PRIOR LAKE SPRING LAKE WATERSHED DISTRICT 50 YEARS

2021-2022 Integrated Pest Management Plan (IPM Plan)

FOR COMMON CARP

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PRIOR LAKE-SPRING LAKE WATERSHED DISTRICT

Integrated Pest Management Plan (IPM) For Common Carp

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PART 1 - EXECUTIVE SUMMARY

1.1 BACKGROUND

Common carp (*Cyprinus carpio*), a non-native fish originating in the Caspian region of Eurasia, are the most widely distributed nuisance fish in the United States (Nico et al., 2012). Carp can have direct and indirect negative effects on water quality by uprooting submergent and emergent aquatic vegetation and by releasing phosphorous sequestered in lake sediments. The phosphorus is then available to free floating algae and can lead to an increase in total phosphorous and Chlorophyll-a concentrations in the lake and to a decrease in water clarity. By removing the carp from the system, both the phosphorus within the carp carcass and the amount that would typically be excreted will be completely removed, while also abating the release of phosphorus created by foraging behavior.

1.2 PRIORITY CARP MANAGEMENT LAKES

Spring Lake, Upper Prior Lake, and Pike Lake are listed on the MPCA's impaired waters list due to excess nutrients, and the TMDLs identify internal loading from rough, benthic fish, such as common carp, as one of its main contributors. These impairments limit recreational opportunities as well as waterfowl habitat, native aquatic vegetation abundance, and native game fish populations. As most of the waterbodies within the PLSLWD are connected, improvements to the impaired waters will also have benefits downstream.

As they are listed as Tier 1 Lakes in the PLSLWD's 2020-2030 Water Resources Management Plan, receive the highest public use, and are currently on the *state's impaired waters list,* the District has established the following two lakes as its **<u>top carp management priority:</u>**

Table 1. Summary of Top Carp Management Priority Lakes.

	2021 Carp Biomass Estimate (kg/ha)	2021 Phosphorus Loading Rate (lbs/year)	2021 Estimated Total Weight (lbs)	Reduction Needed to achieve 100 kg/ha (lbs)	Reduction Needed to achieve 30 kg/ha (lbs)
Upper Prior Lake	**211.7 ± 66.9**	**1,213**	**73,880**	**38,985**	**63,415**
Spring Lake	**225.9 kg/ha ± 45.6**	**1,141**	**119,504**	**66,615**	**103,652**

Note that while Upper Prior and Spring Lakes are top priority lakes, the PLSLWD is tracking the other six connected chain-of-lakes as they are part of the whole system that the common carp population uses. Understanding the dynamics of the entire watershed system is the key component to successful long-term management of carp.

Secondary Priority Lakes. The PLSLWD also partners with SMSC in tracking carp on Arctic and Pike Lakes. SMSC is the lead partner on these two waterbodies and has completed removals on Arctic Lake with plans to prevent carp establishment on Pike Lake after the 2021 winterkill with the introduction of native fish species such as bluegills. PLSLWD is assisting and complementing SMSC efforts with its carp program and plays only a supportive role at this time.

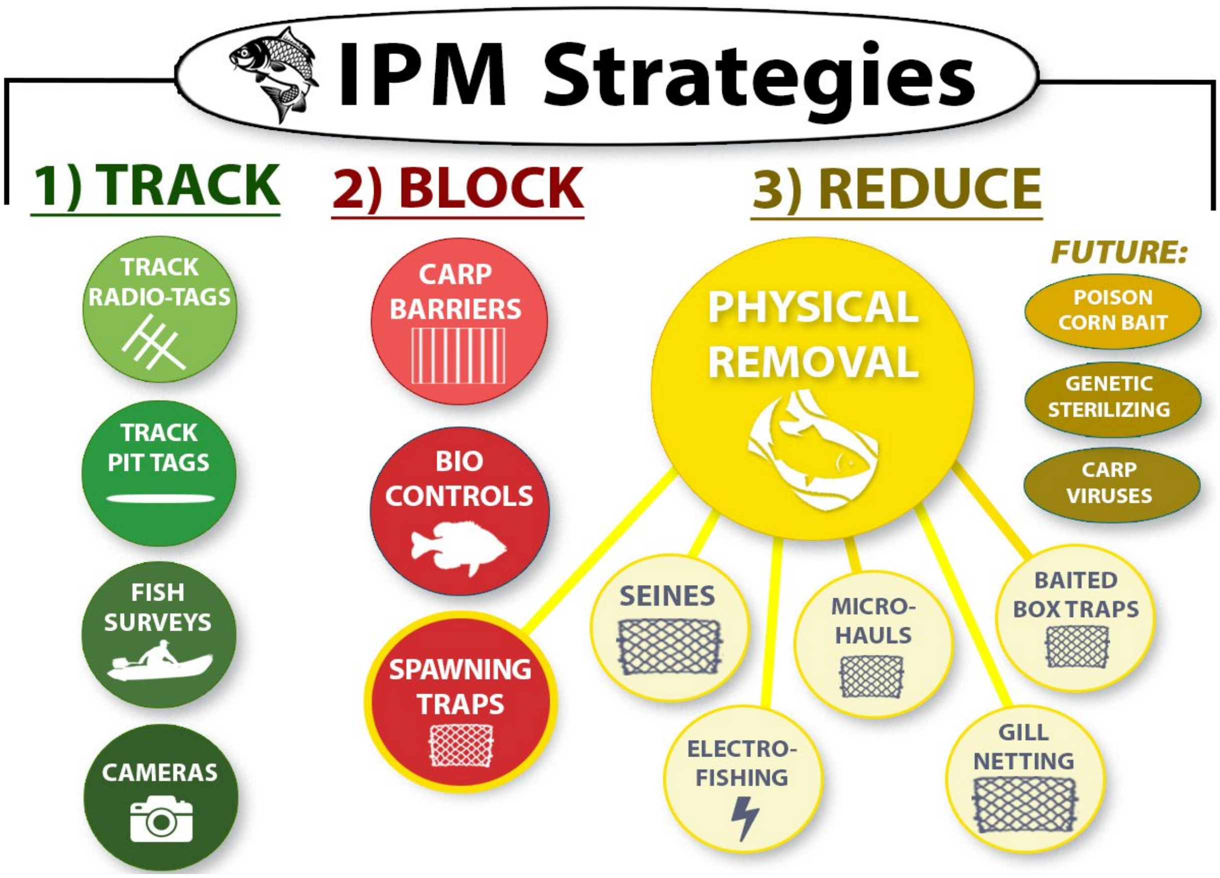


***Figure 1**. PLSLWD IPM Strategies*

1.3 INTEGRATED PEST MANAGEMENT APPROACH

This plan uses integrated pest management (IPM) principles to effectively manage the common carp populations. IPM involves the use of targeted carp removals and barriers, as well as monitoring environmental parameters that can inhibit or promote carp population growth within the waterbodies. Adaptive management will use data that is collected on the carp population including population and biomass estimates as well as migration routes and winter aggregation locations.

This IPM plan is intended to be a living document; using adaptive management may include developing new management strategies and plan goals through data collection and analysis. As new data is collected and analyzed, current approaches, data collection efforts, and prioritization may change. This IPM aims to mitigate the effect that common carp are having on the load of excess nutrients to these lakes, and protect those that are currently meeting water quality standards.

1.4 REMOVAL METHOD SELECTION

By far, the single most expensive component to the IPM Plan is the REDUCE strategies (carp removals). With careful analysis and selection, the PLSLWD can select the best tool for the situation presented.

COST-EFFECTIVE COMPARISON OF METHODS

From January to June 2020, the removal methods were assessed for cost-effectiveness. Those results were pooled together in order to look at each method as a whole. The following table summarizes that assessment comparison with removal methods listed from most to least cost-effective:

Table 2. Cost-Effectiveness Comparison of Carp Removal Methods.

Removal Method	Total Pounds Removed	% of Total Lbs.	Approx. Cost	2020 $ per lb of carp removed	2021 Est. $ per lb of carp removed
Seine:	*13,528*	*45%*	$ 48,840	$ 3.61	$ 0.81
Micro-haul:	*565*	*2%*	$ 2,142	$ 3.79	$ 1.52
Specialized Trap Net:	*2,008*	*7%*	$ 27,716	$ 13.80	$ 2.12
Electrofishing:	*8,358*	*28%*	$ 20,000	$ 2.39	$ 2.39
Baited Box Trap:	*2,989*	*10%*	$ 18,754	$ 6.27	$ 3.17
Gill Netting:	*2,293*	*8%*	$ 15,000	$ 6.54	$ 3.56

Note that in some instances, costs are much lower in 2021 as all of the materials to deploy the method were calculated into the removal method which incurred in 2020. Cost-effectiveness is going to continue being used as a measure for removal metheds and where to allocate future budgeting.

REMOVAL METHOD CONSIDERATIONS

PLSLWD will consider the following when deciding which removal methods to employ:

1) **Feasibility:** How likely will this method result in success? What are the obstacles?
2) **Time-Oriented:** Is immediate removal necessary to meet water quality goal deadlines identified in the 2020-2030 Water Resources Management Plan? Will the timeliness affect success of other projects (e.g. alum treatment)?
3) **Cost-Effective:** Is this method worth the cost based on anticipated results?
4) **Effort for Results:** Is this the best method for the amount of effort required? Given limitations of staff, what methods produce the greatest results for the least amount of effort?

The consideration questions and table above will provide staff with a decision-making tool. Given limited resources, staff will assess which method is most feasible, time-oriented, cost-effective, and requires the least amount of effort for the greatest result.

1.5 2021-2022 STRATEGIES & TIMELINE

The PLSLWD set ambitious goals in 2019 to reach carp management levels of **30 kg/ha on both Spring & Prior Lakes** by 2021. While the PLSLWD made great strides in incorporating new, innovative removal techniques beginning in 2020, it is still far from its goal nearing the end of 2021. A new timeframe has been established to accomplish these goals over a slightly long period of time with increased knowledge and a narrowing budget.

Upper Prior Lake: 63,415 pounds reduction needed
Spring Lake: 103,652 pounds reduction needed

Table 3. EXAMPLE Illustration of Effort Required to Reach 30 kg/ha.

Removal Method	UPPER PRIOR LAKE Estimated Pounds	SPRING LAKE Estimated Pounds	Timeline
Under Ice Seine	10,000		*Winter 2022*
Under Ice Seine		12,000	*Winter/Spring 2022*
Gill Netting	5,000		*Winter/Spring 2022*
Electrofishing	7,000	2,500	*Spring 2022*
Push Trap		2,000	*Spring 2022*
Newman Trap	2,000		*Spring 2022*
Baited Box Traps		3,000	*Summer 2022*
Open water Seine	2,000	2,000	*Fall 2022*
Under Ice Seine	7,500		*Winter 2023*
Under Ice Seine		17,000	*Winter/Spring 2023*
Gill Netting	5,000		*Winter/Spring 2023*
Electrofishing	5,000	5,000	*Spring 2023*
Push Trap		2,000	*Spring 2023*
Baited Box Traps	2,000		*Spring 2023*
Newman Trap		2,000	*Summer 2023*
Open water Seine		2,000	*Fall 2023*
Under Ice Seine	11,000		*Winter 2024*
Under Ice Seine		25,000	*Winter/Spring 2024*
Gill Netting	2,000		*Winter/Spring 2024*
Electrofishing	5,000	5,000	*Spring 2024*
Push Trap		1,000	*Spring 2024*
Open water Seine		5,000	*Fall 2024*
Under Ice Seine		9,000	*Winter/Spring 2025*
Electrofishing		6,000	*Spring 2025*
Push Trap		1,000	*Spring 2025*
Open water Seine		2,000	*Fall 2025*
Total Pounds Removed	**63,500**	**103,500**	
Remaining Biomass	**10,465**	**15,852**	

The table above illustrates the amount of effort that it would take on each lake to reduce carp down to 30 kg/ha goal levels, given the different removal methods available and their potential outputs on an average year. While the success and feasibility of the methods listed in these scenarios can be widely variable, this is meant to provide an example for planning purposes.

Note that successful commercial seines are a large component to removal success on each lake. In 2021, PLSLWD focused heavily on seine removals as its primary tool, supplementing with other tools to reach its goals. These other methods will be especially useful when populations are low enough not to be feasible to seine but high enough that more carp still need to be removed from the system. At this point the Carp Management Program will enter into maintenance phase.

Key supporting strategies will be employed to increase probability of removal success:

- **Tracking Carp:** Continuing to identify migration routes and aggregations for better removals
- **Blocking Carp:** Ensuring that carp barrier are working effectively; identifying additional spawning areas to block to ensure long-term population control after removals
- **Herding Carp:** Using underwater speakers to move carp into suitable seining areas
- **Removing Obstructions:** Diligently clearing known seine areas of any obstructions in October/early November prior to seine season. Checking seine areas with underwater drone so that obstructions can be cleared or avoided prior to removal events.

PART 2 - BACKGROUND

2.1 WATERSHED OVERVIEW

Located within Scott County, the PLSLWD lies in the Minnesota River Basin in the southwestern portion of the Twin Cities metropolitan area, and covers roughly 42 square miles of land area with over 2,500 acres of open water (Figure 1). Spring Lake, Upper Prior Lake and Lower Prior Lakes are the largest waterbodies within the PLSLWD and provide boating, fishing and other recreational opportunities. Spring Lake is connected by a natural channel to Upper Prior Lake which discharges to Lower Prior Lake which then outlets through a channel to the Minnesota River. All three lakes receive intense recreational pressure year-round and are important recreational resources to the Twin Cities metro area.

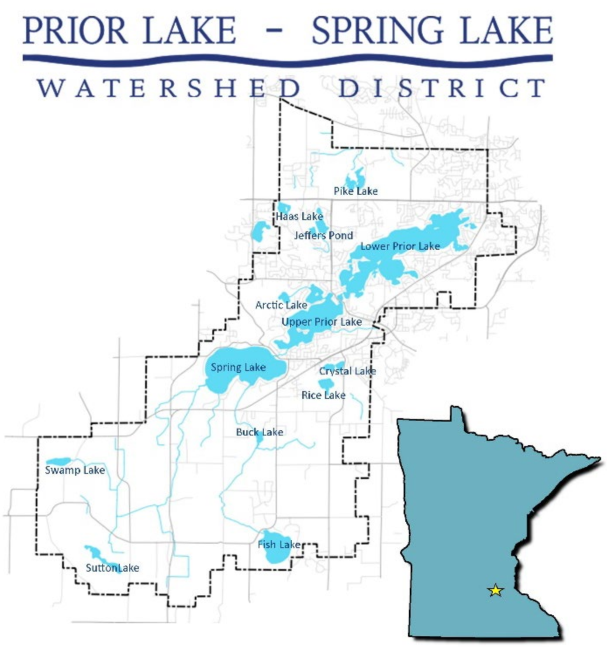


***Figure 2**. PLSLWD Location Map*

The protection and restoration of Spring and Prior Lakes are high priorities for the PLSLWD and are considered Priority Lakes by the Metropolitan Council for their high regional recreation value. A DNR public boat landing is located on each of the lakes, in addition to winter access points. Sand Point, a swimming beach on the north shore of Lower Prior Lake, boasts as much as 48,000 visitors each year. Open water activities on the lakes include fishing, boating, paddling, water skiing, jet skiing, sailing, wake boarding, and swimming. During the winter when the lake is ice-covered, recreational activities include snowmobiling, ice fishing, skating, and cross-country skiing.

Since 1970, the PLSLWD has strived to conserve, protect, and manage the water resources within the PLSLWD and have implemented a variety of projects aimed to improve water quality.

The aerial map in **Figure 3** and highlights the waterbodies and wetland areas that carp may be present and/or use as spawning areas.

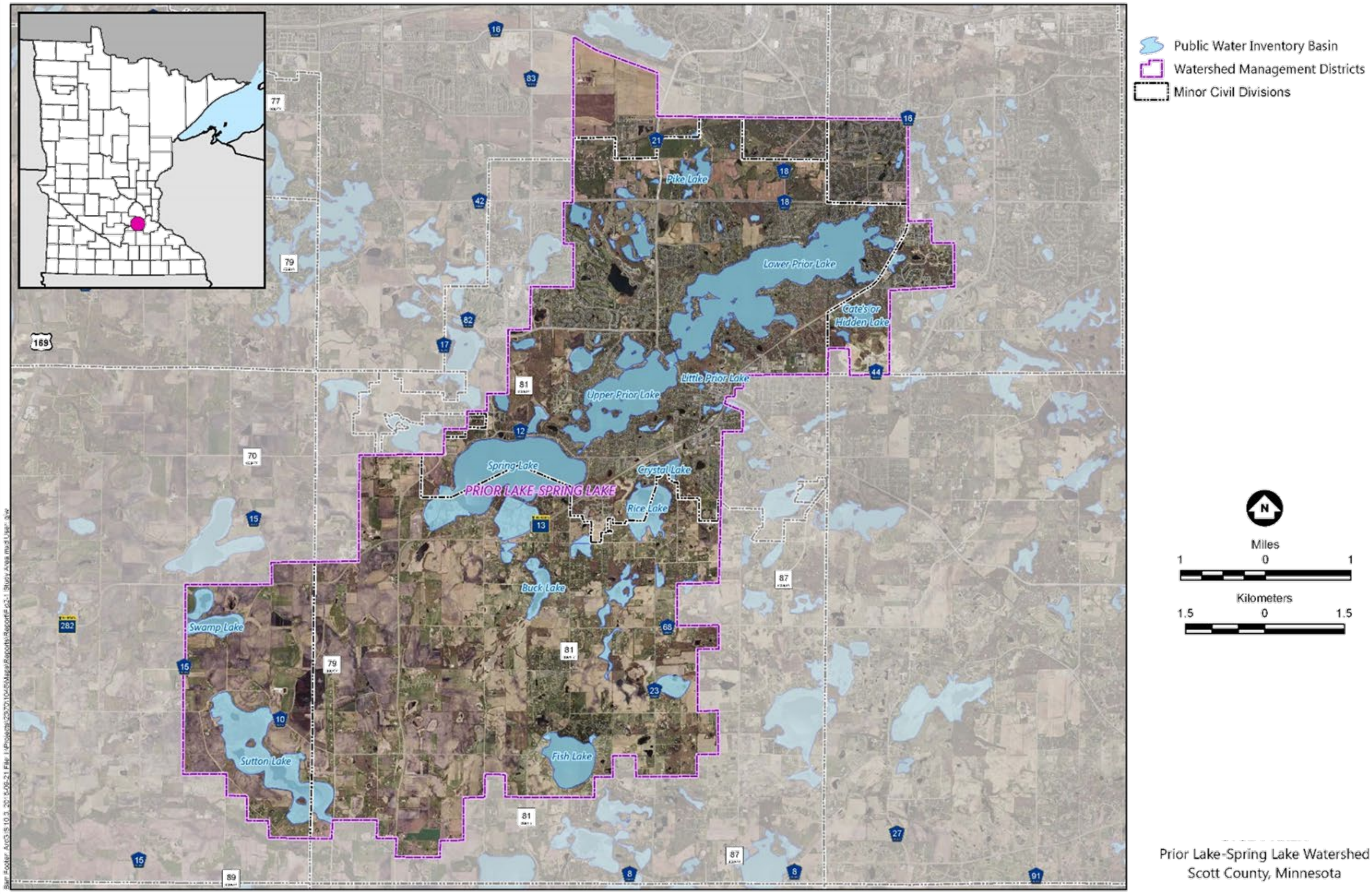


Figure 3. *Watershed Overview Map*

2.2 COMMON CARP SPECIES

Common carp (*Cyprinus carpio*), a non-native fish originating in the Caspian region of Eurasia, are the most widely distributed nuisance fish in the United States (Nico et al., 2012). Carp were intentionally introduced into Minnesota in the 1880s as a game fish and as a food staple for the increasing number of immigrants. By the turn of the century, the previously prized carp was considered a nuisance species for its rapid reproduction and detriment to water quality in the Minnesota's lakes.

A. Life Cycle

Given ideal conditions, carp can be highly prolific. Carp eggs hatch usually within a week and it only takes about 15–30 days before feeding larvae grow into advanced fry. The next life stage, when the fish grows up to become a fingerling, lasts only about 45–85 days. By the end of their first summer, carp are known to get up to as much as 10 inches long, weighing 1 – 2 pounds.

They mature as early as two years old, when the carp is roughly 12-15 inches long. A single female carp can produce over a million sticky eggs which get laid onto vegetation and rocks. While most eggs and larvae die before they reach adulthood, this can result in several hundreds of successful offspring in a single season where there are no bluegills predators present and conditions are right. Floods seem to provide especially favourable conditions for carp breeding.

A. Diet

Carp are omnivores and they consume a variety of small foods including molluscs, crustaceans, insect larvae and seeds. These food items are sucked up with the mud from the bottom of the lake or wetland and filtered out using their gill rakers, spitting out the mud and remaining debris into the water column. Carp can also consume plant material and other organic matter, especially when other food sources are not available. Carp rarely eat fish, but may consume fish eggs and larvae and disturb breeding sites for other fish species.

B. Habitat & Behavior

Like largemouth bass, carp can inhabit a wide range of habitats, but they prefer lakes and slow moving rivers, especially those with turbid water. Carp also can be found in areas where there is abundant aquatic vegetation. They are capable of tolerating a range of environmental conditions. Carp have a greater tolerance of low oxygen levels, pollutants and turbidity than most native fish, and are often associated with degraded habitats, including stagnant waters.

The bottom-feeding habits of carp often create murky lake conditions, and muddy up the water. These conditions are often unsuitable for native fish, and carp drive out their competition for lake resources.

Carp travel in schools, usually of five or more. Carp migrate to and from breeding grounds in large groups during the spawning season, sometimes travelling several miles upstream. This behavior of traveling to shallow, upstream spawning areas allows them to reach wetlands that were either frozen over or had dry, low oxygen conditions in the previous season that winterkilled any sunfish that would have predated on the carp eggs and larvae.

B. Effects

Carp can have direct and indirect negative effects on water quality by uprooting submergent and emergent aquatic vegetation and by releasing phosphorous sequestered in lake sediments. The phosphorus is then available to free floating algae and can lead to an increase in total phosphorous and Chlorophyll-a concentrations in the lake and to a decrease in water clarity. By removing the carp from the system, both the phosphorus within the carp carcass and the amount that would typically be excreted will be completely removed, while also abating the release of phosphorus created by foraging behavior.

2.3 CARP MANAGEMENT FUNDING SOURCES

The District has been fortunate enough to receive multiple sources of grant funding since 2015 to support its carp management efforts as shown in Figure 4. The following is a summary of the funding received:

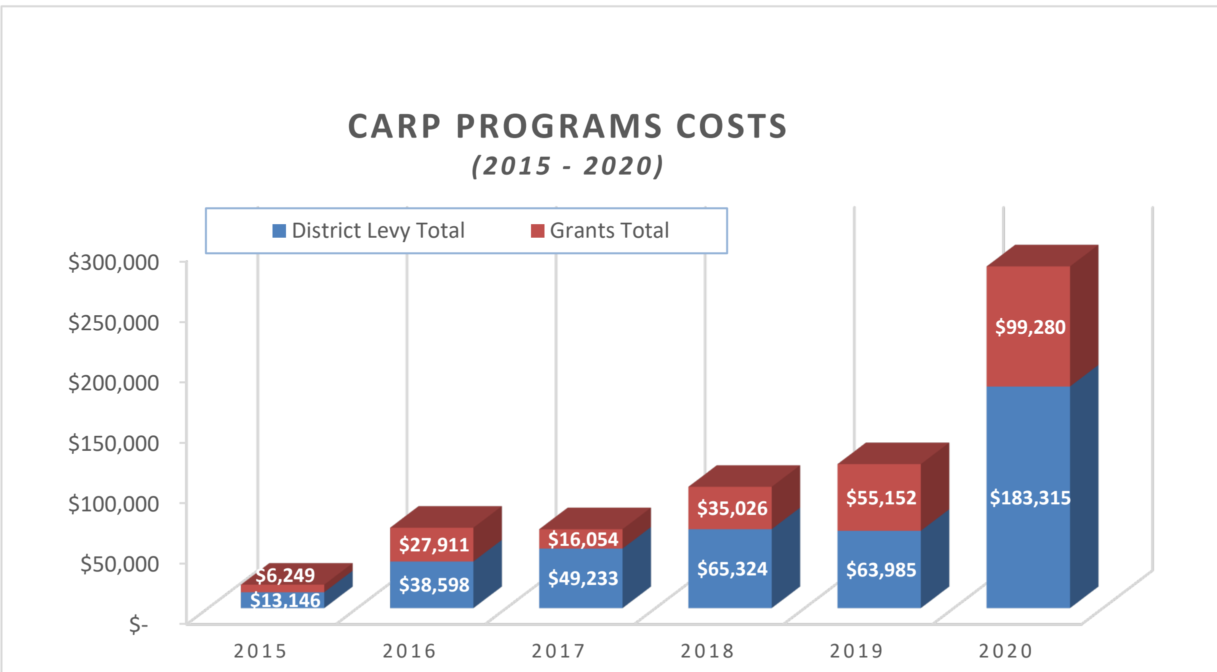


Figure 4. *Annual Carp Management Program Funding Comparison.*

Over the past 6 years the the district's carp management program has been partially funded through state and federal grant funding seen in table 4. The district plans to assess it's program needs and outlook so that a long term budget strategy can be developed. Moving forward into 2022, the district will be supporting the IPM for Common carp through District levy funds only. Continual efforts will be made to seek out additional funding to support the mission of the IMP.

Table 4. Carp Management Program Funding Sources.

GRANT SOURCE	GRANT $	TIMEFRAME
MPCA Clean Water Partnership	**$67,323**	***2015 - 2018***
DNR Clean Water Legacy Grant	**$17,917**	***2017 - 2018***
Federal Clean Water Act Section 319 grant	**$80,300**	***2019 - 2021***
BWSR Metro Watershed Based Implementation Funding	**$144,000**	***2019 - 2021***
TOTAL:	**$309,540**	

PART 3 - CARP MANAGEMENT WATERBODIES

3.1 CARP MANAGEMENT LAKES

While there are 14 lakes within the PLSLWD, this IPM Plan is focused only on those eight connected waterbodies that are known carp migration routes and/or are suspected to contain common carp as shown in Figure 6 below (Fish, Buck, Spring, Arctic, Upper Prior, Lower Prior, Jeffers Pond & Pike Lakes). An overview of each carp management lake is listed below.

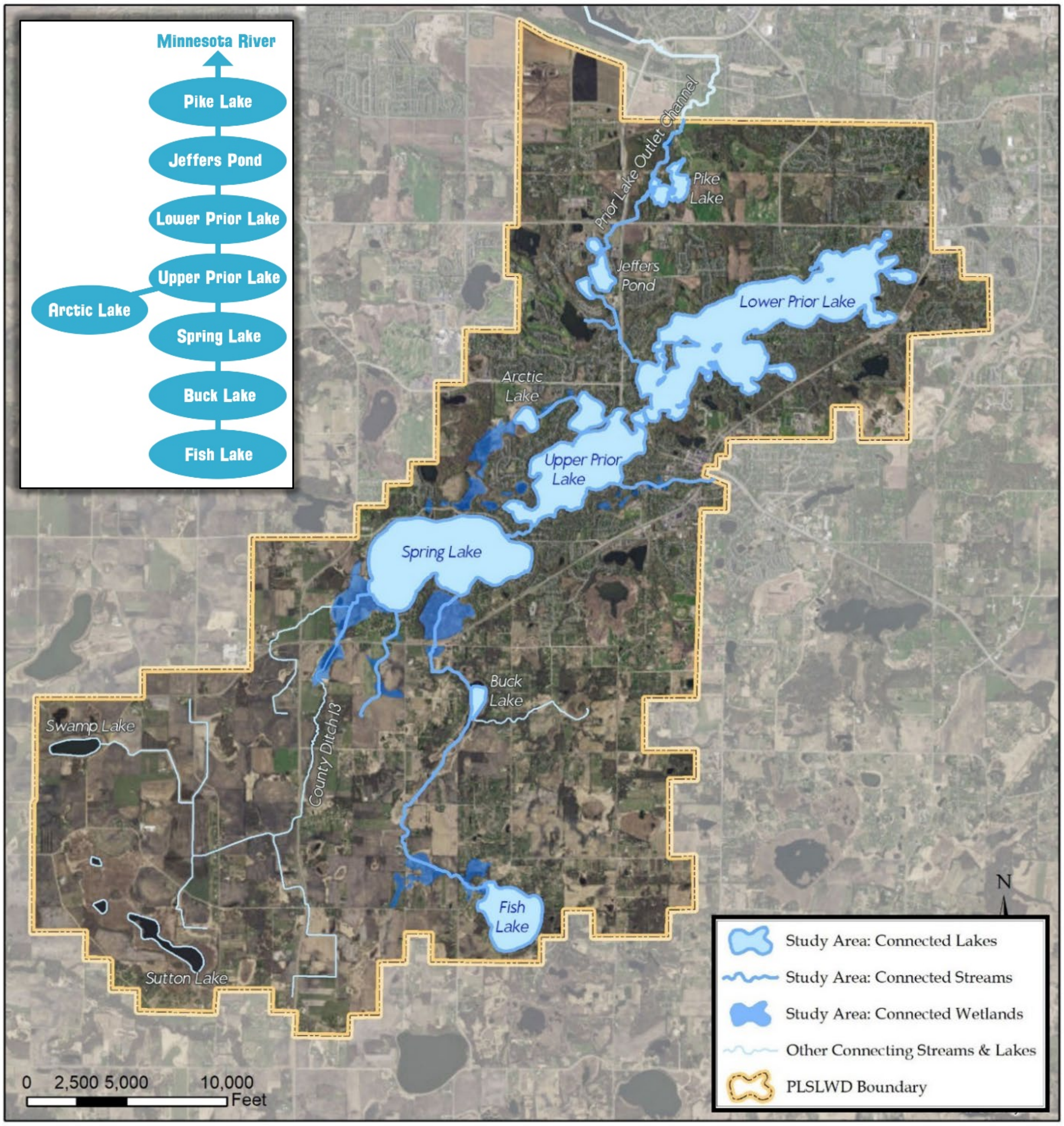


***Figure 5**. Carp Management Lakes*

3.2 FISH LAKE

Fish Lake is a relatively small lake found in the upper watershed seen in figure 6. Fish Lake is approximately 173 acres, has an average depth of 14 feet, and a maximum depth of 28 feet. Roughly 74 acres or 43% of the lake is considered littoral. Fish Lake is a seepage lake-outflow, meaning that there is no direct inflow to Fish Lake; rather, the hydrologic contribution is from watershed runoff and groundwater which then flows out of Fish Lake to the north towards Buck Lake.

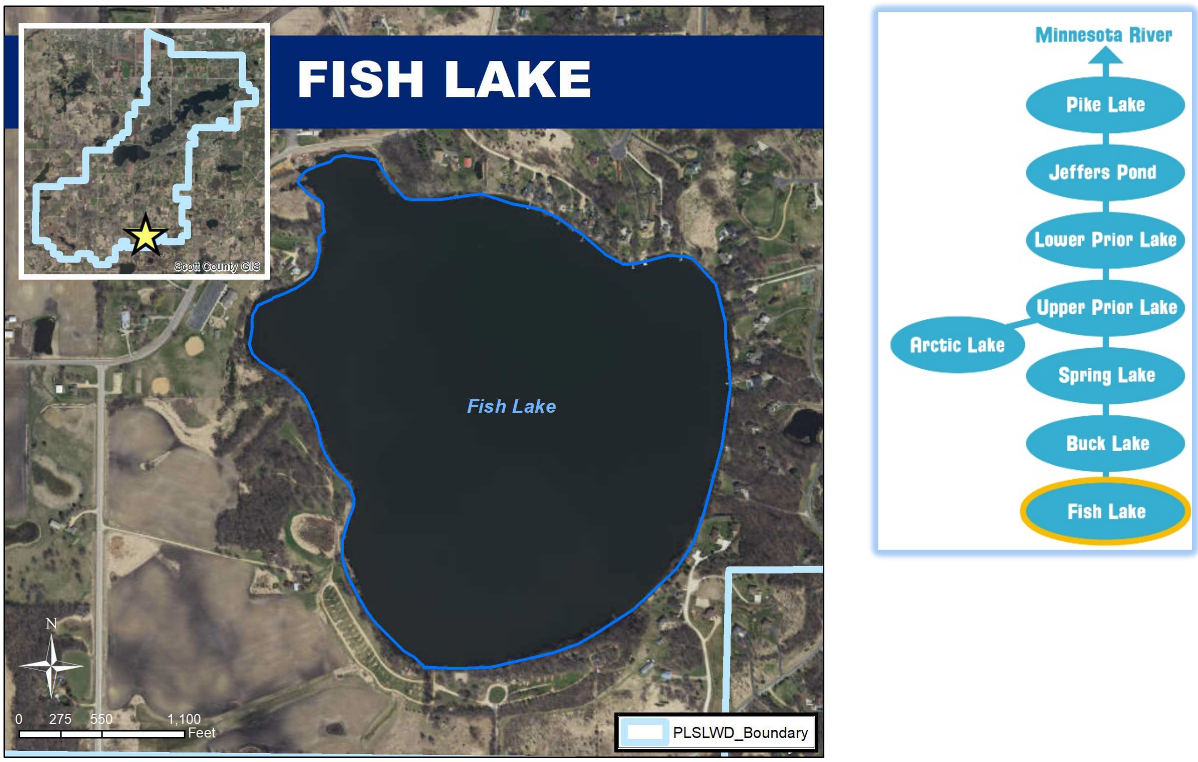


Figure 6. *Fish Lake Map*

INTERNAL LOADING

Fish Lake appears to be heavily impacted by internal loading. The 2006 Fish Lake Sustainable Lake Management Plan identifies an internal load ranging from 111 to 488 kg/yr (244 to 1,075 pounds/yr). The methodology used to derive this estimate is derived from a Canfield-Bachmann model. These models identify internal loading from anoxic release, hypolimnetic mass balance, and fall turnover; no analysis was done to determine the contribution from curly-leaf pondweed (CLP) senescence or from the foraging behavior of rough fish.

FISHERIES ASSESSMENT

A potential source of internal loading is from rough fish bioturbation. MN DNR fishery survey data from 2014 shows that carp and bullhead are present in Fish Lake. LaMarra (1975) identified an internal loading rate of 1.07 mp P/m²/day based on a carp density of 200 kg/ha. A very preliminary fish survey was conducted in fall of 2019 on Fish Lake and showed carp biomass at 88.7 +/- 69.2.

3.3 BUCK LAKE

Buck Lake is a small lake (23 acres) located downstream of Fish Lake in the upper watershed shown in figure 7. The maximum depth is 9 feet; no numerical average depth given but average depth is noted as shallow. It is assumed, based on maximum depth that the entire lake is littoral. Buck Lake receives water from the connecting channel to Fish Lake and from the watershed to the East. Buck Lake then outflows to the north through a large wetland complex to Spring Lake.

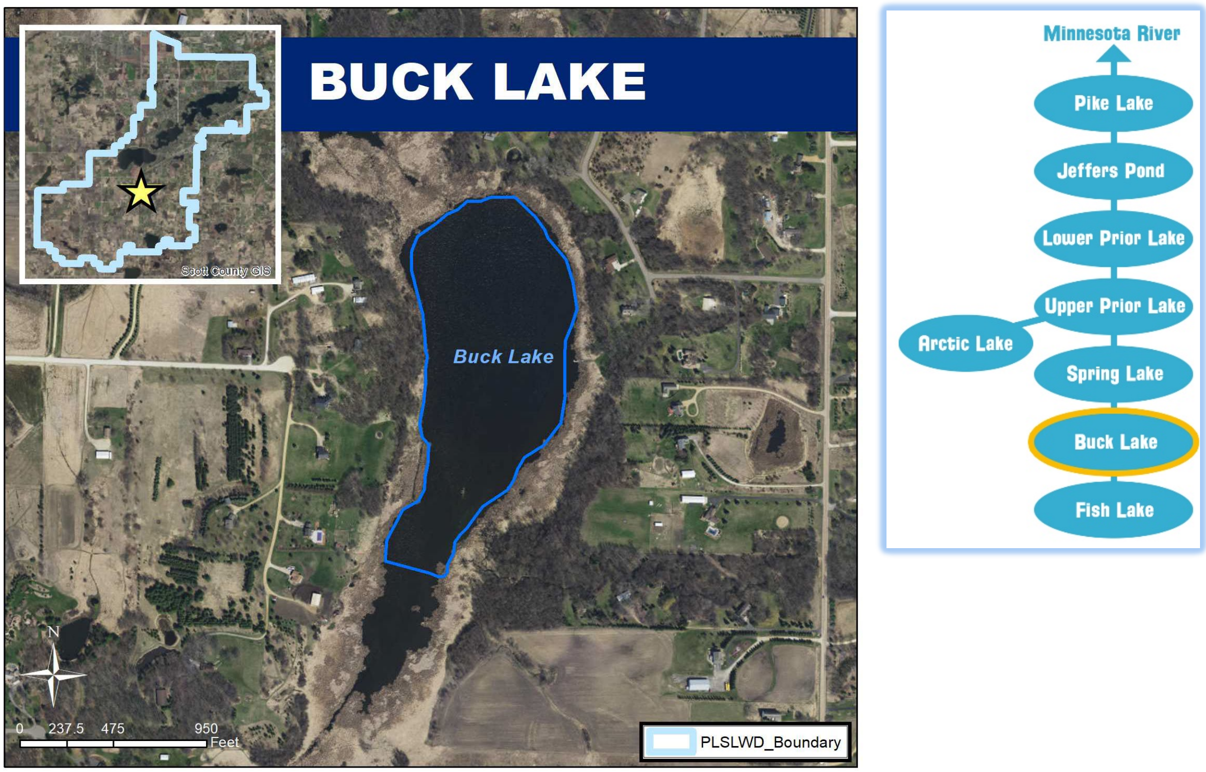


Figure 7. Buck Lake Map

INTERNAL LOADING

The watershed to lake ratio for Buck lake is quite high: ~837:1, which may result in a large amount of phosphorus loading to Buck Lake from the surrounding watershed. The average TP concentration for Buck Lake between 2014 and 2017 was 112.56 µg/l (almost twice the state standard).

While not specifically assessed, anoxic conditions within Buck Lake may be contributing to the phosphorus load through anoxic release within sediments. No assessment has been completed on the sediments in the Buck Lake basin to determine the sediment release rate of TP.

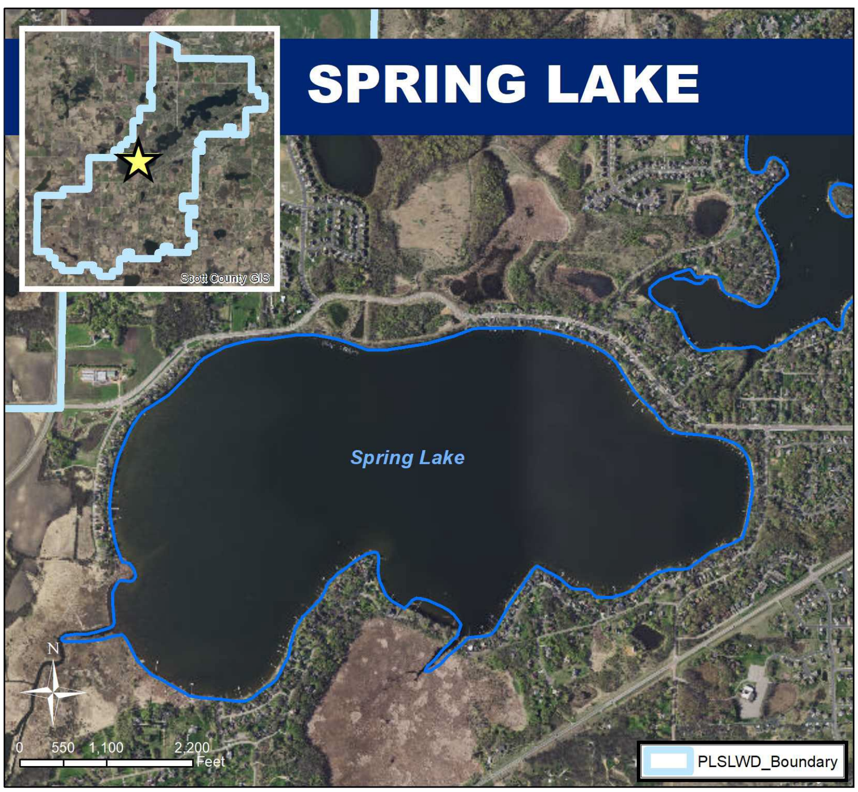
FISHERIES ASSESSMENT

Very preliminary survey data from fall 2019 indicates that carp have low populations on Buck Lake. The widespread presence of aquatic vegetation in Buck Lake also may hint at a low density of rough fish presence in the lake. Typically, lakes that support high rough fish density are incapable of supporting dense or widely-distributed aquatic vegetation.

3.4 SPRING LAKE

Spring Lake is the second largest basin in the PLSLWD. The maximum depth is 34 feet with an average depth of 18 feet. Roughly half (49% or 290 acres) is identified as the littoral area. The watershed is quite large (12,340 acres) with a watershed to lake ratio of 20:1, which is a moderate ratio.

Spring Lake has three (3) major inflows located primarily on its southern and western sides. The 12/17 wetland on the northwest side of the lake also contributes to the overall water budget. County Ditch 13 provides the largest contribution to external load. Spring Lake outlets on its eastern side via a small channel which connects to Upper Prior Lake.



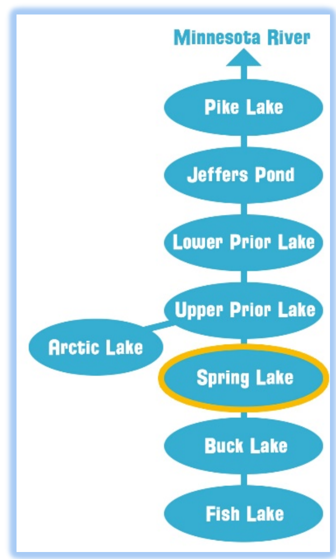


Figure 8. *Spring Lake Map*

INTERNAL LOADING

Internal loading constitutes the bulk of the total phosphorus load to Spring Lake at 5,161 lbs/year or 49%. Internal loading may be from anoxic sediment release of phosphorus, senescence of aquatic vegetation during the growing season, and overabundant rough fish. The 2012 TMDL attributed the entire internal load to anoxic release; however subsequent fisheries surveys documented elevated carp biomass which may be heavily influencing the internal phosphorus load and subsequently, water quality in Spring Lake.

FISHERIES ASSESSMENT

Past surveys show elevated carp biomass in Spring Lake, which is influencing internal loading. In winter 2012, the PLSLWD marked 1,752 adult carp by inserting floy tags in the dorsal area. The carp were initially captured using a commercial fishing crew that deployed a seine net around a winter aggregation of common carp. The carp were captured, measured for length and weight, tagged, and released. An attempt was made to recapture the carp in 2013, but was unsuccessful.

A 2014 study completed by St. Mary's University using a catch per unit effort (CPUE) model showed that carp biomass in Spring Lake was 343.5 kg/ha. A subsequent survey completed in 2016 by WSB showed 122.5 kg/ha using the CPUE method and 84.7 kg/ha using a mark-recapture methodology. Using this abundance estimate and LaMarra's estimation of calculating loading due to an abundance of rough fish, nearly 2.37 pounds of phosphorus per day were being added to Spring Lake. This number equates to an estimated loading rate of over 866 pounds of phosphorus per year caused by the overabundance of common carp.

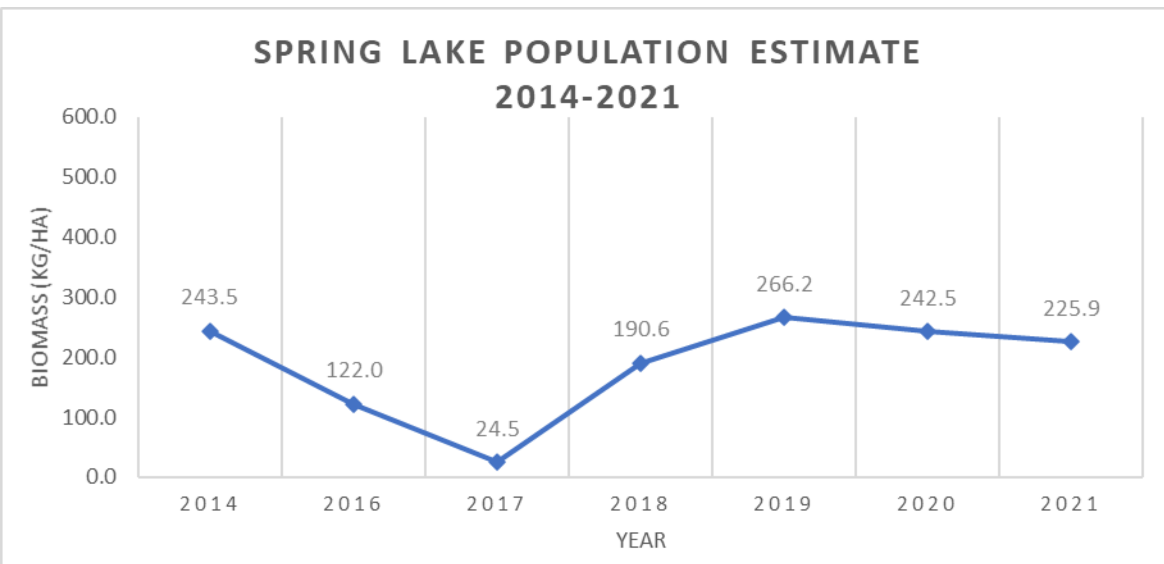


***Figure 9**. Spring Lake Population Estimate 2014 – 2021*

PAST CARP MANAGEMENT EFFORTS

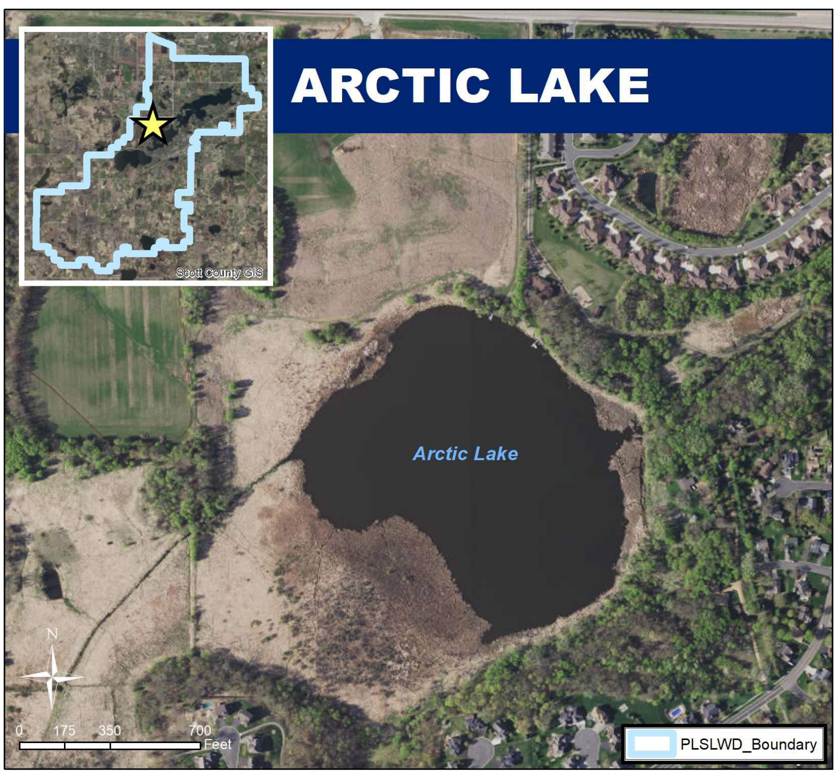
Carp in Spring Lake were netted and inspected for marks on January 30, 2017 as part of a recapture and removal event capturing 2,577 individual carp, an estimated 59.9 kg/ha of carp biomass resulting in a reduction of 615.5 pounds of phosphorus per year. Using the ratio of marked to unmarked carp, WSB calculated a pre-removal population estimate of 3,623 ± 1,167 individual carp in Spring Lake. Using a 5.6 kg average weight, Spring Lake carp biomass was calculated at 84.9 ±

27.3 kg/ha pre-removal, close to the ecological threshold value of 100 kg/ha and well above the value of 30 kg/ha that PLSLWD has identified as a biomass goal. Biomass calculated after removal is estimated to be 24.5 kg/ha ± 7.9.

During 2018 and 2019 there were not successful seine removal events and the population rebounded quickly. In the spring and summer of 2020, PLSLWD decided to add Accelerated Carp Management Strategies and different removal techniques to its toolbox. In 2020, a total of 8,070 pounds of carp have been removed from Spring Lake using these new tools, as well as another 3,078 pounds using traditional open water seines. As of September 1st 2021, 1,315 pounds of carp have been removed between electrofishing and baited box nets, as well as another 7,500 pounds using traditional under ice seines reducing the Spring Lake's estimated population to 225.9Kg/ha. Spring Lake's carp population estimate over the past 7 years is shown in Figure 10 above.

3.5 ARCTIC LAKE

Arctic Lake is 33 acres in size with a maximum depth of 30 feet and an average depth of 9.5 feet shown below in Figure 10. Arctic Lake flows into Upper Prior Lake, entering a large shallow bay on the north side of the lake through an man-made channel. Arctic Lake's watershed is 507 acres resulting in a 15:1 watershed to lake ratio, which is relatively small. Most of the watershed (56%) is composed of wetlands and woodlands with the remaining portions of the watershed composed of residential, prairie, water, open space, and cropland.



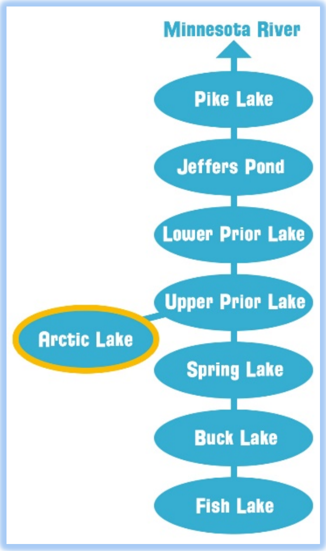


***Figure 10**. Arctic Lake Map*

INTERNAL LOADING

Sediment release rates from sediment coring was not available at the time the 2013 diagnostic report was drafted. However, HDR attempted quantify the internal load from anoxic sediment release using a mass balance approach. Results of this analysis showed that annual loading ranged from 177-327 lbs TP/year.

FISHERIES ASSESSMENT

Carp have been documented in multiple fish surveys completed in 2012, 2014, 2017, and 2018. The 2012 survey utilized standard and mini trap nets to determine assemblage and size structure. Small carp (9.5-13”) were captured in trap nets which indicates recruitment and suggests that Arctic Lake was functioning as a nursery. The 2014 electrofishing survey determined that the carp biomass density was 264.5 kg/ha and found numerous young of the year carp.

A carp mark-recapture population and biomass estimate were completed in 2017. Survey data shows that the carp biomass for Arctic Lake was 462.6 kg/ha, with juvenile carp dominating the biomass (336.9 kg/ha) and adults making up a smaller portion of the biomass (125.7 kg/ha). Note that a carp barrier was installed in 2016 at the connection to Upper Prior from Arctic, which may have prevented migration out of Arctic to Upper Prior, resulting in higher biomass than in 2014.

PAST CARP MANAGEMENT EFFORTS

In 2017 to 2018, an estimated 398 kg/ha of carp biomass was removed from Arctic Lake resulting in a reduction of 230 pounds of phosphorus per year. The monitoring of the recruitment rates of young carp to the system is likely to continue through the partnership between PLSLWD and SMSC formed in 2013 and the actual effects of this removal on the phosphorus concentrations will be monitored by regular sampling throughout the growing months (May-September) of each year.

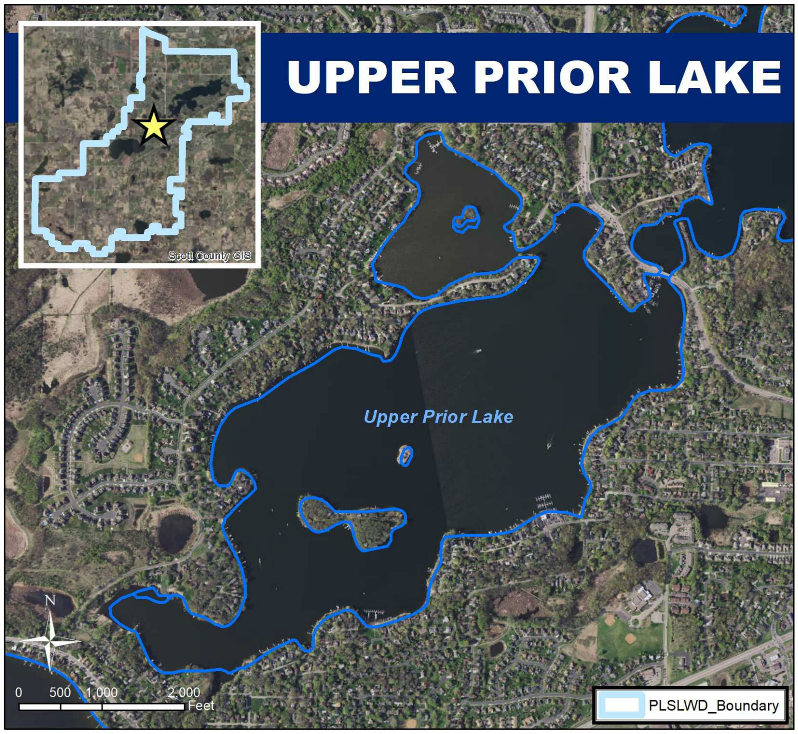
Table 5. Arctic Lake Biomass & Loading Rate Before & After Removals.

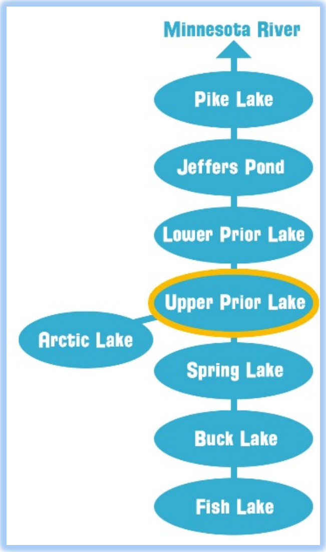
	Carp Biomass Estimate (kg/ha)	Phosphorus Loading Rate (lbs/year)
Before Removal	460.0	265
2017-2018 Reduction Amount	**-398.0**	**-230**
After Removal	62.0	35

Following the biomass removal success from previous years, SMSC and the District continued efforts from 2019 through 2021 tracking fish migration within the Arctic Lake channel using PIT-tag stations. The stations were installed to confirm barrier effectiveness and population size of migration in the channel. In 2021, a PIT station was installed on the West side of Arctic Lake to find if carp are making it through a BMP installed in 2018. Results from 2019-2021 show that carp are not making it past the barrier on the downstream end of the Arctic Lake channel when it is installed as well as no movement throught the BMP on the west side of the lake.

3.6 UPPER PRIOR LAKE

Upper Prior Lake displayed in Figure 11 is 416 acres in size with a maximum depth of 43 feet and an average depth of 10 feet. The littoral zone covers 329 acres or 79% of the basin. The lake receives





water from Spring and Arctic Lakes as well as from a small drainage area on the east side of the lake. The watershed is 16,038 acres resulting in a watershed ratio of 38:1.

INTERNAL LOADING

The internal load of Upper Prior is a major cause of water quality impairment in Upper Prior Lake. The 2012 TMDL indicates that 50% of the total phosphorus budget comes from internal loading. The TMDL assigns the entire internal load to anoxic sediment release; however, Upper Prior supports elevated carp biomass which may contribute and/or exacerbate internal loading.

With the upstream alum treatment of Spring Lake to reduce external nutrient loading, lower concentrations of phosphorus are reaching Upper Prior Lake. However, past studies have indicated that there is still an internal reservoir of phosphorus in Upper Prior Lake that continues to hinder the improvement of water quality in the lake. Beginning in 2020, Upper Prior Lake received its first of 3 planned alum treatment doses to target internal phosphorus in combination with the carp removals to meet TMDL goals.

***Figure 11**. Upper Prior Lake Map*

FISHERIES ASSESSMENT

The initial carp population assessment begun when a number of carp were marked with a right pelvic and pectoral fin clip, radio tags, and passive integrated transponder (PIT) tags in Upper Prior Lake in 2015 and 2016. A mark-recapture estimate was calculated using the total number of fin clips and radiotags captured.

The biomass estimate as a result of this mark-recapture event was 13,840 ± 3,664 individuals in Upper Prior Lake before the removal. Using a 6 kg average weight, Upper Prior Lake biomass was calculated at 531.3 kg/ha ± 140.6, a biomass well above the 30kg/ha biomass goal identified by the PLSLWD.

Using LaMarra's estimation of loading due to an abundance of rough fish, nearly 10.54 pounds of phosphorus per day were being added to Upper Prior Lake as a result of this elevated population. This number equates to a loading rate of over 3,840 pounds of phosphorus per year caused by the overabundance of common carp.

Since 2016, annual CPUE population estimates have been calculated as seen in Figure 12 using PIT tags and fin clips as recapture datapoints during removal events and electrofishing.

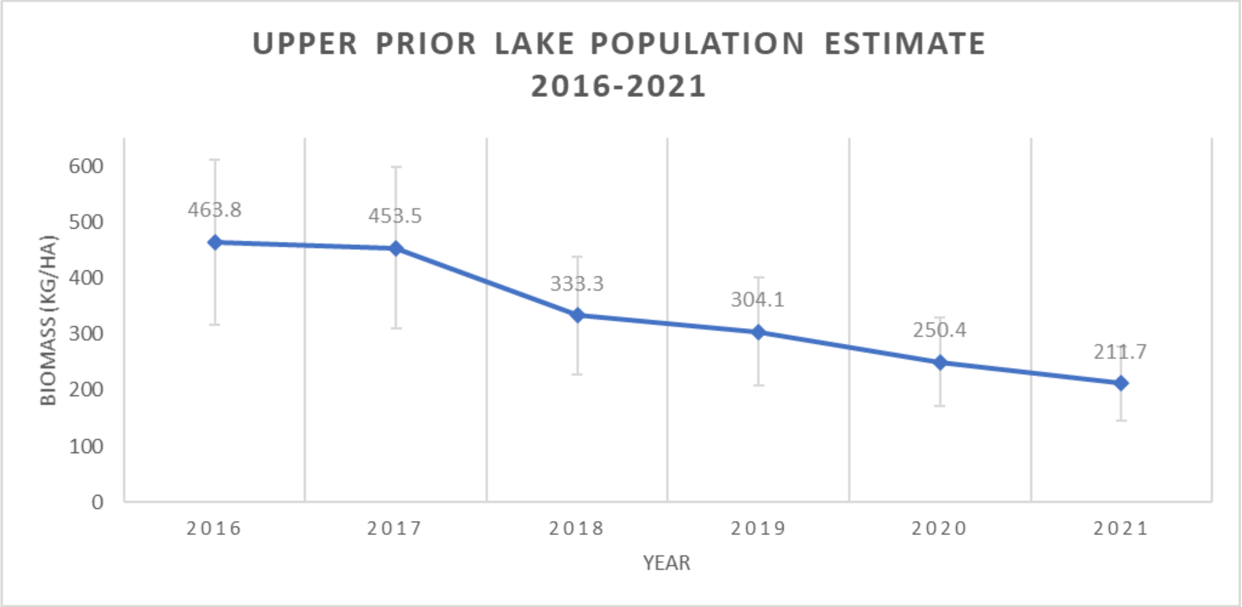


***Figure 12**. Upper Prior Lake Population Estimate 2016-2021*

PAST CARP MANAGEMENT EFFORTS

In the fall and winter of 2017-18, an estimated 113 kg/ha of carp biomass were removed from Upper Prior Lake resulting in a reduction of 845.8 pounds of phosphorus per year.

In the spring of 2019, two seine nettings and one electrofishing effort were completed in Crystal/Mud Bay, removing a total of 10,000 pounds of carp from Upper Prior Lake.

In the spring and summer of 2020, PLSLWD decided to add Accelerated Carp Management Strategies and different removal techniques to its toolbox. During that year, a total of 8,142 pounds of carp were removed from Upper Prior Lake using these new tools, as well as another 10,450 pounds using traditional open water seines.

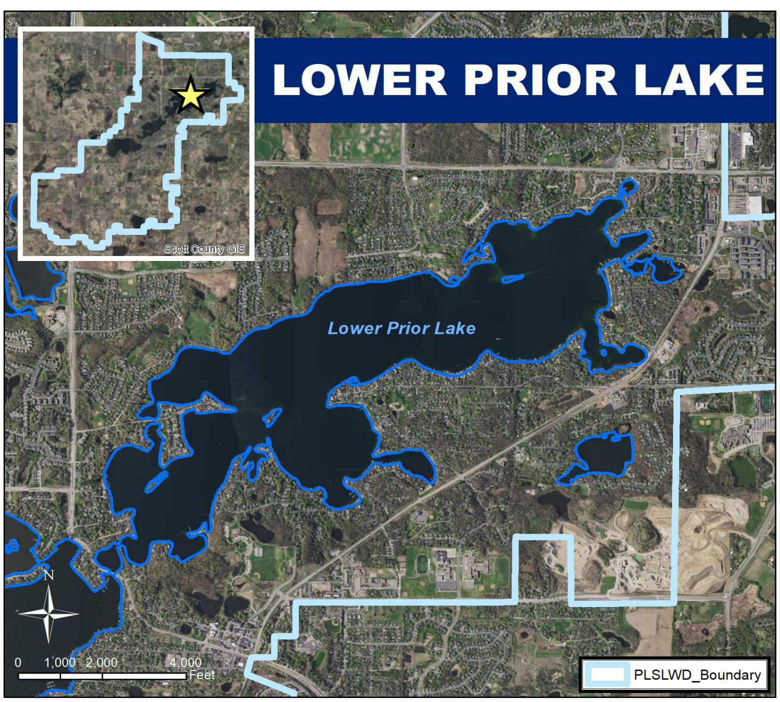
During the winter of 2021, the unified technique was used in Upper Prior Lake using underwater speakers, gill netting, and seine nets to effectively herd, drive, and capture fish from the less desirable rocky bottom location near Knotty Oar Marina out towards known safe seining grounds removing 4,900 pounds of carp.

The monitoring of the recruitment rates of young carp to the system is continuing on a yearly basis and the actual effects of this removal on the phosphorus concentrations will be monitored by regular sampling throughout the growing months (May-September) of each year.

3.7 LOWER PRIOR LAKE

Lower Prior Lake is the largest basin in the watershed at 940 acres shown below in figure 13. It has a maximum depth of 56 feet and an average depth of 13 feet; roughly 39% of the lake or 373 acres is in the littoral zone.

Water flows into Lower Prior from Upper Prior under the County Highway 21 Bridge and is the only major inflow; the remaining hydrology is derived from direct drainage from adjacent upland areas. The lake's outlet is the Prior Lake Outlet Channel (PLOC) located along the western portion of the lake. The watershed of Lower Prior is 18,904 acres, resulting in a moderately-sized 20:1 watershed to lake ratio.



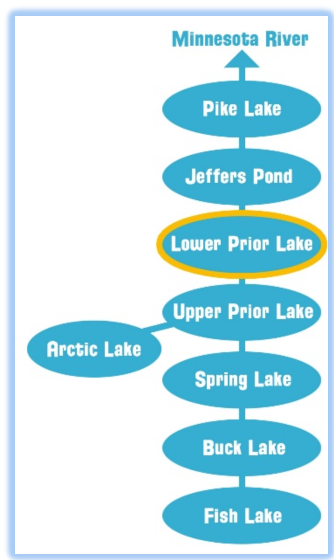


Figure 13. *Lower Prior Lake Map*

INTERNAL LOADING

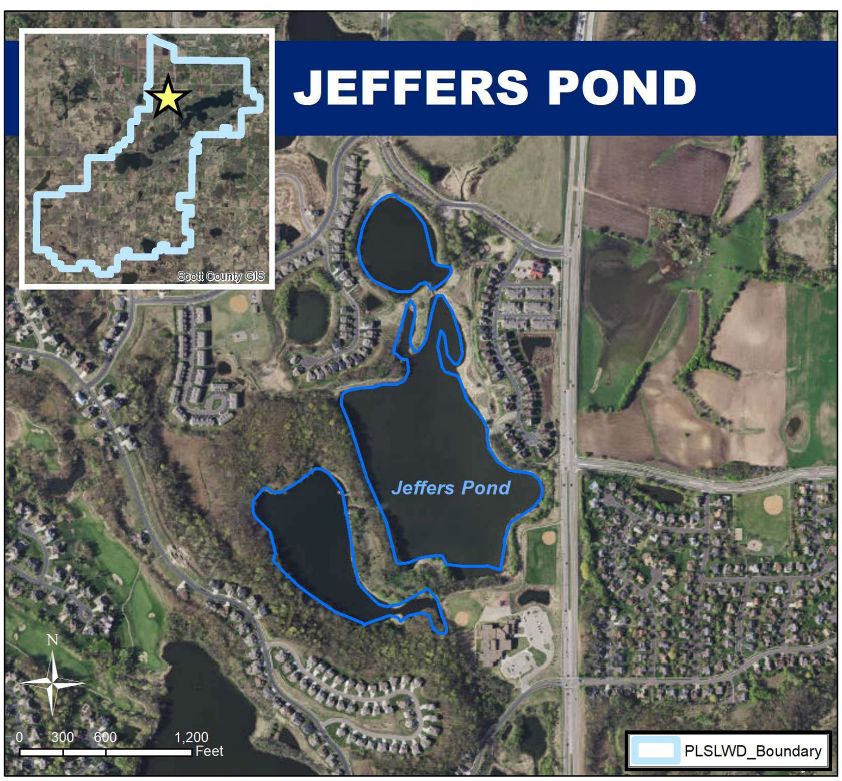
The 2013 Diagnostic report discusses internal loading from sediment release as a possible source of loading but does not quantify the potential loading from this source.

FISHERIES ASSESSMENT

Carp are present in Lower Prior Lake and may travel freely between Lower Prior and Upper Prior Lakes through the existing connection under Eagle Creek Avenue (County Road 21). However, a biomass estimate completed in 2016 using a catch per unit effort (CPUE) model indicates that the annual load from carp is 158 lbs TP/year. Based on this, carp are not a significant source of phosphorus to Lower Prior Lake. Interestingly, during the summer of 2021, 2 radio-tagged carp have moved into Lower Prior Lake from Upper Prior Lake and serves as a reminder system mixing is occurring. Population mixing between systems where barriers are not feasible can impact the population estimates causing greater uncertainties.

3.8 JEFFERS POND

Jeffers Pond is located downstream of Lower Prior along the PLOC. Shown in figure 14, Jeffers Pond is divided into two basins (East and West Jeffers) separated by a narrow land bridge. The PLOC flows into the south side of West Jeffers and flows out on the north side of East Jeffers. The basins are connected by a series of cascading streams. Jeffers is 39 acres in size with a maximum depth of 70 feet (no average depth listed, total acreage includes both basins).



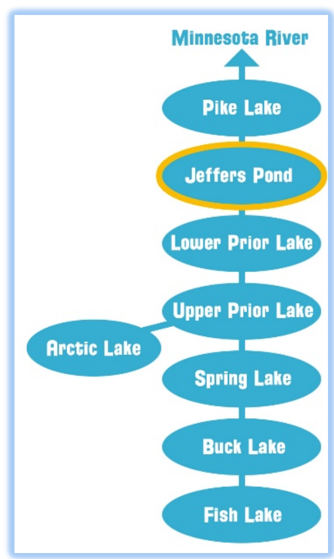


Figure 14. *Jeffers Pond Map*

INTERNAL LOADING

No diagnostic study has been completed to determine the phosphorus load (internal or external) to Jeffers Pond, nor is there any water quality data available to determine the impairment status of Jeffers Pond.

FISHERIES ASSESSMENT

MnDNR lake fisheries surveys from 2016 suggest that Jeffers Pond is a potential carp nursery site, as many juvenile carp were documented. This could potentially be a source for new recruitment to Pike Lake downstream. Observations during the Spring of 2021 showed an extensive winterkill in both Eastern and Western basins of Jeffers Pond. Mortality was observed in high numbers including juvenile and adult carp reinforcing previous assumptions of Jeffers Pond acting as a nursery for Pike Lake.

3.9 PIKE LAKE

Pike Lake is the downstream-most basin in the watershed; located along the PLOC at the northern end or bottom of the watershed seen in Figure 15. Pike is 50 acres in size with a maximum depth of 9 feet and an average depth of 7 feet, resulting in the entire basin being littoral. The west side of Pike Lake is part of the PLOC and receives flow through the system during most years. The east side of Pike Lake is more stagnant and receives runoff from the nearby feedlot and agricultural lands across the road to the east, creating a contrast in water quality compared to the west side

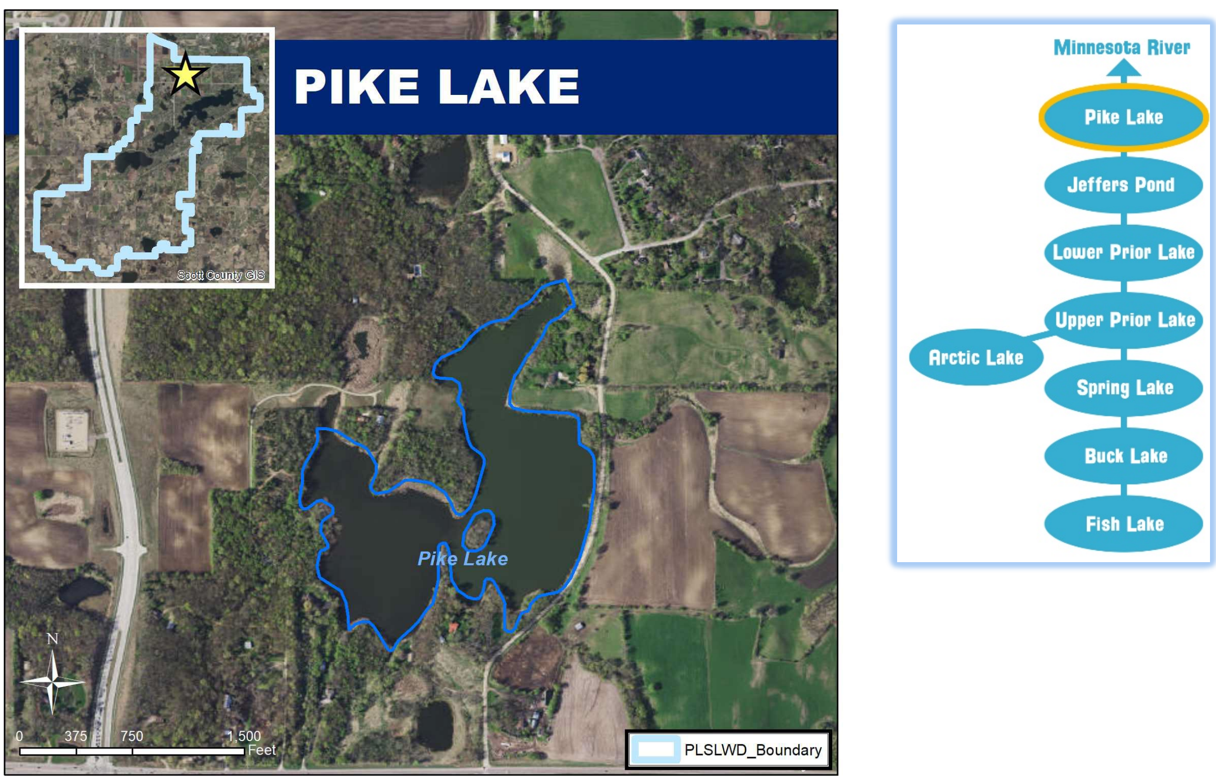


Figure 15. *Pike Lake Map*

INTERNAL LOADING

Based on available water quality data, Pike Lake is listed as impaired for nutrients. The 2020 Lower Minnesota River Watershed TMDL Report identified benthivorous fish, such as common carp, as a "phosphorus source that is higher priority for targeting", along with sediment release and curly-leaf pondweed as internal phosphorus sources to Pike Lake. With an internal load of 2,957 lbs of phosphorus per year, the study recommended reducing internal loading by 99% in the east basin and 87% reduction in the west basin.

FISHERIES ASSESSMENT

SMSC completed a Pike Lake Fishery Assessment in 2020. This study concluded that the carp population is likely as much as three times the level recommended by the MnDNR at 100 kg/ha. While this initial study was only able to grab a small sample, it did conclude that the carp population is at 287.2 ± 137.9 kg/ha. SMSC's assessment is part of a larger carp management project that is funded by a grant that goes through the end of 2021, and includes tracking and removals. Similar to Jeffers Pond in 2021, Pike Lake encountered a severe winterkill from an anoxic water column. Winter and spring observations showed nearly all of the biomass in the lake was from common carp. A 2021 spring fisheries assessment was conducted to evaluate the extent of the winterkill and the results showed only a small populaton of bullheads existed. In order to prevent carp from being established again, SMSC is working toward repopulating the lake with native bluegill and perch.

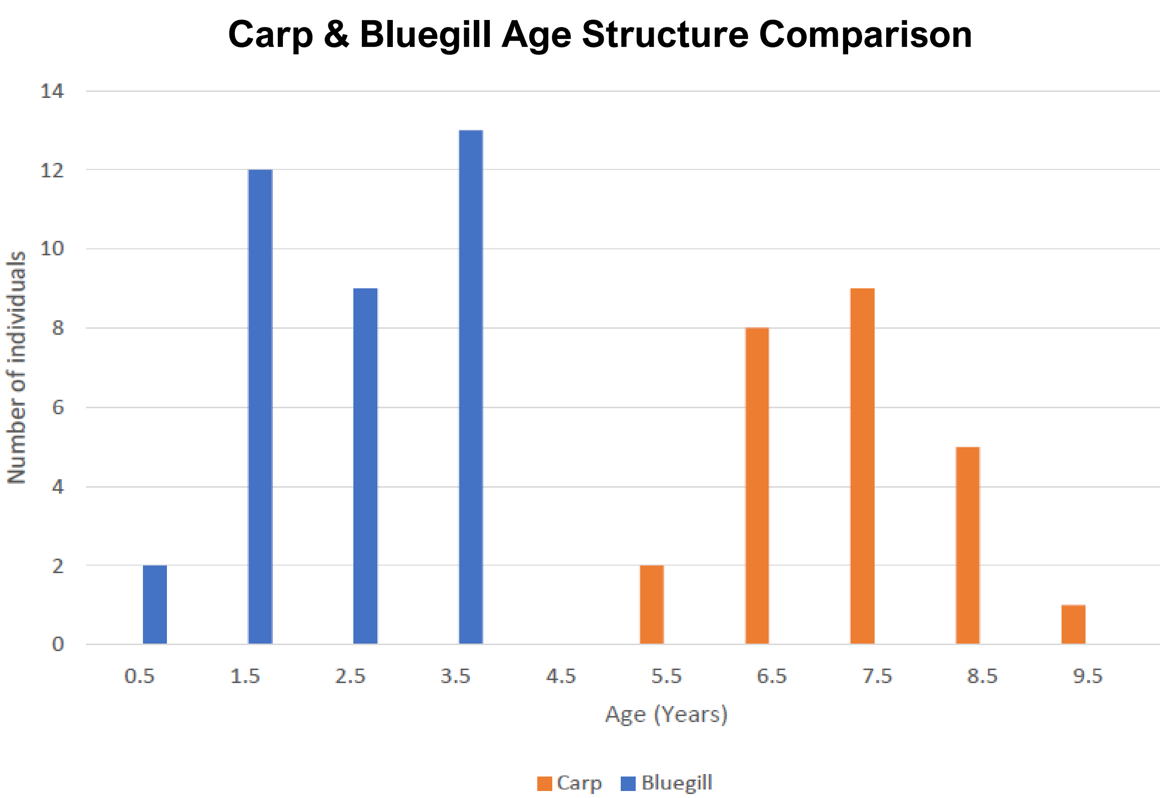


Figure 16. *Carp & Bluegill Age Structure Comparison in Pike Lake (2020)*

When overlaying the age structure of carp with bluegill ages in Pike Lake, it is interesting to note that all the carp analyzed were between 5.5 and 9.5 years old at capture. All samples of bluegill were all younger than four years. Studies within the district have shown that buegill prey on carp carps eggs. Figure 16 shows a direct relationship between bluegills and adverse carp recruitment Recruitment refers to the process of small, young fish transitioning to an older, larger life stage.

PART 4 - CARP MANAGEMENT GOALS

Through this IPM Plan, the District has developed a holistic approach to carp management, treating the entire connected watershed system as a whole. While it is the long-term goal of the District to see all of its lakes reach the water quality goal of 30 kg/ha of carp, the lakes must be prioritized and management focused to address the most imperative concerns first. As carp management information on the lakes and new techniques are always changing, this IPM Plan will address meeting goals of its priority lakes and assuring the efforts achieved through state and federal grants continue to support overarching TMDL goals.

4.1 PRIORITY LAKES

While it is the District's long-term goal to maintain carp populations below the water quality management level on all waterbodies, this IPM Plan prioritizes those lakes that receive the most public use and those that are most affected by poor water quality, as well as their associated waterbodies that may harbor or support carp recruitment.

PUBLIC ACCESS LAKES

The four lakes in the PLSLWD with public access are listed below with highest public use listed first:

1) Lower Prior Lake
2) Upper Prior Lake
3) Spring Lake
4) Fish Lake

Of these four, only Upper Prior Lake and Spring Lake have documented detrimental levels of carp.

TMDL LAKES

The Minnesota Pollution Control Agency's 2020 Impaired Waters List (wq-iw1-65k) shows the list of impaired waters located within the PLSLWD as identified in Table 6 below. The list is approved of March 26, 2021. Of these lakes, only Spring and Upper Prior have approved total maximum daily load (TMDL) reports and an associated TMDL implementation plan completed. Pike Lake and Fish Lake TMDL reports were completed in 2020 as part of the Lower Minnesota River Watershed TMDL.

Table 6. List of Impaired Lakes in PLSLWD.

WATER BODY	YEAR LISTED	AFFECTED USE	POLLUTANT OR STRESSOR
Fish Lake	2002	Aquatic recreation	Nutrient/eutrophication biological indicators
	2006	Aquatic consumption	Mercury in fish tissue
Lower Prior Lake	2002	Aquatic consumption	Mercury in fish tissue
	2018	Aquatic life	Fish bioassessments
Pike Lake	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators
Spring Lake	1998	Aquatic Consumption	Mercury in fish tissue
	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators
	2018	Aquatic life	Fish bioassessments
Upper Prior Lake	2002	Aquatic Consumption	Mercury in fish tissue
	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators

PRIORITY LAKES DETERMINATION

As they are listed as Tier 1 Lakes in the PLSLWD's 2020-2030 Water Resources Management Plan, receive the highest public use, and are currently on the *state's impaired waters list,* the District has established the following two lakes as its **top carp management priority:**

- **Upper Prior Lake**
- **Spring Lake**

In addition, the PLSLWD supports the efforts of SMSC as the lead partner on tracking and reducing carp populations in Arctic and Pike Lakes. Arctic Lake is directly connected to Upper Prior Lake and Pike Lake has a current TMDL that has identified rough fish as a major contributor to internal loading. As such, the PLSLWD has established the following two lakes as its secondary supportive carp management priority:

- **Arctic Lake**
- **Pike Lake**

4.2 COST-BENEFIT ANALYSIS

The PLSLWD attempts to be as cost-effective as possible in all of its practices. In 2020, the PLSLWD completed a cost-benefit analysis comparison showed below in Table 7 on its carp program compared to other District projects (see Attachment C). A 10-year annualized cost was used to compare the carp management program results on Upper Prior Lake to other projects in the District shown in table 7.

Based on this analysis, the PLSLWD concluded that carp management was indeed cost-effective. However, all the different carp removal tools do not always produce the same result. To that effect, the PLSLWD will also consider cost-benefit when choosing carp management goals and tools. At some point, the PLSLWD may decide that reducing carp populations from 100kg/ha to 30 kg/ha would not be worth the cost, as it is increasingly more expensive to reduce carp populations when the existing biomass is already low similar to the law of dimishing returns. This will be assessed during each annual update of the IPM Plan.

Table 7. Cost-Benefit of District Projects.

$ / lb TP Removed	Project
$31	Cover Crops
$81	Upper Prior Lake Alum Treatment
$97	Carp Management Project
$202	Ferric Chloride System
$252	Fish Point Park Iron-Enhanced Sand Filter
$1,131	Indian Ridge Biofiltration Basin
$1,136	Fairlawn Shores Biofiltration Basin

4.3 CARP MANAGEMENT STRATEGIES & GOALS

The PLSLWD has three distinct overarching strategies for carp management. At the direction of the Board of Managers, there are two accelerated carp management goals for Upper Prior and Spring Lakes to reduce and maintain overall carp populations to below the water quality threshold. To help achieve successful long-term management without carp population rebound, it is important to also take steps to block recruitment and to understand how the connected system works as a whole to better management the carp population.

CARP MANAGEMENT STRATEGIES:

1) **Comprehensively TRACK carp to improve the understanding of carp dynamics, behavior, and movement that will inform effective management decisions.**

2) **Effectively BLOCK all identified carp spawning areas connected to Upper Prior & Spring Lakes.**

3) **REDUCE carp down to management goal levels in priority lakes:**

CARP MANAGEMENT GOALS:

Table 8. List of Priority Lake Management Goals for Carp.

PRIORITY	WATER BODY	CURRENT CARP BIOMASS	CARP BIOMASS GOAL	TIMELINE / NOTES
#1	**Upper Prior Lake**	**211.7 kg/ha**	**< 30 kg/ha**	**Achieve goal by 2025**
#1	**Spring Lake**	**225.9 kg/ha**	**< 30 kg/ha**	**Achieve goal by 2026**
#2	*Pike Lake**	*~0 kg/ha*	*< 100 kg/ha*	*SMSC is the lead; Achieved goal in 2021. Efforts focused on preventing reestablishment*
#2	*Arctic Lake**	*62.0 kg/ha*	*< 100 kg/ha*	*SMSC is the lead; Maintain levels*

** Note that PLSLWD takes only a supportive role in carp management.*

Previous studies demonstrate that carp biomass densities of 100 kg/ha are ecologically damaging. To effectively manage and maintain carp below this threshold, an initial reduction to a density of 30 kg/ha has been recommended by the District board of managers for the two top priority lakes. By managing at a lower level, early detection of potential recruitment events may provide managers an opportunity to address the increase in carp population and biomass before it returns to a damaging level. Once this milestone has been achieved and recruitment has been managed, the PLSLWD may consider working towards the 30 kg/ha goal for all lakes in the District.

- **Goal #1: Reduce carp popuatlions to 30 kg/ha in Upper Prior Lake by 2025.**
- **Goal #2: Reduce carp populations to 30 kg/ha in Spring Lake by 2026.**

PART 5 - IPM STRATEGIES

For years after the introduction of carp in the United States, various government agencies and other entities attempted to manage and mitigate carp populations simply through large-effort mass removals. This one swing approach did not include quantifying the amount of carp before or after these efforts, or blocking carp recruitment. Without baseline carp population information, this management method proved to be ineffective as mangers were not able to quantify the extent of the invasion and did not know when they were "done". Carp often recolonized waterbodies since a long-term approach was not implemented, and spawning areas remained open and available. This management approach was largely abandoned in the late 1900s.Ideas and strategies have since been adapted from management practices being used in Australia (Diggle et al., 2012) and by studying movement and behavior patterns of carp in the Upper Midwest. In the early-2000s the University of Minnesota Aquatic Invasive Species Research Center (MAISRC) instituted research to develop a sustainable approach to effectively mitigating and controlling common carp in the United States. This research showed that by addressing different life stages and developing an understanding of the entire system or watershed sustainable carp control could be possible. The following diagram illustrates considerations to be made in the development of a carp IPM for the Prior Lake-Spring Lake Watershed District (Figure 17).

While commercial fishing efforts (seines) are not an effective means to control carp populations by itself, it can be a valuable component of an integrated pest management plan for long-term population management.

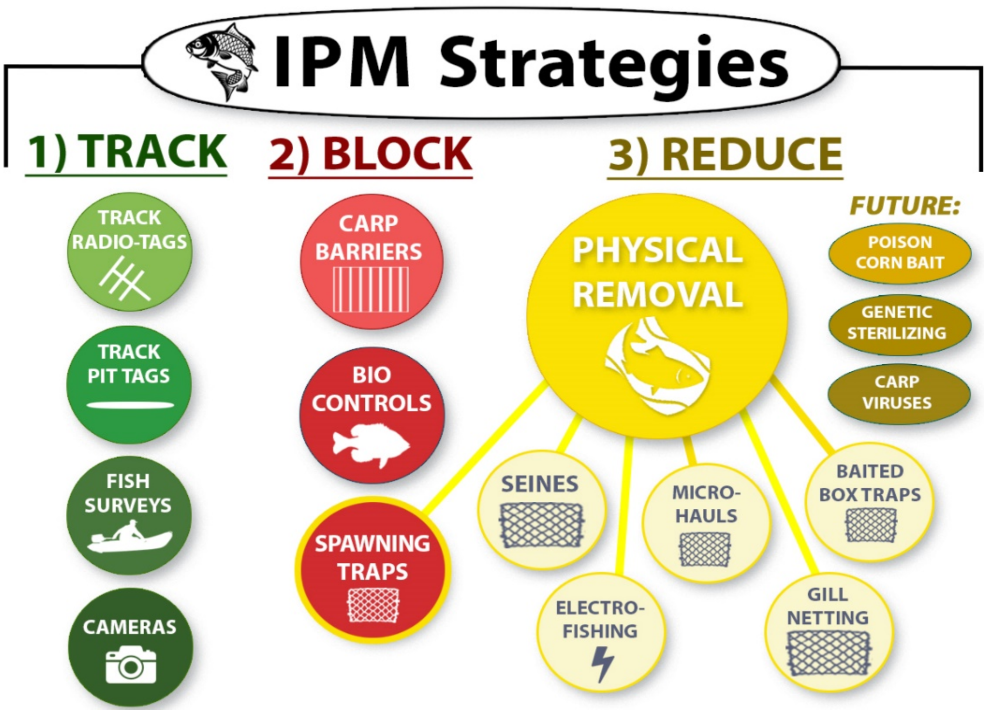


Figure 17. *IMP Strategies*

5.1 TRACK

Before implementation of **BLOCK** and **REDUCE** activities, the extent of the problem needs to be addressed. There are three questions that need to be answered:

1) How many carp are in the system?
   - → *Population estimates*
   - → *Setting removal goals*
2) Where and when do carp travel and aggregate in the system?
   - → *Identify migration routes between waterbodies*
   - → *Locate areas where carp are aggregating to aid in removal efforts*
3) What basins are the carp using to spawn?
   - → *Identify potential locations for carp barriers*
   - → *Use to locate potential spawning trap locations*

A. DATA COLLECTION TOOLS & TECHNIQUES

Whatever method that is used to estimate carp populations, the first step is always to capture the carp for counting and measuring. This can be completed using a variety of methods.

COLLECTING CARP:

Electrofishing. An electric field is generated between anodes and cathodes placed in the water. The current causes muscle contraction and temporary paralysis in fish; most species will float to the surface where they can then be netted. Stunned fish usually recover quickly when the power is switched off. Unfortunately, fish in deep water are not often captured, so this technique is best used in shallower areas near the shore. Different electrofishing methods (e.g. backpack, bank-mounted and boat, including electroseining) are used depending on local site conditions. *Note: This method is also used for small scale removals.*

Gill Netting. Mesh net panels are placed vertically in the water to entangle fish. The net has a rope along the top with floats attached and another rope along the bottom with weights attached. The mesh of a gill net is uniform in size and shape and the netting is large enough for a fish to fit its head through, but not its body, trapping them in place. *Note: When employed with commercial fishermen and with permission from the MnDNR, this method is also used for larger-scale removals.*

Fyke Nets. Collapsible, cone-shaped trap nets, held open by hoops. Leader net panels or wings guide fish towards the trap entrance. Due to their size and placement in shallow locations, fyke nets are effective for catching smaller carp.

Large-Scale Removal Events. While not its main purpose, data is collected during large scale removal events to better estimate current carp populations and removal efforts. These methods include seines, baited box traps, specialized trap nets, and commercial gill netting.

After the carp have been captured, counted, and measured, they are tagged and re-released into the waterbody in order to track their movement and monitor their populations. This tagging effort is completed through a variety of tools used to track carp as listed below.

TRACKING CARP:

Passive Integrated Transponder (PIT) Tags. PIT tags act as a lifetime barcode for an individual carp and when scanned are as reliable as a fingerprint (Gibbons & Andrews 2004). The tag is usually between 10 and 14 mm long and 2 mm in diameter. PIT tags are injected with a needle or inserted by surgical incision under the skin of the fish. PIT tags are dormant until activated; they therefore do not require any internal source of power throughout their lifespan. To activate the tag, a low-frequency radio signal is emitted by a scanning device that generates a close-range electromagnetic field. The tag then sends a unique alpha-numeric code back to the reader (Keck 1994). Scanners are available as handheld, portable, battery-powered models and as stationary, automated receiver devices that are used for automated scanning. PIT tag receivers are strategically placed in suspected carp migratory routes to determine movement behaviors in those channels.

Radio-Tags. A radio-tag consists of a 2.5 inch long cylinder which is surgically inserted inside the body of the carp with a foot long antenna extending outside of its body. Unlike PIT tags, radio-tagged fish can be located manually and tracked in real-time with an antennae from a boat or from on top of the ice in winter. Radio-tags implanted in the carp last for about two to three years, providing the District with key information about where the carp gather to overwinter and where they go to spawn. Each radio tag has a unique frequency, which can be picked up from up to a mile away with the tracking antennae device.

Fin Clips / Plastic Tags. In order to determine population estimates, carp are sometimes marked with a unique fin clip for the waterbody (e.g. right dorsal fin, pectoral fin, etc.) which does not harm the fish but leaves an identifiable marker. In other studies, carp have been marked with plastic tags that are inserted into the body of the fish and are similar-looking to retail clothing tags.

Figure 18. *Plastic Tag*

POPULATION ESTIMATE TECHNIQUES:

Mark-Recapture Estimate. To complete a mark-recapture estimate of abundance, captured carp will be marked with a unique mark (e.g. a fin clip, a plastic tag, a PIT tag, or a radio-tag), measured for length and weight, and released back into the basin that they were captured. Subsequent surveys will note the ratio of marked to un-marked fish and a population estimate will begin to develop using this method of estimation. This method assumes that marked carp are redistributed with the unmarked population, meaning that sufficient time (upwards of one-week) must be given between the date of marking a carp to the recapture event (Chapman, 1951). It also assumes that no emigration or immigration of the species occurs in the lake during the survey period. This method of estimation will be evaluated throughout the project period in case one or more of these assumptions is being violated.

Figure 19. *Measuring carp*

Catch Per Unit Effort (CPUE) Survey. CPUE boat electrofishing surveys can be used to estimate carp abundance and to predict the density of adult common carp in some cases (Bajer, 2012). These surveys are completed in the late summer to early fall and over the span of one to two months. Ideally, up to three (3) separate electrofishing surveys in each lake are conducted to establish an average CPUE. Surveys will consist of at least three (3) 20-minute transects that cover shoreline and littoral zones that are suitable habitat for carp. Time spent, number of carp captured, and length and weight data are recorded. A population and biomass estimate of common carp are then calculated using this data in a CPUE model developed for using the protocol and gear described and reflects the population at the time of the survey (Bajer et al., 2012). An average of multiple surveys aims to develop a more robust estimate over a larger span of time.

Figure 20. *CPUE Survey*

B. CARP ABUNDANCE ESTIMATES

OBJECTIVE 5.1.B (1): Establish abundance estimates for each of the carp management waterbodies in the PLSLWD.

For this plan, the abundance of carp is defined as the number of individuals and the amount of biomass present within each waterbody, reported in kilograms per hectare. To determine the abundance of carp within the system, two methods have been deployed: a mark recapture population estimate and an electrofishing catch per unit effort (CPUE) model. The protocol used for these methods of estimation are described above.

As the PLSLWD implements carp management activities (removal, barriers, etc.), it will be important to monitor changes in carp abundance on these lakes to determine if these efforts are successful in suppression of carp population post-management or if adjustments to existing strategies or new strategies are necessary. Table 8 lists the current population estimates of district lakes. Pike Lake has been estimated to be 0 as a result of the 2021 winterkill and spring fisheries surveys. See Part 3 for specific information on current populations of individual lakes.

Table 9. Carp Biomass & Phosphorus Loading in PLSLWD Carp Management Lakes.

LAKES IN ORDER OF PRIORITY	YEAR	CARP BIOMASS ESTIMATE (KG/HA)	ESTIMATED TOTAL WEIGHT (LBS)	PHOSPHORUS LOADING RATE (LBS/YEAR)
Upper Prior Lake*	**2021**	**211.7 ± 66.9**	**73,880**	**1,213**
Spring Lake*	**2021**	**225.1 ± 45.6**	**119,504**	**1,141**
*Pike Lake***	2021	*0*	*0*	*0*
*Arctic Lake***	2018	62.0	1,094	7.24
Fish Lake	2019	88.7 ± 69.2	13,886	46.89
Lower Prior Lake	2018	8.9	7,593	23.71
Jeffers Pond	-	*unknown*	*unknown*	*unknown*
Buck Lake	-	*unknown*	*unknown*	*unknown*

**** Carp Management Top Priority Lakes***

*** Carp Management Secondary Priority Lakes (supportive role only)*

*** Pike Lake Estimate based on winterkill of entire biomass*

OBJECTIVE 5.1.B (2): Develop a baseline understanding of recruitment patterns in waterbodies that connect to the two top priority lakes.

Although spawning observations can suggest areas for recruitment, the strength of these recruitment events is not known without sampling using nets or electrofishing in these basins. To help determine priority waterbodies to block movement to or from, it is recommended that steps be taken to sample basins suspected for recruitment. Radio-tags and PIT tags can be used to help document springtime movement by adults. Trap netting can be used for small sampling efforts. Another tool for determining potential spawing sites is observing spawing behavior of carp.

Table 10. Carp Survey Status of Potential Spawning Sites Connected to Priority Lakes

Waterbody	Presence/Absence Survey	Carp Biomass Estimate (kg/ha)
Geis Wetland	Present	183.0 +/- 83.6 (2018): surveys on 8/13, 8/15, 10/4 54.3 +/- 12.1 (2019): survey on 8/15/19, 2021 winterkill observed
Northwood Pond	Present	Unknown-2020 Spawning observed, 2021 winterkill observed
Tadpole Pond	Present	Unknown – 2020 and 2021 spawning observed
Charlie's Wetland	Absent	Unknown
Desilt Pond	Present	Unknown – 2020 Spawning observed, 2020 winterkill observed

C. CARP SPATIAL USAGE

Determining how carp use the system is critical to the development of the carp IPM plan. Understanding movement patterns will allow PLSLWD staff to identify potential nursery sites, migration routes, and wintering areas where carp may be vulnerable to large scale biomass removal or blockage to movement to limit recruitment (Bajer, 2011).

To track movement, the PLSLWD has deployed several high frequency radio tags implanted in carp (Judas fish) as well as passive integrated transponder (PIT) tags with seven (7) PIT tag monitoring stations in 2021. PLSLWD and WSB staff have actively tracked radio-tags using a 3-element Yagi antennae since 2015. Survey frequency was greatest during the spring spawning period (1-2/week) and during the winter aggregation period when ice conditions were safe enough for foot travel. The remainder of the year, radio telemetry surveys were completed on a once per week basis.

The District also uses two stationary cameras to be placed at strategic locations to confirm carp migration routes and/or aggregations of carp during spawning season. These cameras are set up wirelessly and transmit real-time information so that staff can move quickly to coordinate carp removals at optimal times.

OBJECTIVE 5.1.C (1): Identify carp aggregations on Spring Lake and Upper Prior Lake

Winter-time telemetry surveys and past studies have proven that carp tend to aggregate together in large groups during the winter (Johnsen, 1977; Penne, 2008). This phenomenon allows for these aggregations to be targeted for removal using under ice netting techniques, thus the identification of carp wintering areas on Spring Lake and Upper Prior Lake was determined to be a main objective in the 2015 carp management project.

Radio-tagged carp have been periodically monitored since 2015 to identify winter carp aggregation areas that could be targeted for carp biomass removal. Two (2) distinct sites were identified, both of which commercial fishermen have been able to pull a seine net through.

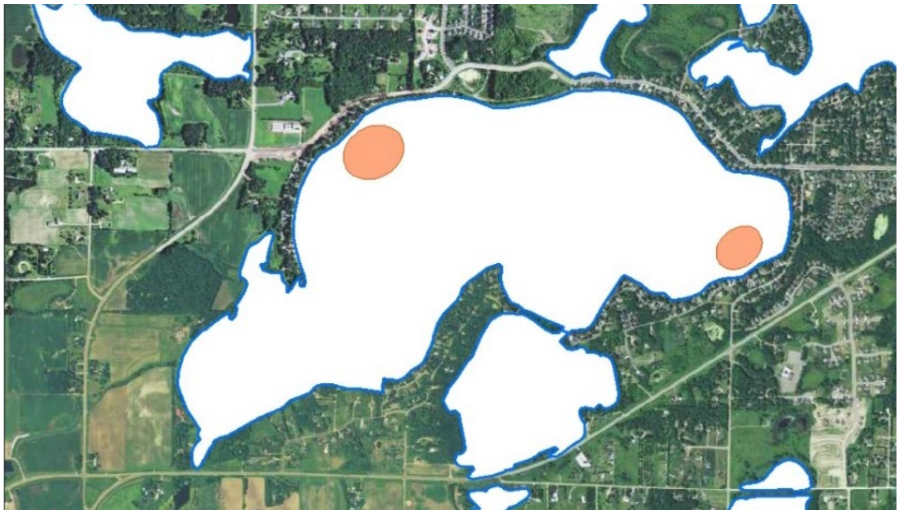


Figure 21. *Identified Spring Lake Carp Aggregation Areas Suitable to Seine*

Four full winters of telemetry data are available to identify winter aggregation areas on Upper Prior Lake and four (4) distinct sites have been identified in figure 22 where carp tend to aggregate, mainly in the winter. Locations 1-3 depicted have been successfully seined in both open water and under ice. Location 4 poses a significant risk of snagging lake bottom rocks and is not suitable for netting. In 2020 and 2021 when carp where located near the rocks at location 4, the district utilized underwater speakers to herd carp from the undesirable seining location. Additionally all 4 locations have been targeted with gill nets during the Gill Netting Pilot project.

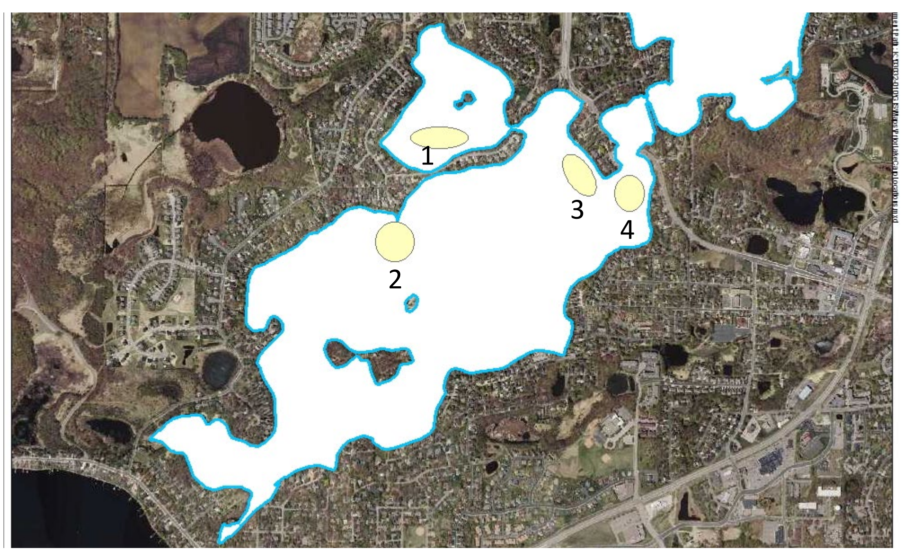


Figure 22. *2016-2021 Upper Prior Lake Carp Aggregation Areas Suitable to Seine*

Radio-tags will continued to be tracked, mapped and documented to identify new and continued areas that carp are congregating on Upper Prior and Spring Lakes.

OBJECTIVE 5.1.C (2): Visually monitor carp at spawning areas to identify aggregations at connections to Spring and Prior Lakes.

Using staff, volunteers, and stationary cameras, monitor the locations at or near Upper Prior or Spring Lakes that are suitable for small-scale carp removals when fish begin aggregating in the spring. This information will be used to coordinate electrofishing, gill-netting, micro-hauls, or seine netting carp removals with consultants and/or commercial fishermen.

OBJECTIVE 5.1.C (3): Map migration routes and identify connected nursery sites for Upper Prior and Spring Lakes.

Migration routes that allow access to shallow basins that carp exploit for use as nursery sites are the support mechanism for carp recruitment in those systems where carp spawn outside the main basins. Carp have evolved to seek out these sites since hard winters in Minnesota periodically freeze shallow basins resulting in winter-kill of most or all fish species. Absence of predator species, such as bluegill sunfish, greatly increase the chance for survival of carp eggs and larvae. Radio-tags and passive integrated transponder (PIT) tags and stationary receivers are currently being used to track the movement of carp each season (Appendix C).

Carp movement out of the Spring Lake and Upper Prior Lake system is being studied using the same radio-tags used in the Judas fish technique to find carp winter aggregations. Several apparent surface connections exist on Spring Lake and Upper Prior Lake and in some cases, anecdotal information suggests that carp are using a connection even though no radio-tags have been detected moving. In response to this, the PLSLWD initiated a study using Passive Integrated Transponder (PIT) tags and seven (7) unmanned receivers/loggers placed in streams to detect movement and quantify the extent of movement in locations of highest priority. Five of the sites are using solar powered PIT Stations which allows for a more complete data set at remote locations where frequent battery swapping is difficult.

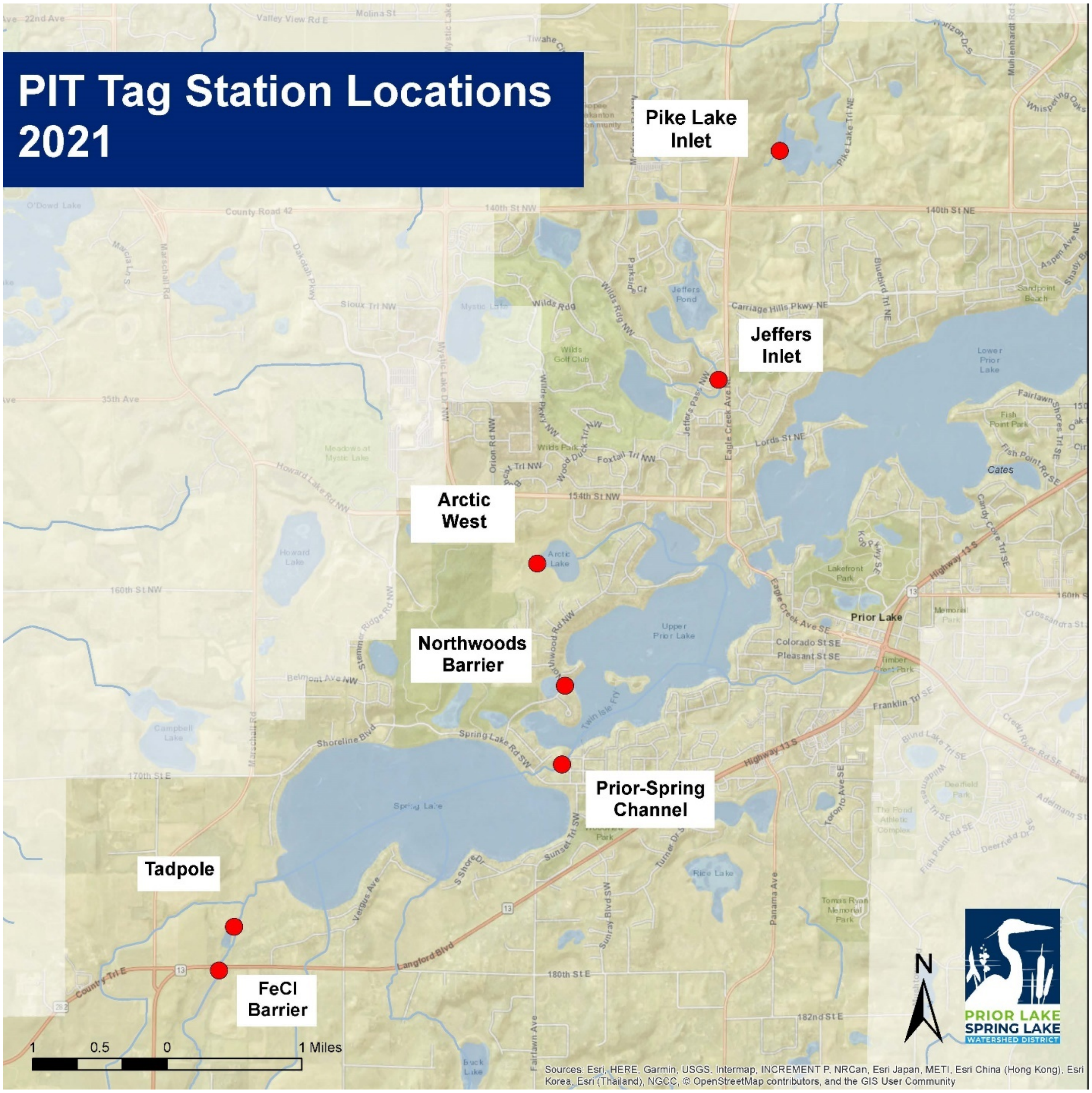


Figure 22. *PIT tag receiver locations in 2021*

Table 11. Current and future PIT tags.

	Current Remaining PIT Tags	2021 Planned PIT Tags	2022 Planned PIT Tags
Upper Prior Lake	**230**	**50**	**50**
Spring Lake*	**156**	**50**	**50**
*Pike Lake***	0	0	0
Arctic Lake	26	0	0
Geis Wetland	114	50	0
Fish Lake	0	0	0
Cates Lake	0	0	50

*A small amount of PIT tags have been removed during recent baited box trap efforts

Table 12. Current and future radio-tags.

	Current Active Radio-Tags	2019 Radio-Tags	2020 Radio-Tags	2021 Radio-Tags	Planned 2022 Radio-Tags
Upper Prior Lake	**7**	**9**	**7**	**5**	**5**
Spring Lake	**3**	**9**	**4**	**5**	**5**
Arctic Lake	6	0	0	0	0
*Pike Lake***	0	5	0	0	0

**Note that SMSC is the lead on the Pike Lake carp management project.

Tagged carp are suspected to have traveled between Upper Prior Lake and Arctic Lake after the barrier was installed in 2016. Additional PIT tags in Arctic will help confirm or deny whether or not carp are finding another way to travel between the two waterbodies. There have not been conclusions on how these tagged fish managed to make their way out of Arctic Lake.

PIT tag stations at the Northwood barrier and the FeCl barrier were reinstalled to help the District verify if these barriers are sufficiently working to prevent carp migration during spawning. Summer 2021 data supports the design of the barrier preventing carp movement. The Tadpole station was placed in the planned 2021 Tadpole barrier location confirming there is movement of carp through the channel. Arctic station was moved to the west side of Arctic Lake to determine if there could be movement westward into a wetland complex through newly constructed BMP. Jeffers Inlet and Pike Lake Inlet are two stations located along the Prior Lake Outlet Channel (PLOC). Low flows likely prevented much movement along the PLOC in 2021.

5.2 BLOCK

A. BIOLOGICAL CONTROLS

Research completed by the Minnesota Aquatic Invasive Species Research Center (MAISRC) showed that bluegill sunfish are the main predator of carp, preying on the eggs and larvae of carp young of year.

Carp actively seek out nursery sites that are devoid of these predator fish and proliferate in lakes where bluegill abundance is low. A robust panfish and gamefish population may act as biological control and complements the other IPM strategies (Weber et al., 2012). These predator fish are necessary to prevent carp recruitment after a significant portion of the carp biomass has been removed or to keep carp from establishing in lakes.

Larger gamefish may also prey upon carp young of the year, but that relationship is not as well documented. Also, carp growth rates are quite accelerated compared to other fish species. By the second growing season (age 1) carp may be > 12 inches, reducing the likelihood that piscivorous fish species will be able to prey upon them.

In 2017, the PLSLWD partnered with the University of Minnesota as part of a graduate reseach project to assess the effectiveness of using bluegill sunfish as biocontrol for common carp (Poole, 2018). The eastern basin at the 12/17 wetland restoration site was one of four study basins in the Twin Cities metro area used; it was stocked with both spawning carp and adult bluegill to measure the effective rate of bluegill predation on carp eggs. The results from the study indicate that bluegill predation had a major effect on the abundance of post-larval carp. In the 12/17 wetland study basin, there 0% recruitment of carp during the study period.

OBJECTIVE 5.2.A (1): Manage lakes & upstream spawning grounds to support a robust gamefish and/or panfish population to effectively control carp recruitment.

MN DNR fisheries data is available for both Upper Prior, Lower Prior, Spring, and Fish Lakes. Two (2) independent fisheries studies have been completed on Arctic Lake, and a recent fisheries assessment was completed on Pike Lake. Existing data for these lakes show a variety of fish assemblages and abundances.

The remaining lakes (Buck Lake and Jeffers Pond) in the watershed have not been assessed. An initial sampling in Buck Lake did not indicate that it was a nursery and it had a good panfish population. Jeffers Pond was confirmed to be a carp recruitment site and should be monitored for carp activity for the next several years. The 2020/2021 winter-kill showed an abundant carp population signaling the lake has suitable habitat. A baseline fisheries assessment is planned in 2022 by SMSC. Data collected after the assessment will be used to prioritize if and how this lake needs to be managed.

An analysis of all existing fisheries data in 2021 will provide insights into each of the fisheries where such data is available, identify data gaps, and determine if the fishery is functioning to biologically control carp where necessary. Habitat improvements and other restorative efforts may be identified through this effort as well as waterbodies that may need additional survey work where minimal data is available.

As recommended by the PLSLWD's Citizen Advisory Committee, the PLSLWD is moved forward in 2020 with its first lake fish stocking event in both Spring and Prior Lakes since 2010. With donations from the Spring Lake Association and the Prior Lake Assocation, along with a District contribution.

OBJECTIVE 5.2.A (2): Stock bluegills as needed in carp nursery locations connected to Upper Prior and Spring Lakes to prevent recruitment.

While winter dissolved oxygen measurements show elevated oxygen levels (7 ppm) in the Geis wetland, which is high enough to support winter survival, it is unknown if the habitat is sufficient to support bluegill recruitment. Waterbody size, water chemistry data along with April and May bluegill sampling helped determine stocking rates.

In spring of 2020, the PLSLWD began stocking the existing carp spawning sites at the Geis wetland, Tadpole Pond, and the Northwoods Pond with 2-4" bluegills before carp migration and spawning. These bluegills were marked with fin-clips before releasing them into the wetland to aid in future assessment of stocking success.

In spring of 2021 the Geis wetland, Northwoods Pond, Tadpole Pond, and Delist Pond were resurveyed to assess if the stocked bluegills survived. There were no 2020 bluegill recaptures during the 2021 pre-stocking surveys. Based on recommended stocking rates, the Geis wetland was stocked with 2,000 bluegills, Northwoods Pond site was stocked with 700 bluegills, and Deslilt Pond was stocked with 700 bluegills to ensure low recruitment in this nursery sites in spring of 2021.

Table 13. Summary of Bluegill Stocking in Nursery Sites

	Spring 2020 Stocking	Spring 2021 Stocking
Geis Wetland	2,000	2,000
Northwoods Pond	900	700
Tadpole Pond	100	0
Desilt Pond	0	700

PLSLWD will continue assessing carp nursery locations for bluegill populations. More bluegills will be stocked in identified nursery locations if deemed necessary to prevent carp recruitment. Additional nursery locations base on spring 2022 spawning observations will be analyzed for potential bluegill stocking 2023.

B. CARP BARRIERS

Barriers can be an incredibly effective component of a carp IPM. Barriers may be employed to protect sensitive areas from the destructive foraging behavior of carp or prevent carp from exploiting migration routes to disrupt recruitment. Barrier placement should be balanced with the potential need for fish passage with respect to native gamefish. Placement of barriers is supported by the implementation of movement monitoring as described in section 5.1.C (3).

Existing carp barriers were placed throughout the Upper Prior and Spring Lake connections based on documented carp migratory information and include the following locations:

- Arctic Lake Outlet
- 12/17 Wetland (west side of Spring Lake)
- FeCl Weir (south of Spring Lake on Ditch 13)
- Desilt Pond (south of Spring Lake at Ditch 13 outlet)
- Northwoods Pond (west side of Upper Prior Lake)

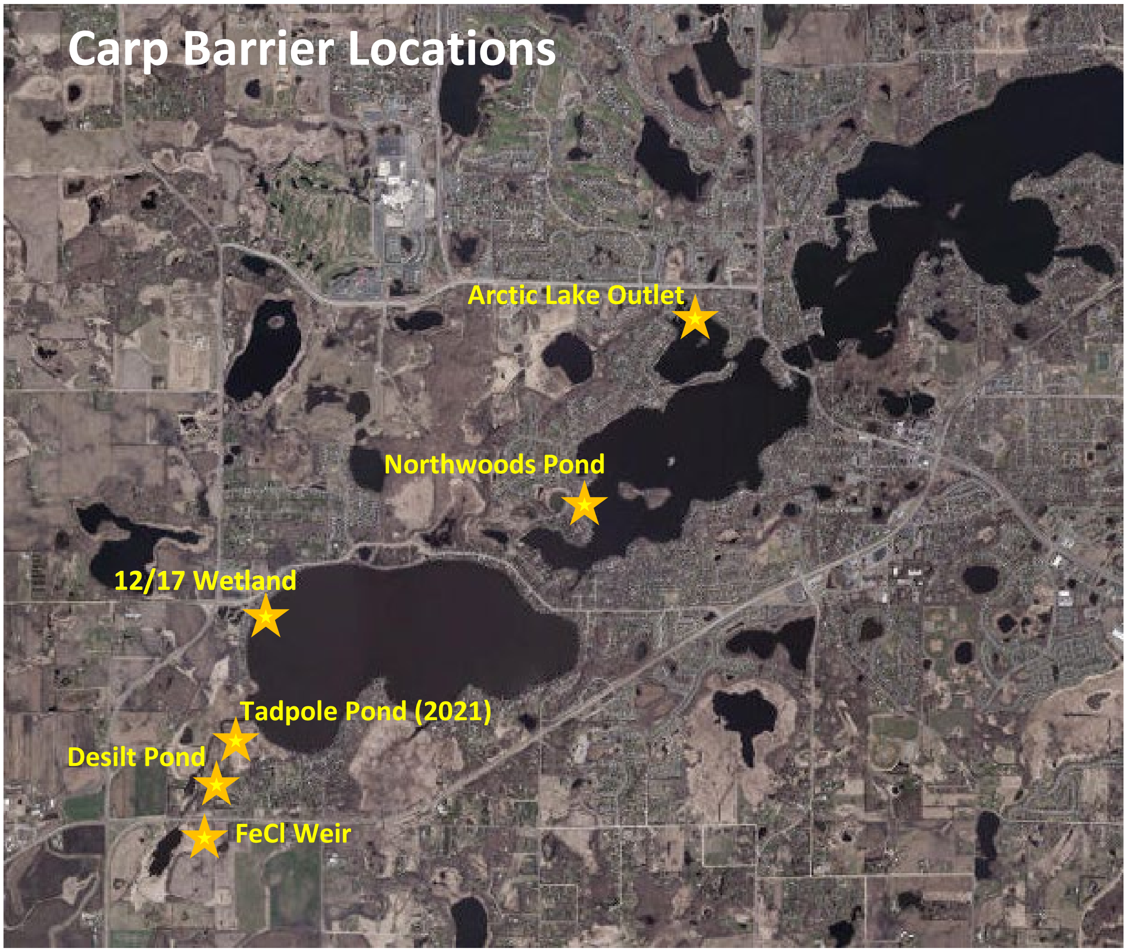


***Figure 23**. Barrier locations within the PLSLWD, including installed and proposed barrier sites.*

OBJECTIVE 5.2.B: Install new barriers within carp migration routes to spawning areas as documented by tracking data or fisheries assessments.

In 2020, the PLSLWD installed one new barrier (Northwood barrier) located on the west side of Upper Prior Lake. This carp nursery site was discovered when radio-tagged carp were documented entering this waterbody during spawning season. Visual observations confirmed that it was an active spawning site.

The existing FeCl Weir barrier from 2003 was also re-designed and updated in 2020. This barrier system was in need of repair for nearly a decade. The new system requires less maintenance and is designed to be more effective in high water flood conditions with less maintenance.

Carp have been documented visiting a small connected waterbody to the southwest of Spring Lake during spawning season named Tadpole Pond. A PIT station installedin 2021 confirmed season movement. The design and permitting for the Tadpole Pond barrier site has been finalized . The build and installation are projected to be completed in fall of 2021.

The PLSLWD plan to continue investigating other potential barrier locations in 2022. These locations will be identified using the tracking methods described in Section 5.1.1. Furthermore, as access to prime spawning habitats are continuously being blocked off, the distrit will be confirming barrier effectiveness and looking at previously identified lower risk connections to potential spawning habitats.

5.3 REDUCE

Carp can be removed from waterbodies using a variety of methods as documented below. PLSLWD will consider the following when deciding which removal methods to employ:

5) **Feasibility:** How likely will this method result in success? What are the obstacles?
6) **Time-Oriented:** Is immediate removal necessary to meet goal deadlines? Will the timeliness affect success of other projects (e.g. alum treatment)?
7) **Cost-Effective:** Is this method worth the cost based on anticipated results?
8) **Effort for Results:** Is this the best method for the amount of effort required? Given limitations of staff, what methods produce the greatest results for the least amount of effort?

While the IPM plan addresses the carp management strateies on a holistic, watershed-based approach, the PLSLWD is dedicated to first reaching carp management goals on its top priority carp management lakes before it works to actively manage the other six lakes.

OBJECTIVE 5.3: Reduce carp populations to 30 kg/ha in top priority carp management lakes: Spring and Upper Prior Lakes.

A. CARP REMOVAL METHODS

SEINES

Commerical fishermen use long mesh nets that hang vertically in the water with floats along the top and weights along the bottom. They are typically used to surround fish in an area and pulled through the water and along the lake bottom to crib up the carp in a shallow area for removal. Both open water and under ice seine netting is very effective but limited to areas where carp aggregate and are snag free.

Figure 24. *Under Ice Seine on Spring Lake*

Clearing Obstructions. One of the most critical factors to a successful seine is have an area that is clear of obstructions on the lake bottom. The PLSLWD can help prepare known aggregration areas prior to seine season (November – April) by engaging a commercial fishermen to run a test seine through areas with their nets, or by running a chain on the bottom of the lake. These obstruction removals may occur on Spring Lake and Upper Prior Lake

FACTORS TO CONSIDER FOR A SEINE EVENT:

LOCATION

- Is the potential seine in an area that has been seined before?
- Are there any deep holes where the nets won't reach?
- Is the nature of the shoreline unsuitable for netting (e.g. substrate, docks, tree for winching, etc.)
- Is there too much vegetation to pull the net through?

AGGREGATION

- Is there a large enough carp aggregation grouped tightly enough?

WEATHER

- Is it too windy for an open water seine?
- Is it too cold for native fish to survive being out of water during an ice seine?

OBSTRUCTIONS

- Has the area been cleared of any obstructions?
- Is this an area where fishermen have thrown in trees for fish cribs?
- Is there rocks or other known obstructions that cannot be avoided or removed?
- Is the lake bottom to muddy to pull the seine net through?

SNOW & ICE

- Is the snow too thick for winter seine?
- Is the ice thick enough to support weight of vehicles?

FISHERMEN

- Are commercial fishermen willing, able and ready?
- Do the nets need to be tagged for zebra mussels? *Note: Due to zebra mussel infestation, the fisherman is not able to use the nets for three weeks during decontamination.*
- Is there an existing market to take the carp to once removed?
- Will the carp haul be large enough for market viability?

Figure 25. *Factors to Consider for a Seine Event*

each October/early November to prep the sites if a seine event is anticipated. In the Fall of 2020, district staff and consultants located obstructions on the lake bottoms that had caused issues during prior seining attepts. The obstructions were mapped using side scanning sonar and verified using an under water drone. Coordinating with commercial fisherman and a diver, debris ranging from tires to blocks were found and either moved outside of the seining perimeter or disposed of.

The PLSLWD will also use its underwater drone to check the removal area conditions prior to a seine to avoid any new or unforeseen obstructions in an area. If there are new obstructions under the ice, they can potentially be avoided or removed prior to the seine.

Upper Prior Lake Seine Net. There has been some hesitancy by commercial fishing crews to commit resources to netting Upper Prior Lake due to the presence of aquatic invasive species (Eurasian watermilfoil, curly leaf pondweed, and zebra mussels) and the DNR's requirement to decontaminate nets and associated equipment. Depending on the weather, the decontamination period may be up to 21 days, meaning that commercial crews may not have gear to net other high priority lakes/projects. The PLSLWD's seine net available for use by commercial fishermen in the District should mitigate this obstacle by providing a net that could be properly decontaminated or used repeatedly in the same waterbody while not restricting the fishing crews' ability to continuously net in other waters.

SPECIALIZED TRAPS

Specialized fish traps were designed at attempting to exploit behavioral patterns during spawning migrations. The idea is to guide carp traveling toward spawning habitat into holding compartments. These traps are usually set in shallow water, and style and size can vary. The District has developed two specialized trap nets for capturing carp during spawning season: the Push Trap Net that will include a one-way trap door style panel on the opening, and the Newman Trap Net that will include multiple-staged guidance walls and openings for enhanced entrapment, both of which can be placed seasonally at carp spawning migratory routes.

In 2020, headed by the accelerated carp management initiative, specialized traps were built and installed. Both traps were successful in captureing carp during the spawning migration. With minor modification, both traps were again installed in the same locations in 2021. The springtime water levels posed a significant challenge as flowing water ceased. Without the flowing water through these traps they failed to catch carp. The silver lining to this is that while carp were not actively being caught, the traps have a secondary purpose as a barrier. Both traps effectively block the movement past their respective sites preventing carp from reaching spawning areas.

Newman Cage. The Newman Cage design is similar to a baited box net. Rather than having to set the net by pulling up the sides to capture the carp, this net provides constant capture of carp when set. Carp swim into the trap and cannot escape. Figure 26 below is an approximate version:

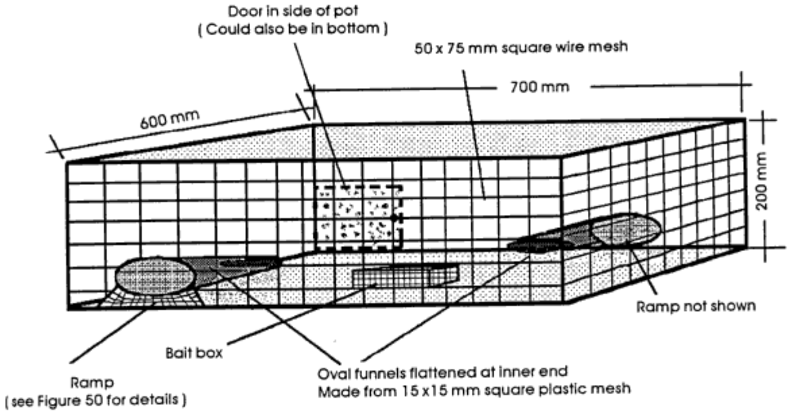


Figure 26. *Newman cage reference example.*

Push-Trap. This trap takes advantage of the migratory behavior of carp as well as their propensity to "push" through barriers and is modeled conceptually on a design described in detail by Thwaites (2015). Initial laboratory results indicate that the push trap was successful in capturing 91% of adult carp in the experiment.

The design incorporates a row of PVC pipe fingers mounted on a crossbar and set at angles that allow carp to push through and swim upstream into a collection basin. The rotating fingers are similar to those mounted at the ferric chloride weir, which rotate on a fixed cylinder. The fingers are set at a height that allow for the forward or upstream movement of the fingers that "open" the trap, but the fingers cannot swing back to allow carp to exit the trap. The trap itself is composed of economical fencing materials.

Figure 27*. Push-Trap at the Desilt Pond*

Figure 28*. Newman Trap in Mud/Crystal Bay*

BAITED BOX TRAPS

The baited box trap is a mesh net trap that lays flat on the bottom of the lake, but quickly forms into a box when lifted to trap the carp inside. Eight solid pipes are secured around the box and ropes are run through the net and up the poles to a pulley system. Carp are typically baited with corn at the box trap location for several days with help from volunteers until a large grouping forms. While a baited box trap catches fewer fish, it holds an advantage over a seine net because the carp are much less likely to escape.

***Figure 29**. Baited box trap*

***Figure 30**. Deploying the baited box trap net*

MICRO-HAULS

Micro-hauls are simply smaller removals that are completed using a variety of methods as opportunities arise. For example, using a small 500’ section of a seine net called a “block net”, the PLSLWD is able to complete small micro-haul events when carp group up in small areas unsuitable for seining. The removal is often assisted by electrofishing efforts, small gill nets and/or the unified sound technique to drive carp towards an area. Corn may also be used to bait an area prior to a micro-haul attempt to achieve greater removal numbers.

ELECTROFISHING

This method was further described above in Section 5.1.A.

GILL NETTING

This method was further described above in Section 5.1.A.

B. ACCELERATED STRATEGIES

OBJECTIVE 5.3.B: Develop alternative or innovative methodologies/techniques to improve or facilitate removal of carp biomass on priority carp management lakes.

In many instances carp may become aggregated, but cannot be removed in the aggregation area due to obstructions on the bottom or along the shoreline. By developing alternative removal methodology, the PLSLWD will be able to expedite carp biomass removal and in some instances, make removal possible. By developing these techniques, the PLSLWD may be able to assist other water resource management entities in addressing carp management; especially in areas where traditional methods are difficult to employ.

The unified method may provide opportunity to enhance carp removal efforts by concentrating carp using underwater speakers; essentially using sound to herd carp to a specific location or drive them from undesirable removal locations.

HERDING CARP

The underwater sound system for herding carp consists of an MP3 player wired to underwater speakers and an amplifier to “pump” sound near an aggregation to drive them into nets or herd them to an area of the waterbody that is conducive to netting. This is especially effective in an area like the northeast corner of Upper Prior Lake where rock obstructions exist near the Knotty Oar Marina. The underwater speakers were successfully used many times during an under ice seine on Upper Prior Lake in 2020 and 2021.

TRAINING CARP

The District is also testing the effectiveness of training carp using sound and bait. Multiple studies have shown that carp can be trained within two weeks of consistent noise and rewards and will remember this training for as long as 4-5 months afterwards. If the District can train carp to come to a location when they hear a specific noise, this could be used to create or enhance opportunities for carp removal efforts (seines, box traps, etc.). In 2020, the District attempted to attract carp to associate the sound of running water with bait but could not produce conclusive results.

FUTURE REMOVAL METHODS BEING STUDIED:

The Unveristy of Minnesota and other colleges are studying ways to reduce the carp population by methods other than physical removal. The PLSLWD is keeping in close contact with researchers of these programs to see if the District can participate as a test site or if there research is ready to implement. Note that the projects are likely a few years away from regulatory approval of these innovative new methods listed below.

Poison Corn Bait. This research project is testing whether common carp can be baited and killed using corn pellets with antimycin-a, a natural fish toxin, without harming other species. Carp have a unique diet (plant seeds, such as corn, which native fish are not attracted to) and can be trained to aggregate in baited areas. Researchers first determined the concentration of antimycin-a needed and the species-specificity of the approach. They then conducted trials to test this “bait and switch” concept with carp of different sizes in experimental ponds. This research project will conclude at the end of 2021.

Genetic Sterilization. This research project is looking at introducing a synthetic species-like barrier to carp reproduction. This method involves altering the genetics of males in the invasive species (carp) before releasing them among the population, leading to sterile offspring and the eventual control of the species overall. In order to make this method usable, this study aims to develop this technology further in zebrafish, from which the system can be applied to other invasive fish species and eventually other vertebrate pests. As of July 2019, researches tested several genetic constructs in the model laboratory fish, Danio rerio., although they have not yet found a genetic design that is suitable for introduction to carp.

Carp Viruses. The koi herpes virus has killed off large quantities of common carp in other lakes in Minnesota, such as Lake Elysian. These die-offs lead to an interest in exploiting this carp-specific virus and introducing it into lakes infested with this invasive species. The University of Minnesota has researched the koi herpes virus, along with two other carp-killing viruses, and are in the process of researching what impacts or unintended consequences this might have on native fish. Once the virus is shown to be carp-specific and non-detrimental, there will still be regulatory hoops to jump through before it is allowed to be introduced into Minnesota lakes.

PART 6 - CARP MANAGEMENT SCHEDULE

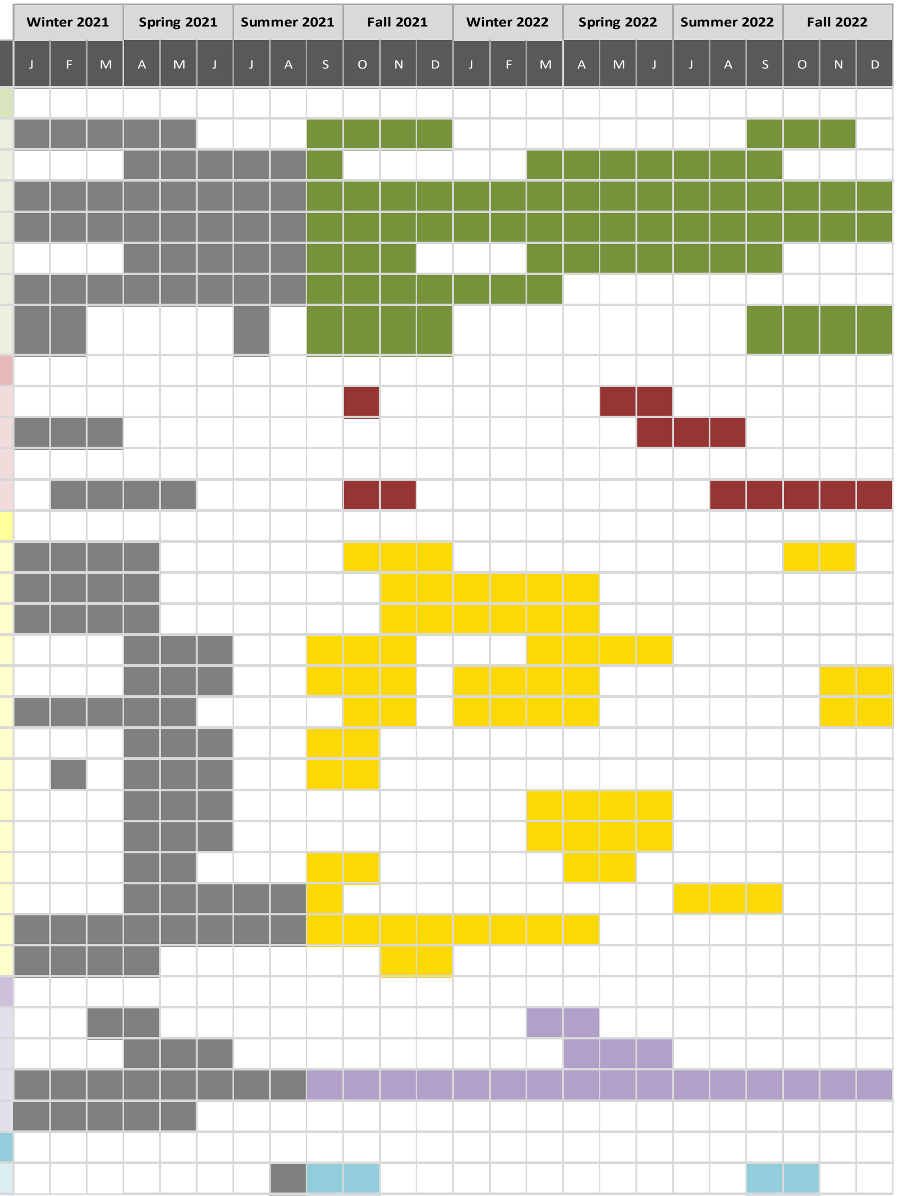
The following table includes the carp activities for 2021-2022 in order to achieve the goals identified in Part 4.

CARP MANAGEMENT SCHEDULE

2021-2022

PRIOR LAKE-SPRING LAKE WATERSHED DISTRICT

TASK	START	END
TRACK: Carp Tracking & Project Development		
Implant carp with PIT tags & Radiotags	*Apr 2019*	*Dec 2022*
Install/monitor PIT tag reader stations	*Apr 2019*	*Dec 2022*
Track PIT & Radio tags across waterbodies	*Apr 2019*	*Dec 2022*
Update GIS location information & online maps	*Apr 2019*	*Dec 2022*
Install stationary cameras at strategic locations	*Sep 2019*	*Dec 2022*
Use underwater camera for tracking/training carp	*Sep 2019*	*Dec 2022*
Analysis: *identify aggregation areas, migration routes and population status*	*Jun 2019*	*Dec 2022*
BLOCK: Carp Barriers & Biological Controls		
Identify strategic locations for carp barriers	*Oct 2019*	*Dec 2022*
Site analysis & design of barriers	*Dec 2019*	*Dec 2022*
Install Northwood Barrier	*Sep 2019*	*Dec 2022*
Install Tadpole Barrier	*Feb 2021*	*Dec 2022*
REDUCE: Carp Removals		
Remove obstructions from seine areas	*Oct 2020*	*Dec 2022*
Spring Lake carp seines	*Nov 2019*	*Dec 2022*
Upper Prior Lake carp seines	*Mar 2019*	*Dec 2022*
Electrofishing removals	*Apr 2020*	*Dec 2022*
Micro-hauls	*Apr 2020*	*Dec 2022*
Gill Netting Pilot Project	*Mar 2020*	*Dec 2022*
Geis wetland carp removals	*Apr 2019*	*Dec 2022*
Pike Lake carp removals	*Apr 2020*	*Dec 2022*
Deploy Newman Trap in Arctic Lake outlet	*Apr 2020*	*Dec 2022*
Deploy Push Trap in desilt pond	*Apr 2020*	*Dec 2022*
Stock bluegills	*Apr 2020*	*Dec 2022*
Box Trap removals with volunteers	*Apr 2020*	*Dec 2022*
Herding	*Jan 2020*	*Dec 2022*
Carp removals in other waterbodies (TBD)	*Nov 2020*	*Dec 2022*
Education & Outreach		
Outreach mailings	*Apr 2019*	*Dec 2022*
Lake Association meetings/presentations	*Apr 2020*	*Dec 2022*
Update website with current information	*Jan 2019*	*Dec 2022*
Educational activities with local schools	*Sep 2019*	*Dec 2022*
Update IPM Plan		
Annually update plan to include new information	*Sep 2019*	*Dec 2022*



Note: The Carp Management Schedule includes 2021 work funded by a 319 Grant, a BWSR Watershed Based Funding Grant, and the PLSLWD District Levy. Proposed 2022 workplan funded only by the district.

PART 7 - SUMMARY

With the understanding that common carp play a role in the decline of water quality within the PLSLWD and with the knowledge that they are present, the goals and action items established in this plan will aid the PLSLWD in accomplishing its primary goal of managing and preserving the water resources across the watershed.

This plan is intended to be a living document; using adaptive management that may develop new management strategies and plan goals through data collection and analysis. As new data is collected and analyzed, current approaches, data collection efforts, and prioritization may change. The PLSLWD Carp IPM should be reviewed annually to provide updates to identified goals and action items and potentially add or modify goals as data collection may dictate. This plan incorporates an adaptive management approach. As data is collected and analyzed it will be used to inform the plan and possibly develop new objectives or approaches.

The PLSLWD Carp IPM has been developed as a guidance document for the management of common carp populations within the Prior Lake - Spring Lake Watershed District. The PLSLWD Carp IPM supports the goals of the 2011 Upper Prior and Spring lake TMDL and goals established for individual waterbodies throughout the watershed.

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APPENDICES

Visit the following sites online to download the appendices documents:

APPENDIX A – 2018 CLEAN WATER PARTNERSHIP GRANT FINAL REPORT
https://www.plslwd.org/wp-content/uploads/2020/09/CWP-Carp-Management-Grant-FINAL-Report_Jun-2018.pdf

APPENDIX B – ARCTIC LAKE FISHERIES ASSESSMENT 2017
https://www.plslwd.org/wp-content/uploads/2020/09/Arctic-Lake-Fisheries-Assessment_Spring2017_Final.pdf

APPENDIX C – CARP MANAGEMENT COST-BENEFIT SUMMARY 2020
https://www.plslwd.org/wp-content/uploads/2020/09/Carp-Cost-Benefit-Summary.pdf

APPENDIX D – CARP REMOVAL DATA 2016 – 2020
https://www.plslwd.org/wp-content/uploads/2020/09/PLSLWD-Carp-Removal-Data.pdf

APPENDIX E – PIKE LAKE FISHERY ASSESSMENT 2020
https://www.plslwd.org/wp-content/uploads/2020/09/Pike-Lake-Fishery-Assessment_FINAL-Report_01-2020.pdf