
# SYNOPTIC SURVEY OF PHYSICAL AND WATER-QUALITY CHARACTERISTICS OF THE LOWER HOOVER RESERVOIR, COLUMBUS, OHIO

Proposal to:
City of Columbus, Ohio

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June 15, 2015

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# INTRODUCTION AND PROBLEM

In the fall of 2013, the City of Columbus' treated drinking water from Hoover Reservoir developed a taste and odor problem. The problem was derived from cyanobacteria (Anabaena) in the reservoir, which produced the compounds geosmin and 2-methylisoborneol (MIB). These compounds are known to cause taste and odor problems. During the months that the problem persisted, the City of Columbus spent an extra $723,000 on water treatment at their Hap Cremean Water Treatment Plant (Columbus Dispatch, Feb. 3, 2014) and were prepared to spend up to $970,000 in treatment in the fall and early winter of 2014-2015 as a preventative measure (Columbus Dispatch, Nov. 23, 2014).

City of Columbus officials speculated that the 2013 taste and odor problem at Hoover Reservoir may have been exacerbated by nutrients adsorbed by sediment or in decaying plant material that had settled to the bottom of the reservoir while it was stratified in the late-summer and early fall. Once the reservoir turned over in the fall, these nutrients were resuspended which contributed to the bloom of Anabaena in the fall and early winter.

The dam at Hoover Reservoir has three valves that the City can use to release water downstream: an upper valve, a middle valve and a lower valve. Prior to 2014, the City usually released water from the middle valve. However, during the summer-early fall stratification period of 2014, the releases were made from the lower valve. The rationale being that nutrients and sediment would be less likely to settle on the bottom of the reservoir during stratification if water was being released from the bottom; this was hoped to result in more nutrients being released downstream during stratification, meaning fewer nutrients would be available to promote cyanobacteria growth, which would result in less geosmin and MIB in the reservoir. The effectiveness of this practice is, however, largely unknown.

# OBJECTIVES

The objective of the proposed work is to do a synoptic survey of the physical and water-quality characteristics of the lower portion of Hoover Reservoir.

Specific objectives include:

1. Measuring and mapping the bathymetry of the lower Hoover Reservoir.
2. Measuring and mapping velocity vectors and selected water-quality parameters in the lower Hoover Reservoir during separate extended releases from two different intake valves.
3. Publish a USGS Scientific Investigation Report detailing the methods and results of the study.

## BENEFITS

The results from the study will provide the City of Columbus with information to make more informed decisions on reservoir releases and could potentially have local, state, and national relevance in terms of reservoir management, drinking water quality and harmful algal blooms.

## APPROACH

A synoptic survey of the lower Hoover Reservoir will be done to map selected water quality parameters, bathymetry and velocities from Hoover Reservoir Dam up to and including the County Line / Smothers Road Bridge (Figure 1).

The water-quality parameters that will be measured during the surveys include water temperature, specific conductance, dissolved oxygen, pH, turbidity, chlorophyll, and phycocyanin. In order to map the distribution of these water quality parameters, an autonomous underwater vehicle (AUV), outfitted with a sensor for each of the parameters mentioned, will continually make measurements as it moves through the reservoir on a preprogrammed path. It will be programmed to make a series of longitudinal passes through the reservoir while moving up and down through the water column in an undulating fashion.

Velocities and bathymetry within the reservoir and around the intakes will be measured by means of an acoustic Doppler current profiler (ADCP). ADCPs calculate three-dimensional water velocities by measuring the Doppler shift of an acoustic signal that is emitted and then returned to the instrument after reflecting off particles suspended in and moving with the water; much the same way a police officer's radar gun uses the Doppler effect to measure the speed of a car. The ADCP also uses an acoustic signal to measure the distance to the lake bed.

The ADCP, mounted to a manned boat, will be used to record velocities and bathymetry within the study area by completing a series of approximately east-west oriented cross sections perpendicular to the longitudinal paths of the AUV. This will allow for a comprehensive look at velocity vectors within the reservoir and how they change as a function of the valve being used for releases.

The data collected at the reservoir will be post-processed and integrated into a set of maps and figures that show how velocities and the measured water-quality parameters are distributed throughout the study area as a function of the valve being used for releases.

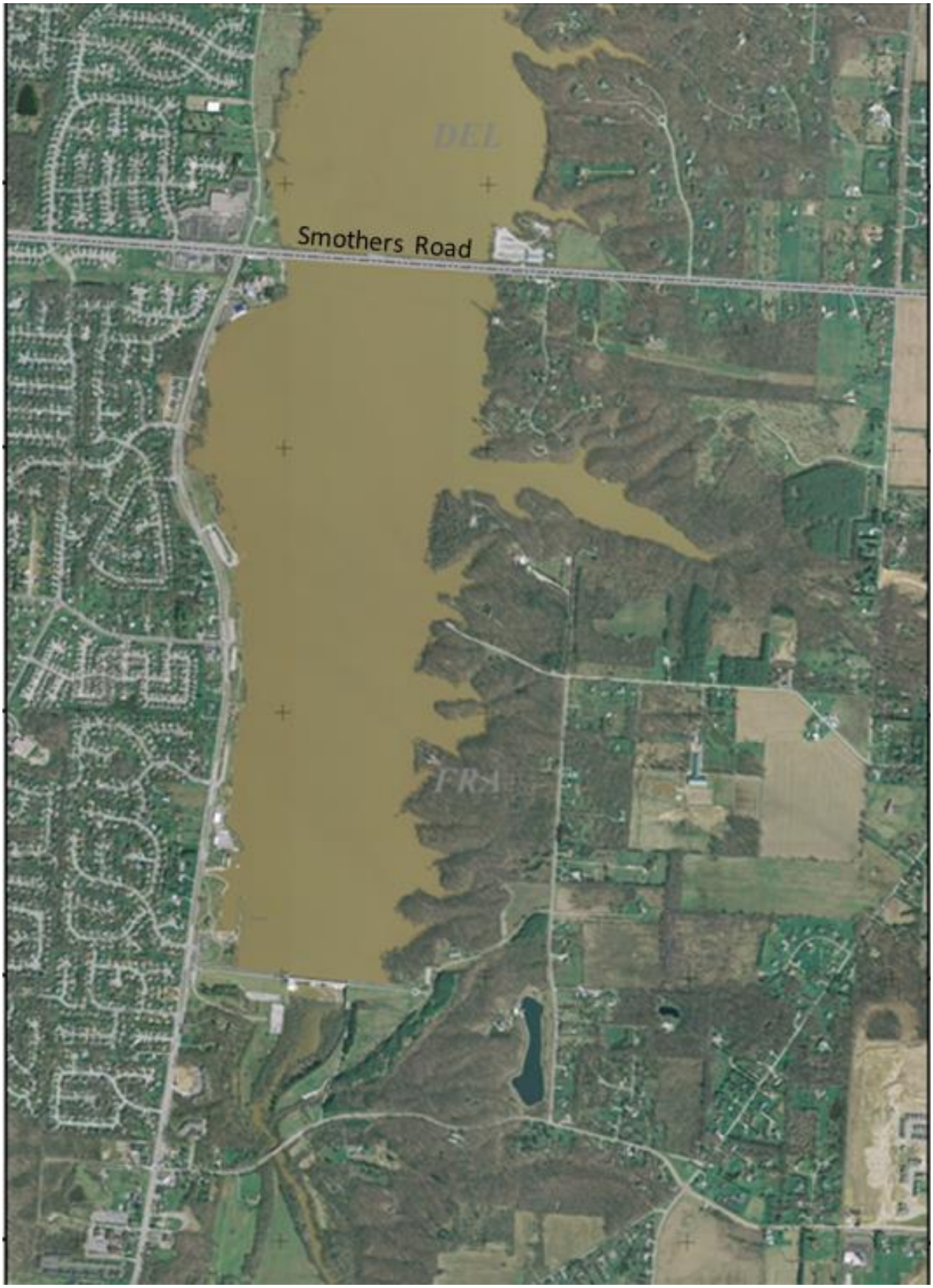


**Figure 1.** Map showing the lower Hoover Reservoir from Hoover Reservoir Dam to Smothers Road.

### Survey Location

The survey will be conducted in the lower end of Hoover Reservoir from the dam to the County Line /Smothers Road Bridge. The USGS will set up a collection pattern to define the velocities and WQ parameters in this section of the reservoir in consultation with the City.

### Survey Frequency

The USGS will collect data twice during a period of lake stratification. One set of data will be collected while the City releases water from the middle valve and a second set of data will be collected during releases from the lower valve. It is anticipated that at least a day will be needed between changes in operations to reach approximate equilibrium of the velocities within the lower reservoir.

## REPORT

A USGS report will be published to present the study methods and the results of the investigation. Copies of the report, in portable document format (PDF), will be available via the Internet through the USGS Publications Warehouse (http://pubs.usgs.gov). The draft text of the final report will be reviewed by peers and editorial staff to ensure accuracy, logical organization, and readability.

## TIMETABLE

This project will begin July 1, 2015 and the final report will be delivered to the City of Columbus by September 30, 2016 (Table 1). These dates are contingent upon the USGS and City of Columbus signing a cooperative joint funding agreement on or before July 1, 2015. Provisional data and results will be released to the City of Columbus before the end of the study as work is completed.

**Table 1. Estimated study timeline.**

| Calendar Year | 2015 | | 2016 | | |
|---|---|---|---|---|---|
| Federal Fiscal Year[1] | 2015 | 2016 | | | |
| Federal Fiscal year Quarters | 4 | 1 | 2 | 3 | 4 |
| Dates | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP |
| Data collection | | | | | |
| Data analysis | | | | | |
| Report preparation | | | | | |
| Report review and approval | | | | | |

[1] Federal fiscal year is from October 1 to September 30 and is designated by the calendar year in which it ends.

## BUDGET

The total cost for the proposed study is $135,700; $63,900 in fiscal year 2015 and $71,800 in fiscal year 2016. The USGS will contribute up to $50,000 of the total cost using USGS Federal-State Cooperative Water Program funds (subject to availability); $44,000 in fiscal year 2015 and $6,000 in fiscal year 2016. Table 2 shows proposed funding by quarter.

**Table 2. Annual study funding**

| Calendar Year | 2015 | 2016 | | | |
|---|---|---|---|---|---|
| Federal Fiscal Year[1] | 2015 | 2016 | | | |
| Federal Fiscal year Quarters | 4 | 1 | 2 | 3 | 4 |
| City of Columbus | $19,900 | $16,450 | $16,450 | $16,450 | $16,450 |
| USGS | $44,000 | $1,500 | $1,500 | $1,500 | $1,500 |
| Total | $63,900 | $17,950 | $17,950 | $17,950 | $17,950 |

[1] Federal fiscal year is from October 1 to September 30 and is designated by the calendar year in which it ends.