Pine Canyon Lake Association

Lake Management Plan

September 22, 2022

Preface

At the request of the Pine Canyon Lake Association Board of Directors, the PCLA Fish & Weed Committee has been working since March on developing a long-term lake management plan for Pine Canyon Lake.

The Committee's Chairman is Jim Yakowicz and the other members are Marsha Beck, Karl King, Kim Webb, and Rebecca Zwepink.

The Committee's first step was to confirm the Pine Canyon Lake community's goals for maintaining the health of the lake and identifying specific problems to be addressed. It was accomplished by a survey of residents.

The Committee's second step was to assess the existing lake conditions by collecting information about the water quality, aquatic weeds, shoreline weeds, and fish population.

The Committee's third step was establishing goals, objectives, and actions that are the foundation of the lake management plan.

The Committee's fourth step was issuing a Request For Proposals to eight companies for executing the actions that require lake management professional services.

The Committee's fifth step included:

- receiving responses from the companies to which the RFP was sent,
- evaluating the proposals submitted, and
- deciding which company we would recommend that PCLA should engage as a contractor to provide lake management services.

On August 31, 2022, the Committee distributed a draft of the Lake Management Plan via email to all Pine Canyon Lake residents for their review and comment. The draft was approved by PCLA members during the 2022 Annual Meeting.

The following is the final version of the Lake Management Plan.

Respectfully submitted,

Pine Canyon Lake Association Fish & Weed Committee

September 22, 2022

Contents

INTRODUCTION

Pine Canyon Lake is a small private lake located near Angola, Indiana. The lake and the surrounding 200 acres of pine and hardwoods are entirely owned by residents and lot owners.

Most of the 57 one-acre lots have frontage on the small, peaceful lake. Homes are set far back from the lake and are built from natural materials to blend in with their surroundings. No gasoline engine. or any other engine in excess of one-half horsepower capacity, is allowed to be used on the lake in any manner. No erection of any pier or other structure, permanent or temporary, is allowed on the lake or anywhere on the beach area.

Pine Canyon Lake has been developed with more ecological controls than most lakes in Indiana, and residents want to take every precaution to maintain the natural beauty of rolling terrain, 200 acres of pine and hardwoods, and sparkling clear water. Accordingly, this lake management plan has been developed.

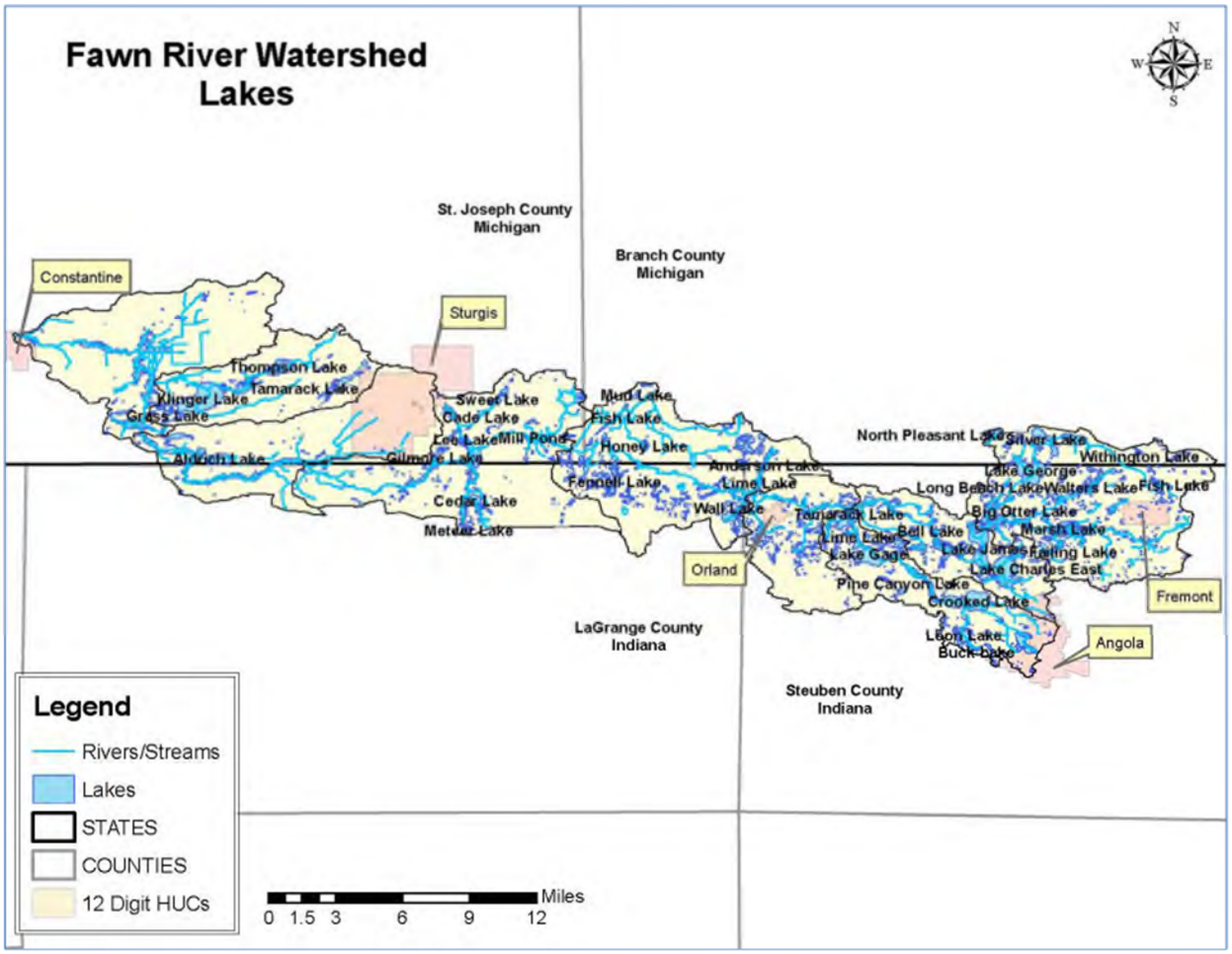
BASIC LAKE FACTS

Pine Canyon Lake has no surface water inflow or outflow and, therefore, is hydrologically classified as a "seepage lake" that receives water from two sources: (i) seepage into the lake from groundwater and (ii) precipitation, both as limited overland runoff into the lake and directly onto the lake. The groundwater seepage is from an unconsolidated aquifer system known as the Howe Outwash System, and the precipitation runoff is primarily from private residential lots and platted vacant lots surrounding the lake.

As shown in Figure 1, Pine Canyon Lake is within the Fawn River Watershed. The Fawn River Watershed, located in Steuben and LaGrange County, Indiana, and Branch and St. Joseph County, Michigan encompasses 165,361 acres of land including over 70 lakes.

The Fawn River drainage begins in Steuben County, Indiana at Fish Lake north of the town of

Figure 1: Location of Pine Canyon Lake within Fawn River Watershed



Fremont and flows northwest for a short distance before entering Branch County, Michigan where it encompasses several large lake systems. The drainage then turns south reentering

Steuben County, Indiana where it encompasses many large and small lake systems north and northwest of the city of Angola.

The Fawn River watershed is divided into nine sub-watersheds: Snow Lake, Tamarack Lake, Lake James-Crooked Creek, Town of Orland-Fawn River, Himebaugh Drain–Fawn River, Clear Lake-Fawn River, Wegner Ditch-Fawn River, Sherman Mill Creek, and Fawn River Drain-Fawn River. Pine Canyon Lake is within the Tamarack Lake sub-watershed.

Table 1 summarizes basic facts about Pine Canyon Lake.

Table 1: Basic Facts About Pine Canyon Lake

Lake Type	Seepage
Aquifer Name	Howe Outwash Aquifer System
Aquifer Type	Surficial sand and gravel commonly 15 - 50 feet thick
Major Watershed	Fawn River
Sub-watershed	Tamarack Lake
Inflowing Tributaries	None
Receiving Waterbody	None
Ownership (lake bottom)	Pine Canyon Lake Association, Inc.
Geographic Location	Latitude: 41.6794947; Longitude: -85.0908012
Elevation[a]	974 feet above MSL
Surface Area[b]	41 acres
Maximum Depth	*Presently unknown* (feet)
Average Depth	*Presently unknown* (feet)
Volume	*Presently unknown* (acre-feet)
Shoreline Length	*Presently unknown* (miles, feet)
Watershed Area Tamarack Lake Sub-Watershed	12,956 acres
Watershed to Lake ratio	316 : 1

Data sources: a) Steuben County Assessor's Department
b) USGS National Map; https://apps.nationalmap.gov/

LAKE CONDITIONS AND TRENDS

Table 2 summarizes data from the Aquatic Enhancement & Survey, Inc. Water Quality reports for 2014 through 2021.

Table 2: Data From Water Quality Reports 2014 Through 2021

Pine Canyon Lake Water Quality Reports Data							
Year	Secchi (Feet)	Phosphorus (mg/l)	Chlorophyll a (µg/l)	E-coli (MPN/100ml)			Carlson's Trophic State Index Score
				Site 1	Site 2	Site 3	
2014	13.60	0.020	no data	7.5	7.5	5.2	38
2015	8.67	0.110	0.51	10.0	3.0	15.0	36
2016	10.50	0.100	1.93	26.2	26.2	26.2	39
2017	13.50	0.007	0.70	3.3	3.3	3.3	33
2018	11.00	0.012	0.47	32.6	32.6	32.6	35
2019	15.00	0.029	0.43	<1.0	<1.0	<1.0	38
2020	12.70	0.010	7.37	2.0	4.1	3.1	43
2021	14.00	0.016	no data	26.6	1.0	3.1	42
Average	12.37	0.04	1.90	15.45	11.10	12.64	38.00

µ g/l *means micrograms per liter, a measure of the concentration of a substance in water, equivalent to "parts per billion."*

mg/l *means milligrams per liter, a measure of the concentration of a substance in water, equivalent to "parts per million."*

MPN/100ml *means Most Probable Number of cells per 100 milliliters*

Water Clarity

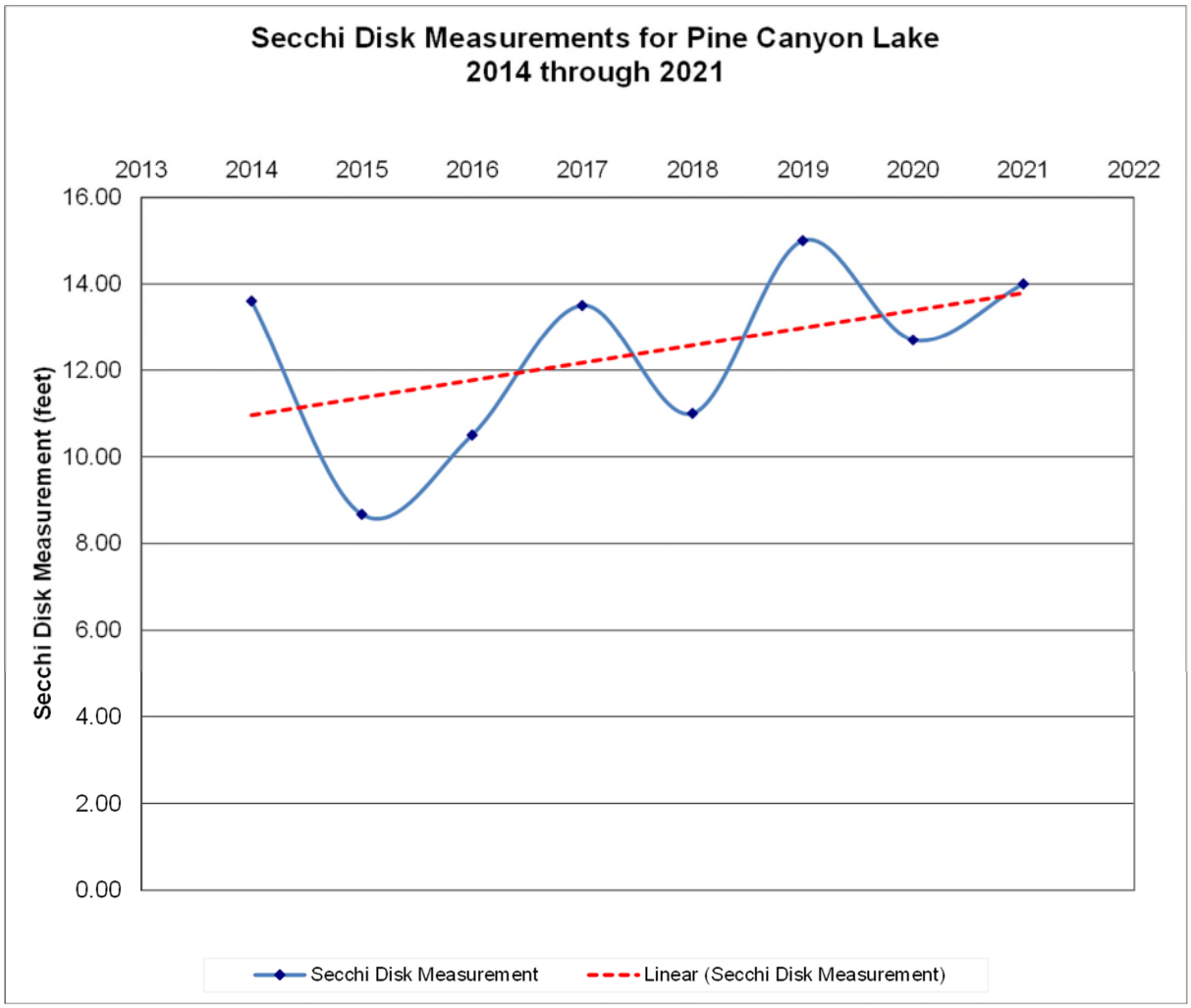
Secchi Disk Transparency Measurements by Aquatic Enhancement & Survey, Inc.

The water clarity of a lake, measured with a Secchi disk, is a reading of the depth to which the black and white Secchi disk can be seen in the lake water. Water clarity, as determined by a Secchi disk, is affected by two primary factors: algae and suspended particulate matter. Particulates (soil or dead leaves) may be introduced into the water by either runoff or sediments already on the bottom of the lake. Lakes with high water clarity usually have low amounts of algae, while lakes with poor water clarity often have excessive amounts of algae.

As illustrated by the data points and trend line (shown in red) in Figure 2, Secchi disk measurements by Aquatic Enhancement & Survey, Inc. have shown water clarity in Pine Canyon Lake to be variable but mostly high, with a 2014 - 2021 average of 12.4 feet.

There was a sharp decline in water clarity in 2015, suggesting that the lake was producing more algae. However, the water clarity has been better in 2016 through 2021—averaging above 13 feet—and the linear trend of Secchi measurement values was favorable.

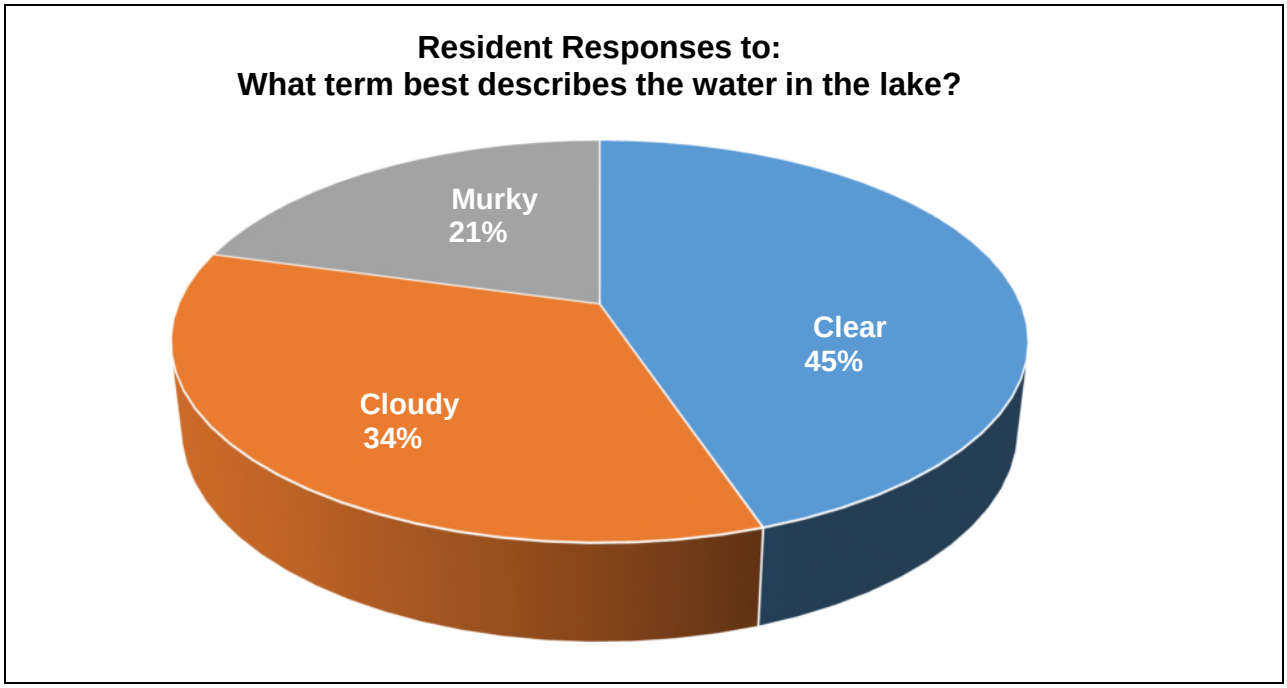
Figure 2: Water Clarity As Indicated By Secchi Disk Measurements 2014 - 2021



Residents' Perceptions As Indicated In 2022 Survey.

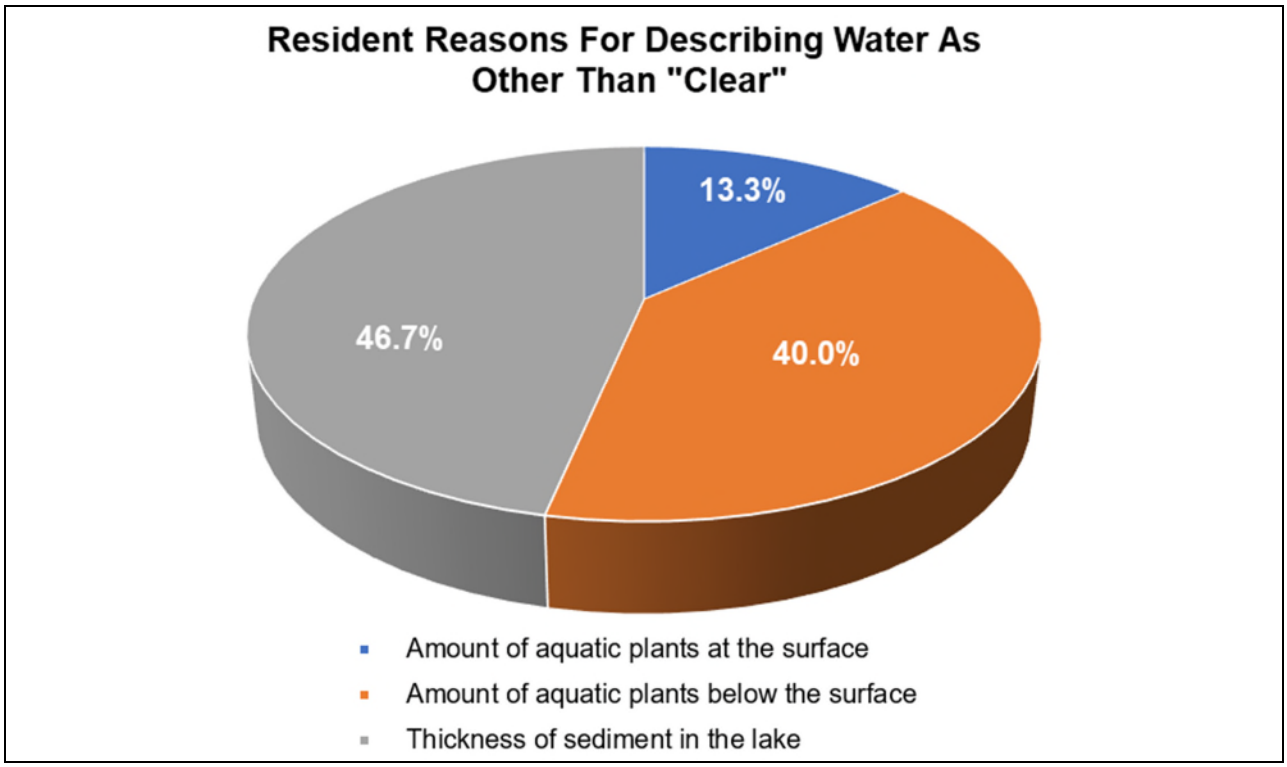
Residents' perceptions of water clarity are not as favorable as the Secchi Disk measurements. In the 2022 survey of Pine Canyon Lake residents, responses to the question "What term best describes the water in the lake—Clear, Cloudy, or Murky?" were as illustrated by the chart in Figure 3.

Figure 3: Residents' Perceptions of Water Clarity



And, the residents who responded with a term other than "clear", said the factors that prompted their answers were as illustrated in Figure 4.

Figure 4: Residents' Reasons For Describing Water As Other Than "Clear"

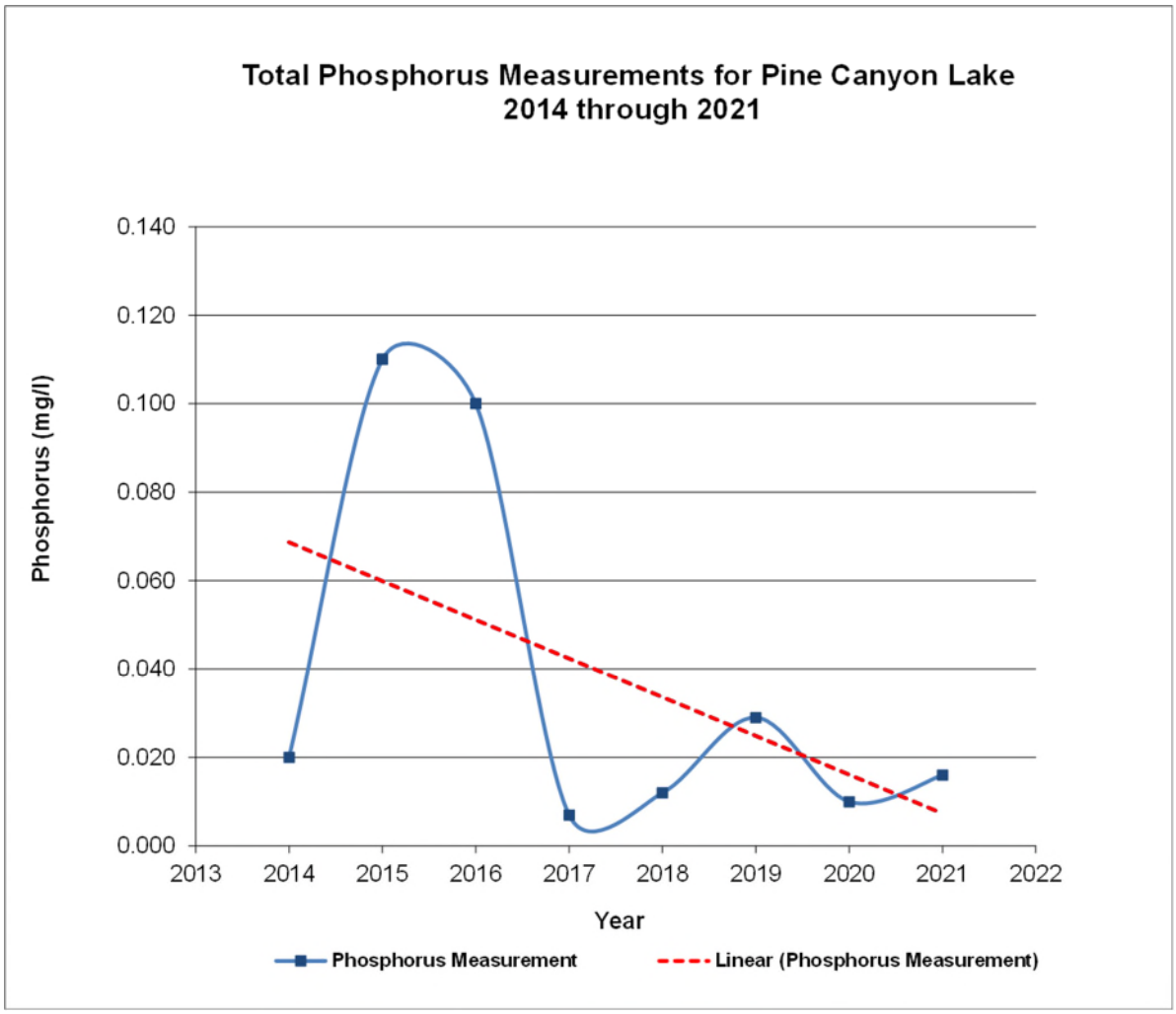


Phosphorus

Phosphorus is an essential plant nutrient. However, too much phosphorus, can pollute a lake and lead to unpleasant growth of algae and rooted aquatic plants. There is no atmospheric (vapor) form of phosphorus. Because Pine Canyon Lake has no streams flowing into it, phosphorus enters the lake through stormwater runoff and by seepage from the groundwater aquifer. Sources of phosphorus include fertilizers, pet and animal wastes, poorly-maintained septic systems, and erosion from land clearing and construction.

As illustrated by the data points and trend line (shown in red) in Figure 5, phosphorus measurements by Aquatic Enhancement & Survey, Inc. 2014 - 2021 have shown phosphorous levels in Pine Canyon Lake to be very low except in 2015 and 2016, and the trend is favorable.

Figure 5: Phosphorous Measurements 2014 - 2021

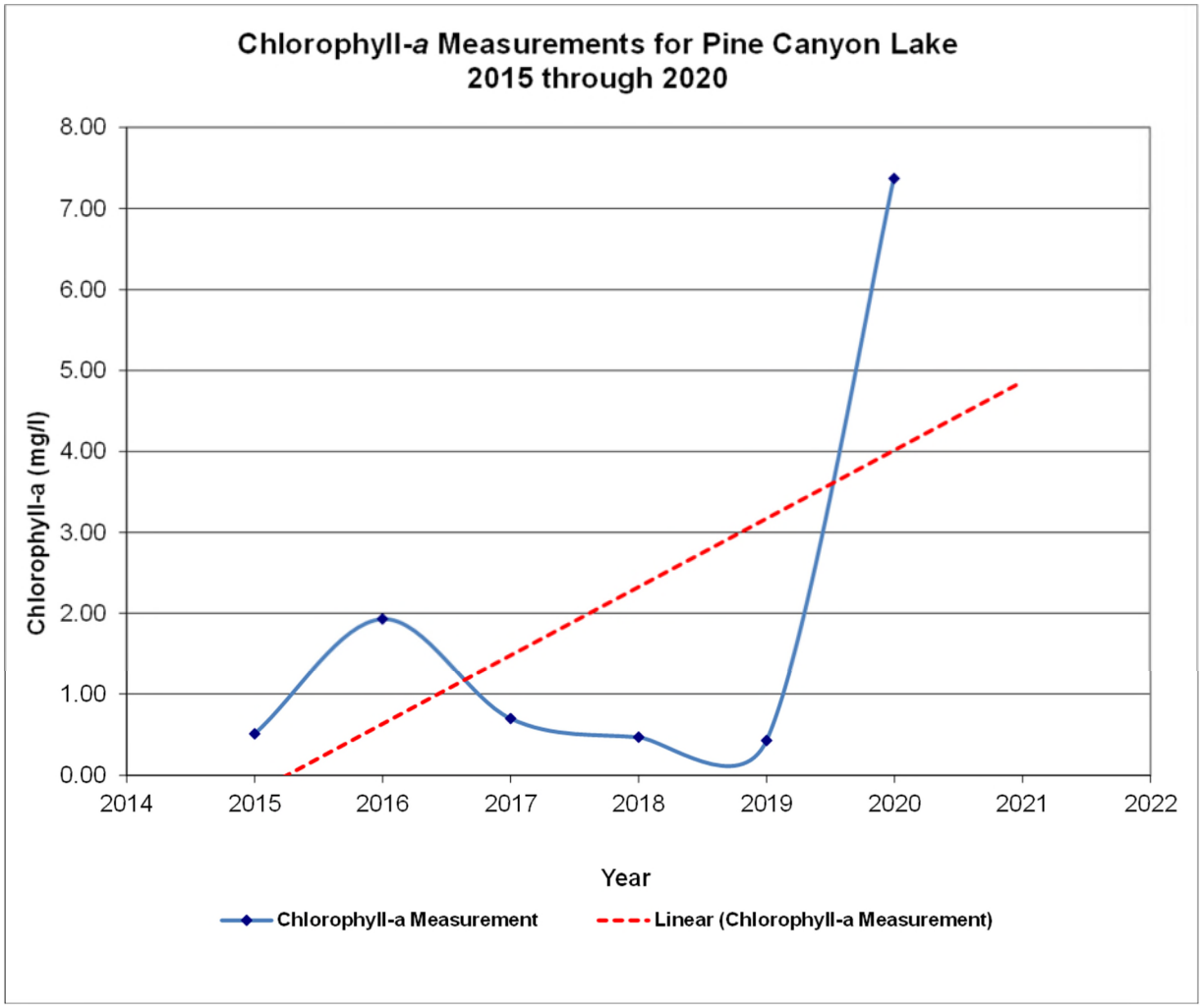


Chlorophyll-*a*

Algae are tiny plant-like organisms that are essential for a healthy lake. Fish and other lake life depend on algae as the basis for their food supply. However, excessive growths of algae, called algae blooms, can cloud the water, form unsightly scums, and sometimes release toxins. Excess nutrients, such as phosphorus and nitrogen, are the main cause of nuisance algae growth in a lake. Chlorophyll-*a* measurements are one method for tracking the amount of algae in a lake.

As illustrated by the data points and trend line (shown in red) in Figure 6, Chlorophyll-*a* values measured by Aquatic Enhancement & Survey, Inc. in 2015 through 2019 showed Chlorophyll-*a* levels in Pine Canyon Lake to be very low. However, the Chlorophyll-*a* level spiked sharply upward in 2020 and the linear trend for 2015 through 2020 was sharply upward. For reasons not stated in their reports, Aquatic Enhancement & Survey, Inc. did not perform Chlorophyll-*a* measurements in 2014 or 2021.

Figure 6: Chlorophyll-a Measurements 2015 - 2020



Dissolved Oxygen/Temperature Profiles

Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. In limnology (the study of lakes), dissolved oxygen is an essential factor. Oxygen is a critical component in lakes, not only for the survival of aquatic organisms, but for many ongoing molecular-level biological and chemical reactions. The amount and depth placement of dissolved oxygen in a lake is critical to understanding the biological patterns within the system. Oxygen is continually consumed in animal respiration and decomposition processes and produced by plant photosynthesis in the lake's epilimnion (upper depths).

The solubility of oxygen within the lake is dependent on the water temperature, and for this reason, these two data parameters are collected and analyzed together.

Aquatic Enhancement & Survey, Inc. performed Pine Canyon Lake Dissolved Oxygen/Temperature Profiles in 2014 through 2018, and the results are graphically depicted in Figure 7.

Figure 7: Dissolved Oxygen/Temperature Profiles 2014 – 2018

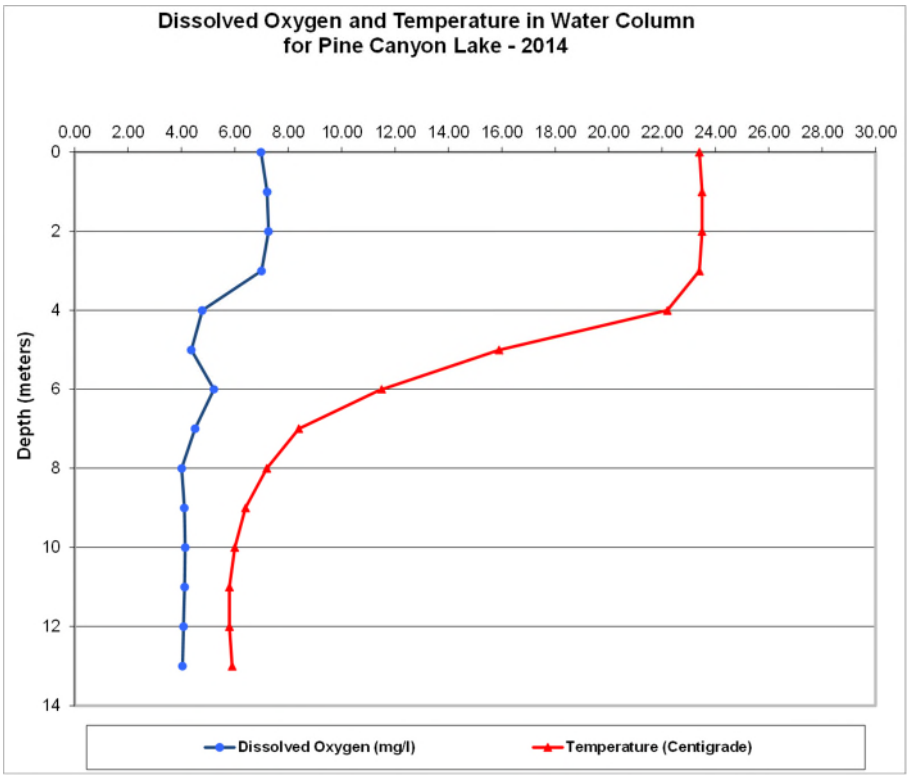


Figure 7 (continued): Dissolved Oxygen/Temperature Profiles 2014 – 2018

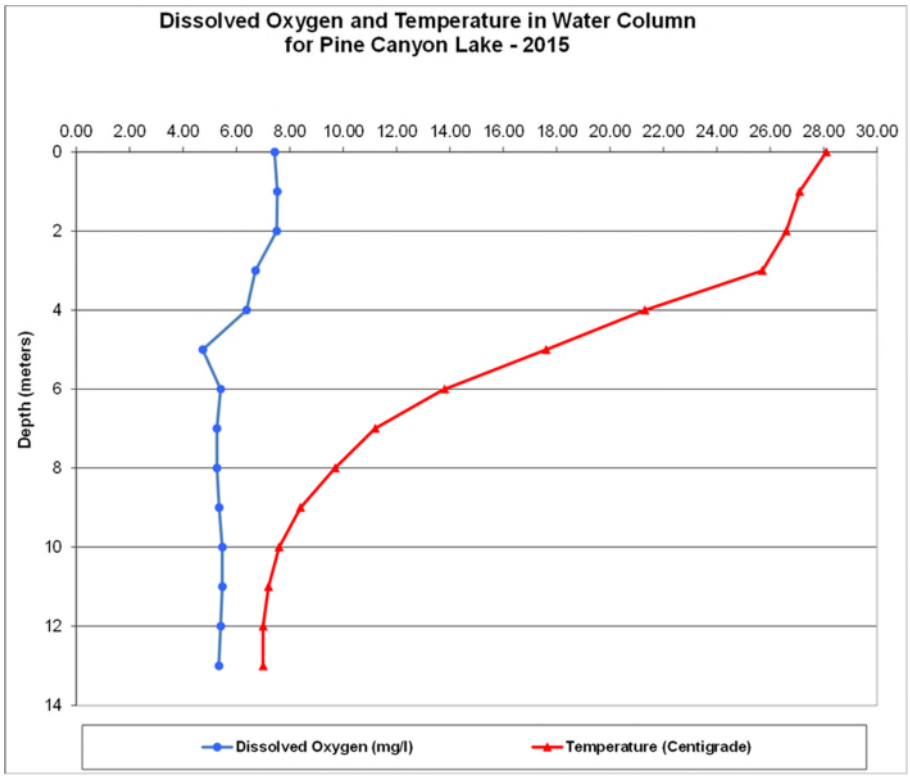


Figure 7 (continued): Dissolved Oxygen/Temperature Profiles 2014 - 2018

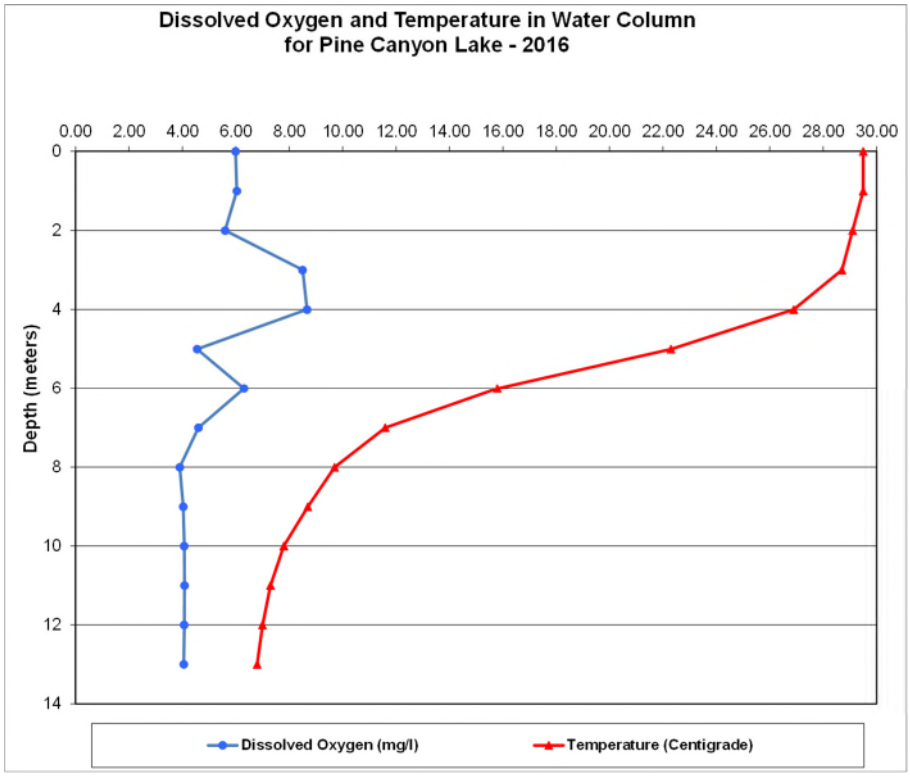


Figure 7 (continued): Dissolved Oxygen/Temperature Profiles 2014 - 2018

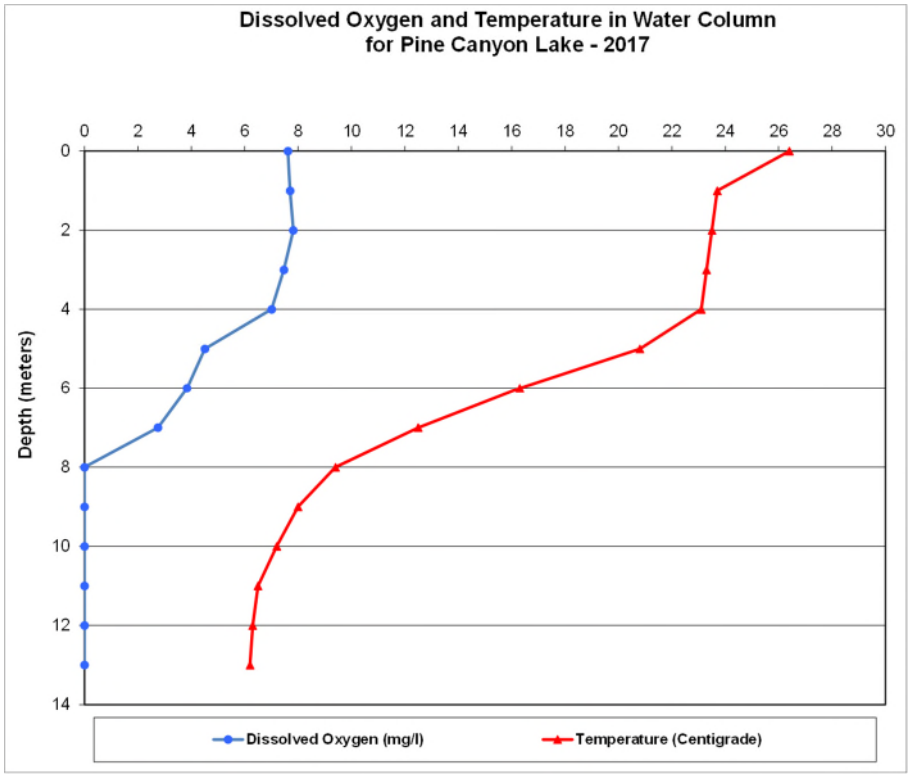
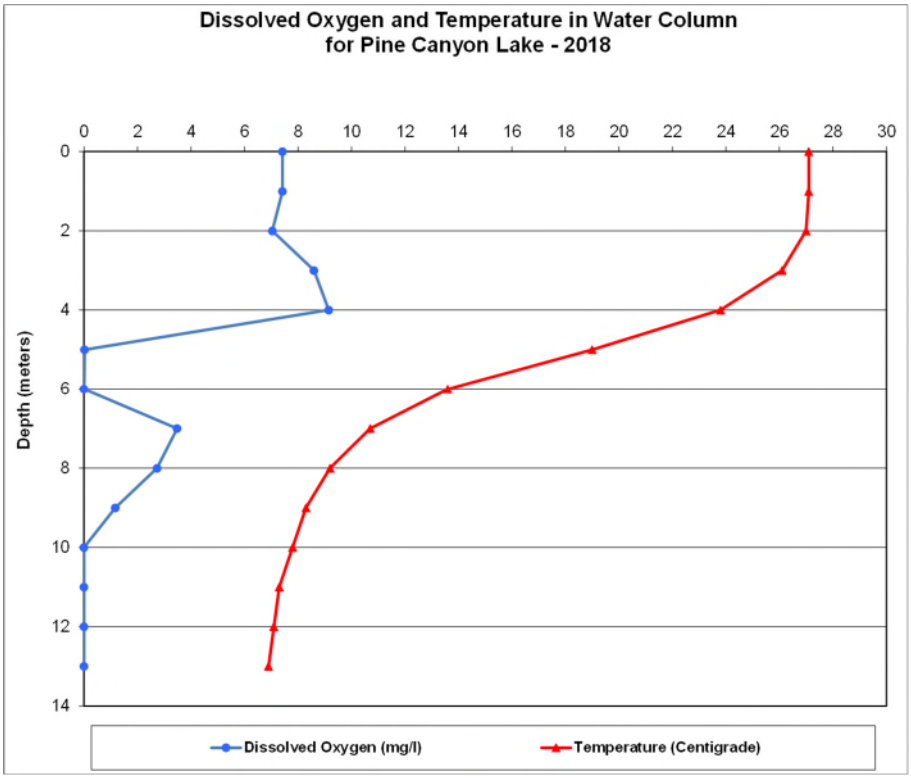
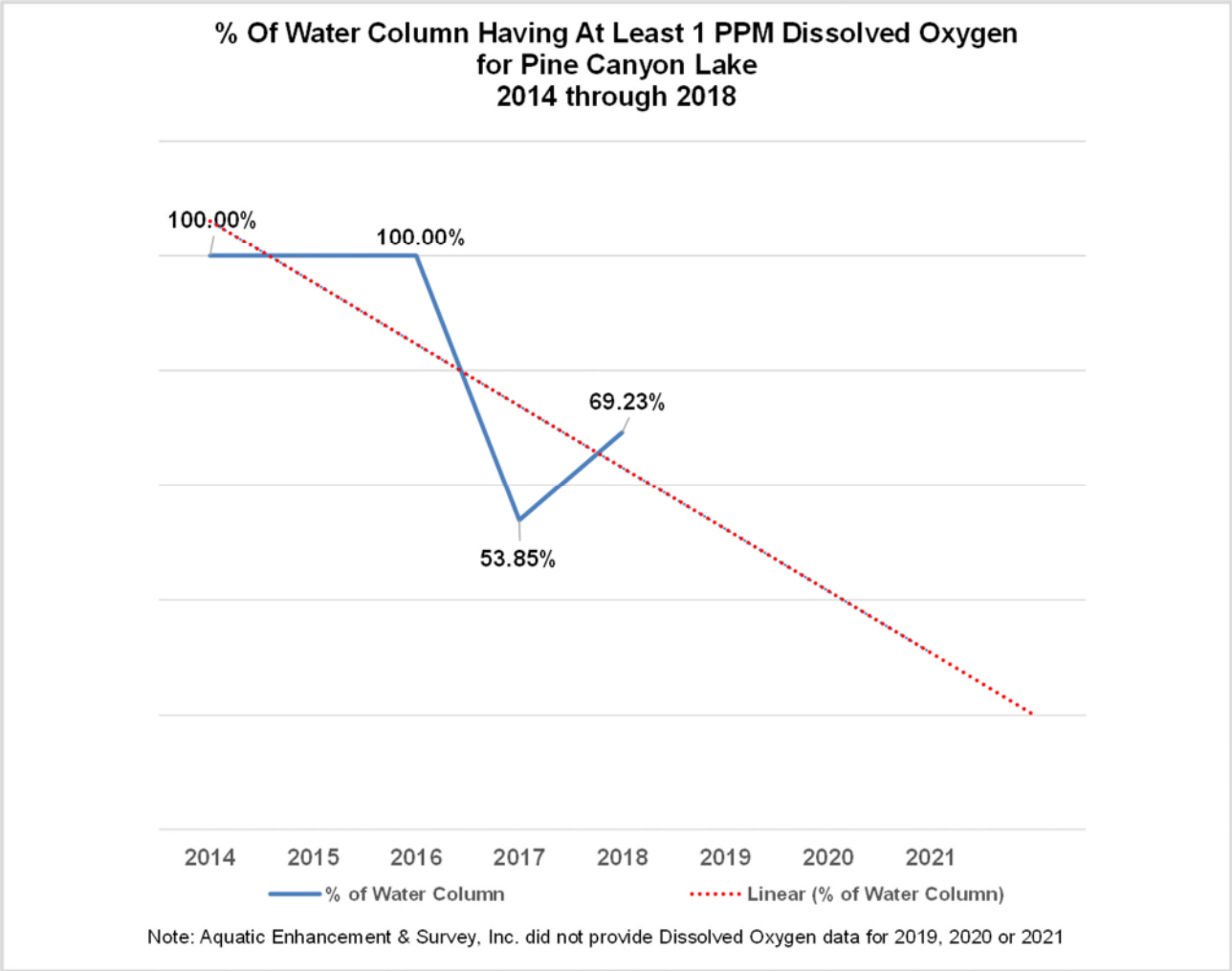


Figure 7 (continued): Dissolved Oxygen/Temperature Profiles 2014 - 2018



The percentage of the Pine Canyon Lake water column having at least one part per million dissolved oxygen in 2014 through 2018 is illustrated by the data points and trend line (shown in red) in Figure 8, and the trend was unfavorable.

Figure 8: Percentage Of Water Column Having At Least One P.P.M. Dissolved Oxygen 2014 - 2018



For reasons not stated in their reports, Aquatic Enhancement & Survey, Inc. has not performed Dissolved Oxygen/Temperature Profiles since 2018. This is a matter of concern because the 2017 and 2018 data show an unfavorable trend in the dissolved oxygen at lower depths, and we do not know whether this trend has continued as projected or has reversed.

We consider the unfavorable trends in dissolved oxygen at lower depths illustrated in Figure 7 and the percentage of the water column having at least one part per million dissolved oxygen illustrated in Figure 8 to be worrisome conditions. Many experts consider dissolved oxygen to be the most important parameter used to characterize lake water quality because oxygen is essential for aquatic life.

Furthermore, many problems can arise from oxygen depletion in the lower part of the water column, including the following:

- Bacteria, fungi, and other organisms living on the lake bottom break down organic matter that originates from the watershed and the lake itself. Algae, aquatic plants, and animals all provide food for these decomposers when they excrete, shed, and die. Like higher forms of life, most decomposers need oxygen to live and perform their important function. When the dissolved oxygen concentration is severely reduced, the bottom organisms that depend on oxygen either become dormant, move, or die. Fish and other swimming organisms cannot live in the lower layer. As a result, fish that require deep, cold water and high oxygen levels may be eliminated from the lake altogether.

- Oxygen depletion in the lower layer occurs "from the lake bottom up." This is because most decomposers live in or on the lake sediments. Through respiration, they will steadily consume oxygen. When oxygen is reduced to less than one part per million on the lake bottom, several chemical reactions occur within the sediments. Notably, the essential plant nutrient, phosphorus, is released from its association with sediment-bound iron and moves freely into the overlying waters. If wind breaks down the lake's stratification, this phosphorus may be transported into the upper layer where it can be used by algae and aquatic plants. This internal pulse of phosphorus (often termed *internal loading)* can thus accelerate algal and aquatic plant problems.

Trophic State

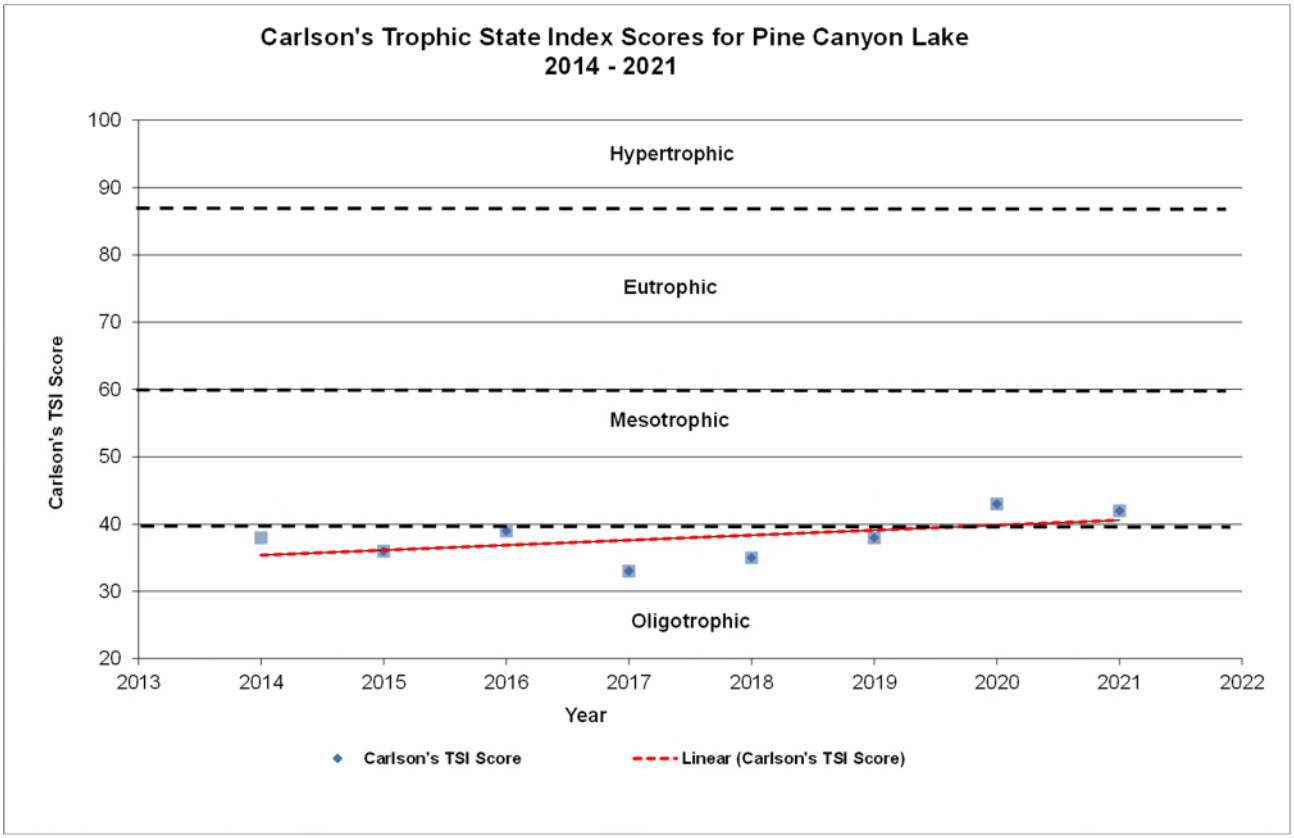
Carlson's Trophic State Index (TSI) is used by professionals to describe how productive, or trophic, a lake is. TSI is based on three different measures of lake productivity: water transparency as measured by the Secchi disk, Chlorophyll-*a*, and total Phosphorus measurements. Mathematical equations for each of the three parameters are calculated to transform numeric values into an index ranging from one to 100. This index is useful for classifying the health and nutrient enrichment of the scored lake relative to a large set of lakes used by Dr. Robert Carlson of Kent State University to produce the index. The index score can then be used to detect the effectiveness of land treatment activities designed to increase lake health over time or to track a decline in lake health due to poor land-use practices in the watershed.

Under the TSI scale, water bodies are typically classified as:

- *Oligotrophic*—TSI 0 to 40—having the least amount of biological productivity, "good" water quality;
- *Mesotrophic*—TSI 40 to 50—having a moderate level of biological productivity, "fair" water quality;
- *Eutrophic*—TSI 50 to 70—having the highest amount of biological productivity, "poor" water quality); or
- *Hypereutrophic*—TSI 70 to 100—having the highest amount of biological productivity, "very poor" water quality).

Aquatic Enhancement & Survey, Inc. computed the Carlson's Trophic State Index for Pine Canyon Lake in 2014 through 2021, and the results are graphically depicted by the data points and trend line (shown in red) in Figure 9, and the trend was upward.

Figure 9: Carlson's Trophic State Index Scores 2014 - 2018

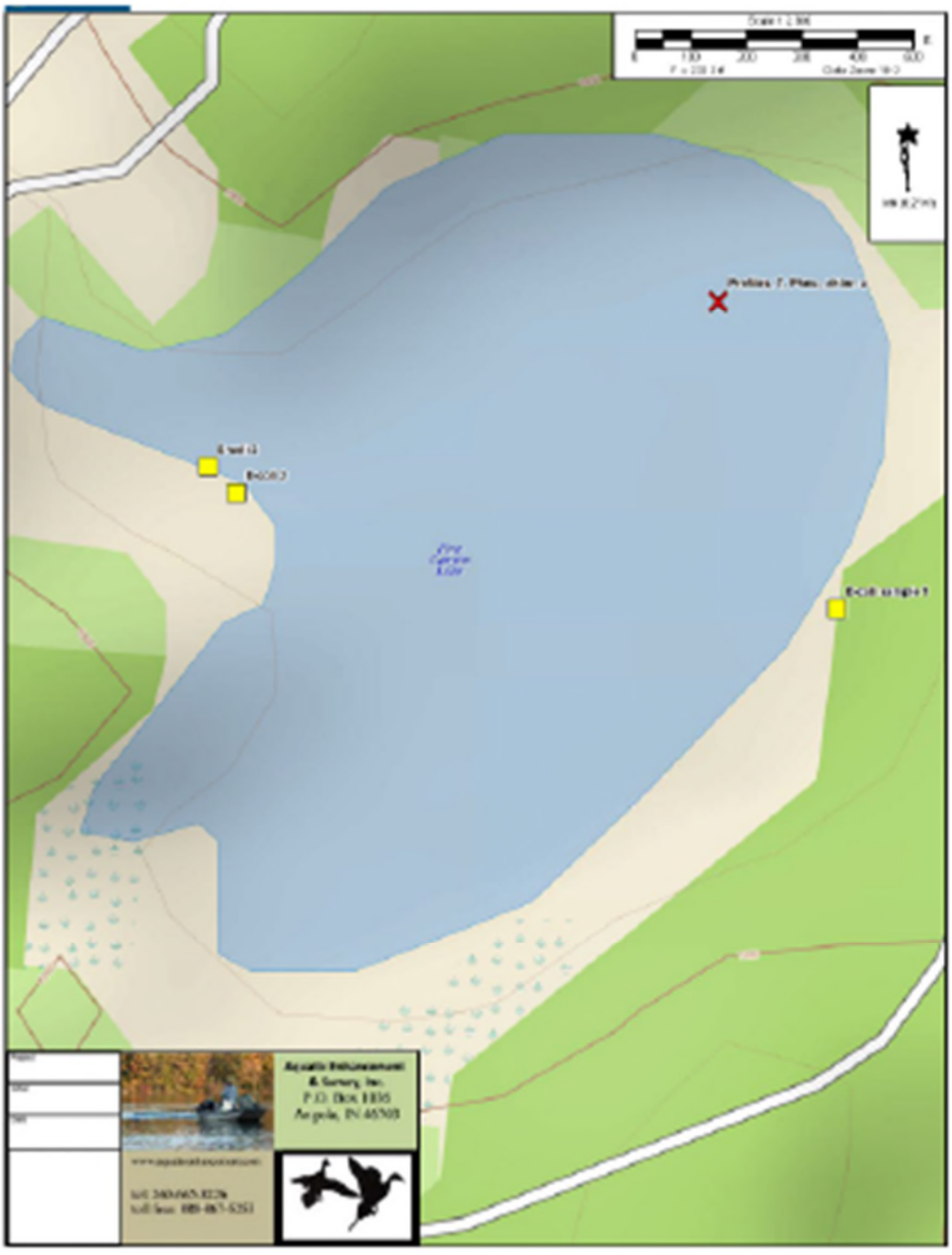


The 2021 score places the lake in the "mesotrophic" category, indicating the lake has experienced a moderate amount of nutrient enrichment. Lakes with this type of score generally support healthy ecosystems, moderately clear waters, and are user-friendly for most recreational purposes. The mean annual Carlson's TSI scores produced in 2014 through 2021 respectively are 38, 36, 39, 33, 35, 38, 43, and 42. Because a score higher than 40 places a lake in the "mesotrophic" category, Pine Canyon Lake in 2020 and 2021 was slightly above the division between "oligotrophic" and "mesotrophic".

E. coli

Because the presence of large numbers of E. coli in water indicates a potential presence of associated disease-causing organisms, it is measured to gauge the safety of the water for swimming. In 2014 through 2021, Aquatic Enhancement & Survey, Inc. analyzed lake water samples from the three Pine Canyon Lake sites indicated in Figure 10 for E.coli bacteria as an indicator of possible human or animal waste contamination.

Figure 10: Lake Water Sample Sites For E. coli Testing 2014 - 2018



The results of the tests are graphically depicted by the data points and trend lines (shown in red) in Figures 11, 12, and 13. The trends were:

- Site 1—level,
- Site 2—downward (i.e., favorable),
- Site 3— downward (i.e., favorable).

Figure 11: E. coli Measurements for Pine Canyon Lake Test Site #1, 2014 - 2018

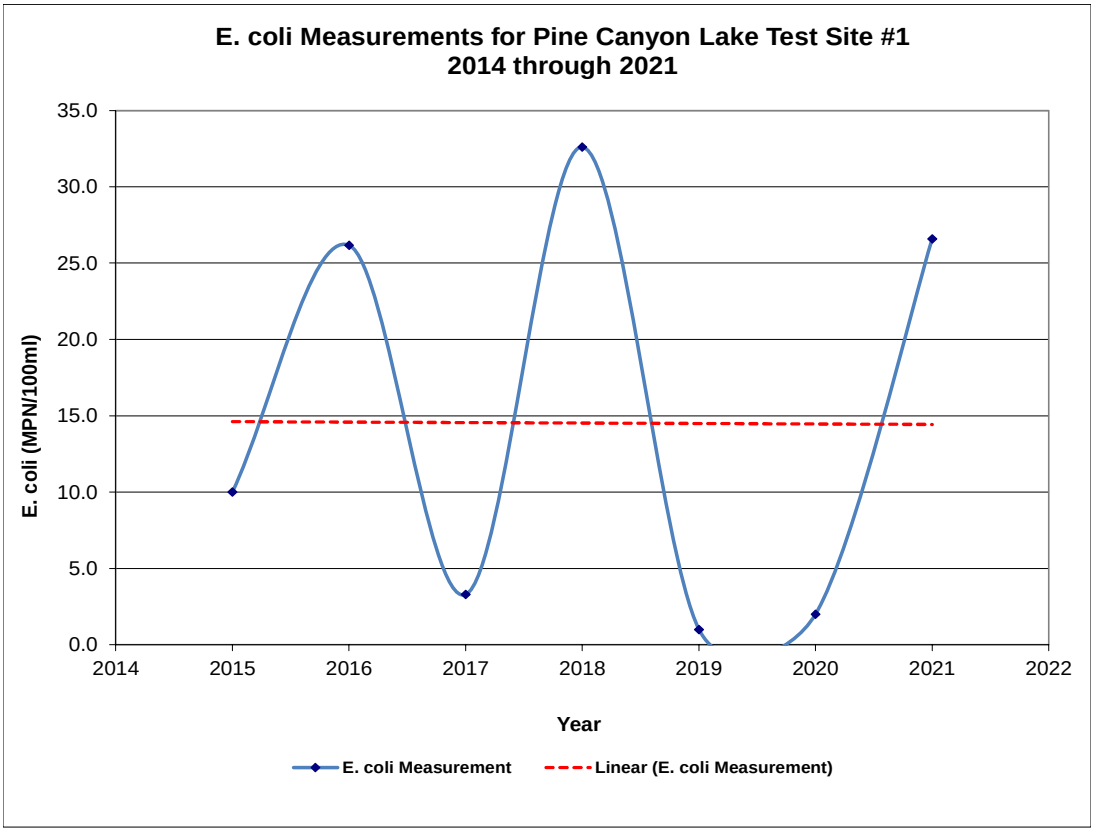


Figure 12: E. coli Measurements for Pine Canyon Lake Test Site #2, 2014 - 2018

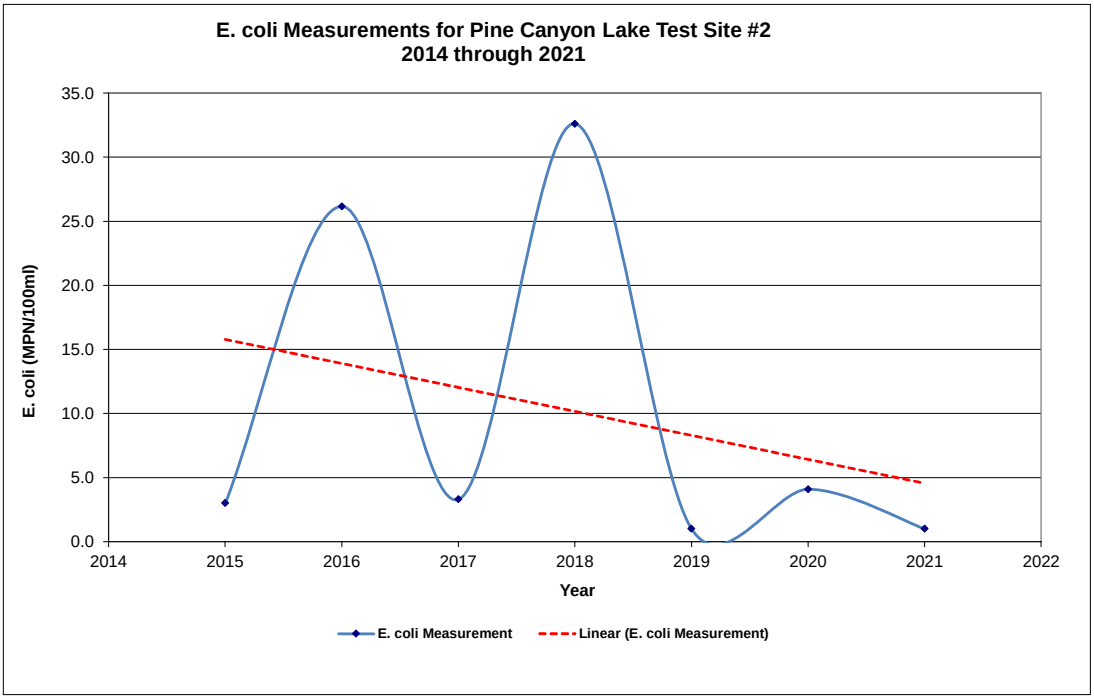
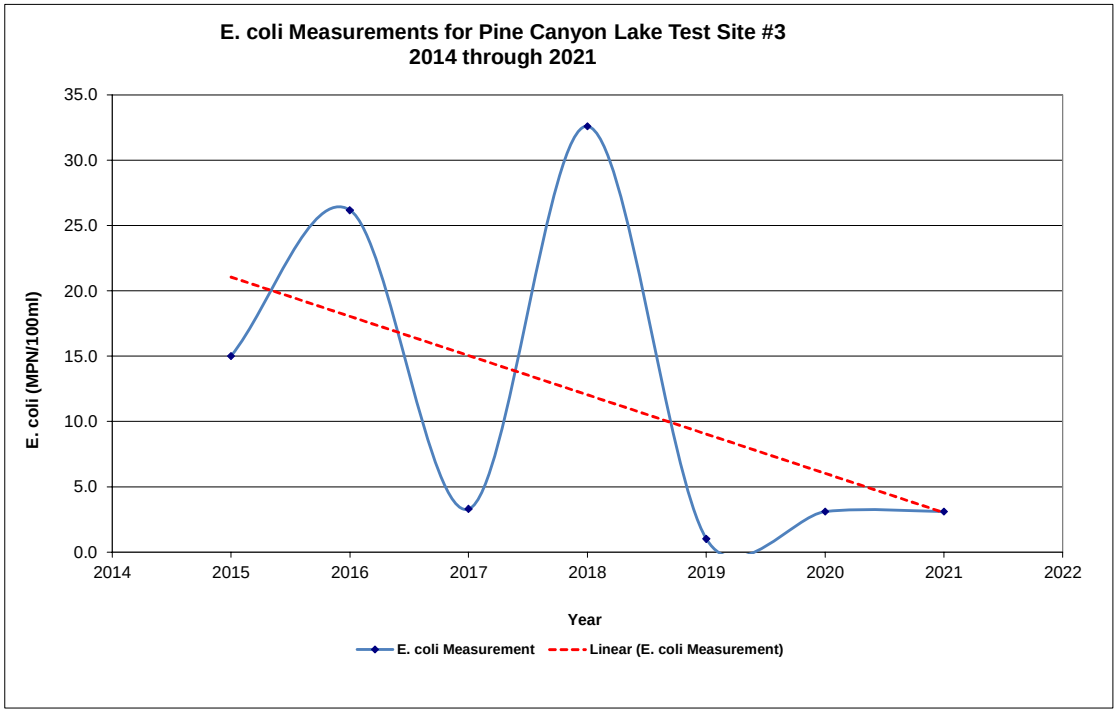


Figure 13: E. coli Measurements for Pine Canyon Lake Test Site #3, 2014 - 2018



All the E. coli samples collected from the lake in 2014 through 2021 showed low counts, ranging between 1.0 and 42.5 MPN/100ml (i.e., most probable number of cells per 100 milliliters). Concern for swimmers and other water users does not typically arise until this measurement is above 235 MPN/100ml.

AQUATIC INVASIVE PLANT SPECIES

A 2018 report of Pine Canyon Lake conditions by Aquatic Enhancement & Survey, Inc. included a finding that the lake is colonized by two invasive plant species: Hybrid Watermilfoil (which is a cross between Eurasian Watermilfoil and Northern Watermilfoil) and Curly-Leaf Pondweed.

Specifically, the report stated:

> "Pine Canyon Lake appeared to have been heavily colonized by the non-native invasive plant Eurasian watermilfoil *Myriophyllum spicatum* by 2013. An early-season treatment performed in April of 2014 had dramatic results in eliminating the Eurasian milfoil while allowing the native plant community to thrive. A cursory plant survey of the lake was performed at the time of annual water quality sample collection on July 30, 2014. Despite the success of the earlier treatment several milfoil plants were noted growing throughout the lake. These plants were difficult to identify, showing some characteristics of Eurasian watermilfoil, but also being similar to the native northern watermilfoil *Myriophyllum sibiricum.* A sample of the plants was collected and sent to Grand Valley State University for genetic

identification. The genetic testing revealed the plants to be a hybrid between the two plants. Since no milfoil identifiable as pure Eurasian watermilfoil has been noted at Pine Canyon Lake since that time it is possible that the lake had been originally colonized by the hybrid and not by pure Eurasian watermilfoil."

"It was recommended that PCLA budget for an early-season herbicide treatment in 2015 of 20.5 acres utilizing 2,4-D liquid herbicide (4 ppm). This treatment was carried out on April 28, 2015. By late spring 2015, it appeared that the hybrid watermilfoil had been eliminated by the treatment. During water quality sample collection on July 28, 2016, no native, hybrid, or Eurasian watermilfoil was noted in the lake."

"On June 28, 2017 a visit was made to the lake to observe the plant community and check for the return of invasive milfoil. Ten native plant species were observed, along with two non-native species. Colonies of invasive milfoil plants were observed in several areas of the lake. A small number of curly-leaf pondweed plants were also present. Curly-leaf pondweed is also an invasive, non-native species. A total of six milfoil plant samples were collected from two locations in the northeast part of the lake. The samples were sent to the laboratory at GenPass LLC for genetic analysis. All six samples were genetically identified as the hybrid cross between Eurasian watermilfoil and northern watermilfoil."

"After a full two seasons of control following the early-season 2015 treatment, hybrid watermilfoil had begun to recolonize Pine Canyon Lake. It was advised that another treatment take place in the spring of 2018. The Pine Canyon Lake Association decided to utilize a 4 ppm early-spring 2,4-D treatment again to achieve control. A total of 20.5 acres was treated."

"Aquatic Enhancement, Inc. visited the lake on September 7, 2018 and we were unable to find a single milfoil plant. Six species of native plants were noted. If past results are repeated, it's unlikely the PCLA will need to treat for invasive milfoil in the 2019 season. We expect some milfoil plants to show up in 2019, but do not expect the growth to be dense enough to cause recreational or ecological impairment until the 2020 season. It will be optimal to repeat treatment for milfoil in the 2020 season if control is to be maintained."

Failure to stop such growth and prevent it in the future will result in severe negative impact on boating, swimming, and fishing in the lake.

However, because the Pine Canyon Lake community felt the 2,4-D treatments had produced undesirable side effects, no treatment for Watermilfoil has been applied since 2018. The result has been that Hybrid Watermilfoil colonization grew substantially and reached a severe nuisance level in 2021.

Watermilfoil

Watermilfoil

Watermilfoil produces long spaghetti-like stems that often grow up to the water's surface. Leaves are feather-like and resemble bones on a fish. 3-5 leaves are arranged in whorls around the stem, and each leaf contains 12-21 pairs of leaflets. At mid-summer small reddish flower spikes may emerge above the water's surface. Perhaps the most distinguishing characteristic, though, is the plant's ability to form dense, impenetrable beds that inhibit boating, swimming, and fishing.

Watermilfoil begins growing earlier than native plants, giving it a competitive advantage. The dense surface mats formed by the plant block sunlight and have been found to displace nearly all native submergent plants. Over 200 studies link declines in native plants with increases in Eurasian Watermilfoil. The resultant loss of plant diversity degrades fishery habitat, and reduces foraging opportunities for waterfowl and aquatic mammals. Eurasian Watermilfoil has been found to reduce the predatory success of fish such as largemouth bass.

The hybridization between Eurasian Watermilfoil and Northern Watermilfoil in Pine Canyon Lake noted in Aquatic Enhancement's report exacerbates the problem. Hybrid Watermilfoil typically has thicker stems, is a prolific flowerer, and grows much faster than pure-strain Eurasian Watermilfoil. These attributes might contribute to this plant being less susceptible to chemical control strategies. An investigation of 28 whole-lake treatments in Wisconsin indicated smaller population reductions and shorter longevity of control on lakes that contained Hybrid Watermilfoil populations compared to lakes with only pure-strain Eurasian Watermilfoil.

During the summer of 2021, the Watermilfoil spread to infest large areas of the lake, as shown in this aerial photo taken in mid-October.

Pine Canyon Lake in October, 2021

Therefore, early in 2022, the PCLA Board of Directors decided that near-term action was needed to reduce Watermilfoil infestation and maintain the boating, fishing, and swimming potential of the lake while protecting the fish and wildlife habitat.

The PCLA Board engaged Aquatic Enhancement & Survey, Inc. to treat the Watermilfoil colonization by applying ProcellaCOR herbicide at the rate of 2 Prescription Dose Units (PDU) per acre to 20.5 acres of the lake (102.5 acre-feet) for $12,054. This treatment was performed on May 19, 2022.

Curly-Leaf Pondweed

Curly-leaf Pondweed

As stated previously, Aquatic Enhancement & Survey, Inc. reported in 2018 that curly-leaf pondweed plants were present in the lake. Then, on May 19, 2022, Aquatic Enhancement reported that they observed during their application of ProcellaCOR to treat the Watermilfoil "a significant amount of Curly-Leaf Pondweed growing the lake". However, the PCLA Board did not engage Aquatic Enhancement & Survey to treat the Curly-Leaf Pondweed in 2022.

Like Watermilfoil, curly-leaf pondweed's aggressive early season growth allows it to out-compete native species and grow to nuisance levels. Because the plant dies back during the peak of the growing season for other plants though, it is better able to coexist with native species than Eurasian watermilfoil. Perhaps the most significant problem associated with Curly-Leaf Pondweed involves internal nutrient cycling. The die-off and decomposition of the plant during the warmest time of year leads to a sudden nutrient release in the water. This often leads to nuisance algae blooms and poor water quality.

Plants such as Watermilfoil and Curly-Leaf Pondweed alter the natural habitat of the lake and eventually will interfere with boating, fishing, and swimming by growing completely to the surface in thick, dense stands. Because they lack specific predators, pathogens, and parasites they can out-compete and displace native vegetation.

SHORELINE CONDITION

The condition of the lake shoreline is important to overall lake health. Development on the lake has modified the shoreline through the removal of natural vegetation, the installation of beach materials such as gravel, and the removal of large logs and branches. Alterations of this type can be harmful to the lake ecosystem because natural shorelines protect the lake from harmful pollution, prevent bank erosion, and provide important habitats for fish and wildlife.

Fortunately, the houses at Pine Canyon Lake are set far back from the shoreline and are sited on large lots. Furthermore, no erection of any pier or other structure, permanent or temporary, is allowed on the lake or anywhere on the beach area.

The only shoreline condition that has been a problem is infestation by a non-native invasive type of Phragmites (*phragmites australis*) also known as “giant reed grass” first noticed in 2019. This wetland plant could form a ring around the lake, displacing beneficial native wetland vegetation and decreasing the value of the lake’s wetland areas for wildlife, while impairing visual and recreational access for residents.

Phragmites at Pine Canyon Lake in September 2019

Lake-wide treatment of these plants using glyphosate was begun immediately in 2019. However, Phragmites have been observed growing on the shoreland in August 2022. Therefore, additional treatment is needed as soon as possible, and future ongoing monitoring and spot treatments will be necessary.

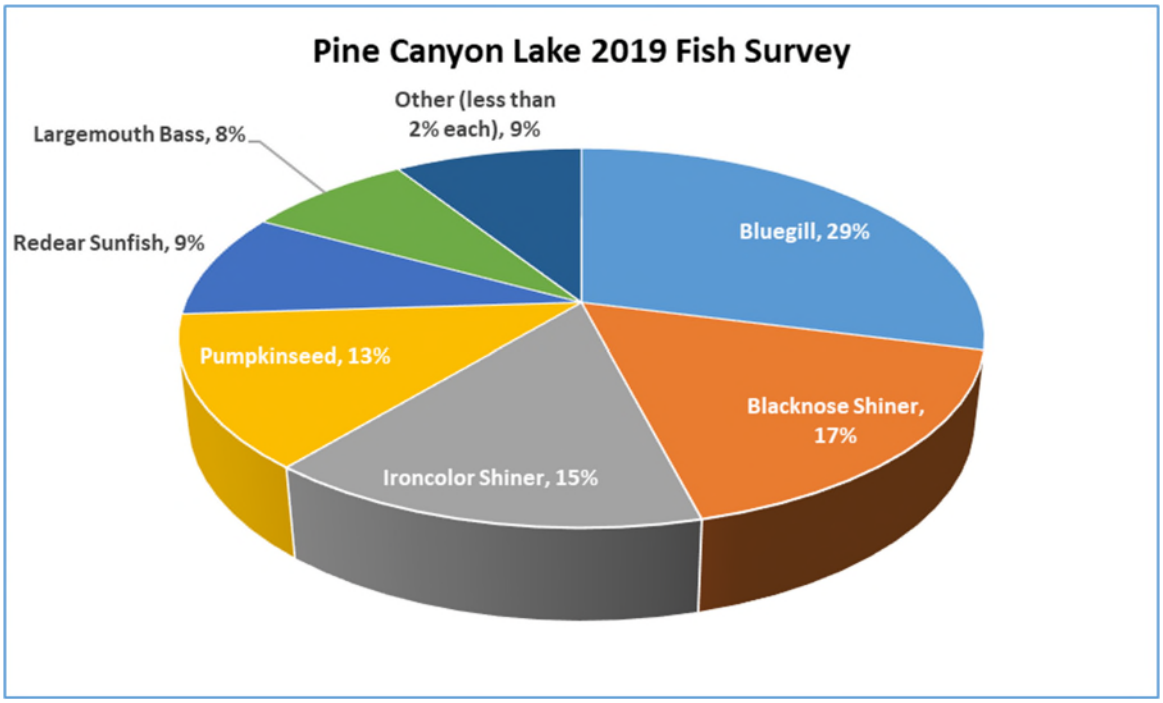
FISH POPULATION

Commonwealth Biomonitoring 2019 Survey

Commonwealth Biomonitoring of Indianapolis, Indiana conducted an electrofishing survey of Pine Canyon Lake on July 25, 2019, and this sampling was supplemented by net sampling on August 3, 2019.

Commonwealth Biomonitoring's report of its findings stated the fish species population was as illustrated in Figure 14.

Figure 14: 2019 Fish Population Survey - Percentages Of Number Of Fish Caught



In addition, the report stated:

- The largemouth bass Percentage Size Distribution is 15, which falls in the “needs help” category because the population is dominated by smaller individuals. Fish condition was also less than optimal. Weights were less than those normally seen in individuals of the same size from the healthiest bass lakes.

- The bluegill Percentage Size Distribution is 25, indicating that the population has a generally well-balanced structure. However, the Sunfish, Redear, and Pumpkinseeds tended to be larger and may be outcompeting Bluegills for spawning territory.
- The Index of Biotic Integrity score for Pine Canyon Lake is 44, which qualifies the lake in Integrity Class "Good".

Commonwealth Biomonitoring's report also included the following recommendations:

- Encourage the harvest of small bass to allow those that remain to grow larger. Release bass larger than 14 inches.
- Stocking fish species that are not native to the lake (e.g., walleye, fathead minnows, golden shiners) is not recommended. Putting these non-native fish into a lake can have unintended ecological consequences. However, stocking some largemouth bass over 14 inches long could be helpful in thinning out the more abundant sunfish species.
- Allow some aquatic vegetation to remain during weed control efforts.
- Encourage erosion control practices to prevent high turbidity in the lake.
- Continue to collect “creel” data from fishermen on a regular basis.
- Conduct fisheries surveys every five years to track progress.

It should be noted that Commonwealth Biomonitoring’s recommendation against stocking of Walleyes is contradicted by published reports of extensive successful Walleye stocking in lakes of Indiana, Michigan, Minnesota, and Wisconsin. One such report that is especially pertinent to Pine Canyon Lake is a December 2021 KPCnews.com article that described recent Walleye stocking in several northern Indiana lakes, including three lakes in Steuben County. (A copy of the article is attached as Appendix B.)

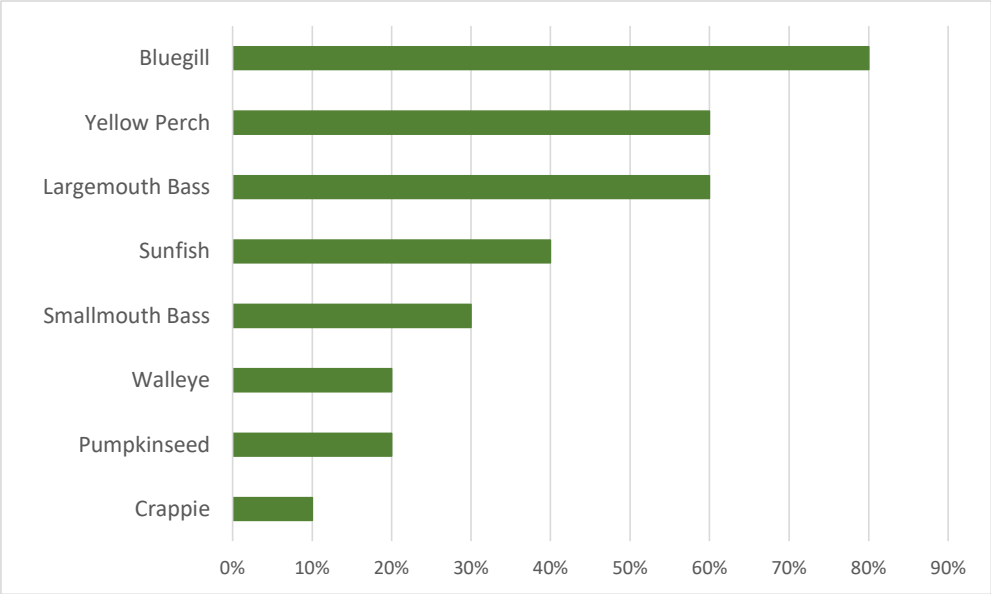
Walleye Stocking

In 2020, the Pine Canyon Lake was stocked with 400 young Walleyes purchased from Gollion Bait and Fish Farm. At this time, it is not known whether these stocked fish are thriving.

Residents' Responses To 2022 Survey Fish Question

In the 2022 survey of Pine Canyon Lake residents, responses by anglers to the question "What species did you catch (check all that apply)?" were as illustrated by the chart in Figure 15.

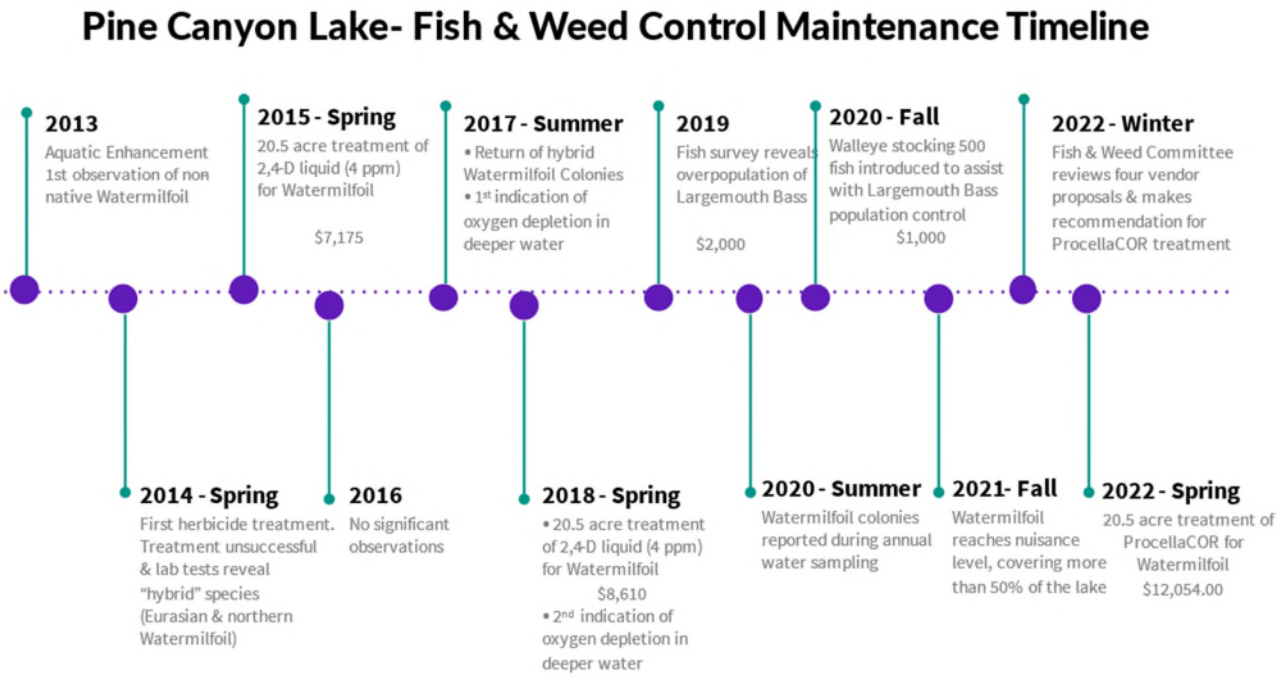
Figure 15: Resident Anglers' Response To "What species did you catch?"



TIMELINE SUMMARY OF LAKE CONDITIONS EVENTS 2014 - 2022

A timeline summary of the events described above is illustrated in Figure 16.

Figure 16: Timeline Summary of Lake Conditions Events 2014 - 2022



CURRENT CONDITIONS – WATERSHED

Watershed Location

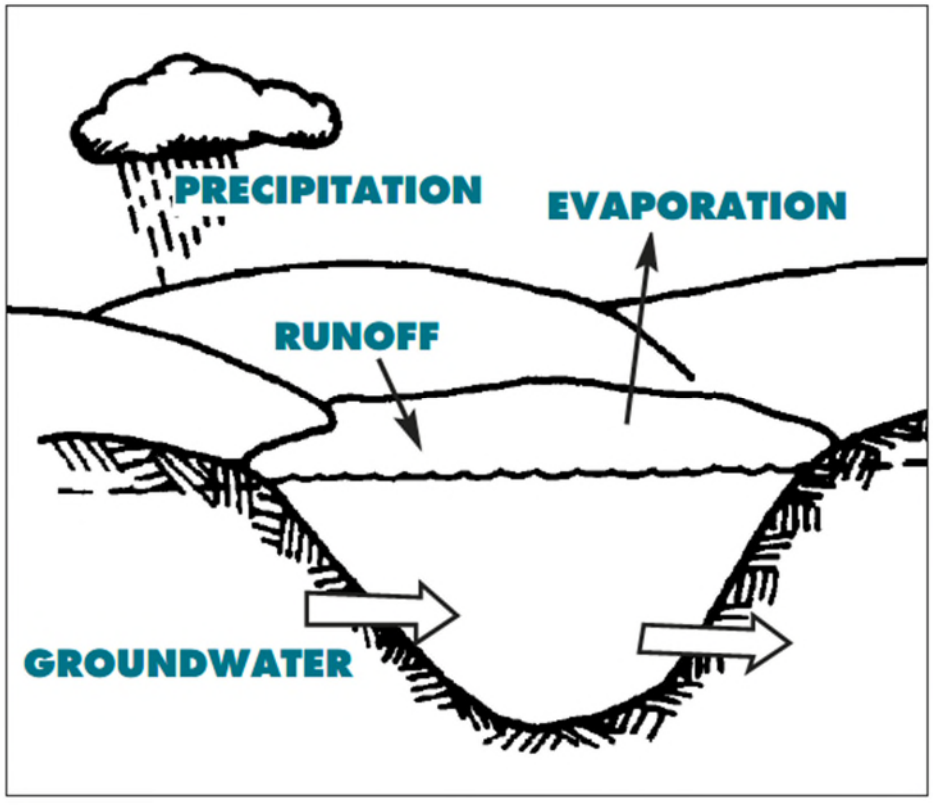
A watershed is an area with defined boundaries such that all land and waterways drain into a particular point. Watersheds are given “addresses” called Hydrologic Unit Codes (HUC) that identify where they are located within the United States and into which point they drain. The largest HUC is two digits and defines a particular region. The more digits to a HUC the more specifically the drainage area is identified.

As stated earlier and illustrated in Figure 2, Pine Canyon Lake is within the Fawn River watershed (HUC 0405000108) and the Tamarack Lake sub-watershed (040500010804).

Why Watershed Conditions Matter To Pine Canyon Lake

Pine Canyon Lake is a natural lake that has no surface water inflow or outflow and, therefore, it is hydrologically classified as a "seepage lake". As illustrated in Figure 17, a seepage lake receives water from two sources: (i) seepage into the lake from groundwater and (ii) precipitation, both as limited overland runoff into the lake and directly onto the lake.

Figure 17: Seepage Lake Function



Because Pine Canyon Lake, as a seepage lake, has groundwater as a major water source and has a relatively small runoff catchment area, the lake tends to be well buffered against acid rain and contain low to moderate amounts of nutrients. Nevertheless, managing the watershed to control nutrients and soil that enter the lake is essential to maintaining its water quality. Protecting groundwater quality and controlling the quality of water that runs from the land's surface into the lake are especially important. Also, of course, local septic systems or other groundwater contamination can cause problems for a seepage lake.

Geology, Topography, and Soils

Geology

The landscape of northern Indiana and southern Michigan is directly influenced by the last great glaciation which occurred over 10,000 years ago; the Lake Michigan Lobe of the Wisconsinan glaciation. As the glaciers melted, they formed the many kettle lakes, like Pine Canyon Lake, that give northern Indiana and southern Michigan the nickname of "Lake Country". The melting glaciers also deposited rock, dirt and sand that they had picked up while traveling across the landscape. In northern Indiana and southern Michigan, where the glaciers melted relatively rapidly, glacial till ridges, called moraines, were left.

The bedrock of the project area was deposited during the Mississippian Age, some 300 million years ago. The rocks deposited during the Mississippian Age are called the Borden Group and in the Fawn River watershed, consist primarily of shale and limestone in Indiana, and shale in Michigan. The bedrock present within the project area accounts for the groundwater wells that supply drinking water to the population centers in the watershed including Sturgis, MI and Fremont and Angola, IN, as well as the many wells that supply drinking water to the rural communities throughout the area. The unconsolidated deposits, above the bedrock, are typically between 200 and 350 feet thick throughout the St. Joseph River – Lake Michigan watershed.

Soils

United States Department of Agriculture (USDA) soil surveys in Steuben County show the soil association descriptions set forth in Table 3.

Table 3: Steuben County's Soil Associations and Association Descriptions

Soil Association	Association Description
Kosciusko-Ormas-Boyer	Nearly level to strongly sloping, well-drained, loamy, and sandy soils that are moderately deep or deep over sand and gravel; on outwash plains and moraines
Riddles-Miami-Brookston	Deep, nearly level to moderately steep, well-drained and very poorly drained, loamy soils on till plains
Glynwood-Morely-Blount	Deep, nearly level to moderately steep, well-drained to somewhat poorly drained, silty soils on till plains and moraines
Houghton-Rensselaer-Milford	Deep, nearly level, very poorly drained, mucky, loamy, and silty soils in depressions on outwash plains and lake plains

The soil in the Pine Canyon Lake area is of the Kosciusko-Ormas-Boyer soil association.

Soil type is important to consider when onsite sewage disposal systems such as traditional septic tanks utilize the soil to absorb effluent discharged from the tank into absorption fields. Septic tank absorption fields are subsurface systems of French drains that distribute septic liquid waste evenly throughout the designated area and into the natural soil. The Natural Resources Conservation Service, an agency of the United States Department of Agriculture, has classified 6.8% of the soils in Steuben County as "somewhat limited" for the installation of on-site sewage processing. However, because the residential lots around Pine Canyon Lake are very large, there is ample absorption field space and separation between residences for onsite sewage disposal systems as a means to safely process wastewater.

Climate

The climate in the Fawn River Watershed area is considered temperate with warm summers and cold winters. The warmest month of the year is July with an average high of 83ºF and an average low of 61ºF. The coldest month of the year is January with an average high of 30ºF and an average low of 16ºF. There is an average of 38.5 inches of precipitation each year. Figure 4 graphically illustrates the average temperature range per month and Figure 4 illustrates the average precipitation per month within the project area.

Figure 18: Monthly Average Temperatures within Fawn River Watershed

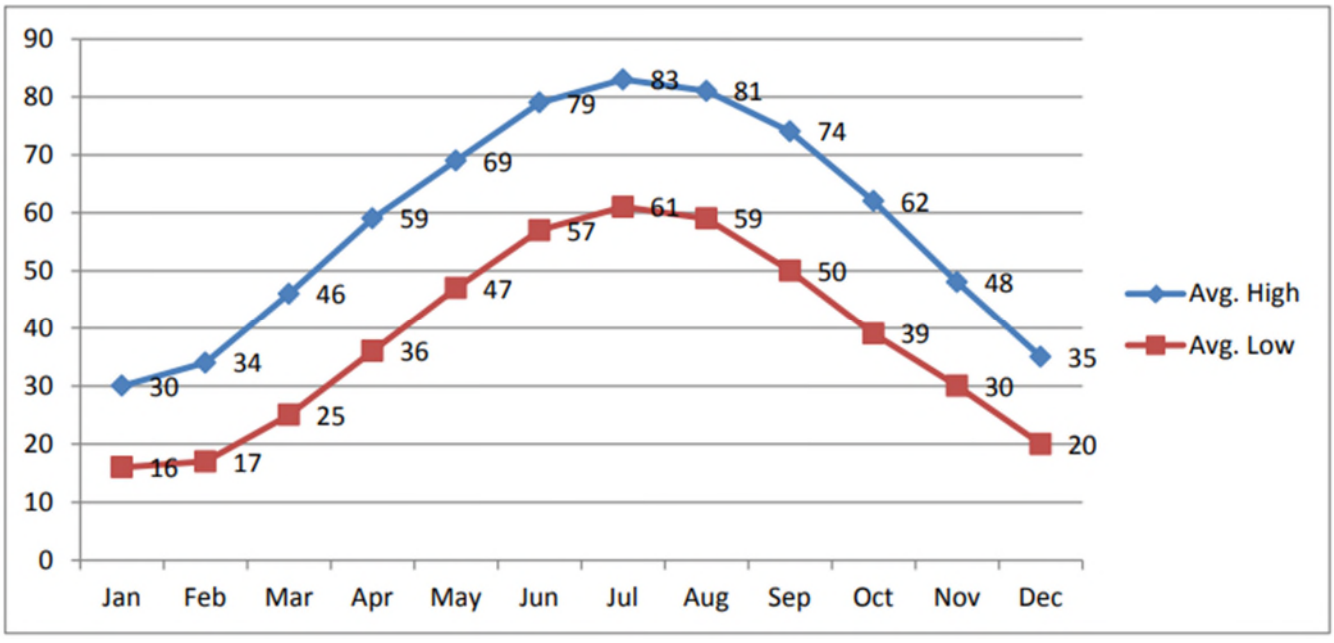
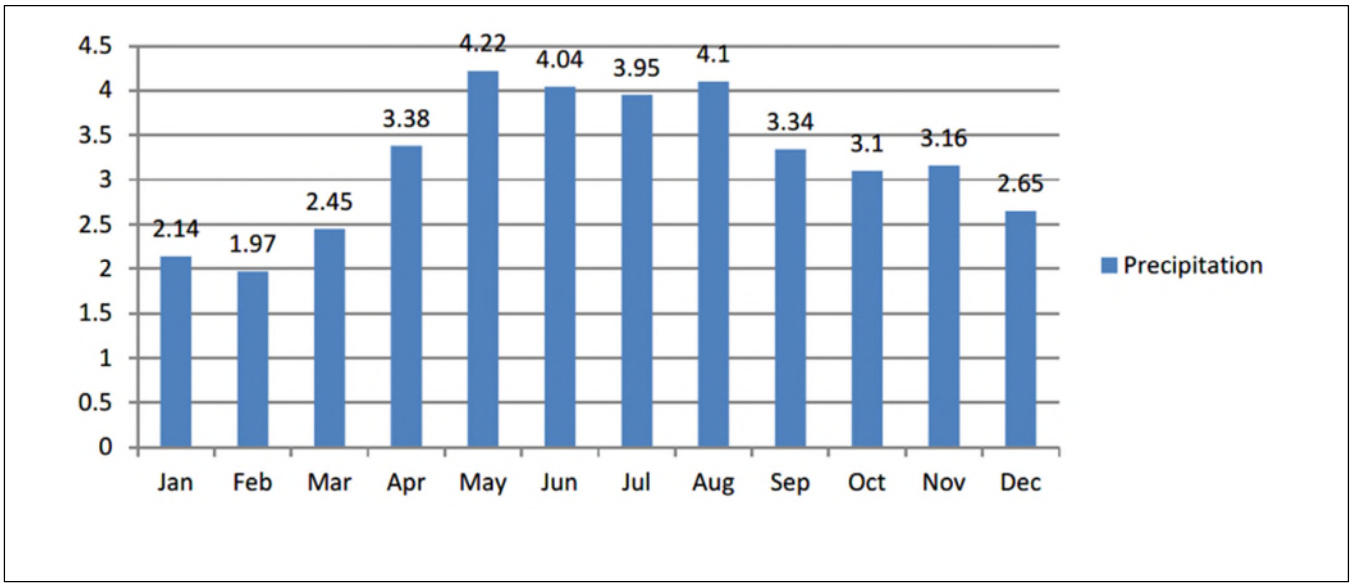


Figure 19: Average Monthly Precipitation within the Fawn River Watershed



Ground Water Resources

As stated previously, Pine Canyon Lake is located over an unconsolidated aquifer system known as the Howe Outwash System. An "unconsolidated aquifer" means that the groundwater present is readily available for uptake and use for drinking and irrigation. However, it also means that the groundwater is much more susceptible to contamination than consolidated aquifers.

The Howe Outwash System consists of surficial outwash sand and gravel up to 145 feet thick overlying glacial till (i.e., part of glacial drift deposited directly by the glacier containing small silt-sized particles to sand, gravel, as well as boulders.) with intertill sand and gravel units. The thickness of its water-producing surficial sand and gravel is commonly 15 to 50 feet, and its intertill sand and gravel is typically 5 to 25 feet.

All residents in the Fawn River Watershed acquire their drinking water through wells. The incorporated areas of Fremont, Angola, Orland, Sturgis, and Constantine supply drinking water to their residents through groundwater wells from one of the various aquifer systems located in the watershed and have some sort of protection plan in place to protect the groundwater from contamination. The other residents in the watershed, such as Pine Canyon Lake residents, have private water wells in which they obtain their drinking and irrigation water. The county health departments are responsible for the safety of the groundwater for private water wells and test the water before a new well can be installed. The wells are typically deemed inadequate for drinking if they test positive for the presence of fecal coliforms.

The most recent available data, a survey of water withdrawals completed by the United States Geological Survey in 2005, showed that Indiana and Michigan withdrew approximately 616 million gallons of water a day from groundwater resources in the Fawn River Watershed.

Land Use In The Tamarack Lake Sub-Watershed

Land use in the area greatly influences the quality of the water resources. Pine Canyon Lake is located in the Tamarack Lake Sub-watershed, and the major land use in the area is agriculture as over 45% of the drainage area is in row crops or pasture and hayland. Unsewered homes and lake communities also have a major influence on the water quality within the Tamarack Lake sub-watershed. Of significance in this sub-watershed is that nearly 25% of the watershed is covered by wetlands. This will be discussed in more detail later in this Section. Approximately 16% of this sub-watershed is developed due to the large lake system, most of which is built up, and a large portion of the City of Angola. Figure 20 is a map showing the delineation of land use in the sub-watershed, and Table 4 shows the percentage of the Tamarack Lake Sub-watershed that is in each land use. All land use data presented was obtained from the National Land Cover Data from the United States Geological Survey.

Figure 20: Tamarack Lake Sub-watershed Land Use

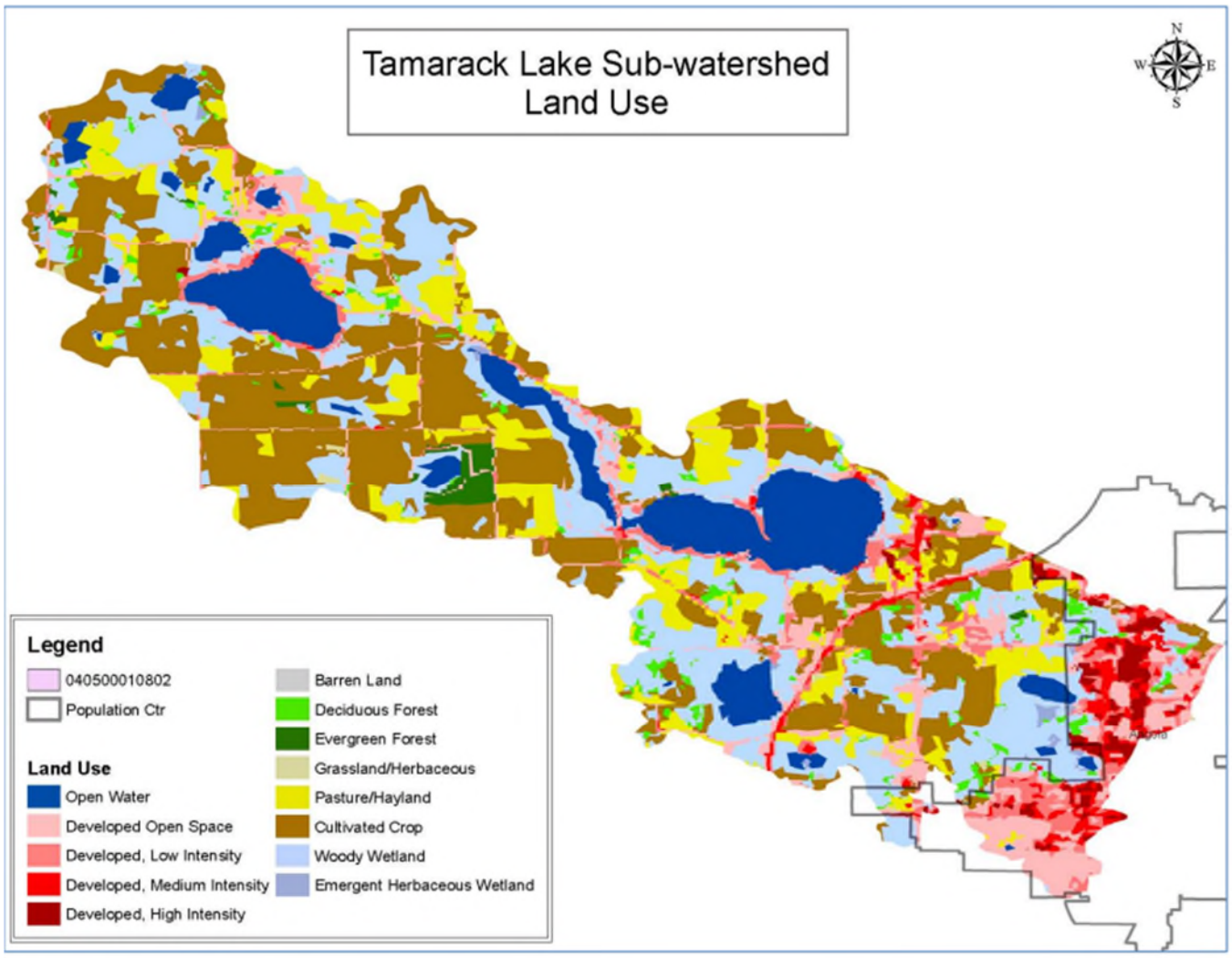


Table 4 shows a general description of land uses in the Tamarack Lake Sub-watershed

Table 4: Tamarack Lake Sub-watershed Land Use

Land Use Designation	Acres	Percentage
Open Water	1,547.26	9.55%
Developed Open Space	1,183.04	7.30%
Developed Low Intensity	781.74	4.82%
Developed Medium Intensity	358.71	2.21%
Developed High Intensity	200.59	1.24%
Barren Land	2.73	0.02%
Deciduous Forest	329.16	2.03%
Evergreen Forest	134.61	0.83%
Grassland Herbaceous	41.15	0.25%
Pasture Hayland	1,891.75	11.68%
Row Crops	5,747.60	35.47%
Woody Wetland	3,937.47	24.30%
Emergent Herbaceous Wetlands	46.91	0.29%

INFORMATION FROM SURVEY OF RESIDENTS

A clear understanding of how the lake is used and perceived by residents is essential for lake management efforts to be efficient, effective, and meaningful. For this purpose, an unbiased social survey of lake users was incorporated into the development of this Plan. The Pine Canyon Lake Association invited 54 residents to respond to a Lake Management Survey between March 19 and April 1, 2022. Responses were provided by 30 residents for a response rate of 54.5%. Of the respondents, 84% indicated that they utilize their property year-round and 16% indicated they utilize their property only seasonally.

The survey produced information about activities for which residents use the lake, their opinions about the health of the lake and factors that might be negatively affecting the lake, and their willingness to support lake management actions. Comments and charts set forth below describe findings from the survey.

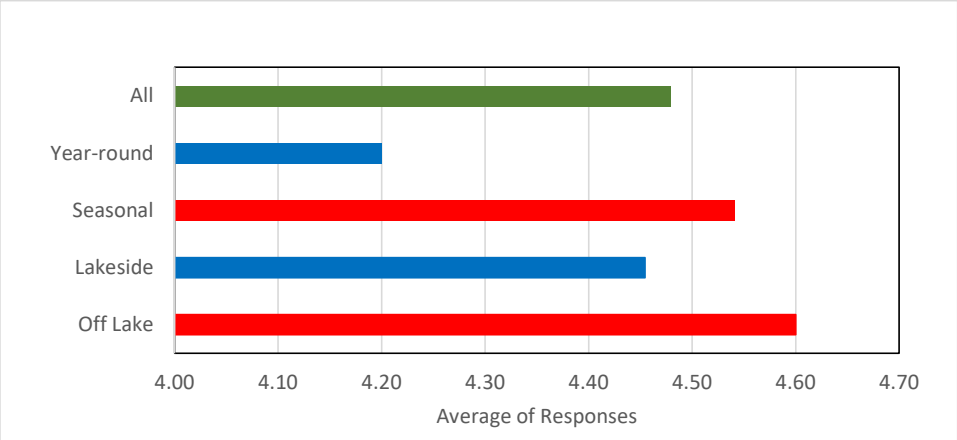
Importance And Uses Of The Lake

Extent to which residents feel the condition of the lake impacts the value of their property

As graphically illustrated in Figure 21, on a scale of 1 to 5, with 5 representing the greatest impact:

- All residents' average response, 4.48, was high;
- Seasonal residents' average response, 4.54, was higher than the 4.20 average response of Year-round residents; and
- Off Lake residents' average response, 4.60, was higher than the 4.45 average response of Lakeside residents.

Figure 21: Average of responses to "To what extent do you feel the condition of the lake impacts the value of your property?"

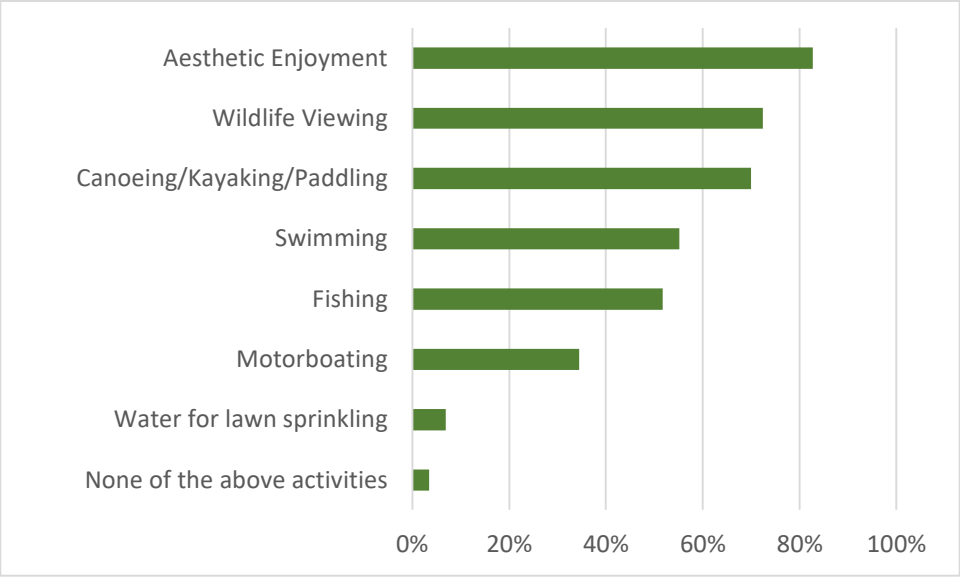


Activities for which respondents use the lake

As graphically illustrated in Figure 22:

- Aesthetic Enjoyment, and Canoeing/Kayaking/Paddling are activities for which more than 70% of residents use the lake;
- Swimming is an activity for which over 50% of residents use the lake;
- Fishing is an activity for which over 50% of residents use the lake;
- Wildlife Viewing is an activity for which 72.4% of residents use the lake; and

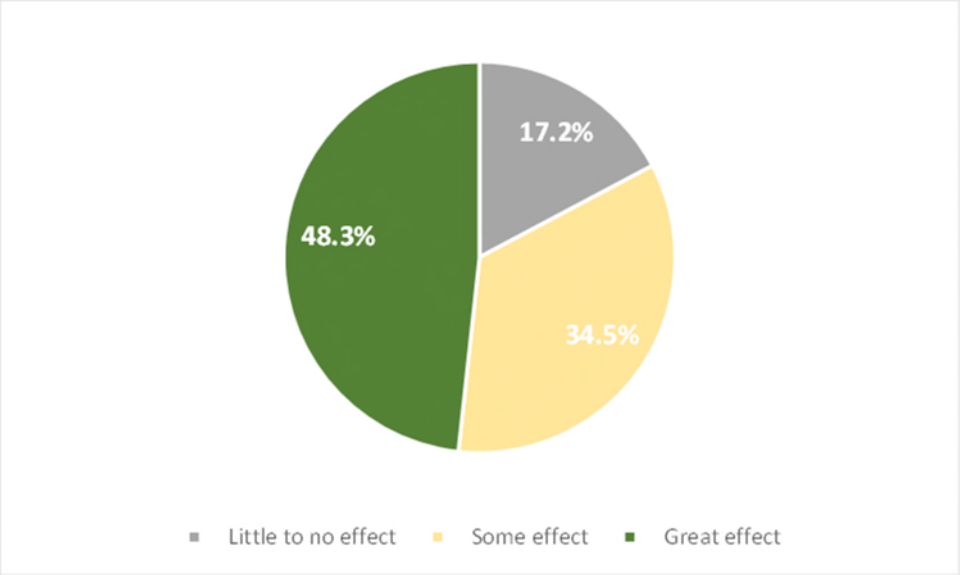
Figure 22: Responses to "What activities do you use the lake for?"



Extent to which water quality has an effect on residents' decisions to use the lake for activities

As graphically illustrated in Figure 23, water quality has at least some effect on decisions by nearly 83% of residents to use the lake for activities.

Figure 23: Responses to "To what extent does water quality have an effect on your decision to use the lake for activities?



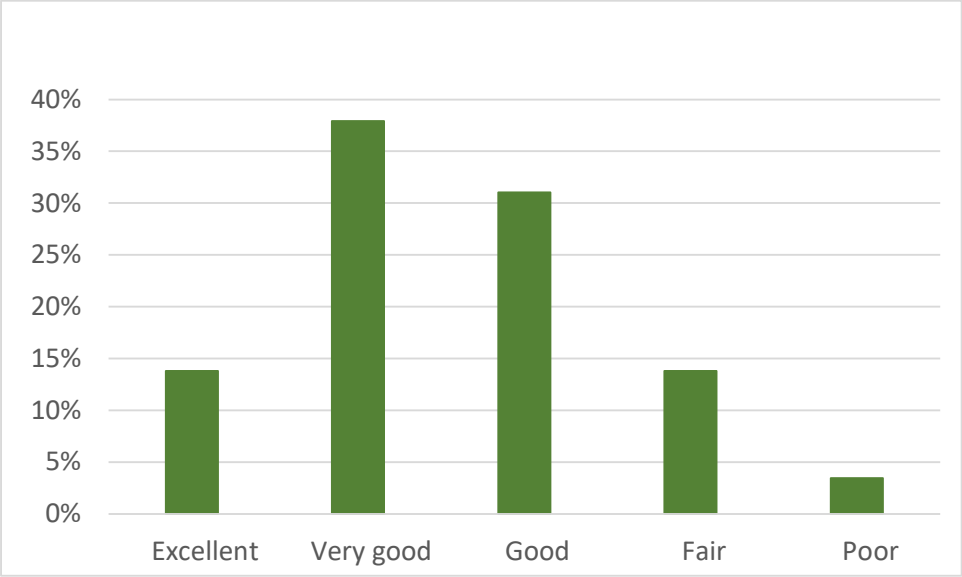
Health Of The Lake

Descriptions of the overall quality of the lake

As graphically illustrated in Figure 24:

- Less than 20% of any respondent residence category described the overall quality of the lake as "Excellent";
- Among all residence categories of respondents, 30% to 40% described the overall quality of the lake as "Very Good";
- The highest percentage for any description was "Good" by 60% of Seasonal residents; and
- Less than 5% of any resident category described the overall quality of the lake as "Poor".

Figure 24: Responses to "How would you describe the overall quality of the lake?"



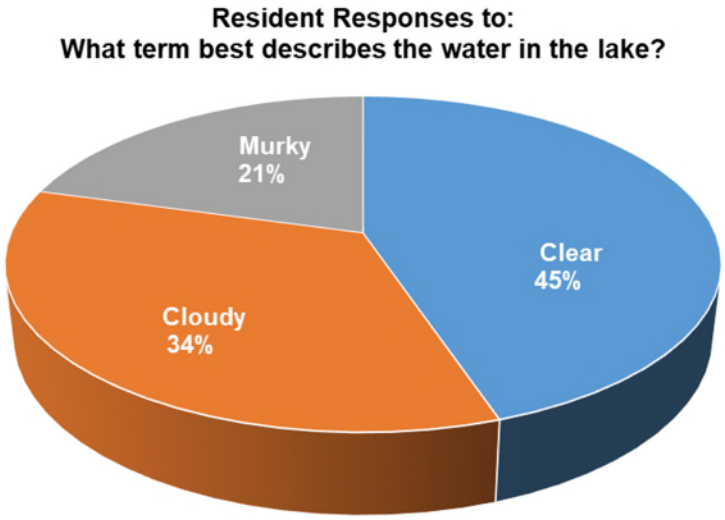
Descriptions of the water in the lake

As graphically illustrated in Chart 6 below:

- "Clear" was the description selected by 45% of All residents and 50% of Year-round residents, 60% of Off Lake residents, and only 20% of Seasonal residents;
- "Cloudy" was the description selected by 30% to 40% of All respondents, Year-round residents, Seasonal residents, and Lakeside residents, but only 20% of Off Lake residents; and

- "Murky" was the description selected by about 20% of All residents, Year-round residents, Lakeside residents, and Off Lake residents, but 40% of Seasonal residents.

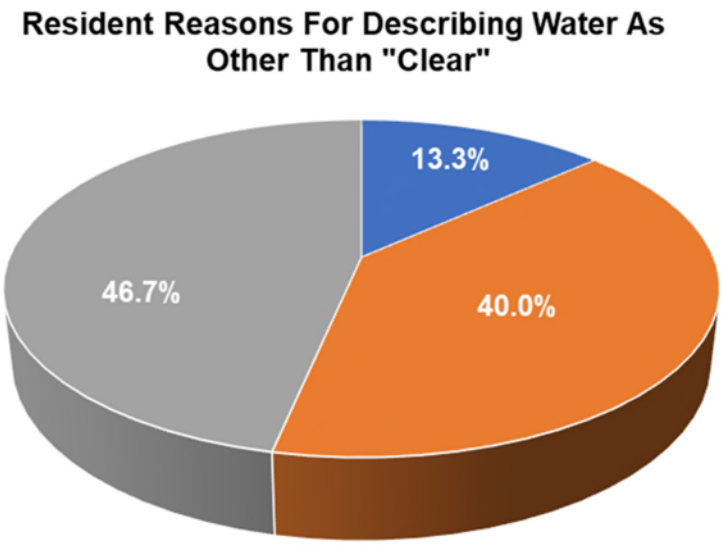
Figure 25: Responses to "What term best describes the water in the lake?"



And, as graphically illustrated in Figure 26, the respondents who described the water in the lake as Cloudy or Murky said their answer was prompted by:

- "Thickness of sediment in the lake" was the factor cited by the highest percentage of respondents—47% of residents;
- "Amount of aquatic plants below the surface" was the second most cited factor—40% of residents; and
- "Amount of aquatic plants at the surface" was the factor cited by the lowest percentage of respondents—13% of residents.

Figure 26: Responses to "If you answered with a term other than 'clear', what factors prompted your answer?"

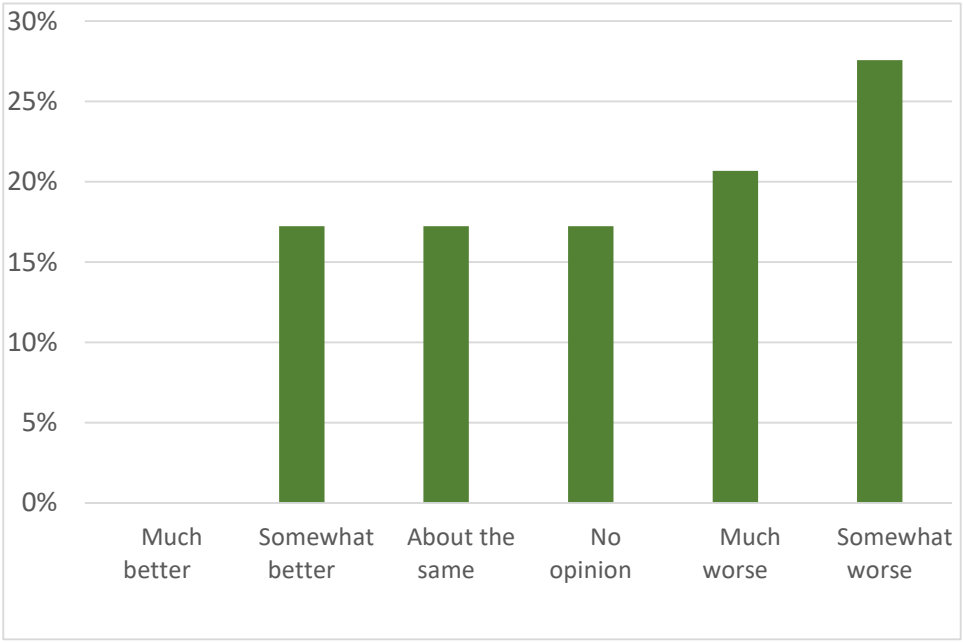


Whether the health of the lake in summer 2021 was better or worse than in summer 2020

As graphically illustrated in Figure 27:

- "Somewhat worse" was the answer selected by the highest percentage—28% of residents;
- "Much worse" was the second most selected answer—21% of residents;
- "No opinion" was the answer selected by 17% of residents; and
- "Much Better" was not selected by any respondent.

Figure 27: Responses to "Would you say the 'health' of the lake in summer 2021 was better or worse than in summer 2020?"

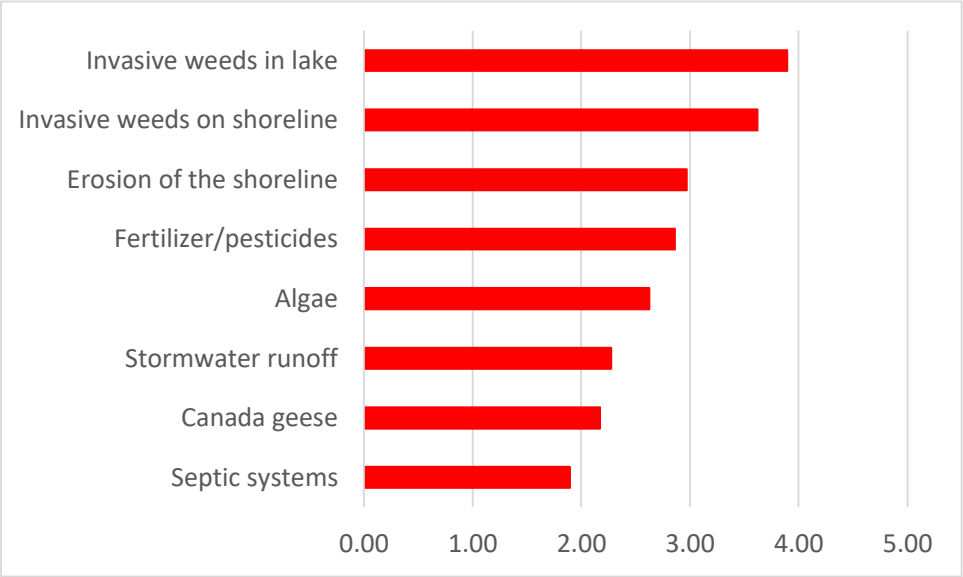


Extent to which issues are negatively impacting the lake and shoreline

As graphically illustrated in Figure 28, responses to "Please rate the issues listed below from 1-5 based on how you feel they are negatively impacting the lake water and shoreline, with 1 being the least amount of impact and 5 being the greatest amount of impact":

- "Invasive weeds in the lake" received the highest average response—3.90;
- "Invasive weeds on shoreline" received an average response of 3.62; and
- "Algae", "Canada geese", "Erosion of shoreline", "Fertilizer/pesticides", "Septic systems", and "Stormwater runoff" all received an average response less than 3.00.

Figure 28: Average of responses to "Please rate the issues listed below from 1-5 based on how you feel they are negatively impacting the lake water and shoreline."



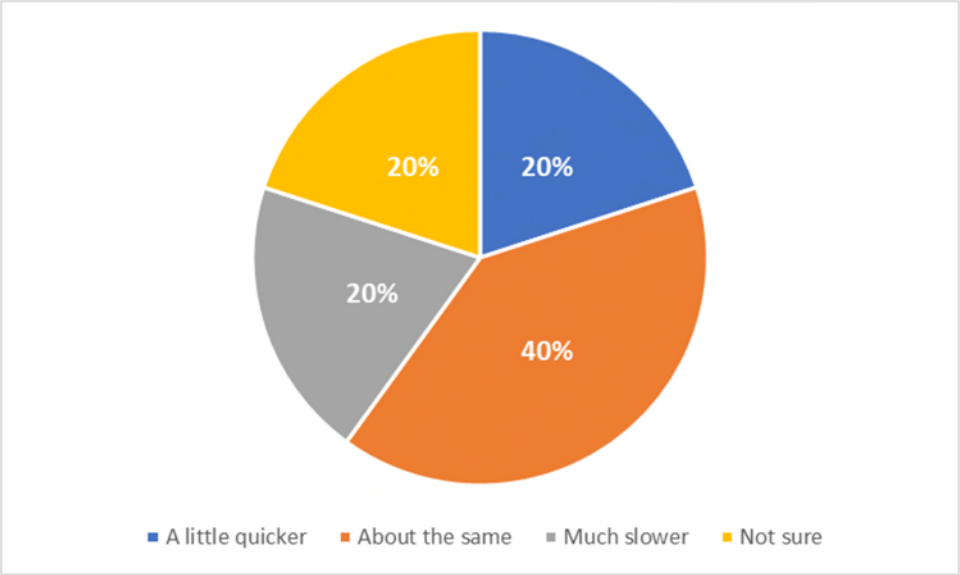
Fishing

Usual fishing catch rate in the summer of 2021 better or worse than in summer 2018

As graphically illustrated in Figure 29:

- "About the Same" was the answer selected by the highest percentage—40%;
- "A little quicker", "Much slower", and "Not Sure" were each the selected answer of 20%; and
- "Much quicker" was not selected by any respondent.

Figure 29: Responses to "How did your usual fishing catch rate in the summer of 2021 compare to your usual fishing catch rate in the summer of 2018?"

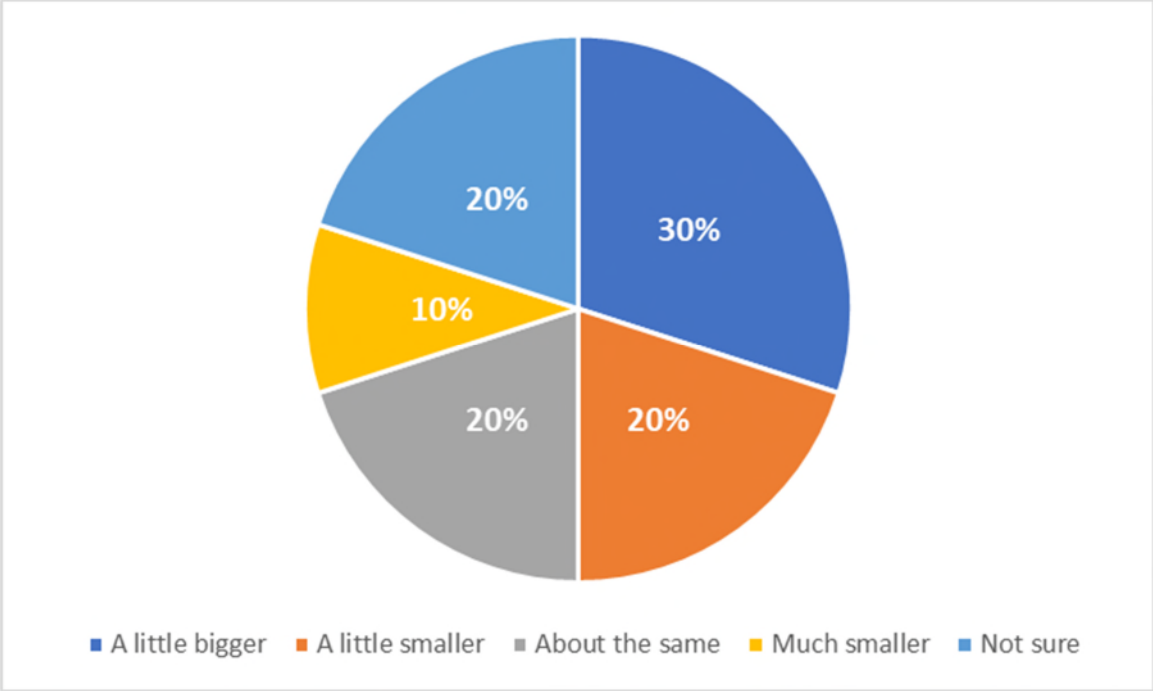


Average size of the fish caught in the summer of 2021 compared to the size of the fish caught in the summer of 2018

As graphically illustrated in Figure 30:

- "A little bigger" was the answer selected by the highest percentage—30%;
- "A little smaller", "About the same", and "Not Sure" were each the selected answer of 20%; and
- "Much smaller" was the answer selected by 10%.

Figure 30: Responses to "How would you say the average size (length and weight) of the fish you caught in the summer of 2021 compared to the size of the fish you caught in the summer of 2018?"

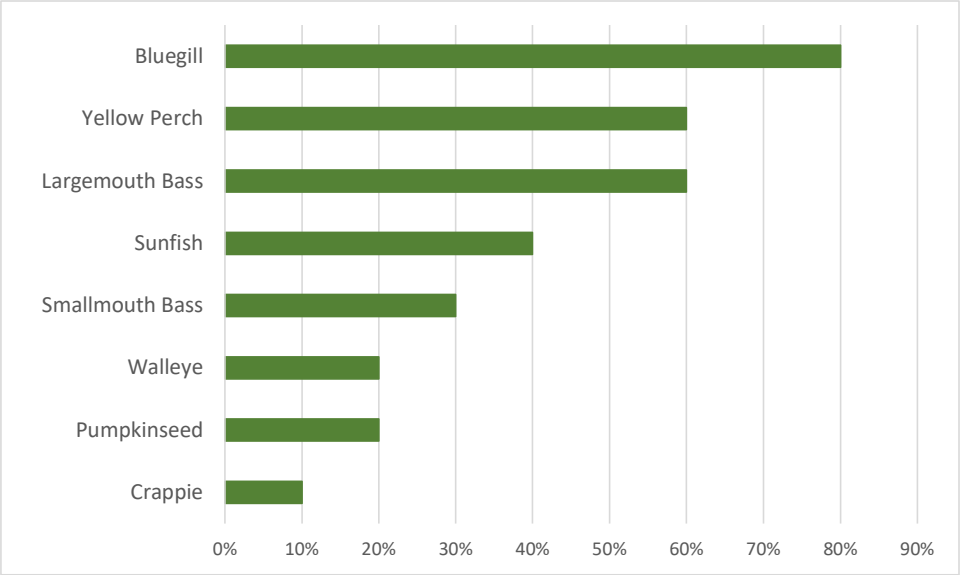


What species did you catch?

As graphically illustrated in Figure 31:

- Bluegill were caught by 80%;
- Yellow Perch were caught by 60%;
- Largemouth Bass were caught by 60%;
- Sunfish were caught by 40%;
- Smallmouth Bass were caught by 30%;
- Pumpkinseed were caught by 20%;
- Walleye were caught by 20%; and
- Crappie were caught by 10%.

Figure 32: Responses to "What species did you catch (check all that apply)?"

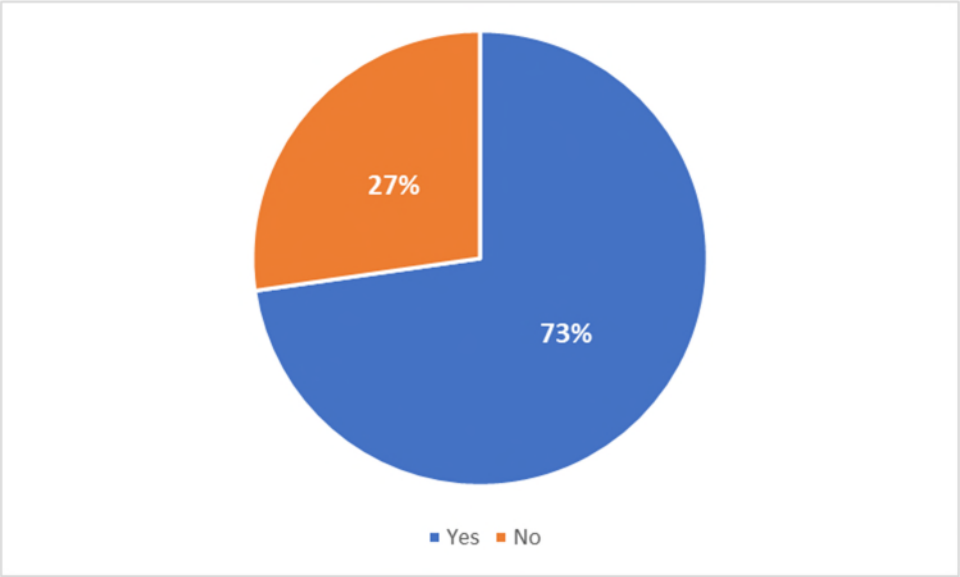


Would you be willing to, maybe 2 - 3 times per season, complete an "angler report" of the species and size of fish you've caught?

As graphically illustrated in Chart 13 below:

- 73% answered "Yes"; and
- 27% answered "No".

Figure 33: Responses to "Would you be willing to, maybe 2 - 3 times per season, complete an 'angler report' of the species and size of fish you've caught?"



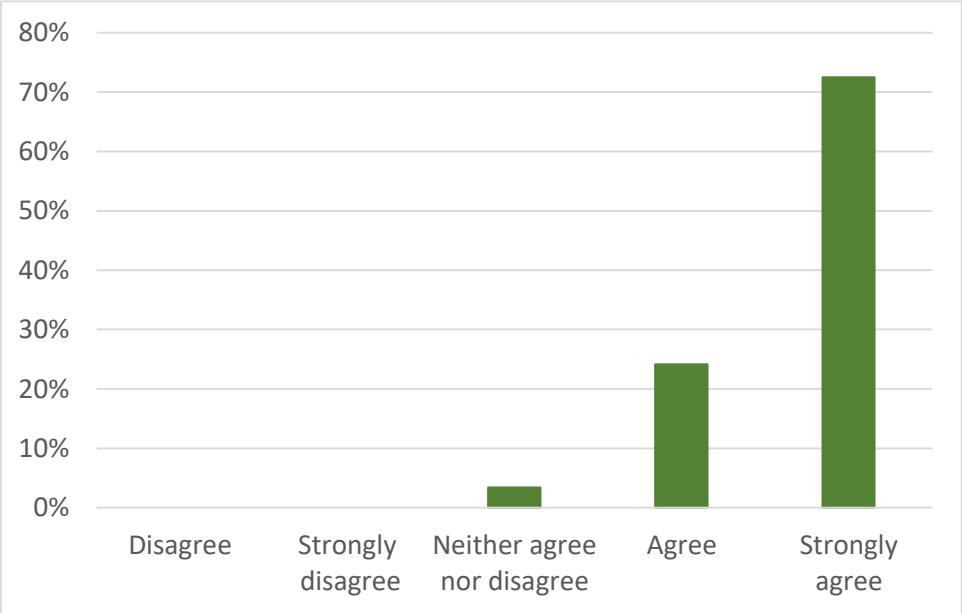
Lake Management

To what extent do you agree that the following statement expresses a goal of lake management for Pine Canyon Lake: "To reduce invasive weed colonization and maintain the boating, fishing, and swimming potential of the lake while protecting the fish and wildlife habitat"?

As graphically illustrated in Figure 34:

- "Strongly Agree" was the answer selected by the highest percentage of at 73%;
- "Agree" was the answer selected by the second highest percentage of All at 24%;
- "Neither Agree Nor Disagree" was the answer selected by 3%; and
- "Disagree" and "Strongly Disagree" were not selected by any respondent.

Figure 34: Responses to "To what extent do you agree that the following statement expresses a goal of lake management for Pine Canyon Lake: 'To reduce invasive weed colonization and maintain the boating, fishing, and swimming potential of the lake while protecting the fish and wildlife habitat'?"

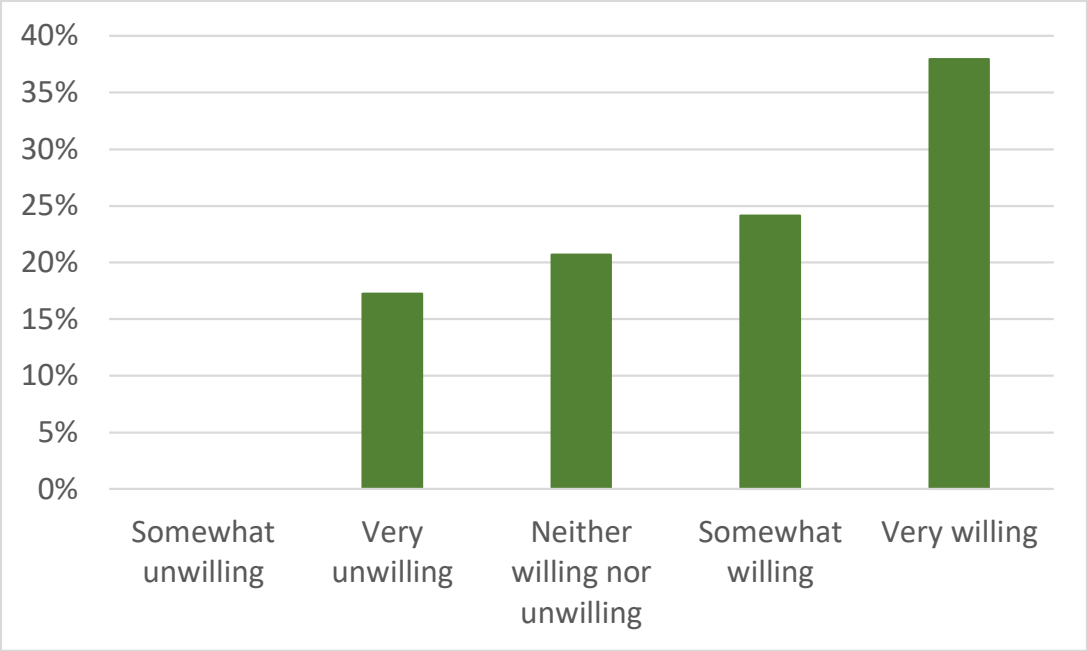


To what extent would you be willing to pay increased annual Pine Canyon Lake Association dues (if necessary) to help fund the cost of services for weed control and lake water quality management?

As graphically illustrated in Figure 35:

- "Very Willing" was the answer selected by the highest percentage at 38%;
- "Somewhat Willing" was the answer selected by the second highest percentage at 24%;
- "Neither Willing Nor Unwilling" was the answer selected by 21%;
- "Somewhat Unwilling" was not selected by any respondent; and
- "Very Unwilling" was the answer selected by 17%.

Figure 35: Responses to "To what extent would you be willing to pay increased annual Pine Canyon Lake Association dues (if necessary) to help fund the cost of services for weed control and lake water quality management?"



PLAN GOALS, OBJECTIVES AND ACTIONS

The following sections set forth the Pine Canyon Lake Association's Overarching Vision for the lake, Goals and Objectives for aquatic and shoreline invasive species, water quality, fish population, watershed conditions and community engagement, and the Actions and Implementation Plan that will be used to achieve those Goals and Objectives.

In this context:

- *Goals* are broad statements relating to what the PCLA wants to accomplish over the long term.
- *Objectives* are measurable steps toward a Goal.
- *Actions* are the specific steps that will be taken to accomplish an Objective.
- The *Implementation Plan* outlines the timeline, resources needed, and funding sources for each Action item.

Overarching Vision

Pine Canyon Lake will host a balanced aquatic plant community that benefits the health of the lake and provides quality habitat, but does not impede lake users' enjoyment of the lake or outdoor activities. Clean, clear water will support abundant fish and wildlife. Beauty and peacefulness will be preserved in the lake's natural setting and promote quality of life spent in aesthetic enjoyment, canoeing/kayaking/paddling, motorboating, swimming, and wildlife viewing.

Goal 1: Control aquatic and shoreland invasive species

Objectives:

A. Presence and extent of Watermilfoil are constrained to less than 5% of the lake.

B. Presence and extent of Curly-leaf Pondweed are constrained to less than 5% of the lake.

C. Presence and extent of Narrow-leaved Cattail, Phragmites, Purple Loosestrife, and Yellow Flag Iris are constrained to less than 1% on the shoreland.

D. Protective measures are established to prevent introduction into the lake of invasive species animals—such as carp, non-indigenous and exotic fish and crayfish species, and Zebra mussels—and pathogens such as the Largemouth Bass virus.

Actions:

A. Engage a lake management professional to identify, map, and apply control treatment to Watermilfoil and Curly-Leaf Pondweed present in the lake.

B. Engage a lake management professional (or a qualified lake resident) to identify and apply control treatment (glyphosate) to Narrow-Leaved Cattail, Phragmites, Purple Loosestrife, and Yellow Flag Iris Present on the shoreland.

C. Maintain in the PCLA treasury a non-lapsable contingency fund for rapid response to the detection of Watermilfoil, Curly-Leaf Pondweed, or other invasive species.

D. Educate and engage lake residents in the execution of protective measures to prevent introduction of invasive species by all likely pathways to entry—such as boats, live wells, trailers, and bait buckets. (See Goal 7).

Goal 2: Protect the natural functions that diverse native plants provide both in the water and on the shore

Objective:

Control measures applied in the Actions under Goal 1 to treat aquatic and shoreland invasive species plants result in no more than minimal damage to native species (i.e., no statistically significant decline in native plant frequency of occurrence within treatment areas).

Action:

Ensure that the lake management professionals engaged for Action under Goal 1 are aware of potential native plant and animal impacts and modify their treatment strategies if necessary to address proven concerns.

Goal 3: Maintain and enhance lake water quality

Objectives:

A. Water quality standards for the testing factors listed in Objective B below are established for Pine Canyon Lake, which:

- are consistent with its ecoregion, hydrological type, and morphometry;
- when used to compute a TSI score, produce a result of 43 or lower; and
- in the most recent version of the "EPA's Lake Comparison Tool" (https://owshiny.epa.gov/nla-lake-context-tool/) provided by the National Lakes Assessment* program of the U.S. Environmental Protection Agency, are in the following percentiles:

- o Secchi Depth above the 98th Percentile for Indiana Lakes (For Secchi Depth, an upper percentile ranking is preferable.)
- o Phosphorous below the 10th Percentile for Indiana Lakes (For Total Phosphorus, a lower percentile ranking is preferable.)
- o Nitrogen below the 10th Percentile for Indiana Lakes (For Total Nitrogen, a lower percentile ranking is preferable.)
- o Chlorophyll-*a* below the 10th Percentile for Indiana Lakes (For Chlorophyll-*a*, a lower percentile ranking is generally preferable.)

***Note:** National Lakes Assessment (NLA) is a statistical survey of the condition of our nation's lakes, ponds, and reservoirs—capturing the values of Secchi Depth, Total Phosphorous, Total Nitrogen, and Chlorophyll-*a*. It is designed to provide information on the extent of lakes that support healthy biological condition and recreation. The NLA has been conducted during the summer every five years since 2007. Survey results are used to assess the extent to which lakes meet designated uses as well as provide statistically-defensible assessments of water quality.

B. Water testing is conducted at least once every summer for the following factors:

1. Secchi Disk Transparency. Secchi Disk Transparency, measures water clarity by indicating how far down light can penetrate through the water column. Clear waters are characterized by low concentrations of suspended soil particles and/or algae, whereas turbid waters are marked by high levels of suspended particles that cloud visibility by absorbing and scattering light. Because water clarity is closely related to light penetration, it has important implications for the diversity and productivity of aquatic life that a system can support. For example, clearer water allows more sunlight to reach submerged aquatic vegetation. The vegetation, in turn, produces oxygen, provides habitat for fish, and provides food for waterfowl, fish and mammals. Additionally, of course, clear water is generally valued for aesthetic and recreational purposes.
2. Phosphorous. Phosphorus is usually considered the "limiting nutrient" in aquatic ecosystems, meaning that the available quantity of this nutrient controls the pace at which algae and aquatic plants are produced. In appropriate quantities, phosphorus can be used by vegetation and soil microbes for normal growth. However, in excess quantities, phosphorus can lead to water quality problems such as eutrophication and harmful algal growth. As phosphorus generally occurs in small quantities in the natural environment, even small increases can negatively affect water quality and biological condition.
3. Nitrogen. In appropriate quantities, Nitrogen supports the growth of algae and aquatic plants. Increased nitrogen inputs to the lake can stimulate excessive growth of algae and aquatic plants, thereby creating eutrophic conditions that interfere with recreation and the health and diversity of vegetation, insects, fish, and other aquatic organisms. Over time, animal and plant species composition may shift as native species decline and are replaced by species that take advantage of high nutrient levels. This change in community composition can cause declines in ecological condition and alter the functions that the lake provides to the environment.

4. Chlorophyll-*a.* The concentration of Chlorophyll-*a* is a measure of the amount of algae growing in the lake. Although algae are a natural part of freshwater ecosystems, too much algae can cause aesthetic problems such as green scums and bad odors, and can result in decreased levels of Dissolved Oxygen.

5. Dissolved Oxygen/Temperature Profiles To At Least 13-meter Depth. Dissolved Oxygen is considered an important measure of water quality as it is a direct indicator of an aquatic resource's ability to support aquatic life. The level of Dissolved Oxygen is measured with a calibrated probe meter, usually in conjunction with measurement of temperature. While each organism has its own Dissolved Oxygen tolerance range, generally, Dissolved Oxygen levels below 3 milligrams per liter (mg/L) are of concern and waters with levels below 1 mg/L are considered hypoxic and usually devoid of life. (Low levels of oxygen or no oxygen levels can occur when excess organic materials, are decomposed by microorganisms. During this decomposition process, Dissolved Oxygen in the water is consumed. Low oxygen levels often occur at the bottom of the water column and affect organisms that live in the sediments.)

6. E. coli. E. coli are indicators of the presence of fecal material in water and, therefore, of the possible presence of disease-causing bacteria, viruses, and protozoa. These pathogens can sicken swimmers and others who the lake for recreation. Health effects can include diseases of the skin, eyes, ears, and respiratory tract. Eating fish harvested from waters with fecal contamination can also result in human illness.

7. Trophic State Index. Trophic State Index (TSI) is a classification system designed to estimate the biological condition of the lake. The concentrations of Phosphorus, Nitrogen and Chlorophyll-*a* are the primary determinants of the lake's TSI. The TSI of the lake is rated on a scale from zero to one hundred. Under the TSI scale, the lake would be classified as:

    - *Oligotrophic*—TSI 0 to 40—having the least amount of biological productivity, "good" water quality;
    - *Mesotrophic*—TSI 40 to 50—having a moderate level of biological productivity, "fair" water quality;
    - *Eutrophic*—TSI 50 to 70—having the highest amount of biological productivity, "poor" water quality); or
    - *Hypereutrophic*—TSI 70 to 100—having the highest amount of biological productivity, "very poor" water quality).

C. Measures are enacted to bring the five-year moving average of the results of all the above-listed tests to be equal to or better than the standards established in Objective A above.

Actions:

A. Engage a lake management professional to recommend water quality standards as specified in Objective A above.

B. Engage a lake management professional to perform the water testing specified in Objective B above, and produce a written report of findings for publication to residents.

C. Publish to residents an annual report of the results of testing specified in Objective B above and related information including (i) a "report card", perhaps similar to the example shown in Figure 36 on the following pages, and (ii) in-depth analysis with data and trend charts like those shown in Table 2, Figure 2, Figure 5, Figure 6, Figure 7, Figure 8, and Figure 9 above.

D. Engage a lake management professional to recommend measures to bring the five-year moving average of the results of all the above-listed tests to be equal to or better than the standards established in Objective A above.

E. Engage a lake management professional to give specific attention to the Dissolved Oxygen depletion below the depth of six meters, by diagnosing the cause and recommending remedial action. For example, if the cause is diagnosed to be possibly decomposing plants, the remedial action might be dredging parts of the lake to reduce biochemical oxygen demand.

Goal 4: Enhance the fish population

Objectives:

A. High-quality Bluegill population, at moderately high density, with a significant proportion of preferred-size fish and Percentage Size Distribution better than the present 25. (High-quality populations of Bluegill have PSD values from 25 to 60.)[1]

B. Well-balanced Largemouth Bass population, at moderately high density, with a significant proportion of preferred-size fish and substantial improvement of the Percentage Size Distribution from the present 15, which falls in the "needs help" category. (High-quality populations of Largemouth Bass have PSD values of 20 to 60.)[2]

C. Walleye population of moderately low density (2 to 4 adults per acre) with a moderately high proportion of quality-size fish—50 to 70% a length of 15 inches or more*. This is beneficial because it aids in achieving a well-balanced Largemouth Bass population by providing a predator to eat small Bass and it adds desirable game fish to the lake.

*Although several external and internal factors will determine their average annual growth and growth rates between different populations and habitats can vary greatly, Walleye typically grow 3 to 5 inches per year during their first 5 to 6 years. Once they reach maturity, their growth rate slows down to about 1 to 3 inches per year. In North America, the typical size of Walleye when caught is on the order of 12 to 20 inches.[3]

[1] Commonwealth Biomonitoring, "Pine Canyon Lake Fish Survey-2019", Indianapolis, 2019

[2] Ibid

[3] FishUSA.com, https://forums.fishusa.com/

Figure 36: Example Lake Health Report Card

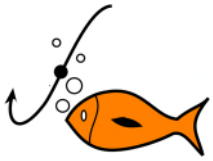
Pine Canyon Lake Association

Lake Health Report Card

PCLA, established in 1993, serves to respect and maintain our privately owned forest, lake and land. We are home to a healthy deer population, a beaver den, and an abundant variety of native fish and birds. Most recently we have been visited by endangered wildlife such as the American Bald Eagle and native gray fox. Our stewardship includes educating residents and guests that we will protect the nature and beauty we all share.

This year we are issuing our first "Report Card" to overview the lake's health. These quality measures will be tracked and monitored each year as part of our long-term plan and commitment.

What we Track			Score	Grade	Trend
Lake & rainfall levels: Measured off the Angola historical average (tracked since 1930).					
Water clarity: measured with a Secchi disk, is a reading of how far one can see into the water. Water clarity is affected by the amount of algae and sediment in the lake.					
Phosphorous: an essential plant nutrient and most often controls aquatic plant growth in freshwater. A scarcity of phosphorus may limit the ultimate growth and production of algae and rooted aquatic plants**.**					
Chlorophyll-*a:* a pigment found in algae, is used as a direct estimate of the abundance of algae in the lake.					

Dissolved Oxygen: Critical for the survival of aquatic life and ecosystem sustainability. A score of 100% means that all of the water column to a depth of 13 meters contains at least one part per million Dissolved Oxygen.					
Fish (measurements reported by residents who regularly fish): Number of species, size, & quantity					
Native and non-native vegetation: Measures the presence of plants essential for a healthy habitat for young fish and aquatic life. Invasion and non-native vegetation are selectively controlled by approved herbicide applications and inspected by regrowth/new colonies.					
Fecal Bacteria: Levels must be below 235 MPN/100ml for safe swimming and water activities. Contamination is caused by sewage discharges and leaks, as well as pets & wildlife. (Residents receive annual reminders for septic maintenance)					
Shoreline: Highlights a healthy and natural habitat of resident water access, includes no docks or construction.					
Stormwater/drain and landscape Runoff: Herbicide and pesticide pollution enters the lake in runoff from farmland, pavement and landscape. Residents receive annual reminders to keep drain collections clean and only use natural, organic and/or phosphorus-free fertilizers.					

D. The lake's Index of Biotic Integrity Class is maintained at "Good". (Biotic Integrity means the ability of a body of water to support and maintain a community of organisms that has the expected species composition, diversity, and functional organization comparable to that of the water in its natural condition. The Index of Biotic Integrity is a protocol to summarize a series of 12 metrics reflecting insights from several aspects of a fishery study into a single numerical value. The Commonwealth Biomonitoring, "Pine Canyon Lake Fish Survey-2019" stated Pine Canyon Lake's Total IBI score was 44, which translated into "Integrity Class: Good"[4].)

E. A bathymetric map of the lake illustrates the land that lies underwater and improves knowledge of where fish and other lake life feed, live, and breed.

Actions:

A. Improve fish habitat in the lake.

1. Reduce the growth of aquatic invasive weeds to improve visibility for Largemouth Bass and improve Bluegill size structure. (See Goal 2.)

2. During weed control efforts, carefully preserve native aquatic vegetation as fish habitat. (See Goal 1.)

3. Encourage shoreland erosion control practices to prevent high turbidity in the lake. (See Goal 5.)

4. Include information about the importance of *native* aquatic plants and woody habitat to the fish community in the PCLA Guidance For Residents Packet distributed to new shoreland owners and annually to existing shoreland owners. (See goal 7.)

B. Adopt limits for Pine Canyon Lake Largemouth Bass, including:

1. a slot limit that prohibits anglers from keeping Largemouth Bass between 12 and 15 inches and permits only two bass over 15 inches, and

2. a bag limit of five, so anglers can fill out limits with Bass under the slot limit or keep up to five "unders."*

*(See Appendix A for a *South Bend Tribune* article describing the results of an experiment with these Largemouth Bass rules on Big Long Lake in Lagrange County.)

C. Conduct alternate-year stocking of at least 400 large (i.e., >7") Walleye fingerlings. A report in 2019 by Commonwealth Biomonitoring recommended against Walleye stocking. Nevertheless, stocking was done in 2020 with the approval of the PCLA Board of Directors. In the course of preparing this Lake Management Plan, the Fish & Weed Committee obtained a December 2021 KPCnews.com article that the Committee believes supports the continuation of Walleye stocking. The article reported recent Walleye stocking in several northern Indiana lakes, including three lakes in Steuben

[4] Commonwealth Biomonitoring, "Pine Canyon Lake Fish Survey-2019", Indianapolis, 2019

County. (A copy of the article is attached as Appendix B.) Accordingly, the Committee believes the continuation of Pine Canyon Lake Walleye stocking is appropriate to aid in achieving a well-balanced Largemouth Bass population by providing a predator to eat small Bass and adding desirable game fish species to the lake.

D. Collect from resident anglers two to three times each season an "angler creel survey" of the species and sizes of fish they have caught.

F. Engage a lake management professional to conduct a bathymetric survey and produce a bathymetric map of the lake similar to that shown in Figure 37.

Figure 37: Example Lake Bathymetric Map

Goal 5: Enhance shoreland area conditions

The shoreland area encompasses three components: the upland fringe, the shoreline, and the shallow water area by the shore.

The lake's shoreland area is important to its biological integrity and water quality. A naturally-vegetated shoreland filters runoff generated by surrounding land uses, removing harmful chemicals and nutrients. At the same time, shoreland vegetation protects lake edges from the onslaught of waves and ice generated by our harsh Midwestern climate. The shoreland area also provides critical habitat for aquatic insects, microorganisms, fish, and other animals, thereby helping to maintain a balance in sensitive aquatic ecosystems.

Of the lakeside platted parcels around Pine Canyon Lake about three-fourths have buildings on them.

Some are like the picture below and would rate as having shoreland with a buffer greater than 50% of the lot width and an understory with greater than 50% natural cover.

But others are like the picture below and do not have a natural shoreland buffer greater than 50% of the lot width. Also, the understory in the upland area would be rated as having less than 50% natural cover.

Objectives:

A. Pine Canyon Lake Shoreland Best Management Practices, as set forth in detail in Appendix C, are created and communicated to the Pine Canyon Lake Community:

1. Creating a Shoreline Buffer Strip - Ensuring Clean Runoff;
2. Establishing a No Mow Zone - Bank Stabilization;
3. Creating Rain Gardens - Ensuring Clean Runoff;
4. Lake-Friendly Yard Maintenance - Ensuring Clean Runoff; and

5. Maintaining On-Site Sewage Disposal Systems.

B. PCLA rigorously enforces the restrictions set forth in Protective Restrictions, Covenants, Limitations and Easements for Pine Canyon Lake, Section 13, which state:

"No person shall erect, construct or maintain any pier or other structure, permanent or temporary, in the lake, on the lake or anywhere on the beach area" and

"Wherever there are trees located between the proposed building site for any residence and the lake, those trees shall, wherever possible, be maintained and not cut for yard area purposes".

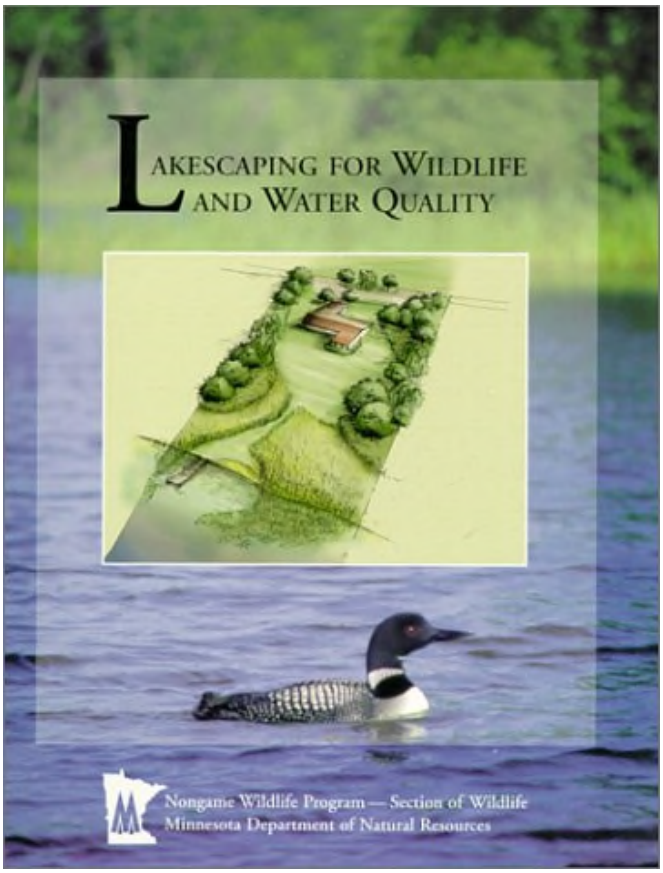
C. PCLA rigorously enforces the restrictions set forth in Protective Restrictions, Covenants, Limitations and Easements for Pine Canyon Lake, Section 13.

D. No boats or recreational items that are no longer in active use are present on the shoreland.

Actions:

A. Use the Pine Canyon Lake Shoreland Best Management Practices described in Appendix B to inform and educate members of the Pine Canyon Lake Community about shoreland best management practices.

Also, there is a book that provides excellent guidance for shoreland improvements, "Lakescaping for Wildlife and Water Quality" by Carrol Henderson.



B. Periodically remind members of the Pine Canyon Lake Community of, and rigorously enforce, the restrictions set forth in Protective Restrictions, Covenants, Limitations and Easements for Pine Canyon Lake, Section 13.

Goal 6: Monitor watershed conditions

Objective:

Up-to-date awareness of activities, changes in plans, changes in land uses, and changes in water quality testing results within the Fawn River Watershed and Tamarack Lake Sub-watershed.

Actions:

Assign a member of the PCLA Environment Committee to serve as a liaison with organizations that conduct ongoing programs and advocacy related to conditions in the Fawn River Watershed and Tamarack Lake Sub-watershed areas, including the following:

1. Indiana Lakes Management Society - promotes the understanding and comprehensive management of Indiana lakes and reservoirs and their watershed ecosystems. PCLA is a member of this organization.

2. Steuben County Lakes Council - works to protect the lakes and streams of Steuben County and shares information about issues affecting the lakes and about county planning issues affecting the lakes. PCLA is a member of this organization.

Goal 7: Engage the Pine Canyon Lake community

Objectives:

A. Members of the Pine Canyon Lake Community are well informed about the PCLA's lake management strategies, and they understand the importance of controlling aquatic and shoreland invasive species, protecting the natural functions that diverse native plants provide both in the water and on the shore, and maintaining and enhancing the lake's water quality, shoreland area conditions and watershed conditions.

B. Members of the Pine Canyon Lake Community conscientiously execute protective measures to prevent introduction of invasive species by all likely pathways to entry—such as boats, live wells, trailers, and bait buckets.

C. Members of the Pine Canyon Lake Community comply with the restrictions set forth in Protective Restrictions, Covenants, Limitations and Easements for Pine Canyon Lake, Section 13, which state:

"No person shall erect, construct or maintain any pier or other structure, permanent or temporary, in the lake, on the lake or anywhere on the beach area" and

"Wherever there are trees located between the proposed building site for any residence and the lake, those trees shall, wherever possible, be maintained and not cut for yard area purposes".

D. Members of the Pine Canyon Lake Community implement the Pine Canyon Lake Shoreland Best Management Practices.

E. Members of the Pine Canyon Lake Community recognize they have a special responsibility to ensure that their on-site sewage disposal systems are not polluting the lake and actively monitor and maintain them.

F. PCLA publishes to residents an annual lake conditions "report card" summarizing the results of testing specified in Goal 3, Objective B above and related information.

Actions:

A. Maintain a program of continuing lake management education through newsletters and meetings.

B. Publish annually a lake conditions "report card", similar to the example shown in Figure 36 on the following pages, summarizing the results of testing specified in Goal 3, Objective B above and related information.

C. Educate and engage members of the Pine Canyon Lake Community in the execution of protective measures to prevent introduction of invasive species by all likely pathways to entry—such as boats, live wells, trailers, and bait buckets.

D. Educate members of the Pine Canyon Lake Community about the Pine Canyon Lake Shoreland Best Management Practices.

E. Annually remind members of the Pine Canyon Lake Community of, and rigorously enforce, the restrictions set forth in Protective Restrictions, Covenants, Limitations and Easements for Pine Canyon Lake, Section 13, which state "No person shall erect, construct or maintain any pier or other structure, permanent or temporary, in the lake, on the lake or anywhere on the beach area" and "Wherever there are trees located between the proposed building site for any residence and the lake, those trees shall, wherever possible, be maintained and not cut for yard area purposes".

F. Annually remind homeowners to actively monitor and maintain their on-site sewage disposal systems—including pumping the septic tank on a regular basis as determined by annual inspection or about every 2-3 years.

MOVING FORWARD

Actions to be executed by lake management professionals

The Actions described above for achieving Goal 1: Control aquatic and shoreland invasive species, Goal 2: Protect the natural functions that diverse native plants provide both in the water and on the shore, and Goal 3: Maintain and enhance lake water quality can be executed only by lake management services professionals.

Therefore, the Fish & Weed Committee sent a request for proposals to eight lake management professional companies which met one or more of the following criteria:

- previously provided services to PCLA,
- member of Society of Lake Management Professionals,
- member of Indiana Lakes Management Society,
- previously quoted services to PCLA.

The Committee reviewed proposals, contacted references, analyzed costs, and decided to recommend to the PCLA Board that PLM Lake & Land Management Corp. be engaged under a five-year services agreement for performing annual lake management services and conducting a bathymetric survey and producing a bathymetric map of the lake. The Committee

also recommended the form of a Professional Services Contract to be used as legal documentation of this five-year services agreement.

PLM is a nationwide company with extensive service capabilities and is well qualified to provide the services PCLA will need to execute the Actions to achieve its lake management goals and objectives. (See PLM'S website at https://www.plmcorp.net/) PLM has an office in Sturgis, Michigan, and staff from that office will perform the services for Pine Canyon Lake.

During the 2022 PCLA Annual Meeting, members authorized the PCLA Board to enter into the recommended Professional Services Contract with PLM. The Professional Services Contract was then signed by authorized representatives of PCLA and PLM effective September 21, 2022.

Lake management services in 2022 - 2023

PLM will perform the following lake management services in 2022 and 2023:

Fall 2022: Set budget for 2023

Winter 2022-2023: Establish a plan for the 2023 season.

Spring 2023: Notify all residents via mailing/email of the proposed treatment schedule.

May/June 2023: Perform Spring Survey, herbicide application for Watermilfoil and Curly Leaf Pondweed, and water quality testing.

June/July 2023: Perform follow-up surveys, follow-up herbicide/algaecide application, water quality testing, and E. coli testing.

August/September 2023: Perform herbicide/algaecide application if needed and water quality testing. Survey for Phragmites and provide PCLA with price for Phragmites found. Perform treatment for Phragmites in September.

Fall 2023: Meet with PCLA representatives for a year-end review of the program and to plan the program and budget for 2024. Perform bathymetric survey and mapping* if actual expenses for 2023 are enough ($875) under budget.

Lake management services 2024 through 2027

PLM will perform the following lake management services in 2024, 2025, 2026 and 2027:

Fall 2024: Perform bathymetric survey and mapping* if it was not done in 2023.

Winter: Establish a work schedule for the next season.

Spring: Notify all residents via mailing/email of the proposed treatment schedule.

May/June: Perform Spring Survey, herbicide application for Watermilfoil and Curly Leaf Pondweed, and water quality testing.

June/July: Perform follow-up surveys, follow up herbicide/algaecide application, water quality testing, and E. coli testing.

August/September: Perform herbicide/algaecide application if needed and water quality testing. Survey for Phragmites and provide PCLA with price for Phragmites found. Perform treatment for Phragmites in September.

Fall: Meet with PCLA representatives for a year-end review of the program and plan the program and budget for the next year.

*The bathymetric mapping will be a one-time service. Other services will be performed in 2024 through 2027 in accordance with an annual plan agreed between PCLA and PLM representatives each year.

Cost of PLM's services

General

PLM's proposal states:

"PLM bills per acre depending on product dosages used. You will only ever be billed for the services and treatments rendered. Therefore, we set our budgets up with a high, expected, and low end to show variances available in management programs. Treatments will vary from year to year as well and that is accounted for in management programs such as the proposal here. PLM will prepare treatment maps and recommendations while working within the established budget to the best of our ability."

"As an incentive to establish a multiple-year agreement we will treat your lake at the same price structure as 2023 for 2024! The remaining three years (2025, 2026, 2027) will have cost increases of three percent per year or less. If total chemical cost increases 10% from the previous year a new agreement will have to be mutually acceptable. If during the life of the contract regulatory agencies significantly change the approved treatment procedures, or for other reasons, either party may terminate this agreement upon giving ninety (90) days advance written notice thereof."

Cost of services for 2023

The PCLA's budget for 2023 provides $5,000 for lake management services, and PLM's services will be limited so the cost will stay within that budgeted amount.

Pine Canyon Lake will definitely need the following services in 2023:

- Eurasian Watermilfoil Control – Despite extensive systemic herbicide treatment of the Watermilfoil in 2022, there will be at least some new growth from seeds carried in from other lakes by wind and birds.
- Curly Leaf Pondweed Control – The lake had Curly Leaf Pondweed in May 2022. Scott Banfield of Aquatic Enhancement & Survey, Inc. recommended in an email that it should be treated, but the PCLA Board did not engage Aquatic Enhancement to do that treatment. So, the lake will have even more Curly Leaf Pondweed by spring 2023.

- Phragmites Control – Phragmites have been observed growing along the shoreline.
- Water Quality Testing – No water quality and E. coli testing has been performed in 2022—for the first time since 2014—and it would be unwise to skip another year.

PLM's cost estimates for these services are:

Service	Cost
Eurasian Watermilfoil Control	$2,940
Curly Leaf Pond Weed Control	$500
Phragmites Control	$800
Water Quality and E. coli Testing	$760
Total	$5,000

It will be highly beneficial for Pine Canyon Lake to have bathymetric surveying and mapping conducted as soon as possible because:

- a bathymetric map will enable much more precise targeting in the application of herbicides to control aquatic invasive species weeds and, thereby, might significantly lessen the future cost of controlling Eurasian Watermilfoil and Curly-Leaf Pondweed,
- a bathymetric map will facilitate enhancing the fish population by illustrating the land that lies underwater and improving knowledge of where fish and other lake life feed, live and breed, and
- a bathymetric map will assist in diagnosing the cause of lower-depth oxygen depletion and evaluating possible steps to remediate the problem.

Therefore, if the actual expense for the PLM services specified in the table above turns out to be enough less than PLM's estimates ($875) in 2023, the bathymetric survey and mapping should be conducted in 2023. Otherwise, the PCLA Board should add $875 to the lake management expenses budget for 2024.

Cost of 2024 Through 2027 Services

The Pine Canyon Lake management program will follow a similar strategy of focusing on exotic species such as Eurasian Watermilfoil, Phragmites, and—if found—Curly Leaf Pondweed, Starry Stonewort, and Cabomba. The program will also include water quality and E. coli monitoring,

Each year, the services to be performed by PLM in the next year will be determined jointly by PCLA representatives and PLM when they meet for a year-end review of the program and plan the program and budget for the next year. The services determined in this meeting will be the basis for PLM providing an estimate of charges for its services in the next year, the PCLA budgeting lake management expense for the next year, and the parties amending the specification of services in the Professional Services Contract between the PCLA and PLM.

PCLA must recognize when doing its financial planning and budget preparation that the cost of lake management services in 2024 through 2027, and in future years, will inevitably increase because of the following:

- The cost of herbicides will increase. Chemical costs have gone up in 2022 and might continue to do so in future years. With a multiyear contract between PCLA and PLM, the prices will be locked in for the first two years and limited to a maximum increase of 3% on treatment for the additional years unless there is an above-average increase in chemical costs.

- Even when appropriate actions are taken to control Watermilfoil, Curly Leaf Pondweed, Phragmites, and other invasive species weeds, new growth will occur every year from seeds carried in from other lakes by wind and birds. This pattern is like dandelions on a lawn—that is, all the dandelions on a lawn can be killed off in one year, but some new ones will appear next spring.

- The health of the lake will be more effectively maintained and enhanced if more of the services PLM offers, such as an Aquatic Vegetation Assessment Survey, are added in future years.

Managing execution of the services agreement

The PCLA Board of Directors should assign to the Fish & Weed Committee responsibility for managing the relationship between the PCLA and PLM and managing the execution of the services agreement, including:

- monitoring the work performed by PLM,

- meeting with PLM each August for a year-end review of the program and planning the program for the next year,

- each year recommending to the PCLA Board the budget for lake management expenses for the next year,

- each year reporting to Pine Canyon Lake residents each year the results of water testing and other work performed by PLM, and

- negotiating with PLM any necessary amendments to the Professional Services Contract between PCLA and PLM.

Alternate-year Walleye stocking

One of the Actions associated with Goal 4: Enhance the fish population is alternate-year Walleye stocking. Walleye stocking was conducted in 2020, but it was not continued because no funding was included in the PCLA's 2022 budget for the purchase of Walleye fingerlings.

The resumption and continuation of Pine Canyon Lake Walleye stocking will aid in achieving a well-balanced Largemouth Bass population by providing a predator to lessen the population of small Largemouth Bass and adding desirable game fish species to the lake.

Stocking of Walleyes in waters where they do not naturally reproduce is most likely to develop over several years a Walleye population of moderately low density (2 to 4 adults per acre) with a moderately high proportion of quality-size fish (50 to 70% a length of 15 inches or more) when stocking of 10 fingerlings per acre of the lake is conducted continuously every alternate year.

Accordingly, the PCLA should:

- include in its budget for 2024 and every alternate year (i.e., every even-numbered year) thereafter an amount for Walleye stocking ($1,000 was paid to Gollion Bait and Fish Farm for the 400 Walleye fingerlings stocked in 2020 and inflation will likely increase the amount to $1,200 or more by 2024); and

- authorize the Fish & Weed Committee to arrange for and supervise stocking the lake with 400 Walleye fingerlings in 2024 and every alternate year thereafter.

Actions to be executed by the PCLA Environment Committee

Executing the Actions under the following Goals is non-technical and will not require the services of a lake management professional. These actions could be executed by PCLA Board members and other Pine Canyon Lake residents.

- Goal 4: Enhance the fish population,

- Goal 5: Enhance shoreland area conditions,

- Goal 6 Monitor watershed conditions, and

- Goal 7: Engage the Pine Canyon Lake Community.

Therefore, the PCLA Board should:

- assign to the Fish & Weed Committee responsibility for executing Actions related to Goal 4 and recruiting resident volunteers to assist in executing these Actions, and

- assign to the Environment Committee responsibility for executing Actions related to Goals 5, 6, and 7 and recruiting resident volunteers to assist in executing these Actions.

Monitoring and adaptation

The concept of “adaptive management” should be embraced in by the PCLA in executing this Lake Management Plan. Simply stated, adaptive management uses findings from monitoring activities to inform future management actions and periodic refinement of the plan. An adaptive management plan accommodates new findings by integrating this information into successive iterations of the plan. So, the plan will be dynamic, successively evolving and improving to fit the needs of Pine Canyon Lake.

This Lake Management Plan is meant to be an adaptive management plan and, therefore, a basic assumption of the Plan is that the management actions will change over time as recommended by lake management services professionals and desired by residents. Through ongoing refinement, the Plan will ever more closely reflect the needs of the lake and the people who care about it. This Plan assumes the desired condition of sustainable lake health but it also attempts to reflect the collective vision of Pine Canyon Lake residents who are concerned with the lake and the surrounding area.

APPENDIX A: ARTICLE – "BASS SLOT LIMIT MAY EXPAND TO OTHER LAKES"

Bass slot limit may expand to other lakes

southbendtribune.com/story/sports/2019/06/08/outdoors-bass-slot-limit-may-expand-to-other-lakes/117178774

The pending results of an experimental bass size limit on Big Long Lake may lead to more Indiana lakes with a slot limit structure.

That's the view of northern Indiana biologists who are conducting a study of what could be done on lakes that have an overabundance of undersize (less than 14 inches) bass.

A slot limit prohibits anglers from keeping bass between 12 and 15 inches and permits only two bass over 15 inches. The bag limit remains five, so they can fill out limits with bass under the slot limit or keep up to 5 "unders." It is the same regulation in place on the St. Joseph River in Indiana.

As we mentioned here earlier this year, the DNR has noticed a trend of too many little bass and darn few quality bass in some lakes. It's taking a closer look at those lakes to get a better handle on the numbers.

Bass over-population, coupled with slow growth, has been an emerging problem on some natural lakes ever since Indiana went to a statewide 14-inch size limit.

Big Long Lake, meanwhile, has been under an experimental 12- to 15-inch slot limit for five years. A DNR crew went back to check results this spring. The 365-acre lake lies in LaGrange County.

"I was shocked to see the difference," said District Fisheries Biologist Larry Koza.

When a similar bass population study was conducted in 2010 before the slot limit went into place, biologists captured 2,000 bass in four hours and only one of those measured 14 inches or bigger.

"There was a load of 11 and 12 inches and the only keeper barely measured 14 inches," Koza recalled.

This year — following five years of the slot limit — they captured 400 bass and 77 were over 14 inches.

"We had a couple in the 20-inch range, three that were 19 inches and five that were 18 inches," Koza said. "The largest was around seven pounds. That's a pretty amazing difference."

The DNR plans to look at seven other potentially troublesome lakes this year — Cedar (LaGrange County); Sacrider, Creek, Bear, Knap and Angle lakes (Noble County); and South Mudd (Fulton County).

"It may be something that takes a while to figure out, but we're gathering data in case we decide to go through the (Natural Resources Commission) rule-making process to change size limits on more lakes," said researcher Linn. "But first, we have to see what the data tells us."

Biologists point out that such changes are considered only on lakes with high small fish/low big fish populations. The problem most frequently occurs on lakes less than 100 acres.

The DNR also will keep a watchful eye on bluegill populations on those lakes. Trends show that lakes with high bass concentrations also have a good bluegill size structure because bass predation help keep the little ones thinned out.

Koza would like to go back to Big Long to check its bluegill population, but noted that he observed a good population of bluegill and redear of all sizes while shocking up bass.

"I would think that having bigger bass feeding on the bluegill would compensate for not having a lot of smaller bass," he said.

APPENDIX B: ARTICLE - “WALLEYE STOCKED IN NORTHERN INDIANA LAKES”

Walleye stocked in northern Indiana lakes

kpcnews.com/outdoors/article_c76ac20d-a251-5fc2-bc01-4907f40f243c.html
December 1, 2021

ORLAND — Almost 43,000 fall fingerling walleyes were stocked at eight locations in northern Indiana in early October. An additional 26,738 fall fingerlings were stocked at five more locations in late October to mid-November.

The fish stocked in the second round were grown at Fawn River State Fish Hatchery to supplement the earlier stockings that were purchased from a private commercial fish supplier. The stocked walleye are primarily 5- to 7-inch fingerlings. A few fish are larger. They will typically reach 14 inches after two years of growth and 16 inches by age 3.

The target stocking rate for these larger fall walleye fingerlings is 10 fish per acre, a figure DNR fisheries biologists say provides the best balance for fishing potential, growth, and fisheries balance.

Lakes and (county) stocked include:

- Bass Lake (Starke)
- Crooked Lake (Steuben)
- Clear Lake (Steuben)
- George (Steuben)
- Pine/Stone Lakes (LaPorte)
- Pretty Lake (LaGrange)

- St. Joseph River (St. Joseph)
- Sylvan Lake (Noble)
- Shriner Lake (Whitley)
- Wall Lake (LaGrange)
- Winona Lake (Kosciusko)
- Wolf Lake (Lake)

Most of these locations are stocked with fall fingerlings each year to sustain the walleye population. A few locations are stocked on alternate years to improve walleye fishing in additional areas. The lakes are continually evaluated by biologists for fish survival and angling use.

Multiple other lakes are stocked with walleyes by privately funded lake associations. A stocking permit that is evaluated and approved by the local DNR fisheries biologist is needed before any stocking can take place.

The young fish are often found in vegetation or large rocky habitat. Anglers should handle young walleye they catch gently because they are the future of the fishery.

Learn more about Indiana walleye fisheries:

https://www.in.gov/dnr/fish-and-wildlife/fishing/walleye-fishing/

APPENDIX C: PINE CANYON LAKE SHORELAND BEST MANAGEMENT PRACTICES

Creating a Shoreline Buffer Strip – Ensuring Clean Runoff

Lawns do not make very good upland buffers. With runoff, short grass blades bend and do not serve as a very effective filter. Tall grass that remains upright with runoff is a better filter. Kentucky bluegrass (which actually is an exotic grass) is shallow-rooted and does not protect soil near shorelines as well as deep-rooted native prairie grasses, shrubs, or other perennials. Grass up to the shoreline offers poor cover, so predators visit other hiding areas more frequently reducing the prey food base and limiting predator populations in the long run. Also with short ground cover, ground temperatures increase in summer, evapotranspiration increases and results in drying conditions, reducing habitat for frogs and shoreline dependent animals.

Ecologists, water quality specialists, land planners, and lake managers all agree that a naturally-vegetated buffer strip along the periphery of a lake is critical to the health and quality of the waterbody. The concept of a buffer is fairly simple. A buffer generally should be comprised of the type of vegetation that naturally exists in a shoreline, or riparian, setting. Buffers require little maintenance, and use of fertilizers and pesticides is discouraged

A functional upland buffer should be at least 15 feet deep. With this you start getting water quality and wildlife habitat benefits. But a 25 foot deep buffer is recommended.

The benefits of a buffer strip include:

- **Runoff filtering:** As runoff from adjacent land filters through a buffer, pollutants and sediment are removed.

- **Shoreline stabilization:** Natural buffers that extend down to the water's edge can be very effective in preventing shoreline erosion. In contrast to conventional turfgrass (which is shallow-rooted and intolerant of flooding), natural riparian vegetation has dense, deep root systems that firmly anchor shoreline soils.

- **Preservation of fish and wildlife habitat:** Many aquatic organisms, particularly insects, spend substantial portions of their life cycles in upland environments. Buffers provide a critical transition zone between upland and aquatic/wetland habitats.

Establishing A No Mow Zone – Bank Stabilization

A No-Mow Zone is a mix of trees, shrubs, and groundcover between the lake and house which is not mowed. Its purpose is to allow shoreland vegetation to stabilize the shoreline, maintain lake quality and wildlife habitat.

A naturally vegetated zone along the shore builds up a duff layer, which is a spongy, absorbent layer of decomposing leaf and twig litter. Duff is essential for healthy lakes because it naturally filters storm runoff by intercepting and absorbing pollutants, and it provides a protective ground cover, preventing erosion. No-mow zones stabilize banks with roots from native species that grow up, and these zones benefit all wildlife.

Stop mowing a zone adjacent to the shoreline as wide as feasible for your property. For sloped banks, the no-mow zone should extend beyond the top of a bank because research shows

that a minimal of 15 feet of vegetation will stabilize the shore. A "no-mow" zone allows native plants to colonize the area, but jump-starting the vegetation by planting a few favorite native species, like blueberry bushes, alternative leaf dogwood, beautiful white flowering viburnums, etc., can also be help maximize the benefits of this important zone along the lakeshore.

Creating Rain Gardens - Ensuring Clean Runoff

Rain gardens are attractive and functional landscaped areas that filter rain runoff. Purpose: Rain gardens are designed to capture and filter runoff from paths and impervious surfaces. They collect water in bowl-shaped vegetated areas, and allow it to slowly soak into the ground. A rain garden reduces the potential for erosion and minimizes the amount of stormwater flowing from the lawn and impervious surfaces into the lake.

Rain gardens can vary in size, but are most effective when built to 20-30% of the contributing drainage area. Rain gardens typically range from 150 to 300 square feet, but even a smaller one will help reduce water pollution problems.

- The garden should be a shallow bowl-shape, with the lowest point of the garden no more than 6" below the surrounding land.
- The sides should be gently sloping towards the center to prevent sudden drop-offs that could lead to erosion problems or walking hazards.
- Rain gardens are often placed in a preexisting or created depression within a lawn, or in a location that receives roof runoff from a downspout.
- To avoid flooding improperly sealed foundations, build your rain garden 10' away from existing structures (including septic tanks), and direct water into the garden with a grassy swale, French drain, gutter extension or other device.

Rain gardens can be placed in sunny or shady regions of your lawn. Plant the lowest point with wet tolerant species, then use moist tolerant species for the sides closest to the center and the edges of the rain garden should be planted with moist to dry or dry tolerant plants. After construction of the garden is complete, the entire area should be covered with a thick layer of mulch.

Lake-Friendly Yard Maintenance - Ensuring Clean Runoff

The following simple yard maintenance practices that, by reducing or eliminating pollutants in runoff, can help to keep lake water safe for people, pets, and wildlife use.

1. Lawn and Garden Watering. Soils, yard wastes, over watering, and garden chemicals become part of the runoff mix that winds its way through streets, gutters, and storm drains and into the lake. For example, over watering wastes water and can increase the amount of pollutants flowing into the lake. Do not over-water. Conserve water by using irrigation practices such as drip irrigation, soaker hoses, or micro -spray systems. Avoid watering onto areas that drain into the lake.

2. Mowing and Natural Vegetation Zones. You can lessen the amount of fertilizer, fuel, and energy your property requires by reducing the amount of mowed lawn and allowing native vegetation to grow. Equally important, creating or maintaining natural

vegetation zones around the lake will help intercept runoff, as well as infiltrate, filter and treat runoff.

3. Plant Selection. Lessen lawn area by planting gardens or use low growing native sedges to mimic lawn. Selecting native plants and grasses lessens the need for watering and pesticides as they are typically more drought tolerant and pest resistant.

4. Fertilizer Application. Fertilizers applied to lawns and landscaped areas can contaminate ground and surface water, and harm beneficial insects. In addition, phosphorus, a chemical in most fertilizers, is one of the leading causes of diminished water quality in lakes. If you feel your lawn must be fertilized, use one of the fertilizers available with no phosphorus. (A popular brand is Jonathan Green's "Green Up No Phosphorus Formula Lawn Fertilizer", and it is available at Walmart in Angola.)

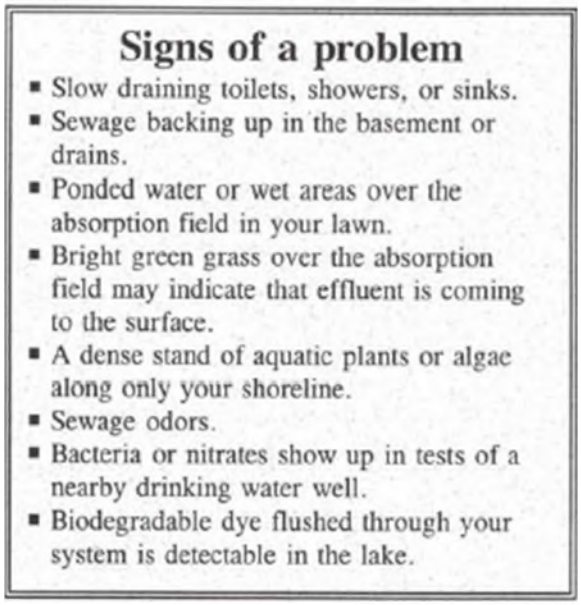
5. Pesticides. Instead of pesticides, use pest management involving physical controls such as barriers or traps, biological controls (e.g., green lacewings that eat aphids), and bacterial insecticides (e.g., Bacillus thuringiensis that kill caterpillars). Chemical control should be considered a last resort. The following are the least harmful: dehydrating dusts (e.g., silica gel or diatomaceous earth), insecticidal soaps, boric acid powder, horticultural oils, and pyrethrin-based insecticides. If you must use a pesticide, use one that is specifically designed to control your pest and use only as directed. The insect should be listed on the label. (Many studies have shown that approximately 90% of the insects on lawns and gardens actually are not harmful.) Rinse empty pesticide containers and dispose of rinse water per the instructions on the product container. Dispose of empty rinsed containers in the trash.

6. Pet Waste. Pet waste left on the ground can be carried away by runoff, contributing bacteria, parasites and viruses to downstream water bodies. Pet waste does not fertilize the ground and can be the cause of significant pollution that presents health risks to adults, children and other pets. To properly dispose of animal waste, use newspaper, bags, or pooper-scoopers to pick up wastes. Place wrapped pet waste in the trash or unwrapped in a toilet. Never discard pet waste in the lake!

7. Yard Scraps. Leaves, grass clippings, and tree trimmings can clog catch basins and storm drains, increasing the risk of flooding. Yard scraps that enter rivers absorb oxygen as they decompose, straining or killing aquatic life. Use approved containers for trash-hauler pickup of lawn scraps, do your own composting, or take scraps to a landfill that composts.

Maintaining On-site Sewage Disposal Systems

A properly-functioning on-site sewage disposal system will remove most disease-causing organisms and some nutrients and chemicals from wastewater. However, it will not remove or treat many water-soluble pollutants such as solvents, drain cleaners, and many household chemicals. On-site sewage disposal systems can be safe and effective so long as homeowners actively monitor and maintain them. Pine Canyon Lake Community homeowners have a special responsibility to ensure that their systems are not polluting the lake.



An on-site sewage disposal system requires regular maintenance to operate efficiently. Annual inspections of the baffles are necessary to ensure that scum is not leaving the septic tank and entering the absorption field. Likewise, accumulated sludge must be removed on a regular basis to prevent it from backing up into the absorption field or reducing the tank capacity to the point that solids are not able to settle out before the sewage slurry leaves the tank. The frequency of sludge removal ("pumping") varies with the amount of use your system receives. For a family of four, a septic tank needs to be pumped out every two to three years. If you are placing heavy demands on the system, such as a large family or a garbage disposal, the tank may need to be pumped every year. Tank pumping must be done by a licensed contractor, but sludge level determinations and tank inspections can be done by you.