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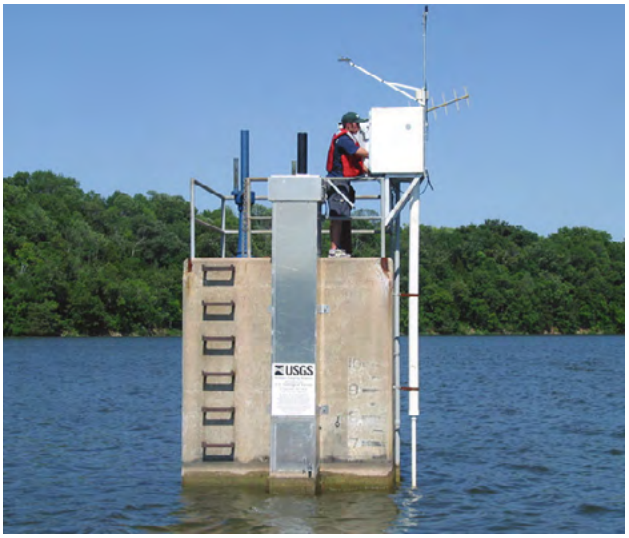
Environmental Solutions

Application Note
YSI Systems & Services • A538-03

Monitoring the Water Quality of Lake Olathe

PROTECTING DRINKING WATER FROM HARMFUL ALGAL BLOOMS

In America's heartland, the **City of Olathe, Kansas** relies on Lake Olathe for about 10 percent of its water needs, including drinking water . The Lake Olathe reservoir was built in 1956 in response to the increased sediment deposition occurring in an upstream lake, Cedar Lake. Following completion of Lake Olathe, Cedar Lake was removed from service as a water supply. Both Lake Olathe and Cedar Lake continue to provide recreational boating and fishing activities to area residents.



Automated vertical profiling station is attached to the drinking water intake structure at Lake Olathe.

The other ninety percent of Olathe's drinking water is pumped from wells in the Kansas River alluvium near Desoto, KS, and treated and distributed at a water treatment plant. Typically, from July to September, a second water treatment plant treats and distributes water from Lake Olathe. Those also happen to be the months when algal blooms are most likely to affect Lake Olathe.

Since 2000, lake levels have been drawn down as much as 8.5 feet during the summer months. However, intakes at two different elevations on an intake structure allow water to be pumped from Lake Olathe when lake levels decline. The intake structure also can be operated according to water-quality conditions. In June 2004, elevated manganese concentrations in the deeper part of the lake prompted the city to close the lower intake and open the upper intake. Taste and odor caused by algae has been an issue for water pumped from the upper intake and the city can close this intake when data suggests an algal bloom is in progress.

For a period of about 20 years, taste and odor issues in the drinking water plagued the city of Olathe. The source was twofold: algal blooms in Lake Olathe were a primary reason, but secondarily the shallow water of Cedar Lake discharged during storm runoff into Lake Olathe via Cedar Creek. This stormwater discharge carried not only algae, but also the taste and odor compounds they produced, exacerbating the issue for Lake Olathe.

Lake Olathe's algae woes , increased with residential and commercial development in the 16.9 square mile watershed. Development created new sources of contaminants, especially nutrients, that migrated by surfacewater or groundwater flow to either Cedar Lake or Lake Olathe. Normally in limited supply in a healthy lake, increased nutrient concentrations shifted the balance from stable populations of algae and bacteria to algal blooms and a reduction in

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Lake Olathe in Kansas

the dissolved oxygen concentration. This nutrient-rich condition, known as eutrophication, occurs in lakes and reservoirs all over the world, often leading to algal blooms, taste and odor issues, reduction in fish populations, and ultimately the elimination of the water body as a resource to the community.

But the city of Olathe decided to take action before things got to that point.

Studying the Water

In response to these concerns, the U.S. Geological Survey (USGS), in cooperation with the city of Olathe, and with support from the Kansas Department of Health and Environment and the U.S. Environmental Protection Agency, conducted studies in the early 2000's to evaluate the water quality, sediment, and chemical transport through the Lake Olathe watershed and at Lake Olathe. This was part of a larger real-time monitoring study by the USGS of four major water resource areas in Kansas.

Results from this study showed that phosphorus concentrations in the bottom sediment of Cedar Lake and Lake Olathe are some of the largest values for small reservoirs surveyed in eastern Kansas. Also microscopic blue-green algae observed in the bottom sediment indicate conditions that were favorable to taste and odor occurrences throughout much of Lake Olathe's existence.

A plan to address these issues, and to ultimately get better-tasting water from Lake Olathe, would require a fuller understanding of overall water quality, and how any steps towards mitigation would impact water quality. The best approach would be continuous water quality monitoring with real-time data delivery to watershed and drinking water managers, as well as to the federal agencies supporting this effort.

Continous Monitoring of Water Quality in Lake Olathe

A YSI Fixed Vertical Profiler was the ideal solution for water quality monitoring at Lake Olathe's intake. The profiler is equipped with an EXO2 water quality sonde bearing sensor for specific conductance, pH, water temperature, turbidity, dissolved oxygen, chlorophyll, phycocyanin, and PAR (photosynthetically-active radiation). The profiler moves the sonde up and down the water column at operator programmed intervals, in a completely autonomous fashion. The system is equipped with a datalogger and satellite radio so that water-treatment managers can view the data in real-time, from anywhere in the world.

Reservoir managers use this information to adjust water-treatment operations at Lake Olathe. For example, models were developed to estimate the nutrient and taste-and-odor compounds at Lake Olathe and Cedar Creek in real time. The models showed that algal blooms are best explained by lake-residence time, turbidity, light penetration, and nutrient concentrations. Further, with real-time-water-quality profile measurements, water-treatment managers evaluate and determine which intake to use and how to optimize water treatment. The measured changes in water quality allow the city to provide improved drinking water.

The system is extremely robust for the long-term, unattended monitoring due to the EXO anti-fouling wiper. This sonde has remained deployed for up to 80 days without compromises in data quality. This is particularly useful in water resources with active levels of algae.

EXO2 Multiparameter Sonde

Benefits of Continuous Monitoring

This continuous monitoring program is the basis for Olathe's watershed protection plan, design to ensure the long-term environmental health of Lake Olathe. Ongoing USGS studies provide a comprehensive assessment with which to manage development and water quality in the Lake Olathe watershed and reservoir. Historical changes in nutrient and sediment loads, evaluated via bathymetric surveys, formed the basis for monitoring for the effects of changes in land and chemical use in the watershed. Results from this study have national benefit, developing tools and approaches that can be applied throughout the country for small watershed water-supply reservoirs and the effects of urbanization on such water bodies. Eutrophication of lakes and taste and odor problems are widespread; they can be addressed through information on the watershed in addition to engineering approaches. Results of this study have broad application in eastern Kansas and the Midwest where there are a large number of small impoundments with similar concerns and problems, as well as citizen groups interested in watershed protection.

Note: Reference to the USGS in this article does not constitute US Government endorsement of this product.

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