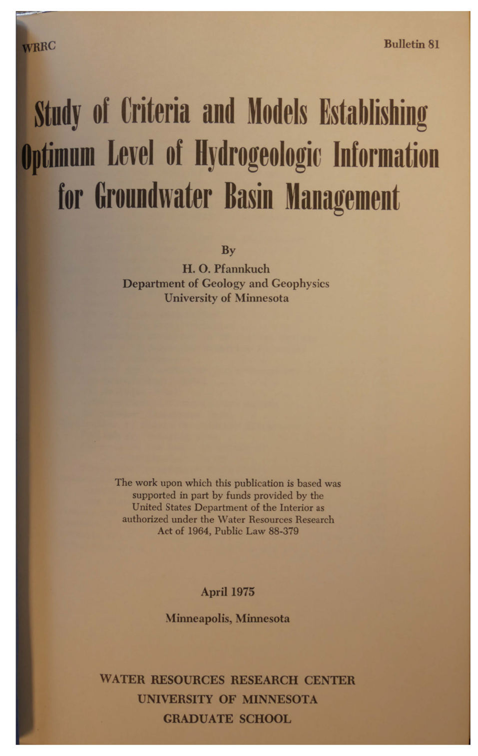
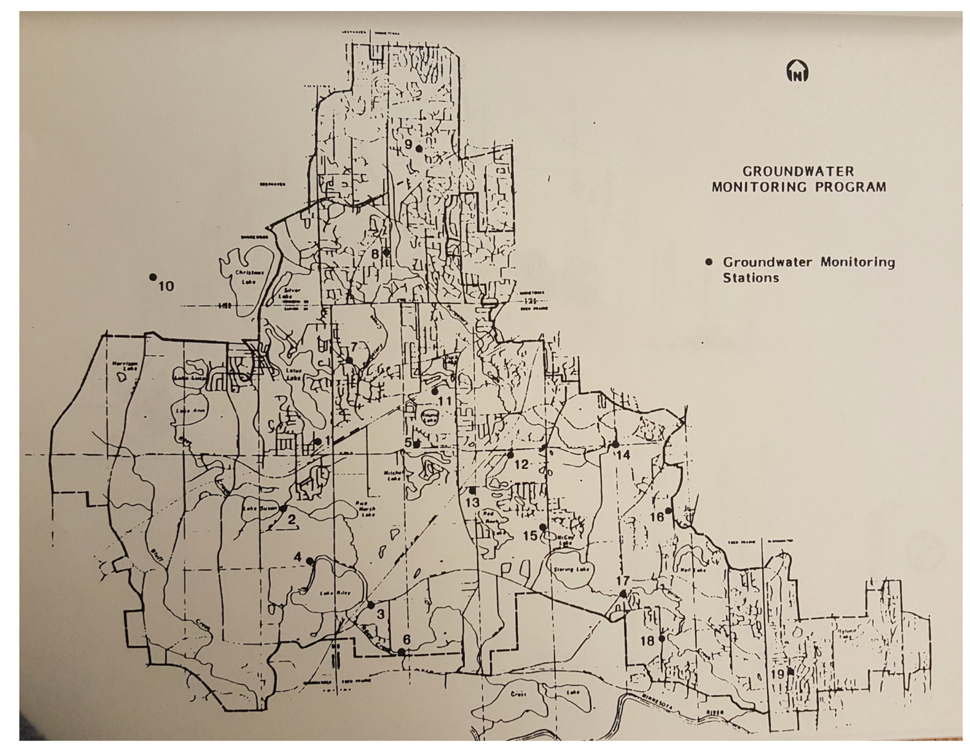
Learning from the resource

The first step in protecting and restoring water resources is to understand both their current conditions and trends over time. Throughout its history, the watershed district has employed a suite of methods and technologies to learn from and better understand the health of the waters in our community.

Groundwater monitoring

Dr. Hans-Olaf Pfannkuck was a hydrogeology professor at the University of Minnesota and a pioneer in the field of watershed management and groundwater-surface water interactions. In 1969, the first District management board agreed to work with him to install and oversee 18 wells to monitor groundwater as part of a larger study he was conducting on groundwater management. During this period, Dr. Pfannkuch also developed a Stream Stability Assessment that is a key piece of the District's own Creek Restoration Action Strategy developed in 2015.





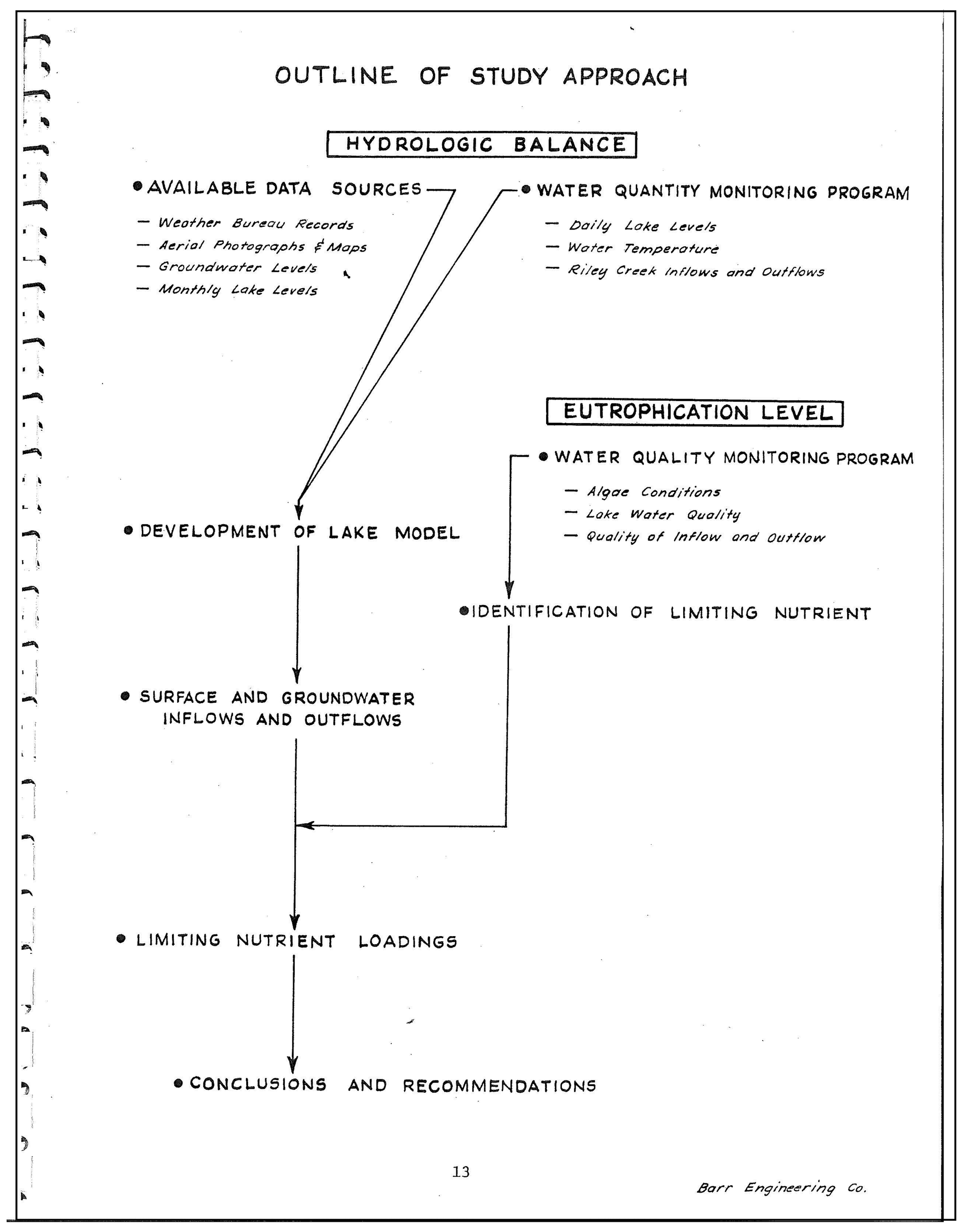
An in-depth look

In 1970, the Watershed District ordered it's first in-depth lake study on Lake Riley. The project was completed in 3 phases, lasting until 1985, and included history, current lake status, and recommendations for improvement.

The study first looked at eutrophication levels (how nutrient rich the lake is), where these nutrients were coming from, and which was the primary culprit in algae growth (phosphorus or nitrogen). It found that phosphorus was the limiting nutrient for algae growth, and therefore the best to target for controlling it. The study also found that about half the phosphorus in Lake Riley was from outside the lake, mostly entering through Riley Creek during spring thaws.[1]

The study concluded that watershed management (land use, non-point source pollution, regulation), in-lake sediment treatment, physical changes (invasive plant removal, habitat restoration), chemical controls, biological manipulation (predator-prey ratios, pathological restrictions) and aeration were the most viable strategies for Lake Riley. Dredging out phosphorus-laden sediment in Rice Marsh Lake was also considered a possible solution.[1]

Since this study was published, the District has applied many of these strategies, including managing runoff, managing carp, stocking for a healthy fish community, improving outlets to control water quality and flow, and implementing chemical treatments to manage phosphorus in the lake.

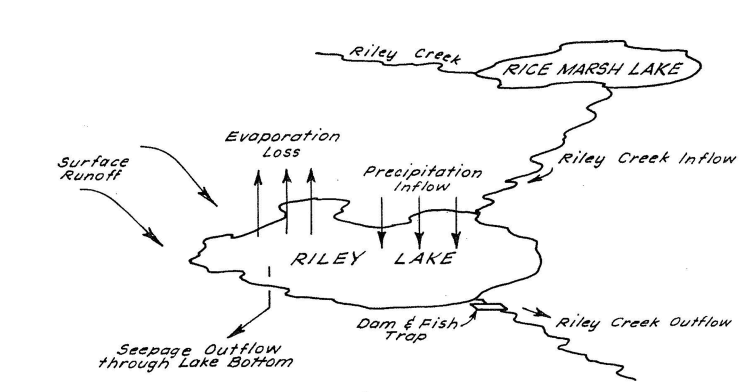


Lake Outflow Quantity - Lake outflow was measured by calibrating the discharge characteristics of the outflow dam, placing a staff gage upstream of the dam, and recording the elevation of the water surface with the staff gage. Mr. Daly also read the staff gage thereby providing additional information to the study.

Water Temperature - Lake water temperature was also measured by Mr. Daly during a portion of the summer of 1971. During 1972, water temperature was approximated using air temperature/water temperature relationships developed on other lakes in this area.

DEVELOPMENT OF THE LAKE MODEL

The hydrologic model of Lake Riley was developed by applying basic continuity to the lake isolated as a free body. Due to the condition of the data, the model was based on a monthly time interval. The figure below illustrates the various components of the lake model.



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Above: Excerpts from the early Lake Riley study, showing the approach to understanding the dynamics of the lake.
Left: an aerial photo of the portion of the eastern portion of Lake Riley in 1971 (MHAPO)

The beginning of long-term data

When monitoring a water resource, it is important to collect data over time in order to track how the healthy of the resource changes. This type of data is the basis for almost all management decisions by helping scientists understand what is going wrong so they can find out why and how to fix it.

Most data records for the District begin in 1972, and the 1975 Lake Water Quality Report was the first time the District was able to analyze trends in water quality, and how the community and the water interact.

TABLE 1
RILEY-PURGATORY CREEK WATERSHED DISTRICT
Yearly Means - 1975 and 1971-1972 Water Quality Data

Lake	Mean Depth (feet)	Year Sampled	Mean Chlorophyll (mg/m³)	Mean Secchi Disc (feet)	Mean Total Phosphorus (µg/l)	Net Change in Water Quality
Ann	18.7	1972 1975	21 15	5.6 4.9	42 40	Slight Improve.
Duck	4.9	1971 1975	113 80	1.6 1.2	159 134	No Significant Change
Hyland	6.6	1971 1975	129 95	1.3 1.0	129 169	No Significant Change
Lotus	16.1	1972 1975	60 49	3.6 2.6	65 62	Slight Decrease
Lucy	7.5	1972 1975	40 33	4.3 4.3	82 67	No Significant Change
Mitchell	4.6	1972 1975	68 56	2.3 4.3	145 157	Slight Improve.
Red Rock	8.9	1972 1975	50.9 59	3.3 3.9	66 98	Slight Decrease
Rice-Marsh	6.6	1972 1975	183 132	0.7 0.8	686 518	No Significant Change
Riley	23.0	1971 1975	28 36	3.8 4.0	73 93	Slight Decrease
Round	13.1	1972 1975	6 15	15.8 7.5	25 66	Decrease
Staring	7.9	1971 1975	34 57	2.6 1.1	69 94	Slight Decrease
Susan	11.5	1971 1975	72 97	3.3 2.1	134 150	Slight Decrease

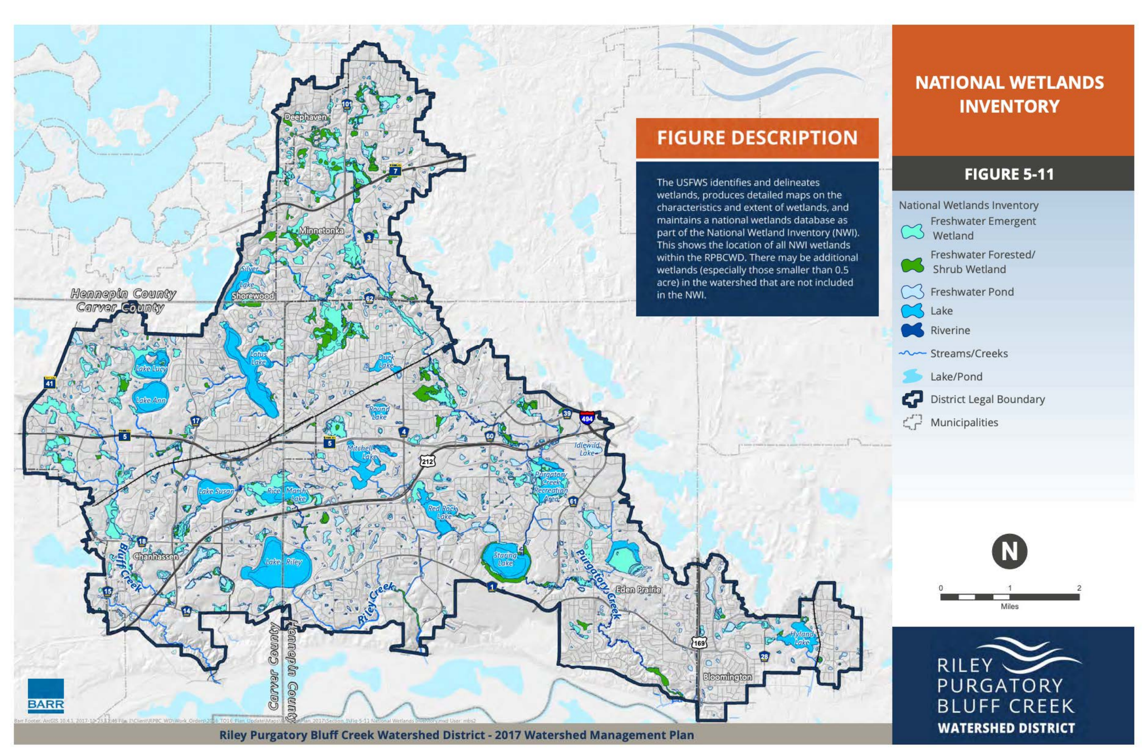
D-4

Inventorying wetlands

Wetlands are critical ecological and community assets. They provide significant wildlife habitat and refuge, while also supplying aesthetic, recreational, and water quality treatment benefits.

In the 1970s, the Department of Natural Resources (DNR) conducted an inventory of wetlands in the Metropolitan region via aerial photographs to better understand their extent. In 1977, the District agreed to partner with the DNR, and paid $840 to support the project in return for copies of the report concerning RPBCWD areas.

In 2018, the District began the process of updating and deepening this understanding through an inventory of all the wetland area within its boundaries. The inventory involves on-the ground assessments of local wetlands including hydrology, geomorphology, soil analysis, cultural significance, water quality benefits, habitat benefits, and plant communities. This inventory will give the District a better understanding of the health and extent of local wetlands. It will also lay the foundation for improving the protection of the remaining wetlands as well as the restoration of drained, filled, or otherwise degraded wetlands.



AGREEMENT

THIS AGREEMENT is made this 6 day of July, 1977, by and between the STATE OF MINNESOTA, acting by and through the Commissioner of Natural Resources, hereinafter referred to as the "State," and the RILEY PURGATORY CREEK WATERSHED DISTRICT, hereinafter referred to as the "District."

WHEREAS, the State has contracted with the University of Minnesota for the latter to undertake a color infrared aerial photographic survey and analysis of twin cities metropolitan area wetlands described in the project proposal attached as Exhibit 1.

WHEREAS, the project will survey and identify the types of wetlands within the district which provide significant wildlife, recreational and aesthetic opportunities. These wetland areas, located in the heart of a fully developed urban area, are important to the District's water management programs since they provide temporary storage of surface waters which run off from the watershed. The District and DNR have as an objective the protection of the water storage capabilities and wildlife habitat of such wetland areas, and the overall water and related land management plans for the District will be affected by the actions of DNR in adopting or permitting uses inconsistent with the District's overall plan objectives for the protection, maintenance and enhancement of floodplain and wetland areas of the District.

THEREFORE, IT IS AGREED BETWEEN THE PARTIES HERETO:

I.

The State agrees that it will cause to be submitted to the District one set of 1:24,000 overlays (which can be used with 7-1/2' USGS quad base or photo maps), that cover the area of the District. Each overlay will include an identifying title block, located and annotated wetlands, and an area

summary by wetland type. Any final report explaining methodology used will also be furnished.

II.

In consideration for the materials supplied by the State, the District shall assume and be responsible for the payment of an amount not to exceed $840.00, which will be due within 30 days after the delivery of the overlays to the District. This payment by the District is based upon the total land area to be surveyed at an estimated cost for the entire metropolitan project of $40,000.00.

III.

This Agreement shall be binding on the parties through the period required to complete the study or July 1, 1977, whichever date first occurs. Additional commitments or time extensions shall require a new agreement.

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the date first above written.

STATE OF MINNESOTA
DEPARTMENT OF
NATURAL RESOURCES

BY [signature]

RILEY PURGATORY CREEK WATERSHED
DISTRICT

BY Conrad [signature]
ITS Secretary
BY Donald F [signature]
ITS President

APPROVED AS TO FORM AND EXECUTION

WARREN SPANNAUS
Attorney General

[signature]
Special Assistant Attorney General

Above: a 1977 agreement between the District and the MN DNR to support the DNR's wetland assessment work
Left, top: wetland inventory map
Left, bottom: District staff collecting wetland data

Water monitoring

The District understands that data collection and decisions based on sound science are critical to protecting, managing, and restoring water resources. Because of the dynamic and the ever-changing nature of water resources, the District operates an extensive lake and stream management program.

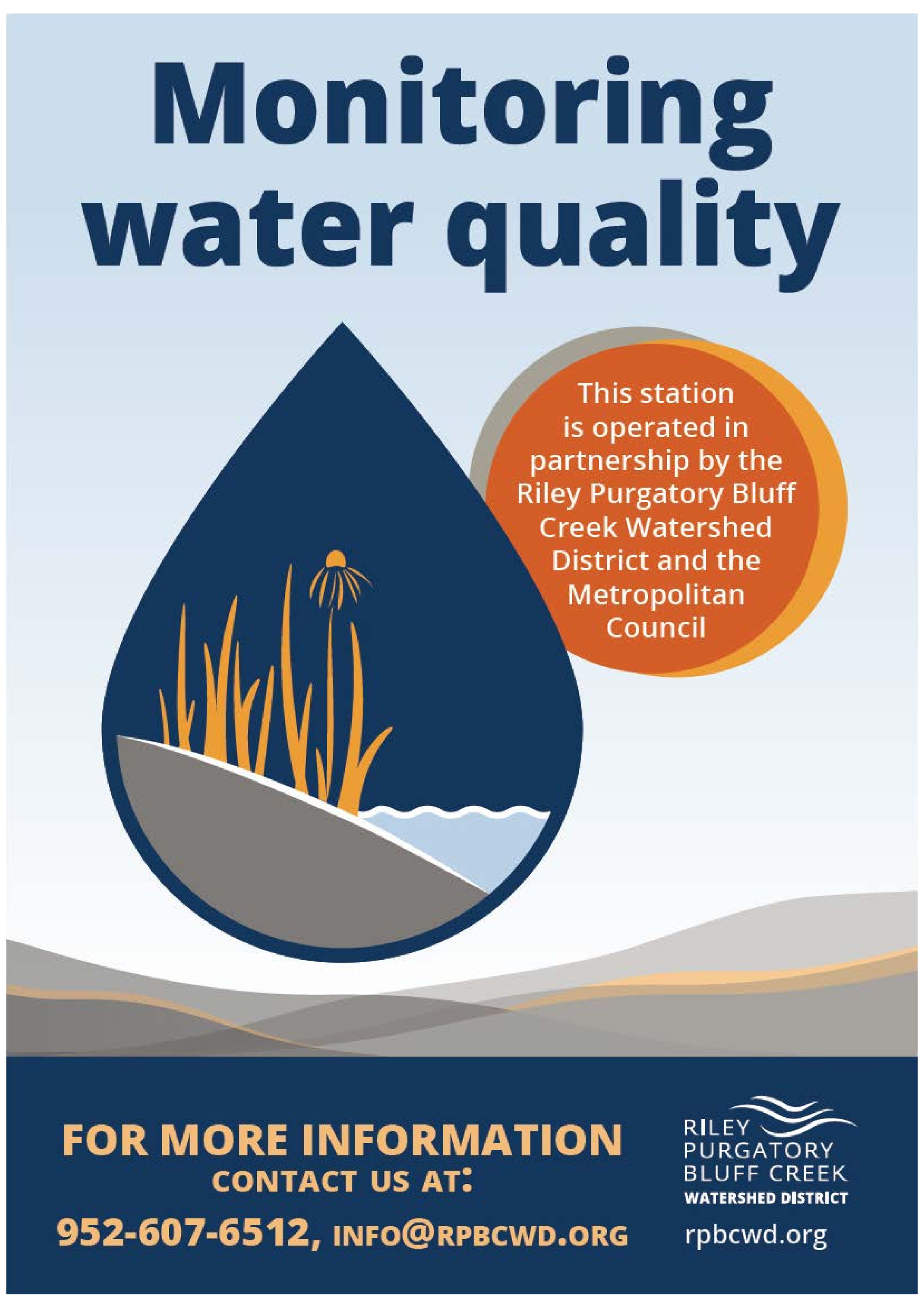
Data is collected year-round on lakes, streams, wetlands, and ponds. This work requires a coordinated effort with city partners and other regional partners. Volunteers also contribute to this work, through service learning internships at the District, as well as through other programs like the Metropolitan Council's Citizen Assisted Monitoring Program, supported by local cities, and the county's Wetland Health Evaluation Program.

A student service learner from the University of Minnesota helps collect winter lake monitoring data in 2018. These student volunteers have been an important part of the District team since 2013, helping to increase the District's capacity to do its work.

Continuous collection

Partnership and coordination are an important part of water resource management. The Watershed Outfall Monitoring Program is administered by the Metropolitan Council.

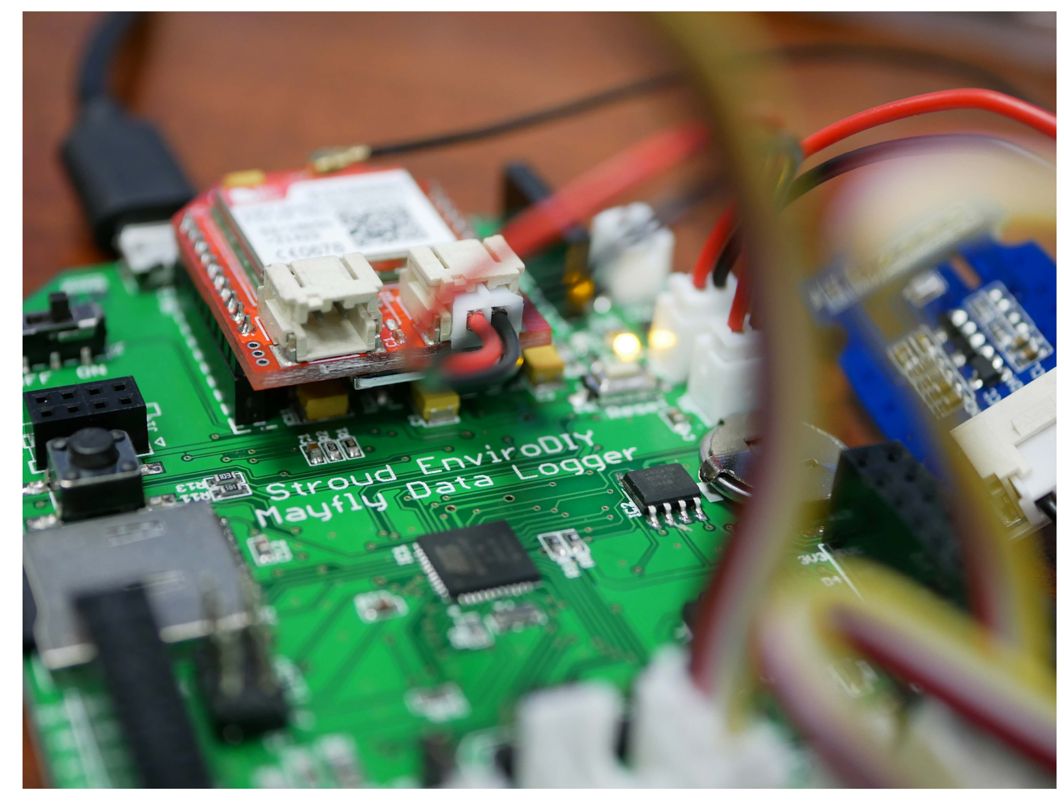
These stations continuously monitor flow and the concentrations of pollutants such as phosphorous and sediment near the outlet of each creek. The work is part of the Metropolitan Council's long-term monitoring program which identifies pollutant loads entering the Minnesota River.



Increasing capacity with DIY technology

The amount of data that can be collected is often limited by cost. Conventional monitoring equipment can be very expensive. In 2018 the District began working with the company LimnoTech to implement EnviroDIY technology into everyday District water monitoring and data collection.

Using open-source code and inexpensive components in the "Do It Yourself" tradition, these stations are a reliable, cost-efficient alternative to monitoring stations used by the District in the past. Not only is there the added benefit of staff being able to edit and troubleshoot sensor/station programming on their own, but these stations are set up to allow for staff, and eventually the public, to access and review real-time data remotely. Additionally, staff can deploy these for Education and Outreach Programming, so kids can instantly compare water quality they collected with the logger data.



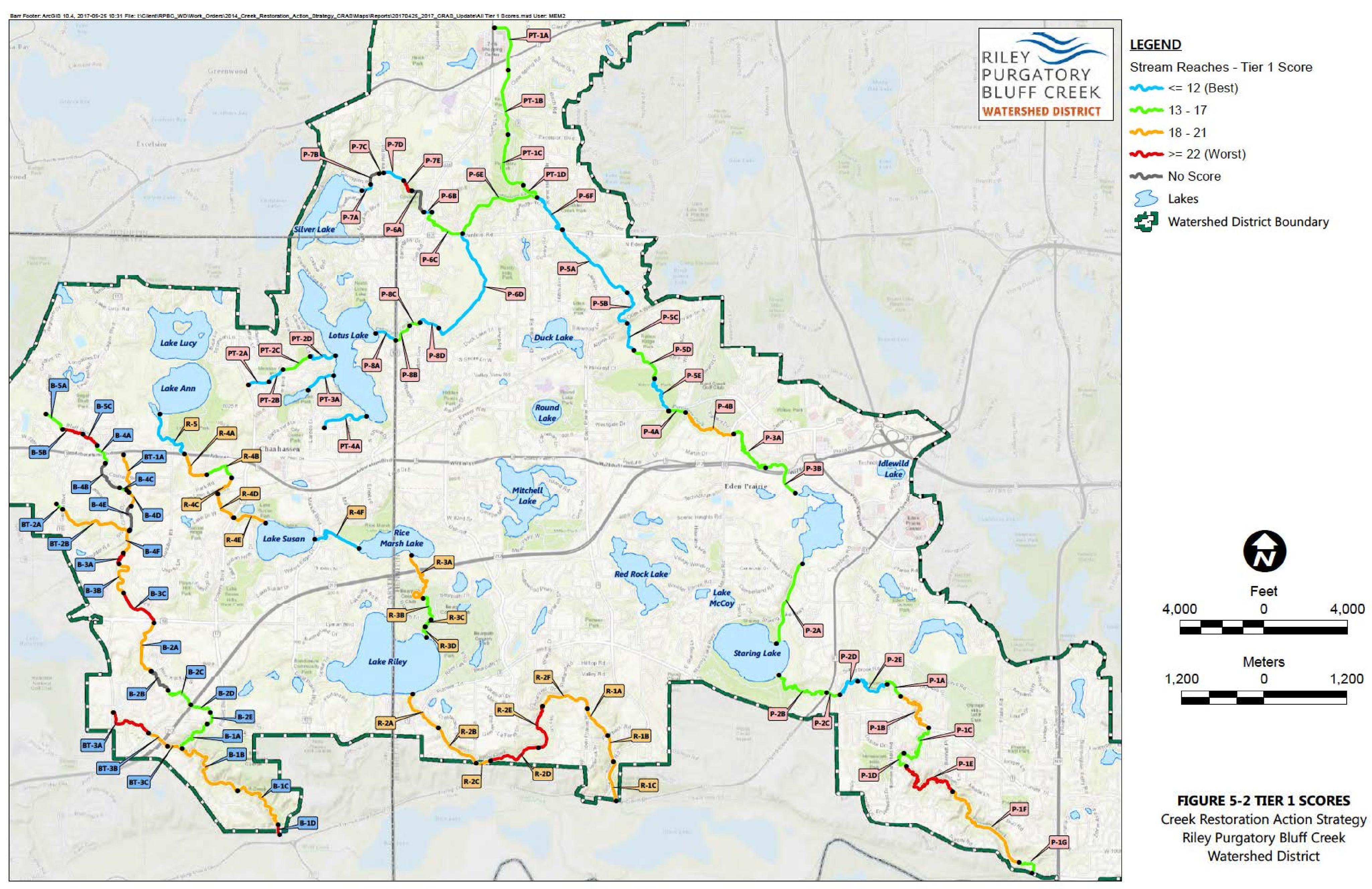
The insides of an EnviroDIY unit. Staff learned to construct and program the units from Limnotech and now have them deployed through the District.

Above: staff assess the amount of erosion in a part of Bluff Creek
Below: map of creek health assessment scores form the CRAS

Understanding creek health

With three distinct creek watersheds spanning different communities, ecosystems, and topographies, it can be challenging to prioritize restoration projects. To address this need, the District developed the Creek Restoration Action Strategy (CRAS) 2015.

The CRAS was built to be a comprehensive yet straightforward ranking system. It integrates multiple assessments including water quality, stream stability, and habitat to determine which creek reaches are healthiest, and which could use help. The strategy also incorporates human factors like partnership opportunities and public education into the ranking. After assessing the entire length of each creek, the District now returns to reaches on a rotating schedule to update the assessment and track changes over time. The CRAS has lead to the identification of multiple high priority restoration sites, where projects are planned to be conducted. The Minnesota Association of Watershed Districts awarded CRAS the "Program of the Year" award in 2015.



Peering into the past

Paleolimnology is the study of lake sediment to gain insights into the history of a lake's health and ecosystem. Looking back 150 to 200 years, we can get an idea of how a lake was prior to European settlement and urbanization. To conduct the studies, a long tube is pushed down through the lake sediment to collect a core sample several meters long. Researchers then look at the chemical composition of the soil as well as the abundance of microorganisms, called diatoms, and the rate of sediment accumulation[1].

In the last few years, the District has worked with the St. Croix Watershed Research Station at the Science Museum of Minnesota to conduct Paleolimnology studies in several lakes. These include Mitchell, Lotus, Round, Silver and Rice Marsh Lakes.

Most of the reports show data consistent with known developmental periods - sediment accumulation and phosphorus levels increase sharply when the local area is developed, and the microorganisms respond accordingly.

For example, both Lotus Lake and Round Lake used to be mesotrophic lakes[2] (medium nutrient levels and biological productivity, and clear water[3]). Because of human changes to the landscape, they have become eutrophic[2] (high nutrients and high productivity).

Since the early 2000s, management actions and regulations have allowed these two lakes, as well as all others in the District, to return to sedimentation levels almost as low as pre-settlement times[1-4]. This does not mean the lakes have returned to pre-settlement conditions, but they are healthier, and likely to improve with continued attention.

Near right: a researcher collects a core sample of sediment to be used in a paleolimnology study

Far right, top: a graph of sediment accumulation rate over time in Rice Marsh Lake. Sediment accumulation rate increased drastically in the 1940's.

Far right, bottom: sediment layers and their dates. Each of these layers were analyzed for diatoms.

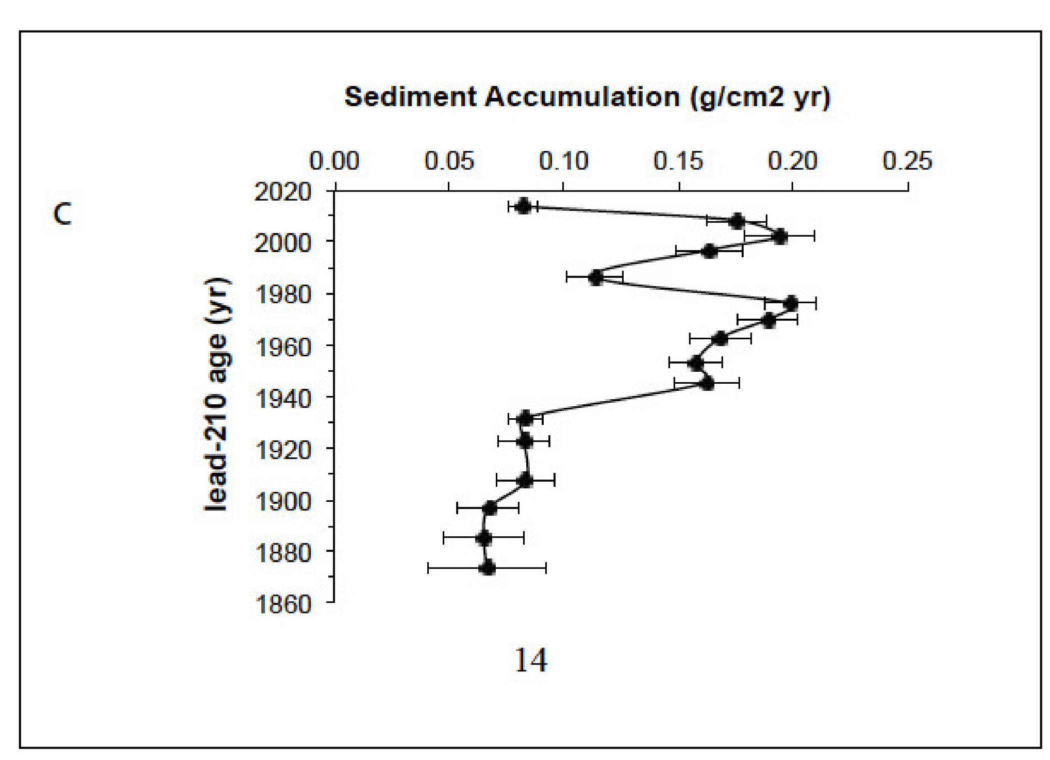


Table 1. Samples prepped for diatom analysis.

Depth (cm)	Lead-210 Date
2	2014
16	2009
32	2002
44	1997
60	1986
76	1976
88	1970
100	1963
116	1953
128	1946
144	1932
152	1923
164	1908
180	1885
192	1867