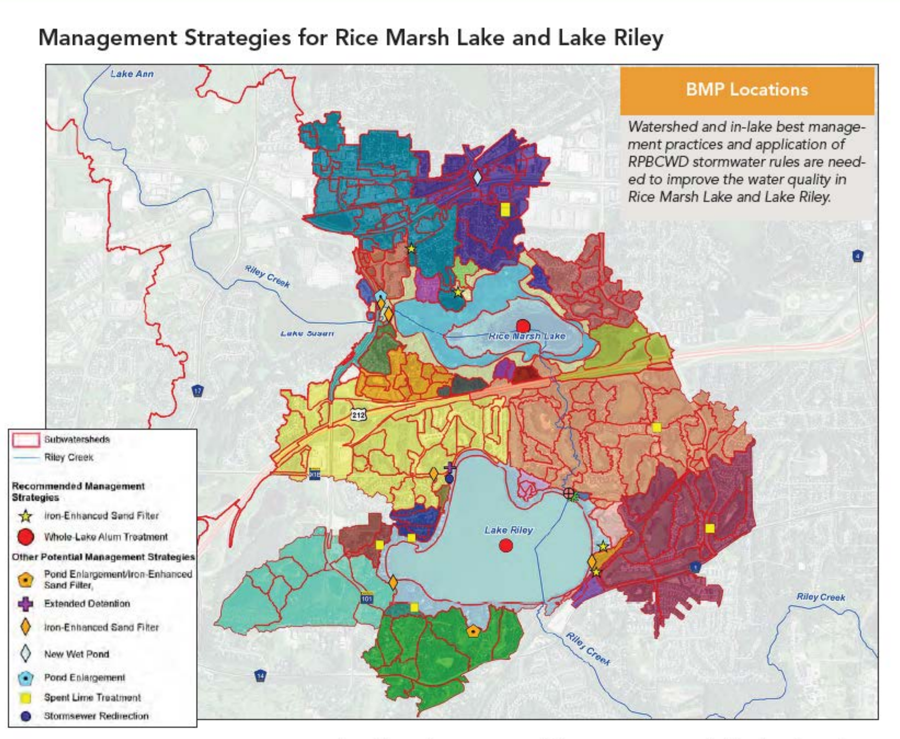
Researching solutions

Once there is a clear understanding of the health of a waterbody, a management decision needs to be made. Sometimes, the path forward is clear. Other times, there may not be an easy solution. Investing in research to discover and test new solutions to clean water problems has helped the District advance its understanding and implement projects to protect clean water and healthy habitat.



Numerous management strategies were evaluated based on phosphorus removal effectiveness, improvements to lake water quality and habitat, cost, and feasibility. The following management strategies are recommended:

- Apply RPBCWD stormwater rules as development or redevelopment occurs within the watershed, reducing the stormwater volume and pollutant loading to the lakes.
- Improve water quality of upstream Lake Susan to meet MPCA shallow-lake standards.
- Improve the water quality in Rice Marsh Lake, which is essential for achieving MPCA deep-lake standards in Lake Riley.
- Construct stormwater BMPs, such as iron-enhanced sand filtration, to remove soluble phosphorus from significant stormwater inflow locations.
- Conduct alum treatments of both Rice Marsh Lake and Lake Riley to control internal loading.
- Continue winter aeration in Rice Marsh Lake to promote a healthy bluegill population that can limit successful carp reproduction.
- Continue targeted herbicide treatments in Lake Riley to control invasive curlyleaf pondweed and Eurasian watermilfoil.

The figure on page 4 compares the improvements in water quality of Rice Marsh Lake and Lake Riley, respectively, through implementation of the evaluated management strategies.

Rice Marsh Lake and Lake Riley Use Attainability Analysis Update | Executive Summary 3

Use attainability analyses

A Use Attainability Analysis (UAAs) is a study that uses an outcome-based evaluation and planning process to obtain or maintain water quality conditions and achieve beneficial uses in a water body, such as swimming, fishing, or wildlife habitat. UAAs include a water quality analysis to identify sources of pollution. Then, the study identifies possible remedial measures for the lakes and their respective watersheds to protect and restore their health based on historical water quality data, the results of intensive lake water quality monitoring, and computer simulations of land use impacts on water quality. The District initiated the first round of UAAs as part of its 1996 water management plan. The studies were updated roughly 10 years later to incorporate additional monitoring data, improved understanding of the resources, emerging treatment technologies, and changing climate conditions. These studies form much of the foundation for the projects included in the District's 10 Year Watershed Management Plan[24].

A figure from the 2016 Rice Marsh Lake & Lake Riley UAA update

Carp questions

Originally introduced as game fish, common carp reduce water quality, uproot native vegetation, stir up silt, disturb the spawning areas of native fish, and produce enough excess waste that it contributes to algal blooms[16]. In the early 2000s, the District began working with University of Minnesota researchers Peter Sorensen and Prezemek Bajer to study carp populations in District lakes. The goals of the studies were to better understand carp behavior and use that information to improve control strategies.

These researchers were the first to use a method known as "Judas Tagging" (electronic monitoring tags) to monitor the carp's winter habits, and discovered that the fish will often congregate in certain areas of a lake. This makes winter netting and removing of carp a highly efficient management option[17].

Work began in the Riley Creek Chain of lakes (Ann, Lucy, Rice Marsh, Riley, Susan). In 2007, almost half of all fish in Lake Susan were carp[18], and that winter the researchers were able to remove 78% of them - approximately 20,000 pounds[19]. The impact water quality was notable. In May of 2009, the water clarity was 15ft, a 6ft increase from the previous year. In fact, the results were too good; the increased clarity allowed more light into the lake, but because native vegetation destroyed by the carp hadn't yet recovered, as the summer progressed there were massive algae blooms. Professor Ray Newman started a project in July of that year to reintroduce native vegetation. By November, the native vegetation had taken hold, and in some places coverage increased from 5% to 60%[20].


PHOTO BY FORREST ADAMS
University of Minnesota Professor Peter Sorenson records data as members of his research team count and box carp on Tuesday afternoon on Lake Riley. Prior to the catch, Sorenson guessed there would be so many carp that teams would be working into the night and even on Wednesday morning to sort through them all.

Above & Lower Left: 2009 Articles on Carp Research (EPN)

A commercial fishing team scoops a load of common carp from Lake Riley as part of the University of Minnesota research led by Professor Peter Sorensen.

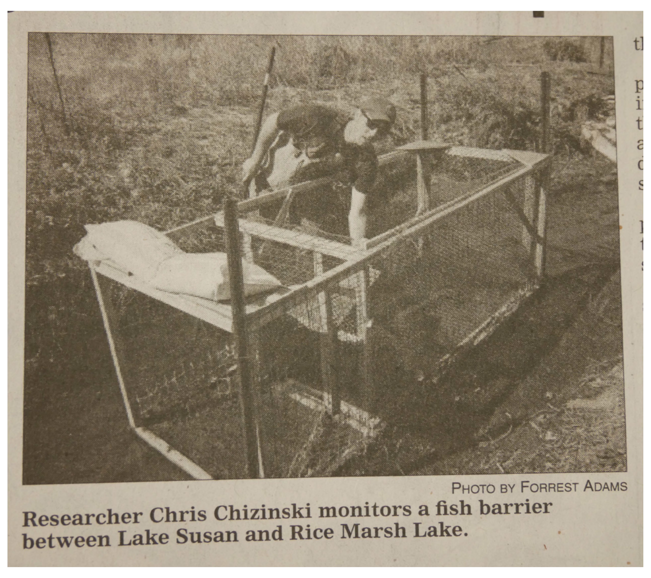


PHOTO BY FORREST ADAMS
Researcher Chris Chizinski monitors a fish barrier between Lake Susan and Rice Marsh Lake.

By 2010, 80% of the carp in lakes Ann, Lucy, Rice Marsh, Riley and Susan was removed[21]. Similar research was also conducted in the Purgatory Creek lakes. Though the study has ended, the District continues to manage carp populations by tag monitoring, summer electro-fishing and winter seining activities. The District also stocks bluegill, which eat carp eggs, into some lakes for carp control, and operates an aeration unit on Rice Marsh Lake to keep the bluegill population thriving during the winter. The reduced number of carp has also made it possible to implement other water quality improvement projects, such as alum treatments and native plant reintroduction.

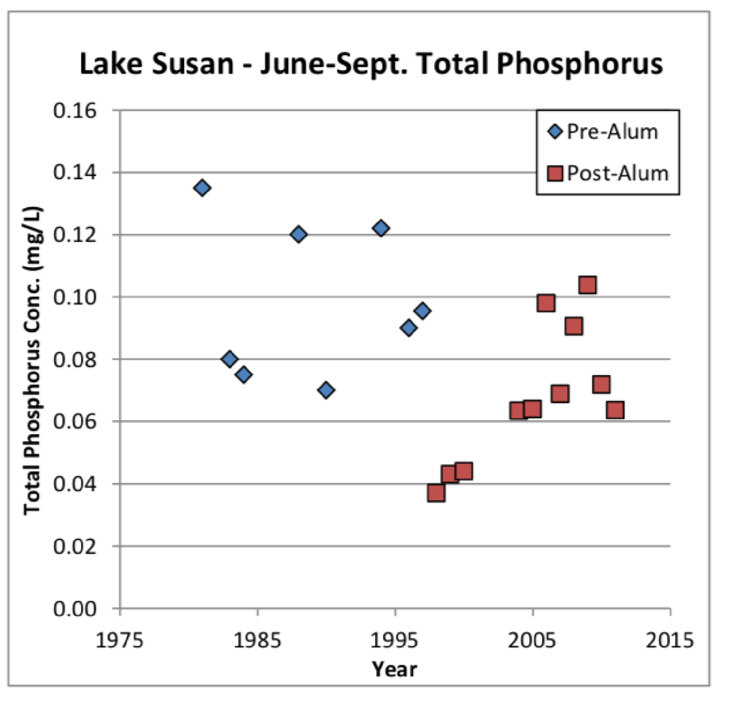
An alum attempt

On Lake Susan, the District initiated its first alum treatment for phosphorus control in 1998.

Alum is short for Aluminum Sulphate (Al2[SO4]3 n H2O), a non-toxic compound "commonly used in water treatment plants to help clarify drinking water"[14]. When it comes in contact with the water, it becomes Aluminum Hydroxide (Al2[OH]3), which is able to bind to phosphorus. Alum sinks to the bottom of the lake and traps phosphorus in the sediment , preventing it from being released into the water or used to feed algae blooms.

Although phosphorus levels decreased in Lake Susan for 3 years, the treatment did not create a lasting difference as expected[12]. It was later determined that these results were due to under-application. Even though the results were not what the District had hoped for, they were helpful. The treatment on Lake Susan helped the District to better estimate how much Alum is required for a lake. The results have also been used in studies comparing alum treatments in different lakes around the world[13] so that the scientific community can better understand and apply this strategy of phosphorus management.

Year	June-Sept Ave. TP (mg/L)	n
1981	0.135	--
1983	0.080	--
1984	0.075	--
1988	0.120	--
1990	0.070	--
1994	0.122	4
1996	0.090	--
1997	0.095	7
1998	0.037	7
1999	0.043	5
2000	0.044	5
2004	0.064	6
2005	0.064	8
2006	0.098	3
2007	0.069	8
2008	0.091	13
2009	0.104	13
2010	0.072	12
2011	0.064	9



Note: Years 1983, 1984, 1988, 1990, & 1996 were estimated from figure in "Lake Susan Evaluation for 2000"

Phosphorus levels in Lake Susan before and after alum treatment. There was a large decrease for the first three years after the treatment, but levels have increased since.

Far left: a service learning student volunteer helps District staff monitor carp populations. The electro-fishing boat they are on sends shocks into water, stunning the fish. When they float to the top, staff net and measure them.

Near left: another service learner helps track tagged carp under the winter ice in the Purgatory Creek Recreation Area in Eden Prairie.

Working together for Round Lake

Improving Round Lake's water quality was of increasing concern after the District's 1999 Use Attainability Analysis (UAA) report that showed phosphorus levels were up 50% and water clarity was down 50% since 1972[3]. The problems came from the increased urban stormwater runoff, and excessive geese waste that fostered unhealthy bacteria and algal blooms.

During a beach closure from 2000 to 2001, Eden Prairie installed a "beach curtain" to prevent algae from reaching the swimming area, and a 4-ft tall fence on shore to keep geese out of the park area. At the request of the City, the District oversaw Greener Pastures Development Cooperation's treatment of Round Lake and nine stormwater ponds with an experimental microorganism-based treatment for algae[4], but it wasn't as effective as hoped. Following this, the lake was closed from 2004 to 2007[5].

In 2002, Eden Prairie petitioned the District to start a stormwater pond project that would reduce the amount of phosphorus flowing into the lake by about 18-25%[6]. The project involved improving three existing stormwater ponds and creating one new one, and was completed in 2010[7]. Eden Prairie followed up this project with an Alum treatment in 2012[8] to blanket the bottom of the lake and prevent phosphorus in the bottom sediment from being released back into the water. These many efforts work together, and water quality in Round Lake has begun to improve.

CITY WORKERS BRING in the diving platform at Round Lake Beach last week. The water was closed to swimming due to high levels of fecal coliform in the water. (Photos by Cameron Potts)

Above: a 1997 article about beach closures due to fecal coliform (EPN)

Right: a highlight from the 2001 watershed district annual tour (EPN)

Donning bathing suits, Mayor Phil Young (left) and his son Patrick take a dip in the waters of Round Lake during its grand reopening party Saturday.

Children hula-hoop during the festivities.

Round Lake's beach was dotted with sandcastles Saturday. Here, four youngsters share sand toys.

Left & above: excerpts from an article on the re-opening of Round Lake in 2007 (EPN)

Evolving management in Hyland Lake

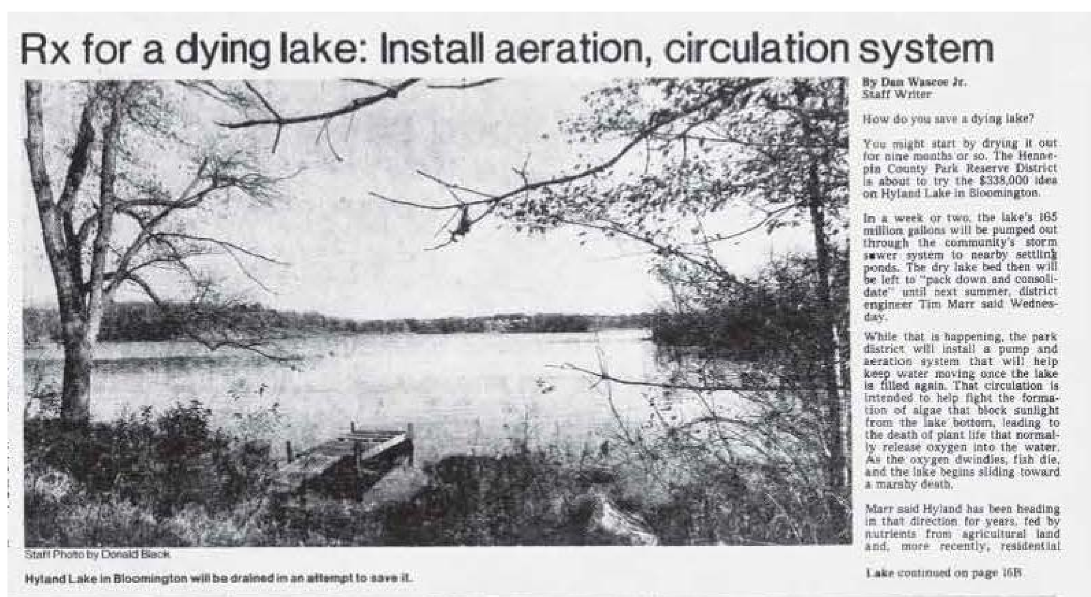
In 1975, the District completed a four year water quality study for Hyland lake, focused on finding solutions to persistent poor water quality conditions. In 1977, the District partnered with the Hennepin County Park Reserve District to initiate the Hyland Lake Restoration Project. The project consisted of four main components, with the goal of restoring the eutrophic lake to allow for recreational use and game fishing[1].

The first component was an outlet from Hyland Lake to Colorado Pond to the Southwest, in order to control the water level in the pond. The second component was an aeration and recirculation system to help fish survive winter low-oxygen conditions.

The third part of the plan involved draining the lake to remove the poor quality water and allow phosphorus in the sediment to oxidize, before refilling the lake from a well. Groundwater is known to be low in nutrients, allowing for clear water, and so to maintain the water quality, the initial plan accounted for pumping over 100,000,000 gallons (about 2/3 of the lake volume) from the well into the lake each year[2] (this process has been discontinued). To help deal with excess water from this filling process, a groundwater recharge basin (overflow pond) was created at the western edge[1].

Though draining and refilling lakes to reduce phosphorus is still done today, it is usually only used in extreme circumstances. The annual refilling of a lake from groundwater aquifers is not considered a sustainable solution, and shows an evolution in thinking about lake management.

Finally, the district created a stormwater pond on the northern edge of Hyland Lake[1]. In 1977, when the project was being completed, stormwater ponds were a new strategy and considered experimental - it wasn't until 1981 that a federal study confirmed their effectiveness. Today, they are considered a key tool for watershed management.


Rx for a dying lake: Install aeration, circulation system

By Dan Wascoe Jr.
Staff Writer

How do you save a dying lake?

You might start by drying it out for nine months or so. The Hennepin County Park Reserve District is about to try the $338,000 idea on Hyland Lake in Bloomington.

In a week or two, the lake's 165 million gallons will be pumped out through the community's storm sewer system to nearby settling ponds. The dry lake bed then will be left to "pack down and consolidate" until next summer, district engineer Tim Marr said Wednesday.

While that is happening, the park district will install a pump and aeration system that will help keep water moving once the lake is filled again. That circulation is intended to help fight the formation of algae that block sunlight from the lake bottom, leading to the death of plant life that normally release oxygen into the water. As the oxygen dwindles, fish die, and the lake begins sliding toward a marshy death.

Marr said Hyland has been heading in that direction for years, fed by nutrients from agricultural land and, more recently, residential

Staff Photo by Donald Black

Hyland Lake in Bloomington will be drained in an attempt to save it.

Lake continued on page 16B

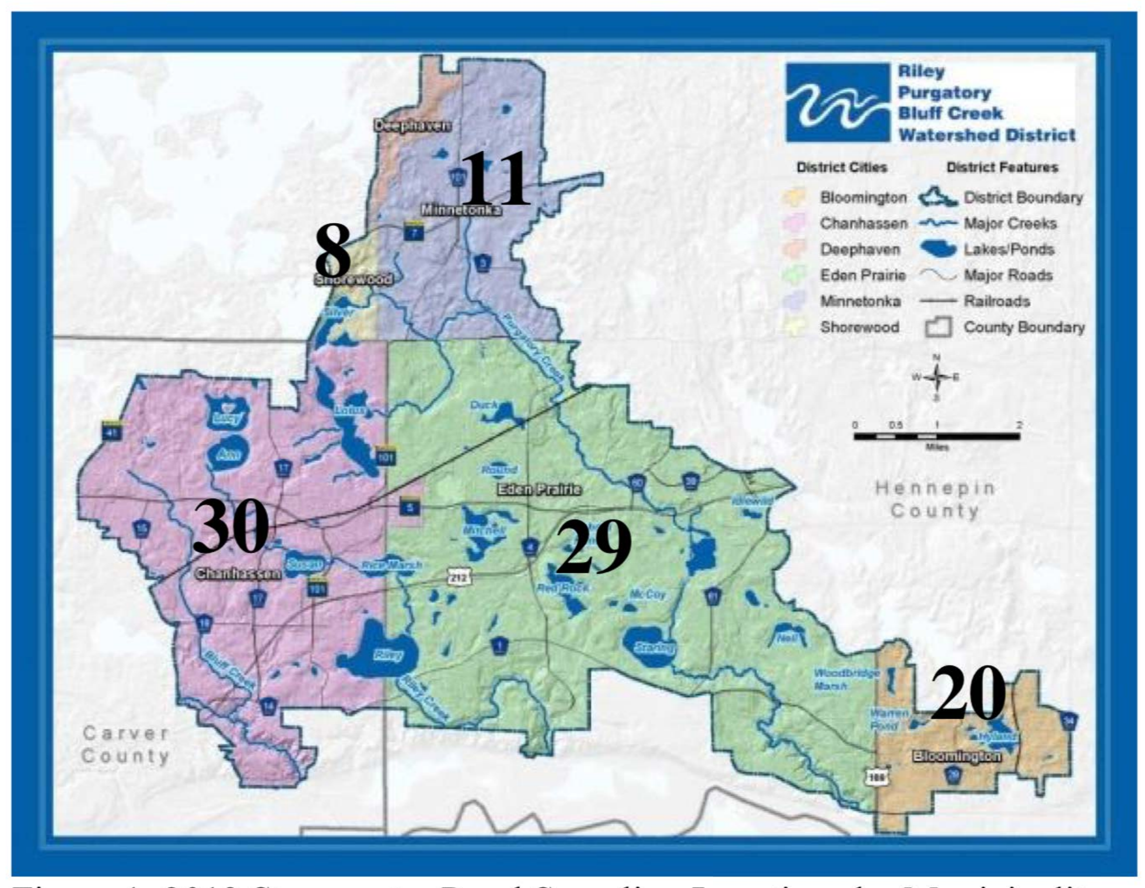


Figure 1. 2013 Stormwater Pond Sampling Locations by Municipality

Understanding stormwater ponds

Stormwater ponds are an important tool for watershed health, and have been the primary strategy to control stormwater runoff since the Nationwide Urban Runoff Program's report in 1983[9]. They help control flow rate, preventing large fluctuations in water levels, and settle pollutants out of stormwater before it reaches the lakes and streams. But not all stormwater ponds are created equal; some are very efficient, others may actually make problems worse[10].

Despite their importance, there is little understanding of what makes an individual stormwater pond successful or not. In 2010, the District began a long-term monitoring study of local stormwater ponds[11], and is currently a partner in four different studies of stormwater ponds. The collected data has been requested worldwide for various research[10].

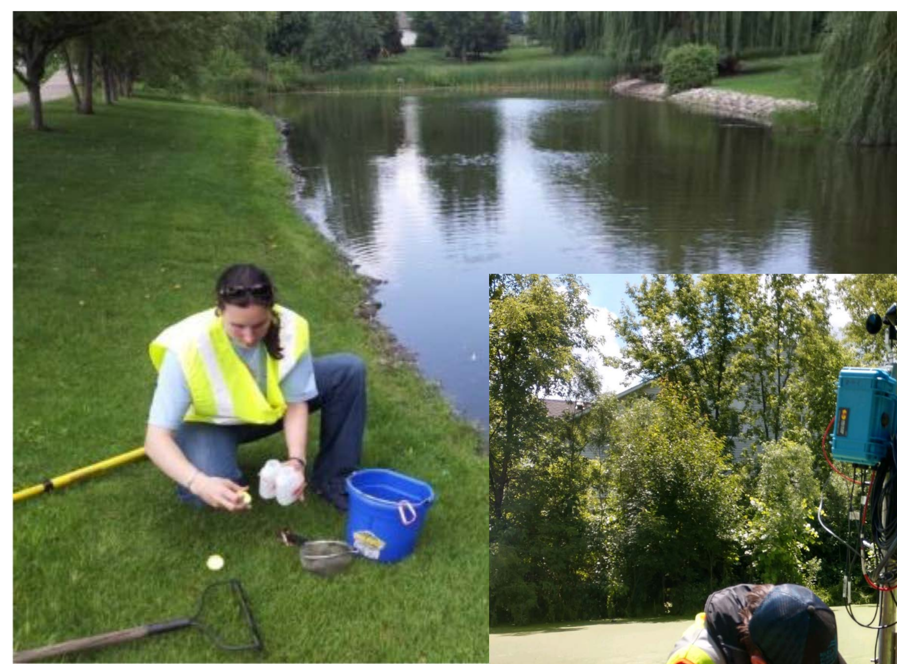
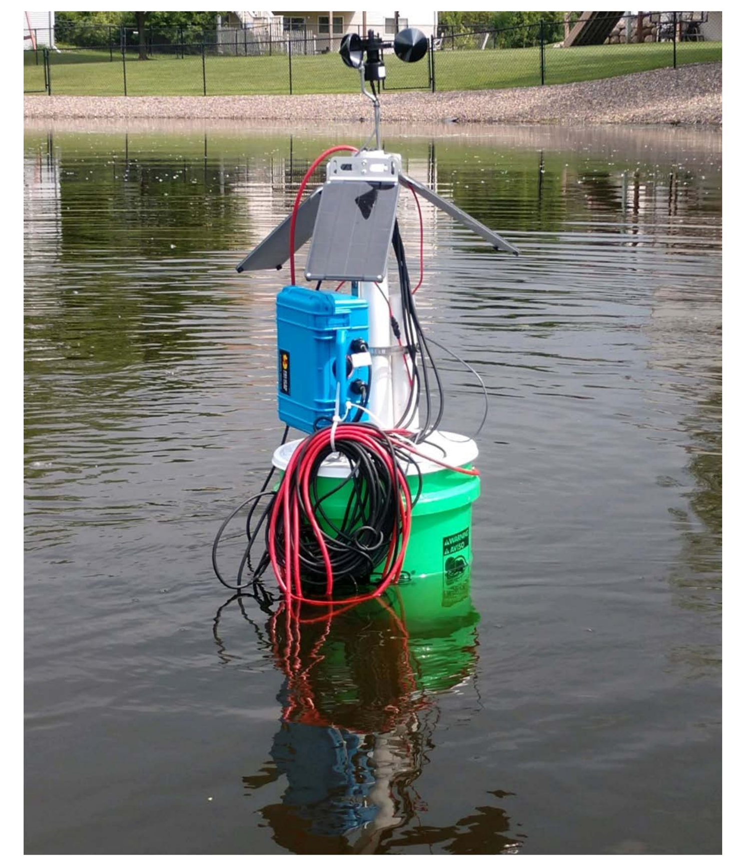


Figure 5. Filtering the water samp

Right: equipment being used in the current stormwater pond study. Enviro DIY equipment is allowing the District and its partners to sample more ponds and more parameters than they would be able to with conventional equipment.



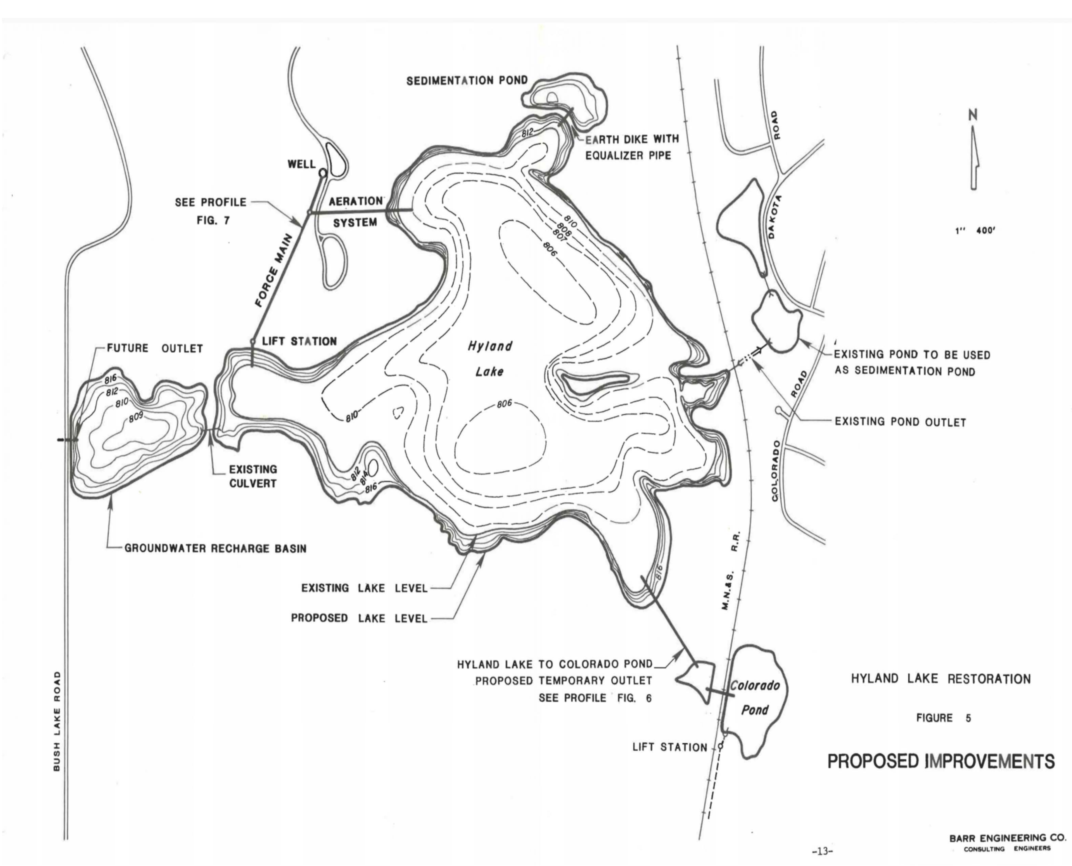
Top: map of the number of stormwater ponds tested in 2013 as a part of the District's pond study

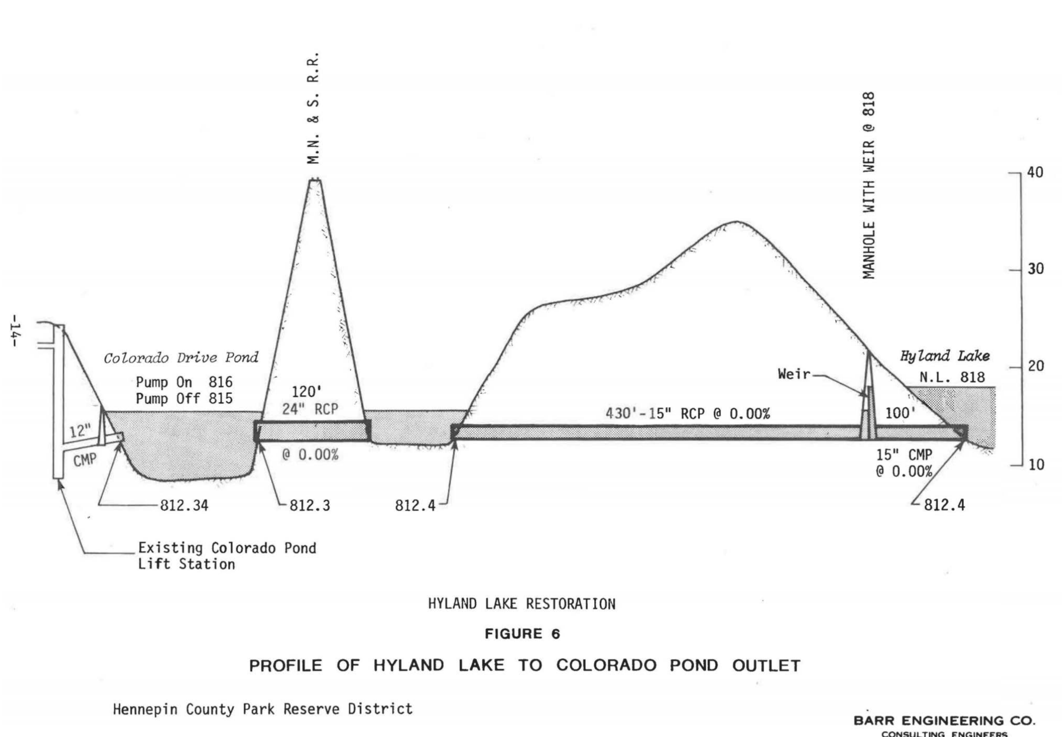
Bottom: staff member collecting samples

Left: District staff install Enviro DIY stormwater monitoring equipment

Left, Top: 1977 Star Tribune article on Hyland Lake Restoration (HCHM)

Left, Center & Bottom: Engineering Blueprints for Hyland Lake Project (Barr)





Recycling stormwater & lime

In 2013, the District partnered with the City of Chanhassen on a water quality and conservation project at Lake Susan. The project included two components: phosphorus removal and stormwater reuse. For the phosphorus removal component, a new method was chosen: spent lime.

When phosphorus in the water comes into contact with the lime (which is left over from drinking water treatment) it binds to it and is filtered out[22]. Spent Lime is a promising but relatively new strategy, and this is the first time the District has used it. The facility was completed in 2018. The District has been conducting tests on the lime and facility as a whole in order to best understand and fine-tune this new technology.

The partnership also included a water reuse system at Lake Susan Park Pond. The city pumps water from the pond to irrigate their baseball fields[22]. When the pump is not being used for irrigation, it instead diverts to a newly built iron-sand filtration system to remove excess phosphorus. Water is filtered through sand mixed with iron filings. The sand filters out phosphorus particulates, and when the iron rusts it removes dissolved phosphorus[23].

Left: the spent lime system, soon after installation

Above, top: spent lime

Above, bottom: District staff member tests filtration efficiency of different combinations of spent lime and sand

Aquatic invasive species

One of the District's most persistent concerns is the management of invasive species. Two of these species are eurasian watermilfoil and curlyleaf pondweed, both of which are aquatic plants that have a tendency to out-compete native counterparts and decrease lake health and recreation opportunities.

From 2015 to 2017, the District partnered with Dr. Ray Newman of the University of Minnesota to study a variety of treatment methods on Lakes Susan, Staring and Riley to find which are the most effective at managing invasive plants while allowing native vegetation to take root and thrive for long term control[15].

Left: curlyleaf pondweed growing in a District lake

Top right: Eurasian watermilfoil

Bottom right: Eurasian watermilfoil relative abundance in Lake Riley, 2017.

Far right: response of curlyleaf pondweed to treatment

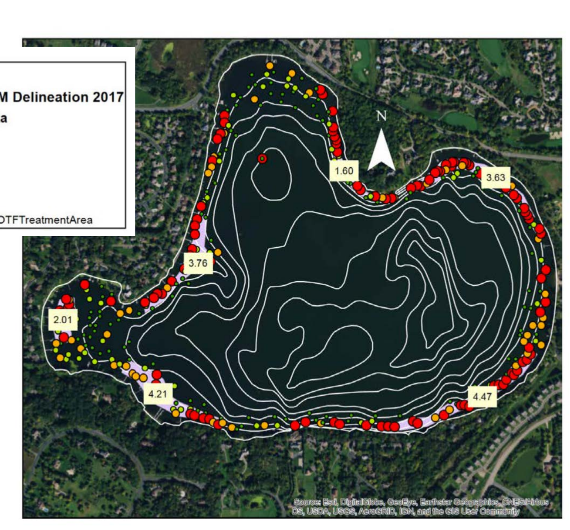


Figure 19. Eurasian watermilfoil June 2017 relative abundance and delineated treatment block (purple) with acreage in yellow boxes. The three plots on the east were treated with Renovate OTF and the three in the west with Sculpin G.

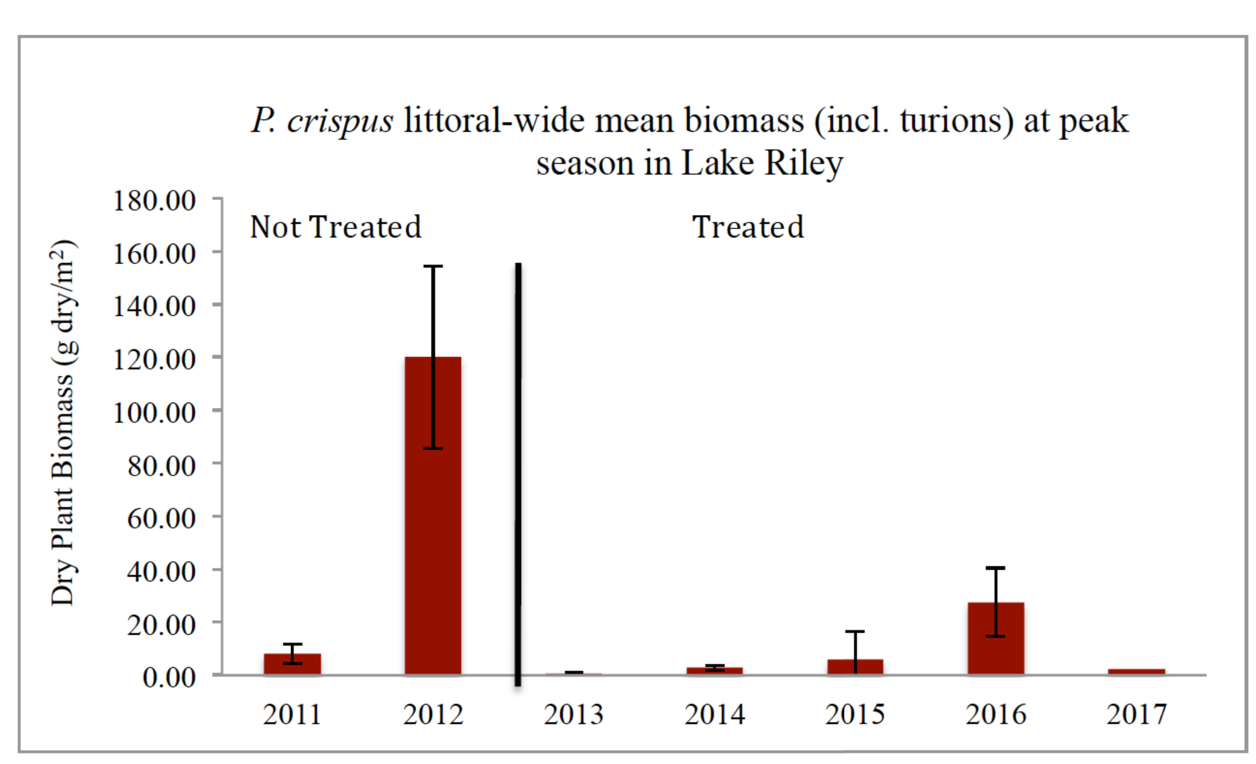


Figure 21. Peak biomass (g dry/m^2) of curlyleaf pondweed in Lake Riley. The vertical line represents the beginning of herbicide treatments and divides pre- and post- treatment years. Post-treatment declines are significant ($p \leq 0.05$).