KIESER & ASSOCIATES
ENVIRONMENTAL SCIENCE & ENGINEERING

MEMORANDUM

To:	Rex Vaughn, Chair Cedar Lake Improvement Board	**Date:**	July 14, 2025
From:	Mark S. Kieser Senior Scientist, K&A	**cc:**	Natalie Crum, K&A

RE: **Summary of July 2, 2025 Water Quality Sampling of Select Nearshore Areas of Cedar Lake with Preliminary Discussion of Field Screening for E. coli Bacteria**

Overview

On Wednesday, July 2, 2025, Kieser & Associates, LLC (K&A) collected a limited number of water quality samples from select nearshore locations along the northwest shoreline of Cedar Lake in Alcona County. This sampling occurred during K&A's routine vegetation monitoring of the lake. Nearshore water quality samples for soluble reactive phosphorus (SRP) were collected in front of two residential properties situated directly south of Jones Ditch. Water samples were also screened for the potential presence of *E. coli*, a common gut-tract bacterium associated with fecal wastes from mammals and avian species.

Phosphorus is the primary nutrient of concern that may be released for septic system drain fields near lake shorelines. These discharges can lead to excessive nearshore weed and algae growths. In select instances, phosphorus discharges can be directly related to Harmful Algal Blooms whereby blue-green algae proliferate at the lake surface forming noxious slicks or scum. Some blue-green algal species can also form toxins into surface waters.

The presence of *E. coli* in surface waters can be an indicator of sewage from septic system discharges, or animal waste contamination from resident waterfowl near the shoreline (such as geese or ducks). Human health concerns relate to the possible presence of viral pathogens associated with human waste that can cause diseases through ingestion or skin contact such as gastroenteritis (diarrhea), giardia, hepatitis or cholera. The State of Michigan has established water quality standards for total body contact (e.g., swimming) at a Daily Maximum Geometric Mean at 300 *E. coli* counts per 100 milliliters (ml).

Residential properties along northern Cedar Lake shorelines in Alcona County are serviced by private septic systems. Long-term groundwater monitoring of these areas by K&A has consistently shown that shallow groundwater along its western shoreline discharges directly to the lake. Groundwater along the eastern shoreline discharges east towards Lake Huron. As such, septic system discharges to Cedar Lake via shallow groundwater will only be found along the northwestern shorelines where there are residential properties.

Sampling Conditions on July 2, 2025

K&A sample collection occurred under partly cloudy conditions with temperatures reaching 84°F. Winds ranging from 6 to 15 mph from the northwest resulted in calm conditions in this sampled section of the Cedar Lake shoreline. (Refer to Attachment A of this memo for site photos taken at the time of sample collection.) Two water quality samples were collected at locations shown in Figure 1 by submersing and then inverting 250ml wide-mouth plastic sample containers to capture water from below the lake surface. Water samples were collected amongst dense growths of *Chara* sp. and filamentous green algae. Site 1 (S1) was located approximately 35 ft from the shoreline while Site 2 (S2) was located approximately 16.5 ft from the shoreline. The depth near each site was approximately 2-3 feet.

Figure 1. Water quality sampling locations on July 2, 2025.

This sampling occurred within Aquatic Resource Observation Site (AROS) 358 (refer to Figure 2). AROS locations have been monitored for aquatic vegetation by the K&A team for almost two decades on Cedar Lake using the LakeScan™ survey methodology. Native vegetation located within this AROS during the July 2 survey included the calcareous macroalgae, *Chara*, and vascular macrophytes including Sago Pondweed (*Stuckenia pectinata*), Variable Pondweed (*Potamogeton graminius*), Broadleaf Pondweed (*Potamogeton amplifolius*), Variable Watermilfoil (*Myriophyllum heterophyllum*), Waterlily (*Nymphaea* sp.), Spadderdock (*Nuphar* sp.), Rush (*Juncus pelocarpus*) and Cattail (*Typha* sp.). Mixed in amongst the *Chara* and vascular plants were notable growths of filamentous green algae. Though not observed in July 2025, the invasive hybrid Eurasian watermilfoil was previously observed at this location prompting past chemical treatments in this area. Observed plants at this location this year appeared at high densities; a consistent observation over the years despite periodic chemical

treatments intended to suppress such luxuriant growth. Such aquatic vegetation at other locations along the northwest was not observed at the densities seen at AROS 358.

Figure 2. Aquatic Resource Observation Sites (AROS) map of the northern section of Cedar Lake.

Preliminary Results

SRP samples have been submitted to the Great Lakes Environmental Center (GLEC) laboratory in Traverse City, MI. Analytical results should be reported by GLEC before the end of July. The luxuriant growth observed in the sampling area (particularly the level of filamentous green algae) suggests a higher level of soluble phosphorus here than is likely present in other observed shoreline areas with little to no algae and lower plant densities. In anticipation of July 2 testing results, K&A will compare reported lab data against nearby Jones Ditch phosphorus sampling in 2024.

Water quality screening for *E. coli* bacteria at these July 2025 Cedar Lake sampling locations revealed very unsafe levels of total coliforms, indicating a significant potential for fecal contamination (Table 1). The total coliform levels at each site are considered very unsafe by the US EPA's recreational water health risk criteria, especially with screening tests revealing the presence of *E. coli*.

Table 1. E. coli and Total Coliform sample results.

Site	E. coli	Total Coliform Count (MPN)	Upper 95% Confidence Level/100 mL	EPA Recreational Water Health Risk Category
1	Positive	>1000 MPN / 100 mL	94351	Very Unsafe
2	Positive	>1000 MPN / 100 mL	94351	Very Unsafe

The field screening method used to test for the presence of *E. coli* and the broader class of coliform bacteria involved the use of an Aquagenx® CBT EC+TC (Compartment Bag Test), "Most Probable Number" (MPN) Kit.[1,2] This is not an EPA-approved method for typical health department analyses (where sample hold times are only 6 hours between collection and lab analysis). It is intended to provide a semi-quantitative indication of the presence of these bacteria.

Total coliform counts shown in Table 1 for both sampling locations indicate a concerning level of these bacteria. In the summer season, the state of Michigan *E. coli* standards for a daily maximum geometric mean (calculated from three separate sampling locations at a site) are 300 counts/100ml of sample. When these levels are found at public beaches by county health departments, beaches are closed to swimming. The >1,000 counts/100 ml (up to a possible maximum of 94,351 counts/100ml), suggest bathers should avoid these areas, and that further laboratory sample testing should be conducted to confirm or refute concerns with full body contact. (Attachment B provides documentation of field kit screening results; Attachment C provides a summary of field kit results with semi-quantitative interpretation of bacterial counts.)

[1] See: https://www.aquagenx.com/wp-content/uploads/2025/06/1-10-Dilution-Instructions-CBT-ECTC-MPN-202506.pdf
[2] See also: https://www.aquagenx.com/wp-content/uploads/2021/06/Basis-of-Aquagenx-MPN-Table_June2021-.pdf

Implications

Comparable 2024 sampling for phosphorus (but not bacteria) in Jones Ditch to the north of 2025 nearshore sample locations revealed concentrations of <7 parts per billion of SRP. These are very low levels of phosphorus, and common for northern Michigan streams in undeveloped areas. Low levels are also consistent with past water quality testing in Cedar Lake. Any elevated SRP levels found at S1 or S2 over the Jones Ditch concentration will suggest a localized source of phosphorus. With no other indications of diffuse pollution inputs, septic system discharges would be a likely possible source of elevated phosphorus.

With the levels of bacteria observed through field-testing, septic leachate would also be the suspected source based on K&A research of other northern Michigan lakes over the past decades. Thus, additional testing should be performed at this nearshore location. K&A recommends this testing be conducted by the county health department which could also assist residents with recommendations for additional inspections of existing septic system performance.

The high total coliform levels and presence of *E. coli* suggest a significant potential for fecal contamination and the associated health risks in this section of Cedar Lake. These findings present a public health concern, as fecal contamination is associated with various waterborne illnesses which disproportionately impact children younger than 5, adults 65 and older, as well as people with weakened immune systems (U.S. Centers for Disease Control and Prevention).[3] As such, county health department testing should also include additional sampling to the north and south of these particular nearshore areas.

Of note, research indicates that *Cladophora*, a genus of filamentous green algae, can serve as a secondary habitat for *E. coli* in surface waters. Filamentous algae reduce many of the environmental stressors that affect survivability of *E. coli* bacteria upon introduction to an aquatic environment. This algal species can provide sites for adherence, elevated nutrient concentrations and protection from UV radiation (Beckinghausen et al. 2014, Brettar and Höfle 1992, Byappanahalli et al. 2003, Whitman et al. 2003). Studies show variable survival time of *E. coli* on *Cladophora*, with the longest length recorded being more than 48 days (Engelbert et al. 2008). This suggests that *Cladophora* mats can harbor naturalized strains of *E. coli*, not only allowing *E. coli* to persist, but to also successfully grow (Badgley et al. 2011, Byappanahalli et al. 2007).

[3] Centers for Disease Control and Prevention. (n.d.). *Risk and E. coli infection*. Centers for Disease Control and Prevention. https://www.cdc.gov/ecoli/risk-factors/index.html#:~:text=Some%20groups%20of%20people%20are,immune%20systems%2C%20and%20international%20travelers.

Many filamentous green algae exhibit similar growth habits and are morphologically similar to *Cladophora* (John and Rindi 2015). Because of these similarities, it is possible that the prolific filamentous green algae growths observed as Site 1 and 2 may also act as a secondary habitat for *E. coli,* prolonging its presence in this area. As a substantial source of soluble phosphorus is required for the observed algal growth, these conditions lead K&A to believe that septic system leachate could be the primary reason for observed conditions.

References

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Attachment A

Field Photos of Site Conditions

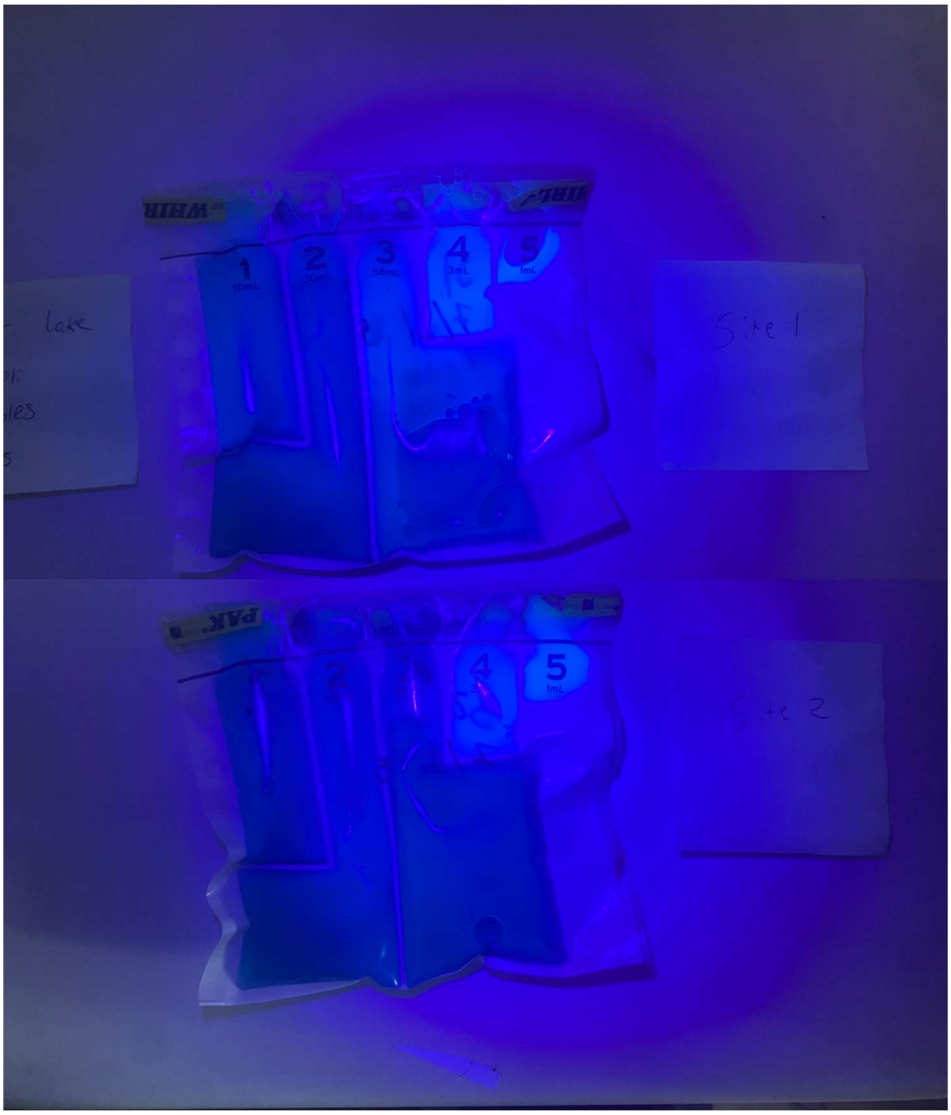
Photos of the excessive growth of *Chara sp.* and filamentous algae near the sampling locations, taken on July 2, 2025.

ATTACHMENT B

Field Test Kit Results

Photo of S1 and S2 Aquagenex Field Test Kit results in ambient lighting after a 5-day incubation period at room temperature. Blue coloration indicates the presence of *E. coli* (Channels 1-3 for Site 1; Channels 1-4 for Site 2).

Photo of Aquagenex samples under UV lighting after a 5-day incubation period at room temperatures. The blue fluorescence (Channels 4 and 5 in each sample pack) indicates the presence of other coliform bacteria.



Attachment C

Explanation of the Upper 95% Confidence Limit with MPN

The Upper 95% Confidence Limit (CL) is the highest possible Most Probable Number (MPN) that could be present in the water sample if the same sample is repeatedly tested. That is, the "true" concentration of bacteria in the sample will be at or below the 95% CL. It represents a worst-case upper limit of the quality of the water that would not be exceeded 95 times out of 100 on average if the same sample is analyzed over and over again."[4] (Basis of Aquagenx® MPN Table, 2021)

Using the Aquagenx® MPN table: Total coliform analysis is based on the yellow cells that fluoresce under UV light (representing positive for coliforms). Cells that are blue in ambient light are positive for *E. coli*, which also means they are positive for coliforms (Attachment B). This means that both Sites 1 and 2 would fall under the last row of the MPN estimation table provided by Aquagenx®.[5] Therefore, the MPN/100mL of both samples is greater than 1,000 MPN/100mL, with an upper 95% confidence level of 94,351.

[4] See Footnote 2.
[5] See Footnote 1.