there were several locations that may have been suitable for a mechanical or electrical barrier, however, it was also determined that watershed breaches were also present. Several breaches from the LSR watershed to the Upper West fork of the Des Moines River (DMR) Watershed were identified as well as a single Watershed breach from the Rock River Watershed to the LSR Watershed and a single breach from the Upper West Fork of the Des Moines River Watershed to the Cottonwood River Watershed. These watershed breaches needed to be

plugged to fully contain any additional introductions of Invasive Carp to the LSR Watershed alone and prevent expansion to additional waterways across the state of Minnesota from the LSR.

As a result of Invasive Carp within the LSR Watershed that extends into Iowa, bait harvest was closed within the Minnesota portions of the watershed by Commissioner's Order No. INF-12-001, effective April 30, 2012 (Appendix 1). In addition, infested waters designations were assigned to Minnesota waterbodies due to direct connection to Iowa waters infested with Invasive Carp (Figure 2). Coupled with the bait closure and infested waters designations 9 potential project sites including 3 electric barriers, 2 mechanical barriers, and 4 watershed breaches were identified within the LSR Watershed using ArcMAP 10.1 Geographic Information System (GIS) software utilizing Light Image Detection and Ranging (LiDAR) aerial contour imaging and a suite of aerial photography during different years representing different hydrological events as well as field inspections (Figure 3). Legislative appropriation of \$7.5 million through the Lessard Sam's Outdoor Heritage Council (LSOHC) was funded to the Minnesota (MN) DNR in 2013 to address these concerns as well as others throughout the state. The LSR Watershed projects received \$1.22 million of the 7.5 million appropriation and a separate \$261,000 allocation of this fund was provided to Iowa for barrier work at Site 5. The original list of 9 project sites within the LSR Watershed was focused down to 6 and included 2 electric barriers and 4 watershed breaches as well as 1 additional watershed breach from the Upper West Fork of the Des Moines River Watershed to the Cottonwood River Watershed.

Project Focus Area

Sites were labeled 1 through 6 within the LSR Watershed in reference to priority ranking and each was defined (Figure 4). Site 1 was a glacial till outwash watershed breach from the LSR Watershed to the Upper West Fork of the Des Moines River Watershed. Site 2 was a glacial till outwash watershed breach that included a previously constructed privately owned dyke incompletely separating the LSR Watershed from the Upper West Fork of the Des Moines River Watershed. Site 3 was a minor glacial outwash watershed breach that also included surface and subsurface (tiling) agricultural drainage that created a breach from the LSR Watershed to the Upper West Fork of the Des Moines River Watershed. Site 4 was an outlet structure of a Wildlife Management Area impoundment that directed water from the LSR Watershed to the Rock River Watershed. Site 5 was the outlet of the Iowa Great Lakes at Lower Gar Lake and the headwaters of Mill Creek that is a tributary to the LSR in Iowa. Site 6 is an identified location of an electrical barrier that will protect establishment of Invasive Carp in Lakes (Round, Illinois, and Plum Lakes) within the LSR Watershed.

Explanation and Implementation of Projects

Site 1A

Site 1 was determined by Windom Area Fisheries Staff to be a watershed breach. The LiDAR aerial contour imaging indicated a potential problem with a glacial outwash site crossing the LSR Watershed Upper West Fork of the Des Moines River Watershed boundary. Minnesota DNR Ecological and Water Resources independently verified the watershed breach with hydrological modeling and indicated a concern at this location. Field inspection of the site along township road 320th avenue in Ewington Township in Jackson County (T102 R38 S6; UTM Zone 15: 303645E, 4837322N) revealed two 30 inch culverts under a township road (Figure 5). The culverts essentially acted as a breach through the township road right-of-way which was acting as a dyke separating the watersheds. It was determined that the best course of action was to remove the culverts to reduce the risk of a watershed breach at this location. Since the road was a township road bordering private land, permission and cooperation from the Township and landowners was necessary. Area fisheries staff worked with Ewington Township, and the area landowners that would be affected with floodwater by removing the culverts. It was determined that a flowage easement or fee title purchase of the land was needed to allow water to be pooled on the private land after removal of the culverts. In addition, a Joint Powers Agreement (JPA) between the MN DNR and Ewington Township was needed to remove the culverts from the road (See <http://www.mmd.admin.state.mn.us/pdf/21jointpowersandinteragency.pdf> for information regarding JPA usage and regulations). Ewington Township contracts all road work to Jackson County Highway department that cannot be done quickly and easily with Township equipment. Therefore, Jackson County Highway department was the contractor specified in the JPA to perform the removal of the culverts under the township road and then properly refill and grade the surface with clay and gravel. Approximately \$3,800 was spent from the appropriation of LSOHC funds entering into the JPA with Ewington Township (Table 1). In, addition nearly \$560,000 was spent from statewide DNR RIM credits to pay for a 79 acre perpetual flowage easement (determined was most cost effective) that DNR Lands and Minerals organized with the private land owner and \$14,000 was expended from Fish and Wildlife Fish Management Water Recreation Account (2100) and FAW Management Game and Fish Account (2200)(Table 1). These two processes started in June of 2012 and were finalized by September of 2014 (Table 2).

Site 1C

It was determined that site 1 needed additional solidification (redundancy) due to concerns of road grade failure and past flooding events over the Township Rd 320th at Site 1A.. Two additional sites on a ditch downstream of site 1 were identified as potential areas for an electric barrier to prevent Invasive Carp from gaining access to the watershed breach area

(Figure 4). Of the two locations, 1B and 1C, 1C (Township 102 Range 38 Section 15-16; UTM Zone 15: 306812E, 4835144N) was the easiest location to install the barrier for several reasons. Site 1C was at a Township road crossing and was on a stretch of private ditch so a public waters permit was not required. Even though the ditch was private and a public waters permit was not needed, the Army Corp of Engineers still needed to approve the plan. Site 1B was located at a County Highway crossing and within the public waters stretch of the ditch which would have required a permit. In addition, a meeting with the Jackson County Highway Department resulted in a recommendation to install the barrier at the Township road which would reduce the overall cost of the barrier installation and increase ease of construction. Therefore, two private landowners that lived near the Township road were contacted and informed of the decision to build the electric barrier at the Township Road crossing. The landowners were both favorable to the plan and agreed to the construction design. A 30 year lease was entered into with one of the landowner's to allow the MN DNR to install the operational area for the electric barrier on private land. Hydraulic modeling was contracted to Erickson Engineering in June of 2013 to determine elevations of flood events at this location, per Jackson County Engineers request, to determine the impact of the barrier design to the ditch system and the Township road. Additionally, hydraulic modeling indicated protection of the Township road from overtopping up to a 100 year flood event. A Smith-Root electric fish barrier was chosen for implementation as a result of a MN DNR request for proposal (RFP) conducted by Regional DNR staff. After a bidding process that resulted in bids from potential contractors, Sherbrooke Turf was selected to remove existing Township road infrastructure (two round metal culverts) and construct the electric fish barrier infrastructure (12 foot by 6 foot box culvert) and repair the township road. Smith-Root, Inc. and L&S electric then wired and set up the electric barrier controls and officially commissioned the electric barrier in June 2014 (Figure 6). Total cost for the electric barrier, private land lease, hydraulic modeling, and various costs associated with engineering and design with MN DNR management resources division (MN DNR MR) was near \$488,100 (Table 1). Minnesota DNR in kind salary expenses related to this project totaled approximately \$14,000 (Table 1). Length of project from start to finish was approximately 12 months (Table 2).

Site 2

Site 2 was another glacial outwash area identified near the headwaters of the LSR along the northern boundary of the LSR Watershed in Rost Township (T102, R37, S4; UTM Zone 15: 315379E, 4836839N) (Figure 7). The site 2 area is characterized as a historical wetland that had the ability to back flow from the LSR Watershed into the Upper West Fork of the Des Moines River Watershed during periods of high flow. A private dyke was built in the past to contain the flood waters and keep an agricultural field from flooding. A pump was installed to remove flood water from the agricultural field to the wetland on the west of the dyke, from the DMR

watershed to the LSR watershed. The private landowner indicated that the dyke in its current design had been overtopped with floodwater in the past. Technical assistance from the Southwest Prairie Technical Service Area – Rock County Soil and Water Conservation District (SWCD) supported that claim and indicated that hydrological modeling indicated an additional 2.1 feet was needed to build up the dyke and prevent 100 year flood events from overtopping the dyke. As a result, a JPA was entered into with the Jackson County SWCD to raise the elevation of the dyke 2.1 feet with permission from the private landowner and the Jackson County Board of Commissioners. In addition, a modified pump and updated electrical feed was installed to handle the additional rise of 2.1 feet and allow the landowner to continue to mitigate floodwater on the agricultural field. Electrical contracting was required to complete this job, so Jackson SWCD subcontracted the electrical work. The project was started in the winter of 2013 and was completed by fall of 2013 (Table 2, Figure 8). Total cost of the project was approximately \$57,100 from the LSOHC appropriations and \$7,000 from DNR in kind salaries (Table 1).

Site 3

Site 3 is located approximately 1 mile south of Site 1 near Okabena Creek in Ewington Township (T102 R38 S7, UTM Zone 15: 303220E, 4835414N). Site 3 is a combination glacial outwash area and agricultural surface and subsurface drainage (Figure 9). Site 3 is also identified as a restorable wetland on the MN DNR and Jackson County databases. Site 3 pools water during flood events and subsurface drainage directs water from Site 3 to Okabena Creek. An earthen berm is in place to the south of Site 3 and to the north of Jackson County Highway 12 that restricts surface flow to the DMR Watershed. However, to the south of the berm there are two 8 inch county tile intakes that drain surface water to the LSR Watershed. In addition, surface flood water south of the berm flows in the Jackson County Highway 12 ditch and through a culvert under the road to the south and then to the LSR Watershed. There existed in this area a potential for surface and subsurface water from the LSR to mix with surface and subsurface water from the DMR Watershed along with aquatic organisms in the water. There have been verified sightings of Common Carp within the wetland created by flood water that are able to potentially move across the earthen berm when flood waters are high. Therefore, with approval from the Jackson County Commissioners, the Jackson County Highway Department, and the private landowner a JPA was formed with Jackson County to add Hickenbottom caps to the county tile intakes and a grated culvert inlet cover for the culvert under County Road 12 (Figure 10). Design and implementation of this project started in the summer of 2013 and field work was completed by Jackson County Highway department in the spring of 2014 (Table 2). Total expenditures from the LSOHC appropriations related to design and construction of this site was approximately \$8,700 and total DNR in kind salary expenses were approximately \$7,000 (Table 1).

Site 4

Site 4 is located along the northwestern border of the LSR Watershed and the Rock River Watershed and comprises the area known as Herlein-Boote Wildlife Management Area (WMA; T102 R40 S6; UTM Zone 15: 282720E, 4837463N) (Figure 11). Herlein-Boote WMA was constructed for several purposes; first, as an impoundment of a tributary that flows to Kanaranzi Creek and then to the Rock River and secondly as a diversion that flows to Okabena Lake in Worthington, MN within the LSR Watershed to replenish the city of Worthington's public water well field. These two water diversion structures are known as Sites 4a and 4b. Site 4a is the western structure that was constructed to outlet water to the Rock River Watershed (natural flow) and Site 4b is the eastern structure that was constructed to divert water to the LSR Watershed (created flow line). However, the western outlet structure to the Rock River Watershed was only a 24 inch outlet while the eastern diversion was a 36 inch outlet structure. In order to prevent movement of Invasive Carp from within the Rock River Watershed to the LSR Watershed and vice versa, it was determined the best course of action was to permanently close the eastern diversion structure and resize the western outlet structure to increase capacity. The City of Worthington was concerned about the elimination of water from Herlein-Boote to their public water wells downstream. After an extensive series of meetings in 2013 dealing with questions regarding water availability and hydraulic analysis with Worthington City officials, Nobles County officials, and Okabena-Ocheda Watershed District officials it was determined to move forward with closing the eastern diversion. A final step was meeting with the Worthington City Council at a business meeting during the winter of 2014 and creating an official resolution to permanently close the eastern diversion structure. When official approval was obtained, the MN DNR division of fish and Wildlife, section of wildlife, was assigned the official DNR project supervisor due to the inclusion of a WMA and outlet structure modification that may influence management of the WMA. Minnesota DNR contracted an engineering firm and general contractor to remove and construct a new western outlet structure and permanently close the eastern diversion structure (Figure 12). Work was started in the winter of 2014 and completed in May of 2014 (Table 2). Landowner permission was needed to potentially increase water levels in the reservoir at Herlein-Boote and some dispute is still occurring over compensation from potential flood damage if it occurs. Over the course of the project from start to completion approximately \$104,400 was expended from the LSOHC appropriation and \$11,000 was expended for DNR in kind salaries for MN DNR Fish and Wildlife, section of fisheries employees (Table 1).

Site 5

Site 5 is the only site not located in the Minnesota portion of the LSR Watershed (UTM Zone 15: 327180E, 4500938N). Site 5 is located at the Lower Gar outlet, which is also the outlet

to the Iowa Great Lakes (Figure 1, Figure 3). Originally, several sites were identified within the Minnesota portion of the LSR Watershed as sites to prevent Invasive Carp expansion into Minnesota waters. Those sites included Site 8, and Site 9 (Figure 3). Site 8 is the Loon Lake outlet in Minnesota. A modification of the Loon Lake outlet to include mechanical or electrical technology to exclude Invasive Carp from Loon Lake and the upstream Clear Lake was considered. However, at the time, Iowa DNR was considering putting in an electrical barrier downstream of Lower Gar to protect future introductions of Invasive into the Iowa Great Lakes which would also protect Minnesota waters including Loon and Clear Lake. Site 9 is the location of an existing grated culvert barrier that prevents stocked muskellunge within the Iowa Great Lakes to leave to Little Spirit Lake in Minnesota. The grated culvert barrier was going to be altered, if possible, to prevent Invasive Carp from leaving the Iowa Great Lakes and entering Little Spirit Lake in Minnesota. It was determined that only an electric barrier would be effective enough to reduce the spread of all sizes of fish, but infrastructure (County Road System) and safety concerns (popular fishing area at the culvert) were too high to construct at this location. Due to concerns with sites 8 and 9 and the ability to potentially partner with Iowa on the construction of their electric barrier, it was determined that LSHOC appropriations should be leveraged to Iowa to help with the project. Following a review of laws and regulations regarding usage of LSOHC funds for out of state projects, it was determined that the Iowa electric barrier also held value to protect Minnesota resources and thus it was legal to leverage the funds to the Iowa DNR. Work was completed in December of 2013 for the Iowa electric barrier and \$261,000 from the LSOHC allocated to Iowa in a partnership to protect combined LSR Watershed Lakes and Streams within Iowa and Minnesota (Table 1, Table 2, Figure 13). In addition, approximately \$7,000 was expended for Minnesota DNR Fish and Wildlife, section of fisheries salaries related to this project from 2100 and 2200 funds (Table 1).

Site 6

Site 6 was identified as an area that could be protected from expansion of Invasive Carp into Illinois Lake, Plum Lake, and Round Lake upstream of the original location near the Iowa border (101T 37R 33S; UTM Zone 15: 315667E, 4819289N). Round Lake is an extremely important recreational lake in the Windom Fisheries Management Area and protection from expansion of Invasive Carp is sought for maintenance of a destination recreational fishing lake. However, the original location near the Iowa border was found to be cost prohibitive with an estimated price of \$7,000,000 for construction of an electric fish barrier. Additionally, likelihood of barrier failure was greater at this location and jurisdiction was in question at the state boundary line. Therefore, several other options were identified as locations for an electric barrier. They were identified as sites 6a, 6b, 6c, and 6d (Figure 4). Site 6a is located where the West Fork of the LSR crosses under Jackson County Highway 5 (UTM Zone 15: 308124E, 4823069N). Site 6a was a potential electric barrier location for upstream protection of Illinois

Lake, Plum Lake, and Round Lake. Site 6a had drawbacks of difficulties due to constructing an electric barrier under a county highway, construction on private land, and safety concerns related to people nearby and snow accumulation on the county road. Site 6b was another location of an electric barrier at the outlet of Round Lake (UTM Zone 15: 304567E, 4825513N). Site 6b was also the location of Site 7 in an earlier identification of barrier locations (Figure 3). The potential drawbacks in construction of an electric barrier at this site were many; they included the loss of protection for Illinois Lake and Plum Lake, construction on private land, and construction within a campground near people that would create unwanted safety concerns. Site 6c was another location that was identified as a potential location for an electric barrier. Site 6c is located south of Illinois Lake and north of Jackson County Highway 4 within the Illinois Lake State Wildlife Management Area (UTM Zone 15: 306845E, 4824011N). Site 6c would provide protection for Illinois Lake, Plum Lake, and Round Lake and the location is on public land in an isolated area away from public. The inclusion of this area within state land made this location the best option for ease of construction. Site 6d was simply the name for the original location of site 6, from above, near the Iowa border. Sites 6a, 6b, and 6d had too many negative aspects in terms of safety and cost and were ruled out of consideration. Site 6c was chosen as the location for the electric barrier for protection of Illinois Lake, Plum Lake, and Round Lake due to the benefit of construction on DNR owned land and lack of major safety concerns while maintaining protection for all lakes originally identified.

Engineering and design for the electrical barrier at site 6c was completed by Smith-Root and MN DNR MR (Table 2). The project design and engineering started in the fall of 2013 along with engineering and design for site 1c. Funds from the LSOHC appropriation were insufficient to complete site 6c at the time 1c was constructed, so site 6c was postponed until additional funds could be acquired from the original allocation of 7.5 million to MN DNR for Invasive Carp projects statewide. Additional funds were secured in the summer of 2014 so the implementation of site 6c could continue. The barrier project was started in summer of 2015 and completed in the fall of 2015 with commissioning of the barrier in fall 2015. Approximately \$55,000 was expended from LSOHC appropriations and nearly \$11,000 was expended for DNR in kind salaries (Table 1). The total project cost for construction and DNR management resources was \$353,308.

Site 10

During the identification of watershed breaches along the LSR Watershed boundary with the DMR Watershed and the Rock River Watershed the DMR Watershed and the Rock River Watersheds were also analyzed for watershed breaches to other watersheds. Another problem area was identified along the northern boundary of the DMR Watershed creating a watershed breach to the Cottonwood River Watershed (T106 R38 S26&35; UTM Zone 15:

309839E, 4869293N). This area was near several wetlands, Round and Long Lakes that were in different watersheds and named Site 10 (Figure 14). At an unspecified point in the past, an illegal ditch was constructed on private land that connected Round Lake to Long Lake in order to drain high water levels from Round Lake in a reverse direction from a natural southern flow and force water to the north into Long Lake. It was determined that this area was a public waters violation by area DNR ecological and waters resources staff and a restoration order was issued to recreate an outlet on Round Lake to the south. In the meantime, DNR LSOHC funds were used to permanently plug the constructed ditch from Round Lake to Long Lake. A contractor was bid to bring fill of clay and top soil and plug the ditch. This area was identified as a breach in the spring of 2012 and meetings with landowners and County Commissioners occurred in summer and fall of 2012. The project was started in the winter of 2012 and finished in February of 2013 (Table 2, Figure 15). Approximately \$3,000 of LSOHC appropriations was expended to the completion of Site 10 (Table 1). An additional amount of \$3,000 was expended from 2100 and 2200 funds for DNR salary expenses.

Additional low priority watch sites were identified with ArcMap using LiDAR along the Rock River Watershed Boundary and the Big Sioux River Watershed. Follow-up field assessments of these areas by Hutchinson Area Invasive Carp Staff revealed no connectivity across the watershed boundary. Watch sites will continue to be monitored to assess future connectivity in light of potential modifications to roads or water control structures and assure connectivity is not inadvertently created.

Summary

Overall, six project sites within the LSR Watershed and one site within the DMR Watershed totaling roughly \$1,914,100 including LSOHC funding, RIM credit monies, and salary expenditures were identified and completed over the course of 3 years (Table 1). Protection for a portion of the 321 square miles of the LSR Watershed within Minnesota (proportion susceptible to Invasive Carp) as well as protection for 5,823 square miles of the West Fork of the Des Moines River upstream of Saylorville dam in Iowa and Minnesota, of which 1,334 square miles is in Minnesota, was completed with these projects. A simple cost benefit analysis was done by comparing the number of direct watershed square miles protected in Minnesota (1,655) and total (6,144). Overall, the cost per square mile was between \$312 and \$1,157 when looking at direct benefits of the project. However, many square miles of Minnesota watersheds were impacted by eliminating a threat of Invasive Carp to breach from one watershed to another, and then to the Minnesota River via a backdoor route conceivably affecting many thousands of square miles of Minnesota Watersheds and potentially many rivers and hundreds of highly valuable recreational lakes. While this may be difficult to measure; it is understood through these protection efforts that a lasting positive relationship should promote economic

prosperity and conservation stewardship in this agricultural region. Therefore, a monetary cost benefit analysis only shows the minimum benefit of the projects completed in Southwest Minnesota. Many partners were leveraged and worked with to accomplish these projects including Federal, State, County, Township, and private groups. Procedures used to identify breaches and rank existing barriers as deterrents, or not deterrents, for the identification of sites in this project were refined and used on a statewide basis in Minnesota (See <http://www.dnr.state.mn.us/invasive-carp/migration.html>). The outcome of the statewide identification of breaches and locations for potential modification of barriers or placement of electrical barriers holds tremendous value to the overall health of Minnesota waterways. In addition, a map was developed that shows the vulnerability of watersheds within Minnesota to potential Invasive Carp expansion (Figure 16). The work completed within the LSR Watershed was pioneering in terms of scope and implementation. Future projects for Invasive Carp deterrent and control will most likely follow the example of these projects. The overall recommendation from the implementation of the projects within southwest Minnesota is to include any and all stakeholders in the process of each project as early as possible, particularly when the U.S. Army Corp of Engineers is needed for waterway project approval. As a result of the many relationships created during this project and the projects implemented in the LSR Watershed and surrounding area, southwest Minnesota waterways including specifically the DMR and the LSR are much safer from potential expansion of Invasive Carp from the Missouri River and its Minnesota tributaries. An outcome of this effort as projects were completed was the establishment of long-term monitoring strategies and adopted maintenance protocols to insure the protection of aquatic resources. New learning opportunities were nurtured on a unique set of strategies to block Invasive Carp from entering watersheds. Local project coordination was improved and partnerships were developed with stakeholders and interagency staff to work through the challenges and processes for overcoming this issue.

Table 1. Expenditures from Lessard Sam’s Outdoor Heritage Council (LSOHC, 3/8% sales tax legislation for dedicated funds), Reinvest in Minnesota (RIM) credits, and in kind salary costs for each project site within the LSR Watershed (Site 1, 1C, 2, 3, 4, 5, 6C) and Site 10 along the Cottonwood River Watershed and the Upper West Fork of the Des Moines River Watershed from 2012 to 2016.

Project	Expenditures from Funds			Total Expenditures
	LSOHC	RIM Credits	DNR in kind Salary	
Site 1	3,800	560,000	14,000	577,800
Site 1C	488,100		14,000	502,100
Site 2	57,100		7,000	64,100
Site 3	8,700		7,000	15,700
Site 4	104,400		11,000	115,400
Site 5	261,000		7,000	268,000
Site 6C	354,000		11,000	365,000
Site 10	3,000		3,000	6,000
Total	1,280,100	560,000	74,000	1,914,100

Table 2. Timeline of action items for Invasive Carp Projects in southwest Minnesota. Dates are arranged according to Minnesota State Government fiscal calendar (July to June). Dates are grouped by season with summer as July to September (Jul-Sep), Fall as October to December (Oct-Dec), winter as January to March (Jan-Mar), and spring as April to June (Apr-Jun).

Action Item	Date																	
	2011			2012			2013			2014			2015					
	Jul-Sep	Oct-Dec	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan - Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
Silver and Bighead Carp enter Iowa Great Lakes - Little Sioux River Watershed	█	█																
Identification of Breaches and Barriers in Watersheds of SW Minnesota			█	█	█													
Lessard Sam's Outdoor Heritage Funding				█	█													
Site 1				█	█	█	█	█	█	█	█	█	█					
Site 1C							█	█	█	█	█	█						
Site 2							█	█	█	█	█							
Site 3							█	█	█	█	█	█						
Site 4							█	█	█	█	█	█						
Site 5							█	█	█	█								
Site 6C													█	█	█	█	█	█
Site 10				█	█	█												

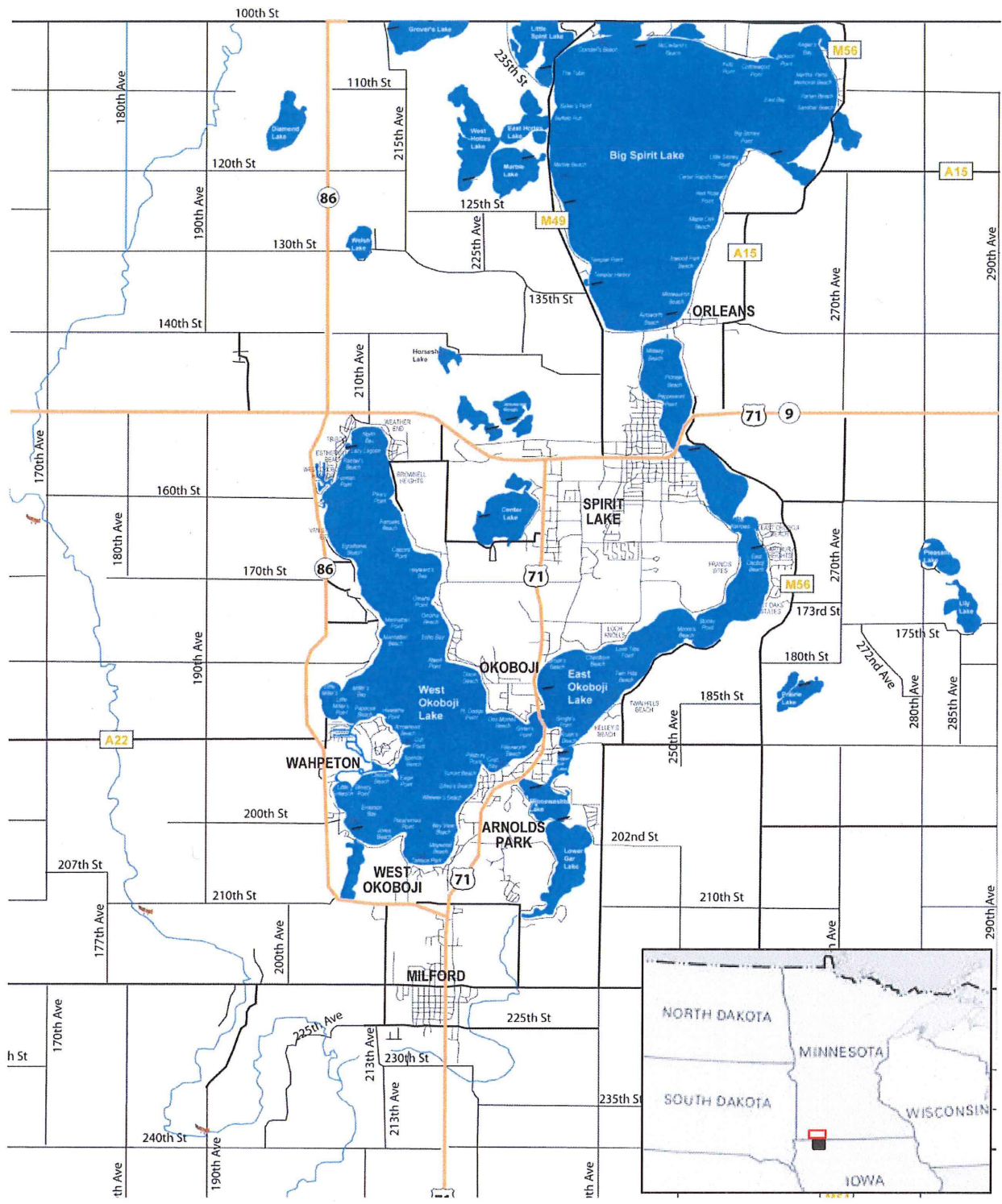


Figure 1. Map of Iowa Great Lakes including from north to south, Big Spirit Lake, East Okoboji Lake, West Okoboji Lake, Minnewashta Lake, and Lower Gar Lake. Inset map shows the location of the Iowa Great Lakes (black square) in comparison to the Little Sioux River Watershed in Minnesota (red area). Map from <http://www.iagreatlakes.com>.

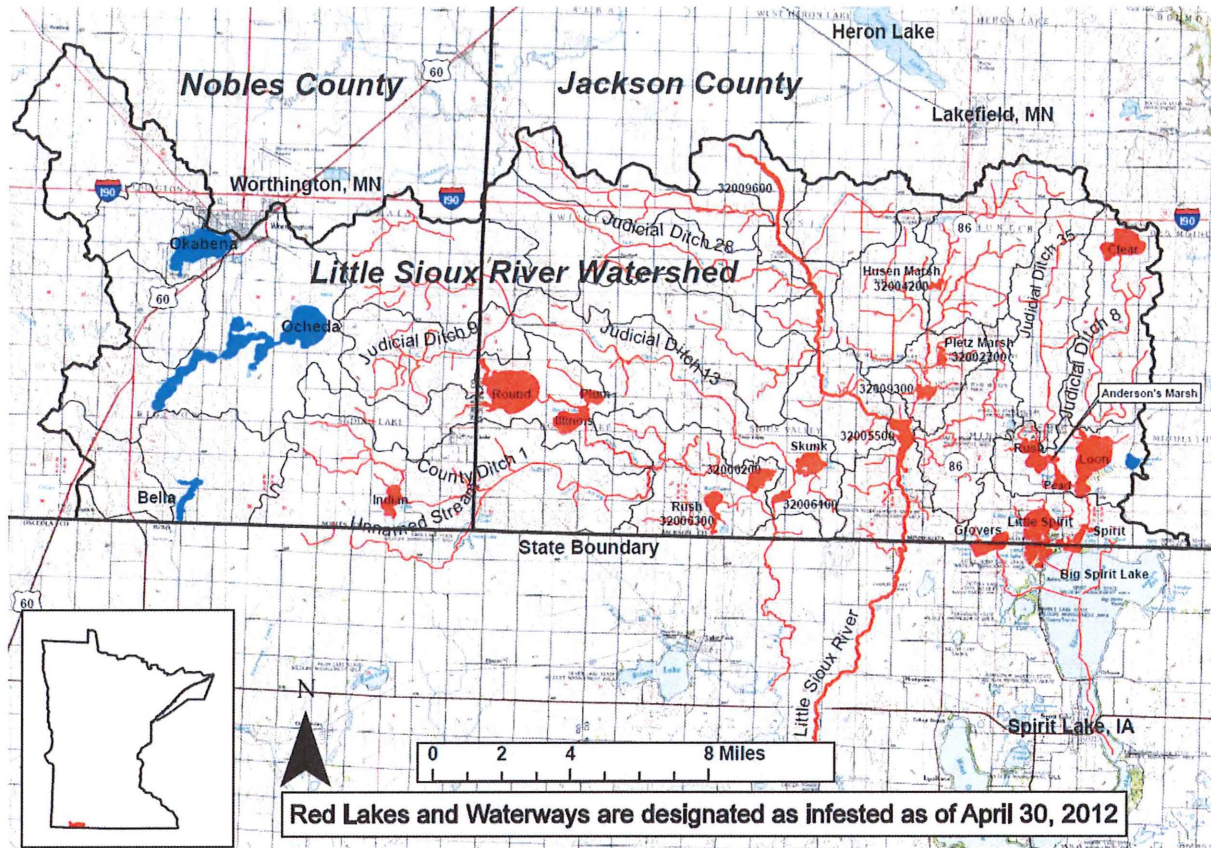


Figure 2. Infested water designations within the Little Sioux River Watershed in Minnesota as of April 30, 2012 due to connection to waters infested with Silver Carp and Bighead Carp in Iowa. Red waterbodies are listed as infested due to connectivity and blue waterbodies are not listed due to disconnectivity.

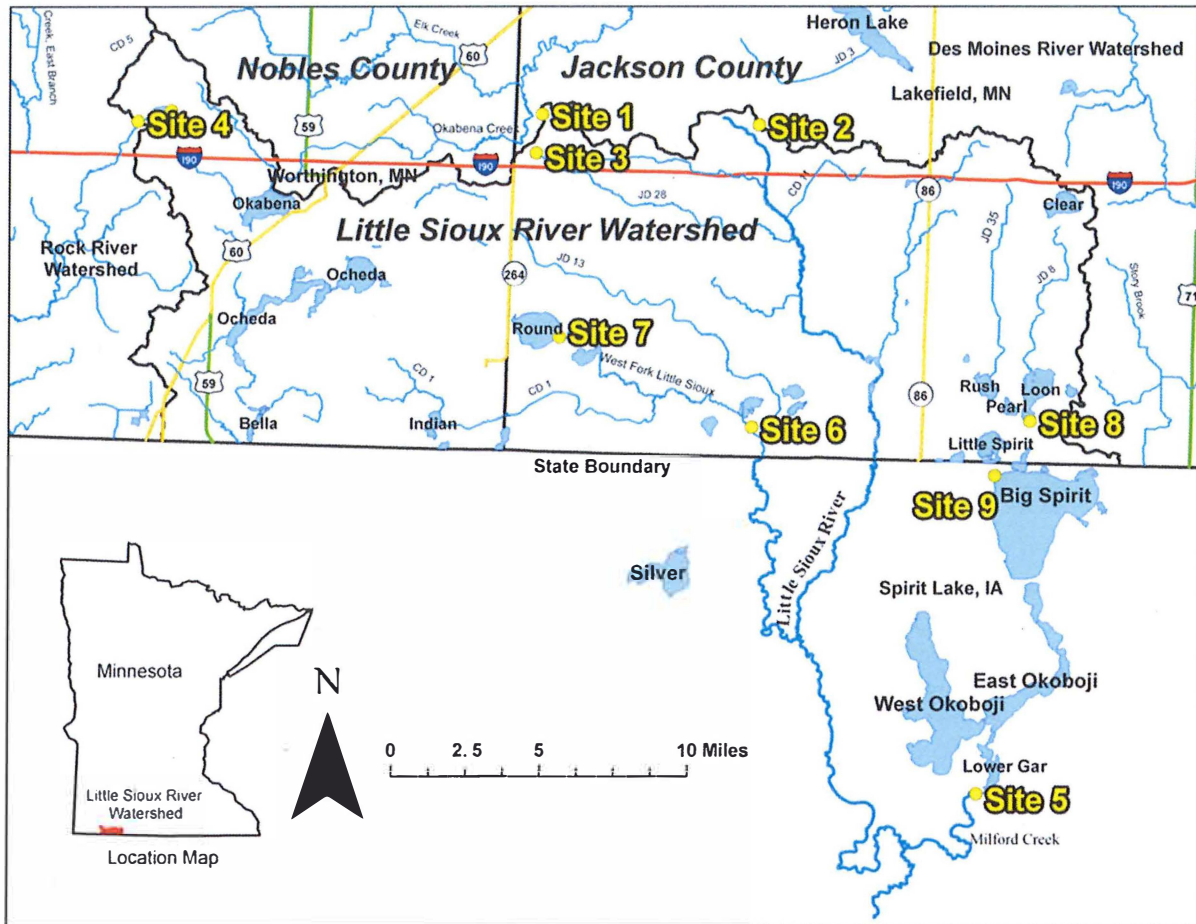


Figure 3. Location of potential projects sites with the Little Sioux River Watershed in Minnesota and Iowa for deterrance of Invasive Carp (Silver and Bighead Carp). Sites 1, 2, 3, and 4 were identified as watershed breaches to adjacent watershed and sites 5, 6, 7, 8, and 9 were identified as areas for potential mechanical (sites 8 and 9) or electric fish barriers (sites 5, 6, and 7).

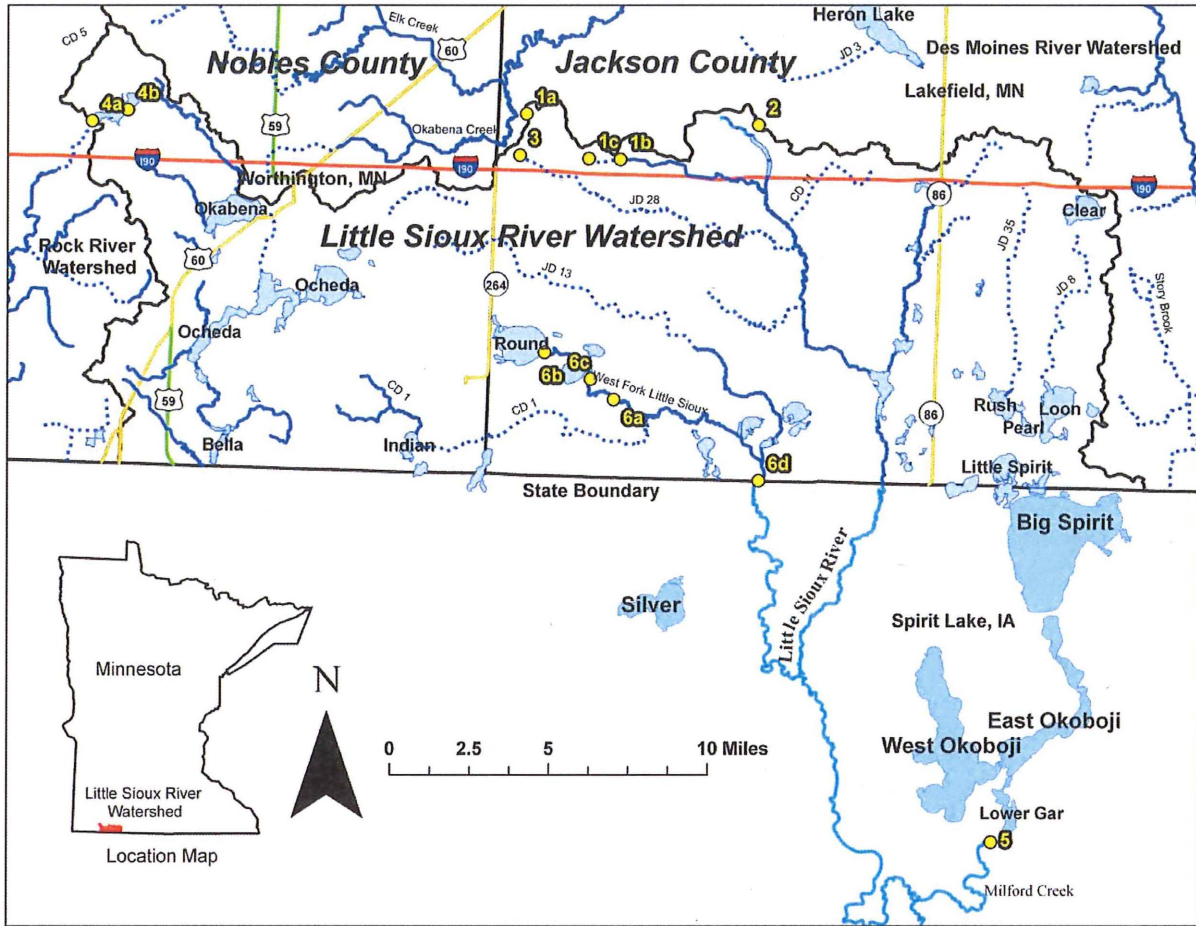


Figure 4. Location of Invasive Carp breaches and barrier sites with numbering related to priority order. Site 1 (sites 1a, 1b, and 1c) was the most critical and site 6 (6a, 6b, 6c, and 6d) was the least critical. Sites 1, 2, 3, and 4 (4a and 4b) were identified as watershed breaches to adjacent watersheds and sites 5 and 6 (6c) were identified as locations for electrical barriers to protect important recreational lake resources.

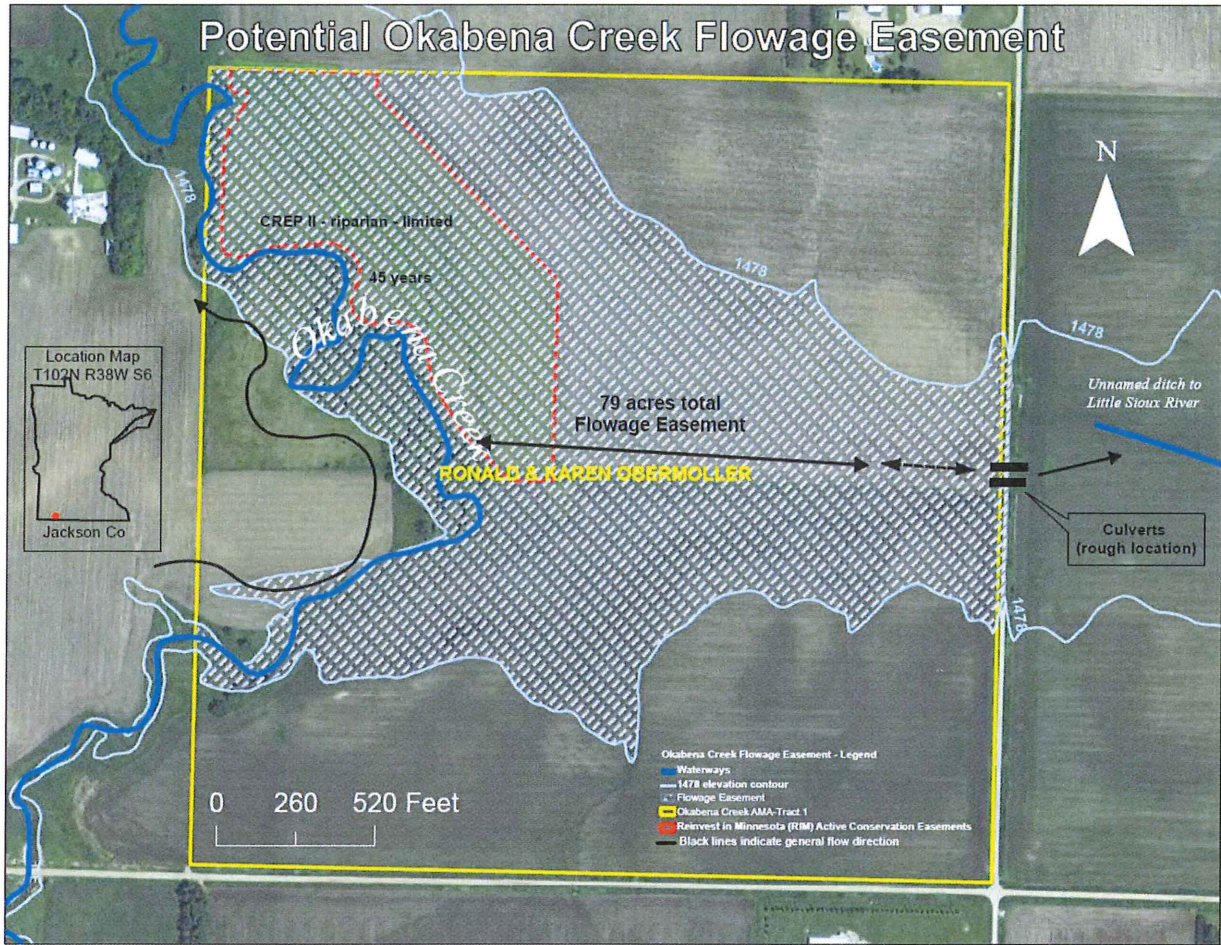


Figure 5. Site 1a (Okabena Creek Flowage Easement, see Figure 4) showing the influence of the floodplain (shaded) upon the identified watershed breach point (culverts). Landowners, flow direction of Okabena Creek, and total flowage easement acreage are listed for reference.



Figure 6. Site 1C (See Figure 4) showing the completed and functional fish barrier on a private ditch in Ewington Township, Jackson County. Picture A shows the upstream view of the ditch in the direction of the watershed breach at site 1A. Picture B shows the downstream view of the electric barrier from upstream to downstream. Picture C shows from downstream viewing upstream the completed barrier and exclusion fencing as well as a portion of the barrier controls to the left. Picture D shows the barrier controls within the fencing showing the electrical pulsators and computer command and communication center.



Figure 7. Location of site 2 (See Figure 4) showing the watershed boundary of the Little Sioux River Watershed and the Upper West Fork of the Des Moines River Watershed (Des Moines River – Headwaters). A dyke was built (unknown build date) along the east side of the wetland in the Little Sioux River Watershed. A pump is utilized to drain water from the field to the northeast of the dyke to the wetland and across the watershed line.



Figure 8. Site 2 (See Figure 4) showing the build-up of the existing dyke by 2.1 feet. In addition, a new pump was installed and modified to lift water from the Upper Fork of the West Des Moines River Watershed to the Little Sioux River Watershed. The superimposed line is the rough location of the watershed boundary.

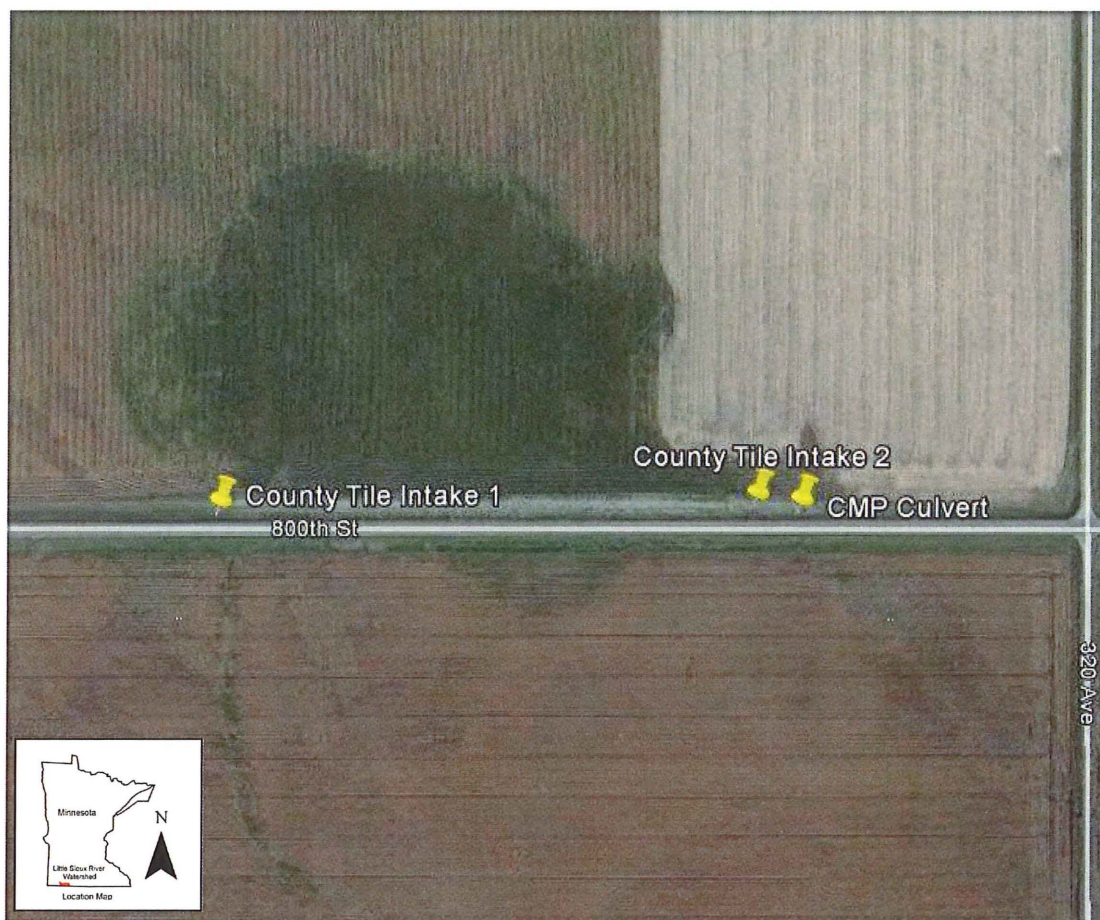


Figure 9. Location of site 3 (See Figure 4) showing a wetland and two county tile inlets to the north of Jackson County Highway 12 (800th St) and a corrugated metal pipe (CMP) culvert under 800th St.



Figure 10. Picture A showing site 3 (See Figure 4) with final construction of Hickenbottom caps and a grated corrugated metal culvert (CMP) inlet with an overflow inlet if grate becomes plugged. Picture A shows the location of the dyke separating the ditch from the wetland.

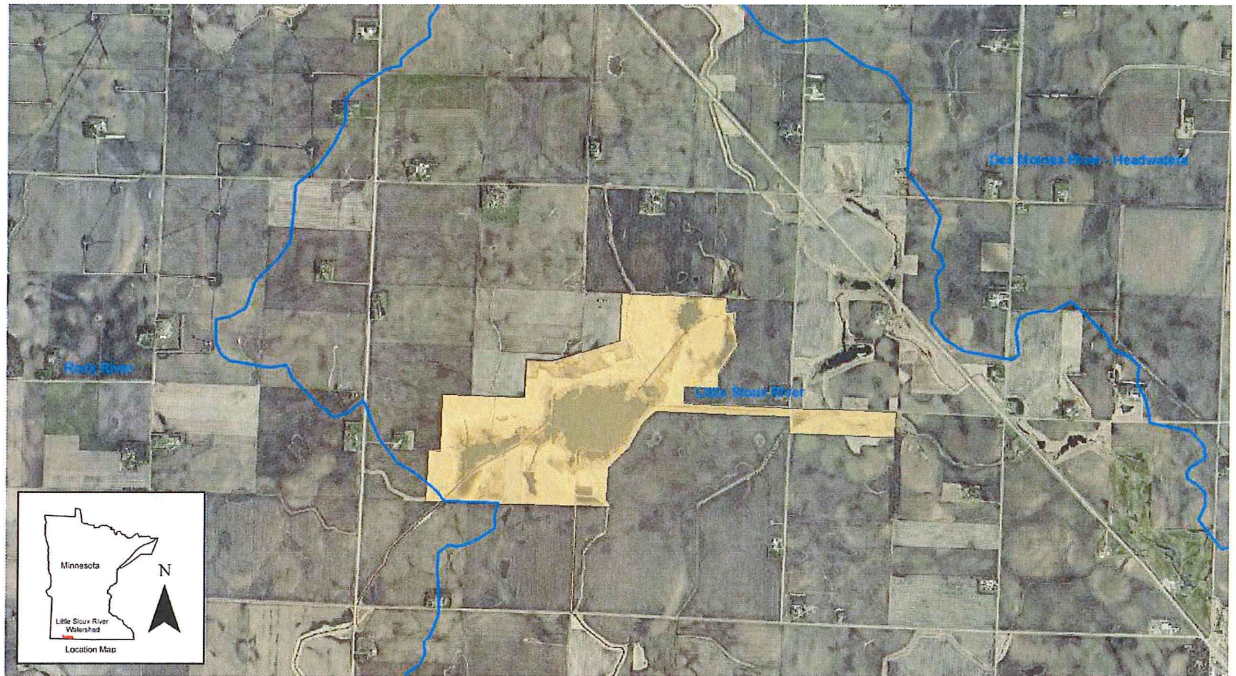


Figure 11. Location of Herlein-Boote Wildlife Management Area (shaded area) within the Little Sioux River Watershed, Site 4 (See Figure 4), in relation to the Rock River Watershed and the Upper West Fork of the Des Moines River Watershed (Des Moines River – Headwaters).

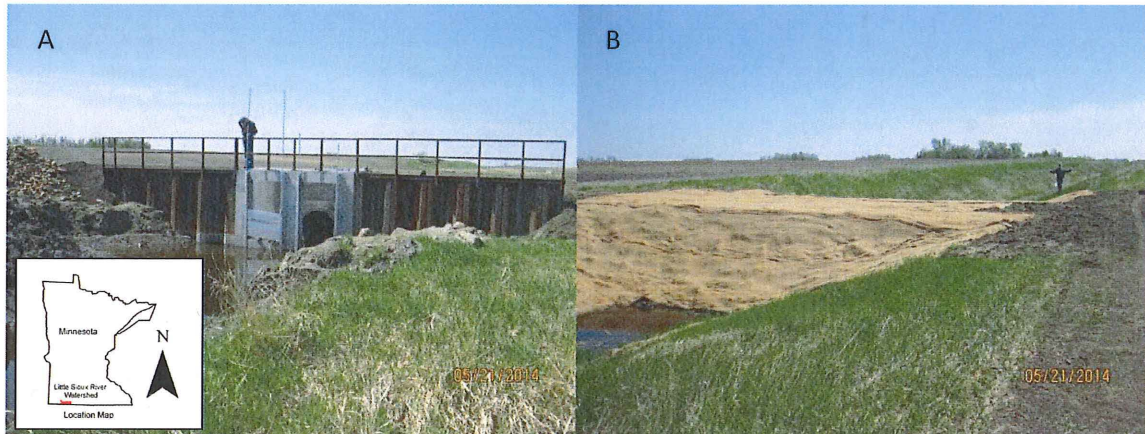


Figure 12. Site 4 (See Figure 4) showing the completed projects for site 4a (A) and 4b (B). The newly constructed outlet in A is increased to handle greater capacity now that site 4b (B) is permanently closed with a ditch plug.



Figure 13. Site 5 (See Figure 4) in Iowa at Lower Gar Outlet. Eight electrodes were placed within the concrete sill to provide an electric barrier for Invasive Carp movement. This location is a population fishing area and is monitored with a remote camera to insure public safety. The controls for this electric barrier are similar to the controls shown in Figure 6.

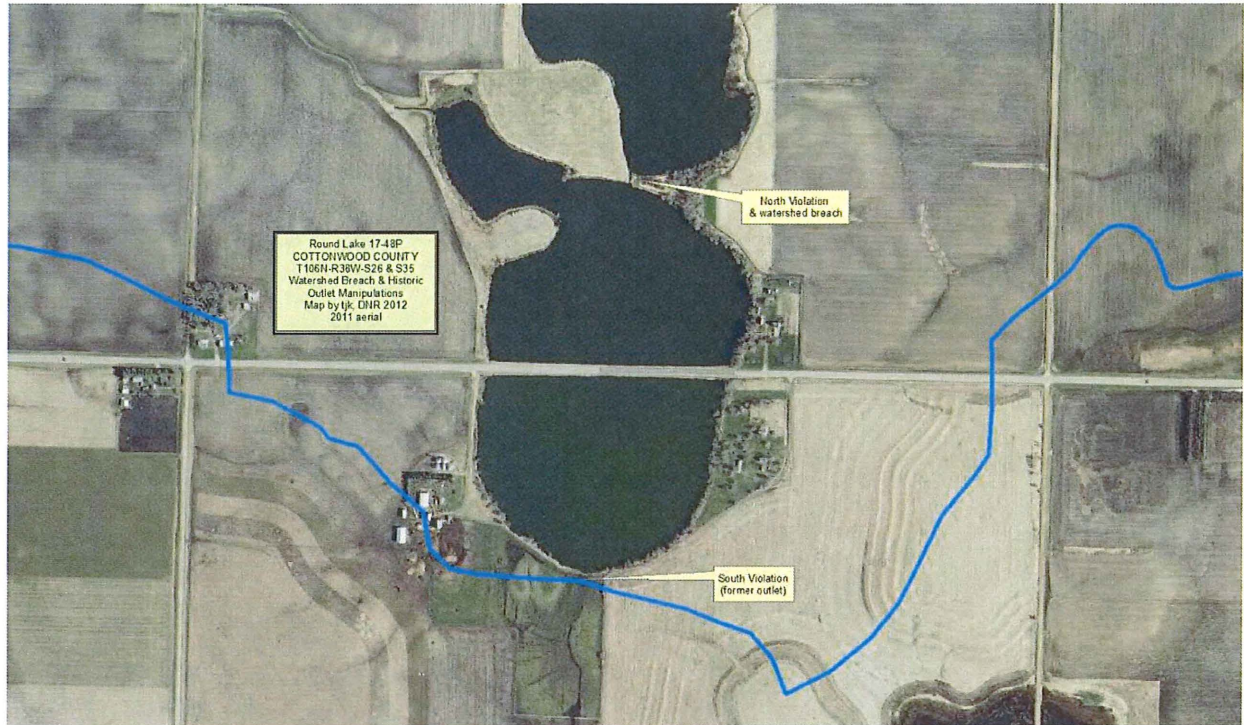


Figure 14. Site 10 showing the location of the watershed breach (North Violation & watershed breach) and the location of the former outlet of Round Lake (South Violation (former outlet)). Cottonwood County Highway 13 goes through the middle of Round Lake. The watershed boundary is highlighted in blue and shows the divide of the Upper West Fork of the Des Moines River Watershed (south) and the Cottonwood River Watershed (north).

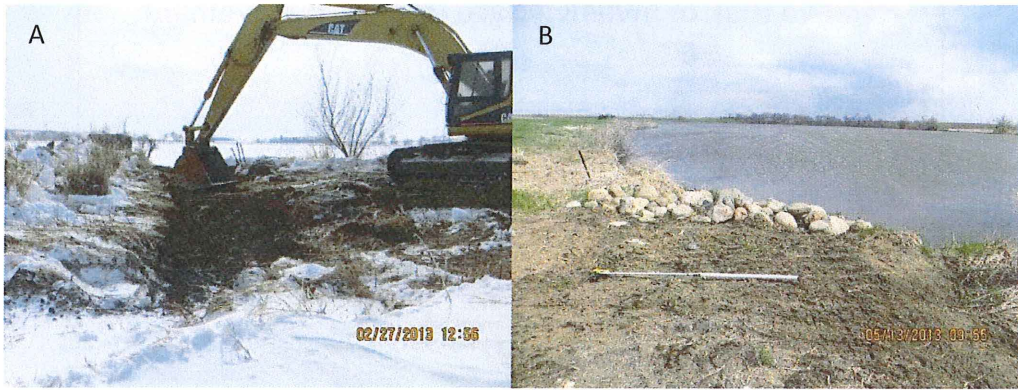


Figure 15. Site 10 showing the plug that was installed in February of 2013. Picture A shows the plug being installed and picture B shows the final project completion facing north.

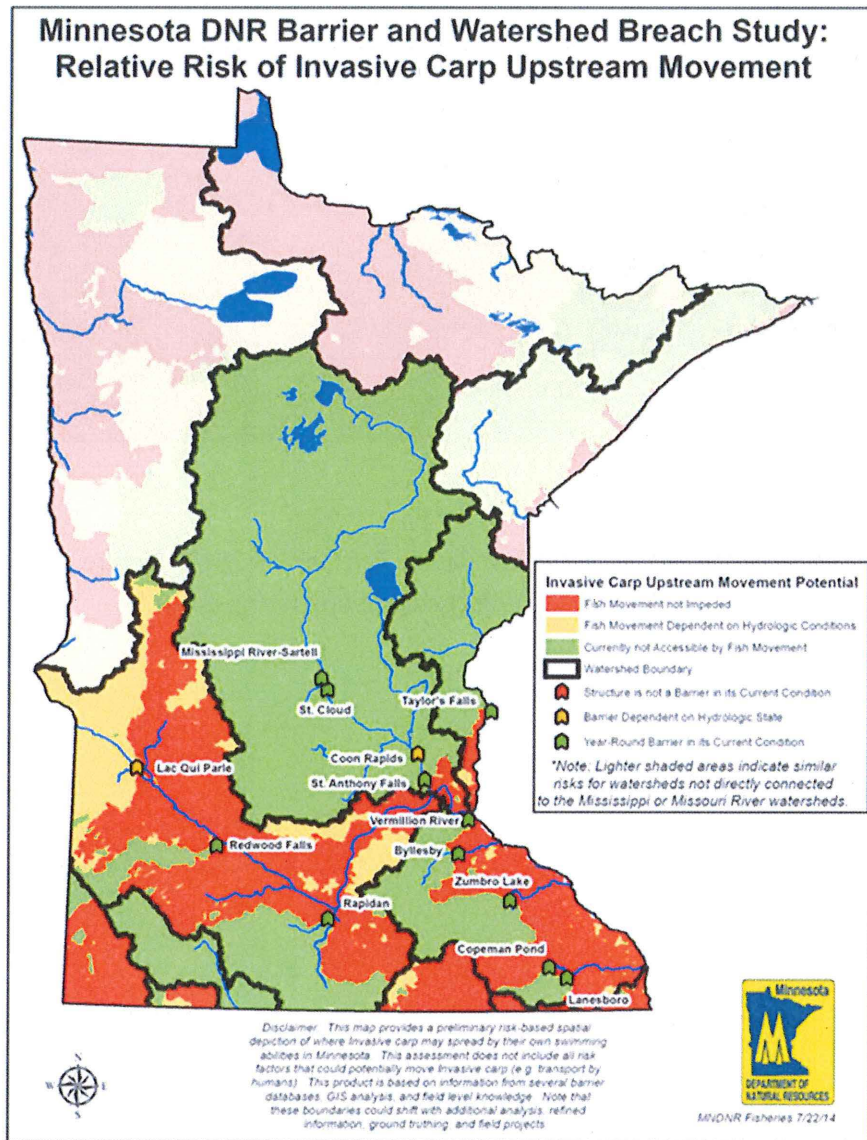


Figure 16. Map of the results of a statewide Invasive Carp Risk Assessment following the methodology of the southwest Minnesota Invasive Carp risk assessment and location of watershed breaches and barriers. Red locations indicate that fish movement is not impeded and thus vulnerable to Invasive Carp. Yellow locations indicate seasonal or incomplete barriers are in place based on hydrologic conditions and watershed may be susceptible to Invasive Carp. Green areas are locations that were determined to be impassible for Invasive Carp and thus risk is low.

Appendix 1. Minnesota Department of Natural Resources Commissioner’s Order Number INF-12-001 listing Invasive Carp waters as infested as of April 30, 2012.



	Commissioner’s Order No. INF-12-001
	Designation of Infested Waters
	EFFECTIVE DATE: Upon publication in the <i>State Register</i> on April 30, 2012
	Statutory authority: <i>Minnesota Statutes</i> , section 84D.03, subdivision 1
	Supplements: Commissioner’s Order INF-07-001 dated October 4, 2007, Commissioner’s Order INF-08-001 dated April 21, 2008, Commissioner’s Order INF-08-002 dated July 7, 2008, Commissioner’s Order INF-09-001 dated May 7, 2009, Commissioner’s Order INF-09-002 dated July 9, 2009, Commissioner’s Order INF-09-003 dated December 28, 2009, Commissioner’s Order INF-10-001 dated April 27, 2010, Commissioner’s Order INF-10-002 dated June 13, 2010, Commissioner’s Order INF-10-003 dated August 9, 2010, Commissioner’s Order INF-10-004 dated December 15, 2010, Commissioner’s Order INF-11-001 dated April 21, 2011, and Commissioner’s Order INF-11-002 dated October 3, 2011.

WHEREAS, pursuant to *Minnesota Statutes*, section 84D.03, subdivision 1, the commissioner shall designate a water of the state as an infested water if it is determined that the water contains a population of an aquatic invasive species that could spread to other waters if use of the water and related activities are not regulated to prevent spread, or the water is highly likely to be infested by an aquatic invasive species because it is connected to a water that contains a population of an aquatic invasive species.

WHEREAS, pursuant to *Minnesota Statutes*, section 84D.03, subdivision 1, the designation of infested waters by the commissioner shall be by written order published in the State Register.

WHEREAS, the following described waters in the state meet the criteria established in *Minnesota Statutes*, section 84D.03, subdivision 1, for designating infested waters and the following explanations apply to the list:

1. A lake in more than one county is listed under the county corresponding to its public waters inventory number, but the designation applies to the entire lake. Lake Superior and designated portions of rivers that flow through more than one county are listed under the heading Multiple Counties.
2. Ponds and wetlands that are not on the public waters inventory are listed with “none” in the number column.
3. Rivers and streams on the public waters inventory are listed without a number in the number column.
4. Changes to previous designations of infested waters are shown by underlining the new text and strikethrough of deleted text.

NOW, THEREFORE, IT IS HEREBY ORDERED, pursuant to authority vested in me by law, including but not limited to *Minnesota Statutes*, section 84D.03, subdivision 1, the following waters are

designated as infested waters and previous designations are modified or removed from designation. All currently designated infested waters are listed at the Department of Natural Resources Web site at http://files.dnr.state.mn.us/eco/invasives/infested_waters.pdf.

Waters infested with bighead and silver carp.

The following water bodies are infested with bighead carp (*Hypophthalmichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*).

Name	DNR Public Waters Inventory Number
Jackson County	
Anderson's Marsh	32-0032
Clear Lake	32-0022
County ditches connected to designated infested waters in Jackson County	
Grovers Lake	32-0025
Illinois Lake	32-0072
Judicial Ditch No. 8, between Clear Lake and Loon Lake	
Judicial Ditch No. 35, from Sec. 14, T 102, R 36 to Rush Lake	
Judicial ditches connected to designated infested waters in Jackson County	
Little Sioux River and its tributaries	
Little Spirit Lake	32-0024
Loon Lake	32-0020
Loon Creek, between Loon Lake to Spirit Lake	
Pearl Lake	32-0033
Plum Lake	32-0071
Round Lake	32-0069
Rush Lake	32-0031
Rush Lake	32-0063
Skunk Lake	32-0059
Spirit Lake	32-0023
Unnamed creek, between Pearl Lake and Loon Lake	
Unnamed creek, between Anderson's Marsh and Pearl Lake	
Unnamed creek, between Rush Lake and Anderson's Marsh	
Unnamed lake	32-0027
Unnamed lake	32-0042
Unnamed lake	32-0055
Unnamed lake	32-0061
Unnamed lake	32-0062
Unnamed lake	32-0093
Unnamed lake	32-0096
West Fork Little Sioux River and its tributaries	
Nobles County	
Indian Lake	53-0007
Multiple Counties	
Mississippi River, downstream of Lock and Dam 2 (Dakota, Goodhue, Hennepin, Houston, Wabasha, Washington, and Winona)	
St. Croix River, downstream of the dam at Taylors Falls (Chisago and Washington counties)	

Waters infested with Eurasian water milfoil.

The following water bodies are infested with Eurasian water milfoil (*Myriophyllum spicatum*) or its hybrids.

Name	DNR Public Waters Inventory Number
Dakota County Cobblestone Lake	none
Thomas Lake	19-0076
Goodhue County Lake Pepin	25-0001
Steele County Unnamed gravel pit (located in Section 16, Township 108, Range 20W)	
Washington County Colby Lake	82-0094

Waters infested with zebra mussels.

The following water bodies are infested with zebra mussel (*Dreissena* spp.).

Name	DNR Public Waters Inventory Number
Douglas County Irene Lake	21-0076
Goodhue County Lake Pepin	25-0001
Hennepin Forest Lake	27-0139
Libbs Lake	27-0085
Peavey Lake	27-0138
Tanager Lake	27-0141

This order is effective upon publication in the State Register.

Approved by: /s/ Tom Landwher	Date signed: April 24, 2012
Title: Commissioner	

