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*Orange Lake, Oakland County*

# 2022 Water Quality Summary

The goal of this testing protocol was to monitor various water quality parameters of the lake, compare results to historical data, and identify any potential risks to the health of Orange Lake. Water samples were taken from one location in the lake and tested for various parameters. Field tests and water samples were taken on May 20th and July 27th. This report describes conditions at the times the samples were taken. The quality of the water was tested only to the parameters listed below.

| | May 20th, 2022 | | July 27th, 2022 | | |
|---|---|---|---|---|---|
| **Parameter** | **West** | **East** | **West** | **East** | **Target Range** |
| Temperature | 62.1 ˚F | 61.3 ˚F | 81.2 ˚F | 80.9 ˚F | Less Than 80 ˚F |
| Dissolved Oxygen – Concentration | 7.1 mg/L | 7.1 mg/L | 6.7 mg/L | 6.5 mg/L | 4.0 – 12.0 mg/L |
| Phosphate | 80 ppb | 70 ppb | 30 ppb | 40 ppb | 0 – 100 ppb |
| Nitrate | 396 ppb | 484 ppb | 396 ppb | 440 ppb | 0 – 1,000 ppb |
| Transparency | 6.3 feet | | 7.4 feet | | More than 6.5 Feet |
| pH | 8.0 | 8.2 | 7.8 | 7.6 | 7.0 – 9.0 S.U. |
| Total Dissolved Solids | 485 ppm | 463 ppm | 438 ppm | 432 ppm | 0 – 1,000 ppm |
| Conductivity | 746 µS | 721 µS | 689 µS | 671 µS | 0 – 1,500 µS |
| Alkalinity | 154 ppm | 142 ppm | 126 ppm | 117 ppm | 0 – 250 ppm |
| Hardness | 174 ppm | 184 ppm | 128 ppm | 134 ppm | 100 – 300 ppm |
| Salinity | 320 ppm | 300 ppm | 260 ppm | 280 ppm | 0 – 500 ppm |
| *E. coli* | 0 CFU | 0 CFU | 0 CFU | 0 CFU | 0 – 300 CFU / 100 mL |

## Preface

2022 was the thirteenth year of our water quality testing on Orange Lake. We are now able to compare annual averages over the testing history. The trend lines on the following graphs show the change from 2009 to 2022. Each successive year of testing will provide more insight into how the lake changed on a long-term scale.

Each test represents a snapshot of the water quality when the sample was pulled. Water quality parameters can change from morning to night, day to day, or year to year. The discussion below will focus on the results listed above. We drew conclusions from the data, timing, and weather, but it is important to understand that each successive year of testing will help support trends and averages and improve our discussion.

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## Discussion

The results of this year's testing indicate that the water of Orange Lake remained relatively healthy throughout 2022. The results show that the aquatic environment was very suitable to support natural wildlife. Also, the lake was safe for recreational uses, such as swimming, boating, fishing, etc., as there are no signs of pollution.

The water **temperatures** were within the target range during spring testing events while summer temperatures were slightly higher. Colder water can hold more oxygen, so cooler water is better for aquatic organisms. As expected with these water temperatures, the **Dissolved Oxygen** was healthy during both tests.

At the spring test, the concentrations of **Phosphate**, the usable form of phosphorus, were near the upper threshold of the target range. During the late summer test, this nutrient decreased to the lower end. Rainfall and snowmelt in spring often deliver excess nutrients from the watershed. Also, plant production is slow this time of year, so more phosphorus was still unused at the time of the spring test. The decrease from spring to summer was likely helped by aquatic plants utilizing nutrients, removing them from the water column.

The **Nitrate** concentration showed a similar pattern. The nitrate level was within the target range in the spring and decreased further by the summer testing event. The improvement was most likely due to plant uptake and outflow. Although concentrations are still in the target range, residents must ensure their property is not contributing excess fertilizers to the lake.

The **Transparency** was above the target depth in the summer. Transparency can be affected by many different factors, including suspended solids, dissolved solids, acids, and algae growth. The clear water is generally a positive attribute, but it also allows more sunlight to reach the lake bottom to fuel plant growth.

The **pH** was within the target during both tests.

The **Total Dissolved Solids** and **Conductivity** were within their target ranges and decreased from spring to summer. This usually occurs in most lakes and is aligned with the nutrient decreases.

The **Alkalinity** and **Hardness** both decreased from spring to summer while remaining within their target ranges. The primary reason for the decreases was biological productivity. As organisms become more active in the summertime, they produce more carbon dioxide. As this gas dissolves, it needs to be buffered, using up the carbonate ions.

The **Salinity** decreased from spring to summer, which aligned with the other chemistry parameters.

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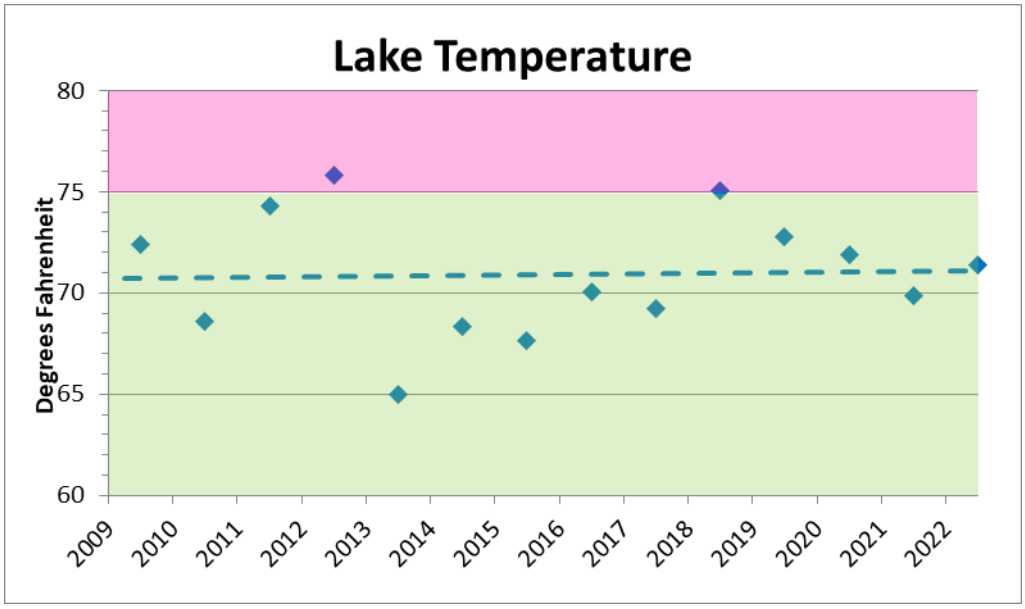
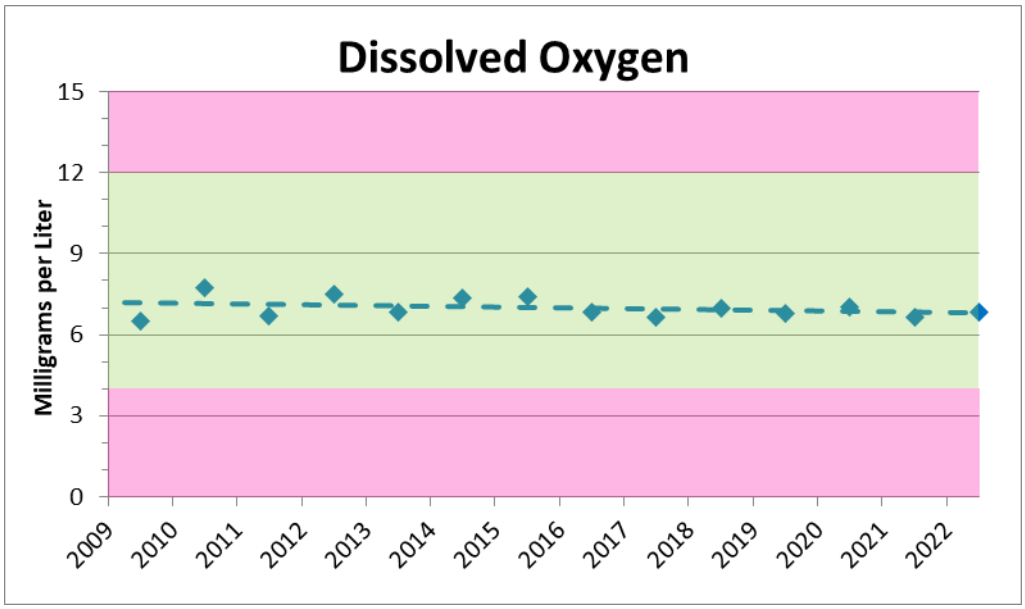
## Historical Trends




**Target Range: < 75˚F**

The temperature was affected by the dates selected for testing and the weather of each year. As we collect data in subsequent years, the trend line should become a more accurate indicator of the changes in the lake. Overall, the trend did not show any significant changes in the surface temperatures.




**Target Range: 4.0 – 12.0 mg/L**

As the temperature increases, water holds less oxygen. Despite temperature fluctuations over the testing history, the oxygen concentrations remained very healthy and showed no significant change since testing began.

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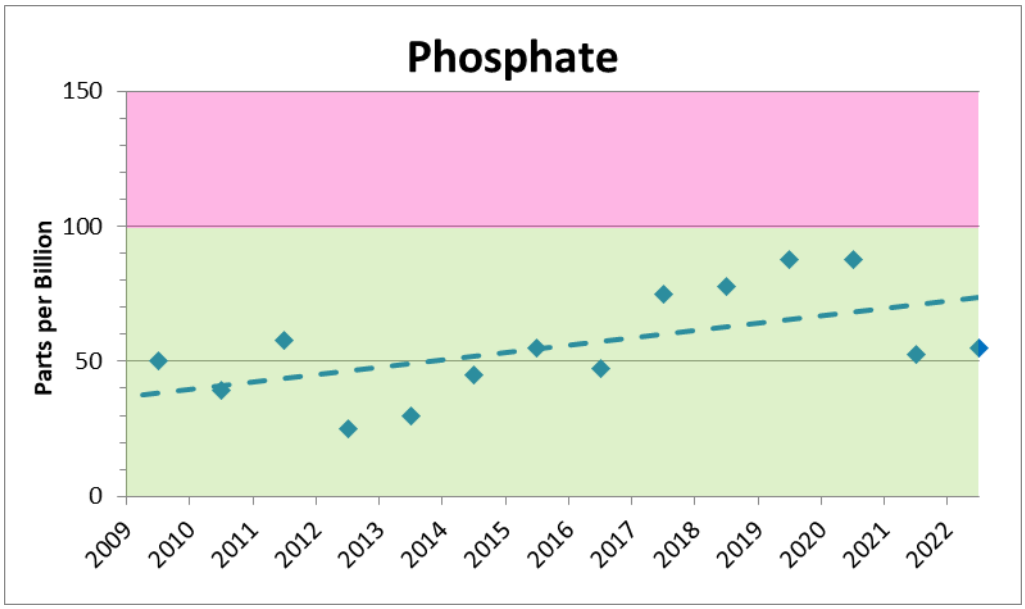
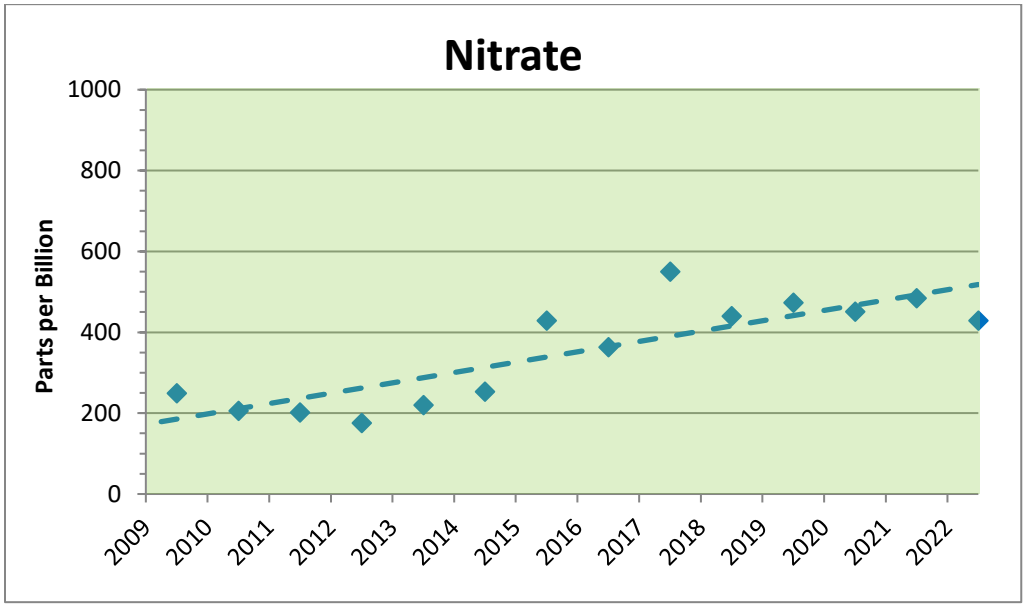



**Target Range: 0 – 100 ppb**

Phosphate is a significant nutrient that fuels aquatic plant growth. The historical trend showed a steady increase over the testing history. Lakes are basins that undergo eutrophication, the process of accumulating sediment and nutrients, leading to a shallower depth and more plant growth. This process speeds up over time, so it is vital to maintain the lake's health.




**Target Range: 0 – 1,000 ppb**

Nitrate is another vital nutrient for the growth of aquatic plants. This nutrient also increased over the testing history, although the last three years have decreased. It is crucial residents continue to be conscious of their properties and landscaping methods to ensure more nutrients do not enter the lake.

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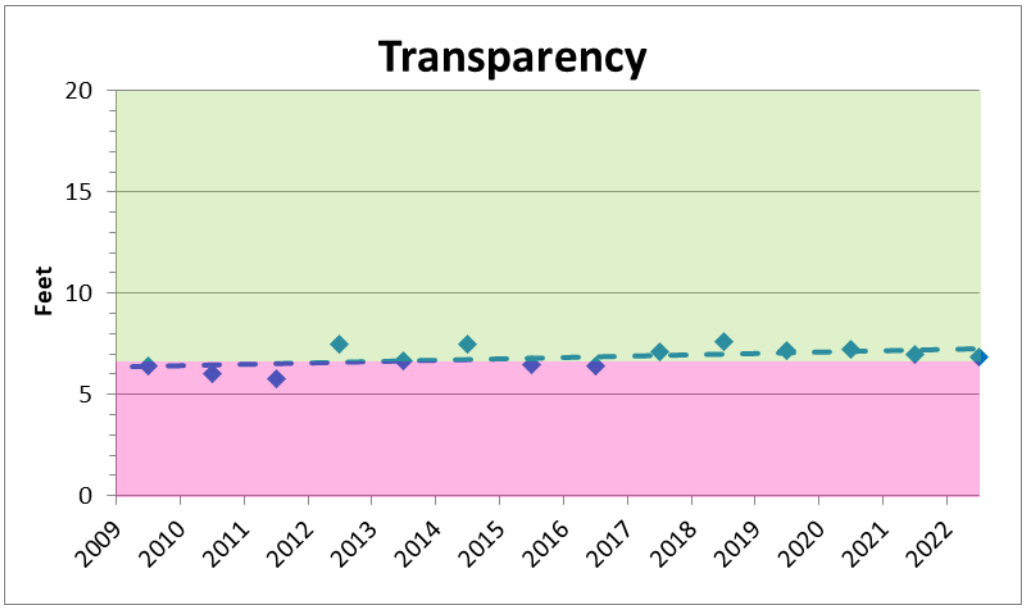
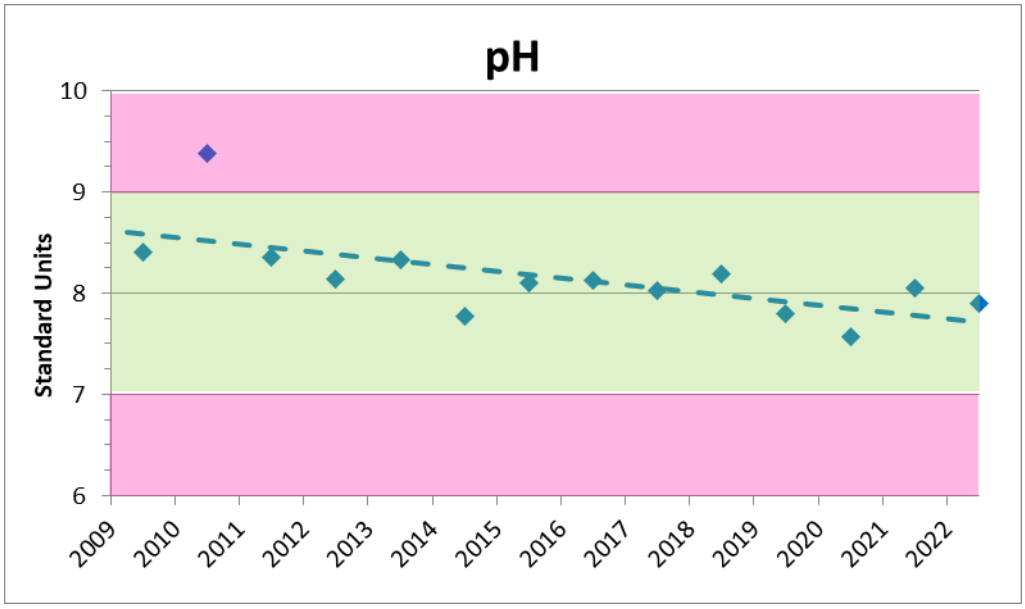



**Target Range: > 6.5 feet**

Transparency is affected by total dissolved solids, total suspended solids, algae growth, and rain frequency and amount. Overall, the transparency of the lake increased slightly over the testing history.




**Target Range: 7.0 – 9.0 S.U.**

There was a slight decrease in pH over the testing history, but it stayed in the target range of 7 to 9. We will look for the pH to level off in future years. If the pH ever continues to decrease at this rate, we will look for the cause of that change to mitigate the trend.

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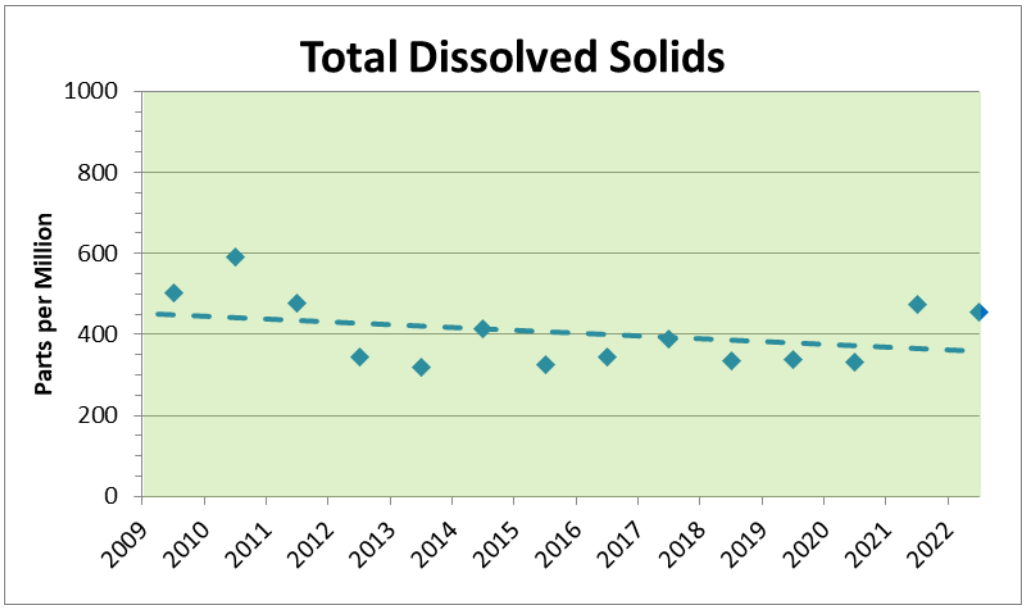
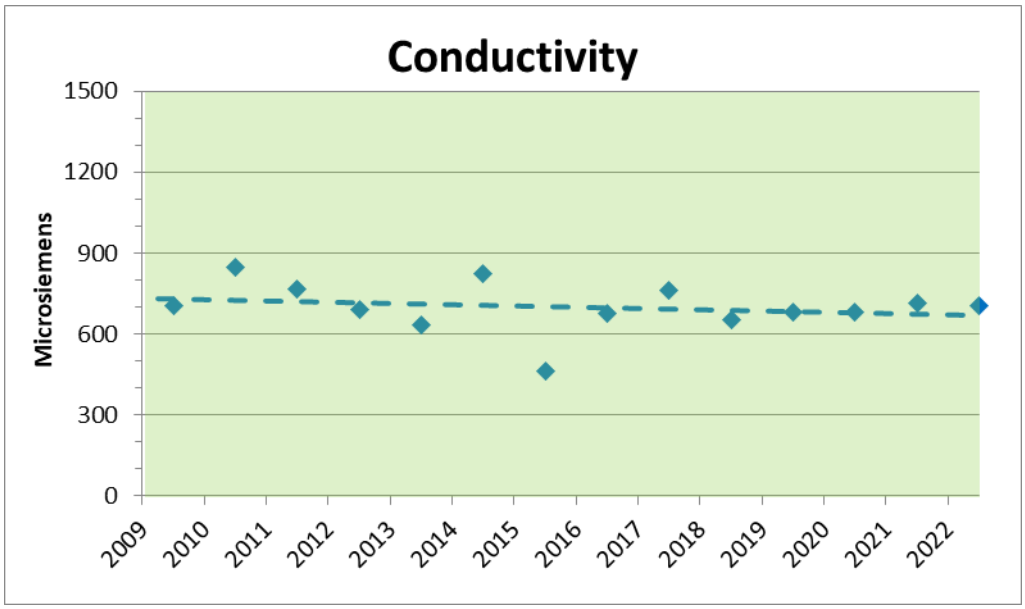



**Target Range: 0 – 1,000 ppm**

The Total Dissolved Solids decreased from the previous testing events & continues to show a downward trend over the testing history.




**Target Range: 0 – 1,500 µS**

Like the TDS, Conductivity showed a downward trend. Conductivity measures the amount of ionic molecules in the water (which conduct electricity, usually salts).

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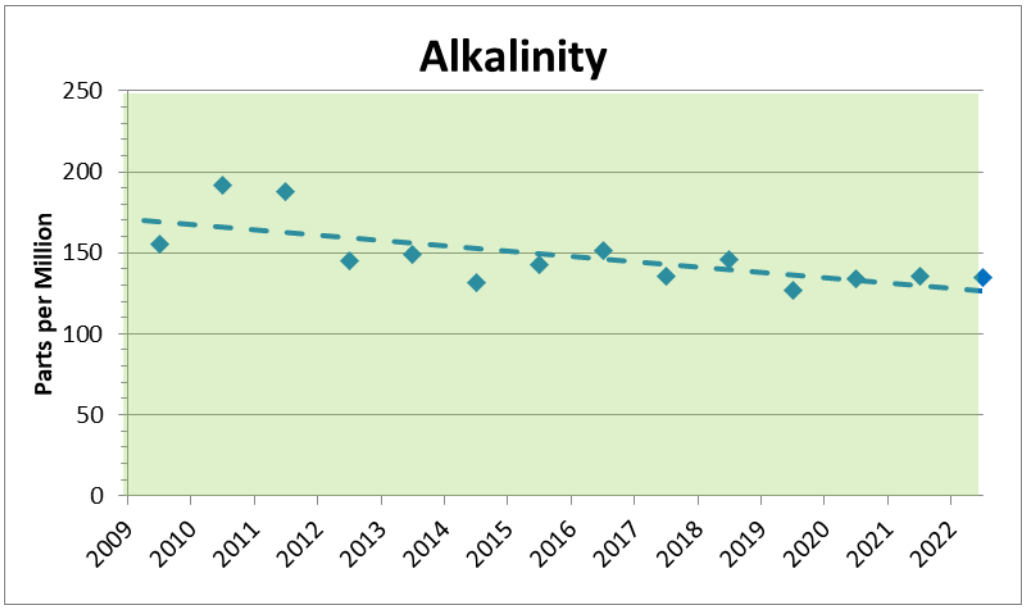
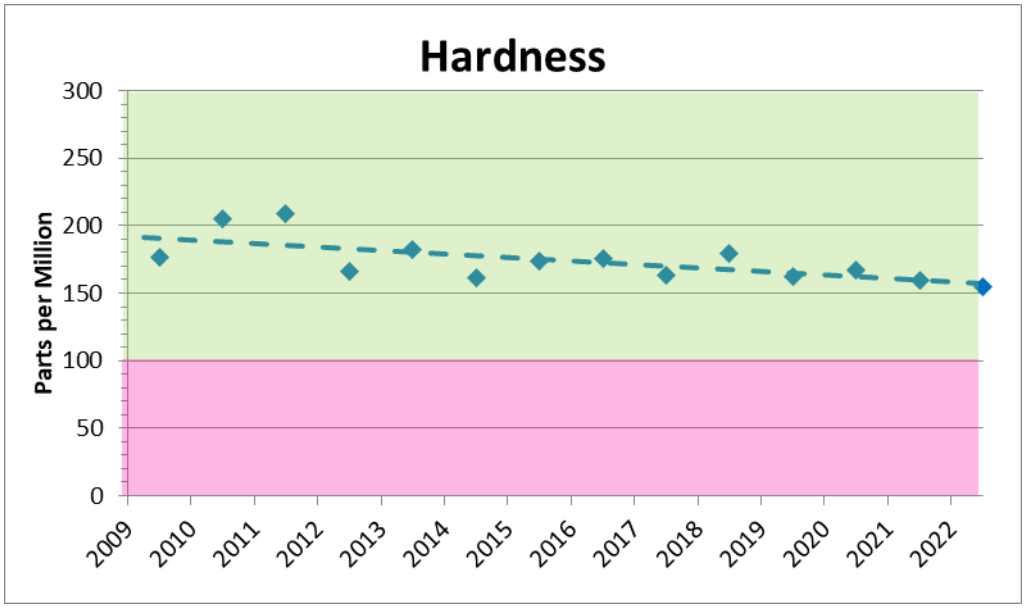



**Target Range: 0 – 250 ppm**

The alkalinity decreased over the testing history. Alkalinity works as a buffer to stabilize the pH when foreign substances enter the lake or when carbon dioxide accumulates. The decreasing alkalinity aligned with the decline in both dissolved solids and conductivity.




**Target Range: 100 – 300 ppm**

While alkalinity measures the acidic neutralizing capacity, mainly in carbonate, hardness measures the polyvalent cations, such as calcium ions. Since one of the most common salts in the water is Calcium Carbonate, hardness generally follows alkalinity.

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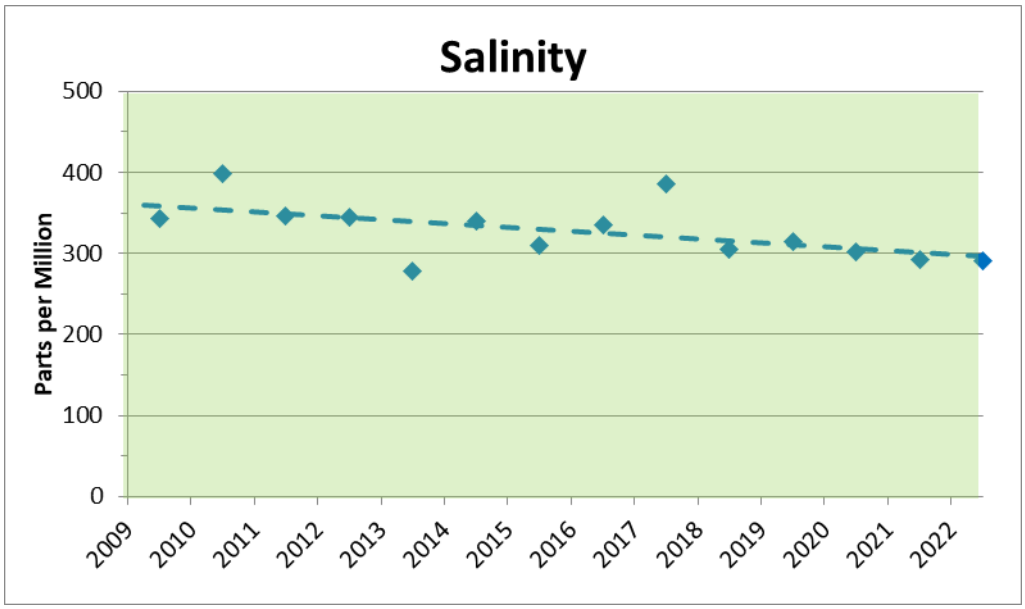


**Target Range: 0 – 500 ppm**

The Salinity decreased slightly over the testing history. A significant concern for lakes is the accumulation of salts, particularly from road salt. It is essential to continue monitoring the salinity in future years to see if this trend worsens.

## Conclusion

Overall, the water quality of Orange Lake was excellent this year. The dissolved oxygen remained very healthy even in the heat of summer. Nutrient levels were within their target ranges, but we will continue to watch the long-term increases. The transparency showed improvement. All other water quality parameters were excellent.

Orange Lake is a valuable water resource with healthy water quality despite a heavily developed watershed and homes surrounding the lake. There will always be areas that the quality of the water could improve, primarily nutrients. You should take pride in the lake and continue your efforts toward improving it.

Completed and Certified by: _____

Tyson Wood
*Lake Manager*

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**Analysis Information**

| | |
|---|---|
| Temperature: | The water temperature directly affects the amount of oxygen that is able to dissolve into the water. The temperature of surface waters is not indicative of the entire water column. |
| Transparency: | The ability of light to penetrate the water column is determined by the amount of dissolved and suspended particles in the water. Although aesthetically desirable, transparent water allows increased light to reach the lake bottom and may result in vegetation growth. |
| pH: | pH is a measure of acidity or alkalinity. pH is a general measure of lake health and can roughly indicate the range of other measurements such as alkalinity and hardness. |
| TDS: | Total Dissolved Solids is the amount of all organic and inorganic substances in the water in a molecular or ionized state. Higher values generally indicate richer and more productive water. Lower values usually indicate cleaner and less productive water. |
| Conductivity: | Conductivity is a measure of the ability of water to conduct electricity. Dissolved ions in the water increase conductivity, thus TDS and Conductivity are closely related. |
| Alkalinity: | Alkalinity refers to the ability of the water to neutralize acids, mainly through the hydrogenation of carbonate ions. Therefore, the alkalinity is expressed as "ppm as $CaCO_3$". However, other basic molecules in the water can also contribute to alkalinity. |
| Hardness: | Hardness is very closely related to alkalinity. It is a measure of the dissolved salts and metals in the water, including but not limited to $CaCO_3$. |
| Salinity: | Salinity is the measure of the dissolved salt content of water. Salinity influences the types of organisms that can survive in the water. Salinity also affects the chemistry of the water, including conductivity and potability. |
| Dissolved Oxygen: | D.O. is a measure of the amount of oxygen dissolved in the water. This oxygen is available to fish and other animals for respiration. Vegetation generally increases DO, particularly during the day and early evening. Animals and other respiring organisms consume the oxygen, mostly during the day. Oxygen is also added to the lake through wave action, rain, fountains and aerators. |
| Phosphates: | Phosphorus is an essential nutrient for plant growth. Phosphate is the form of phosphorous that is most readily available to plants and algae. |
| Nitrate: | Nitrogen is also essential for plant growth. Nitrate is the predominant form of nitrogen in water. Excessive nitrate concentrations may also result in pollution and increased vegetation. |
| Fecal Coliforms: | Non-fecal coliforms are naturally found as soil organisms. Fecal Coliforms, such as *E. coli*, are coliforms found in the intestines of warm-blooded animals and humans. The presence of fecal coliforms indicates contamination from either animals or humans. |

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**Trophic States**

| | |
|---|---|
| Oligotrophic: | Water is very clear. Nutrient levels are generally low. Plant and algae productivity are also low. Sufficient dissolved oxygen in the bottom, cooler waters allows cold-water fish to survive, such as salmon and trout. |
| Mesotrophic: | Water is moderately clear. Nutrient levels are slightly elevated. Plant and algae productivity are present, but generally not a nuisance. Oxygen and temperature in the lower portion of the lake allow walleye and perch to survive. |
| Eutrophic: | Water is not clear due to high nutrients levels, increased turbidity, and excessive algal growth. There is no oxygen in the bottom, cooler waters, restricting the lake to warm water species, such as bass and bluegill. |
| Hypereutrophic: | Nutrient levels are extremely high, promoting very high algae productivity. Blue-green algae blooms are likely. High turbidity and algae growth make the water opaque. Little plant growth is restricted to invasive plants. The only fish that can survive this environment are rough fish, such as carp, catfish, and mudminnows. |