

How Deep Is It? The Mapping and Bathymetric Survey of Lake Allure in Quarryville, Pennsylvania

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Abstract

Freshwater lakes and flooded quarries are important for SCUBA divers in training. During the Spring and Summer of 2021, a survey of Lake Allure in Quarryville, Pennsylvania was completed to determine the bathymetry of the lake, identify areas that would be most conducive to SCUBA training, and identify potential hazards using Millersville University's remote operated vehicle "Dora." Mapping deeper sections of the lake was conducted using a Garmin Echomap UHD 63CV + Transducer mounted on a kayak. Transects along lines of longitude were paddled and depth soundings were taken every 20 feet and recorded in a notebook along with the longitude and latitude. The data were then converted for use in Ocean Data View® to produce a contour map of the lake. The bathymetric survey highlighted underwater features, and attractions such as sunken boats for the enjoyment of SCUBA divers. This research successfully demonstrates the use of multiple technologies for creating detailed bathymetric maps of small inland lakes and serves as a model for mapping other potential SCUBA dive training facilities.

Methods

Initial surveys of Lake Allure were performed using Millersville University's Remote Operated Vehicle (ROV) "Dora." The ROV was operated from the surface with a computer, video monitor, and video game controller powered by a portable gas generator. The ROV consisted of two thrusters, one camera capable of still and video photography, and two lights. Inputs from the video game controller were transmitted underwater to the ROV via a 100-meter tether which allowed the operator to control the speed, direction, depth, lights, and camera of the ROV. The ROV was

equipped with a camera capable of still and video photography which allowed us to document the habitats and pelagic species of fish along the eastern end of the lake.



Figure 1. Google Earth satellite image of Lake Allure in Quarryville, Pennsylvania. The dock which was used for Remote Operated Vehicle Surveys is in the upper right (Northeast) corner of the lake.



Figure 2. Mapping Lake Allure using a Garmin and recording latitude and longitude in real time on a map in the field.

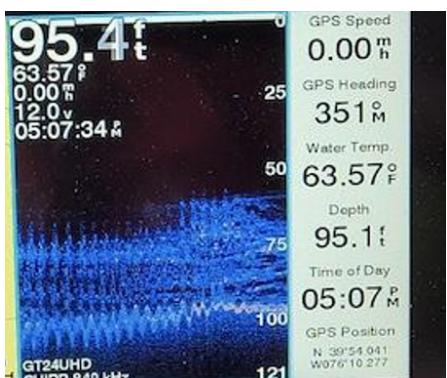


Figure 3. A closeup of the Garmin fish finder showing speed, GPS heading, water temperature, depth, time, and GPS position. This data facilitated creating an accurate map of Lake Allure.



Figure 4. Author operates the ROV with a video game controller used to input controls to the ROV,

and a computer and video screen are used to monitor the position of the ROV through a live video feed.



Figure 5. Author with the Remote Operated Vehicle, "Dora" at Lake Allure.

Due to the limitations of the ROV's 100-meter tether, methodology had to be reconsidered to thoroughly and accurately map the entirety of Lake Allure which measures over 2500 yards by 1400 yards. In April 2021, an Ocean Kayak® Trident 13 was outfitted with a Garmin ECHOMAP UHD 63cv Fish Finder/ Chart Plotter® to map Lake Allure. As a standard in Geographic Information Systems, each quadrat of seconds is 101 feet x 80 feet. Because the dock is a permanent fixture in the lake, its longitude and latitude were used to determine the margins of each quadrat's longitude and latitude. Starting at the eastern most edge of the lake, depth soundings were taken along parallel lines of longitude every 20 feet. Then, starting at the north end of the lake, depth soundings were recorded on parallel lines of latitude every 20 feet. The Garmin provided information such as longitude and latitude, Global Positioning Satellite (GPS), depth, and a sonar image of the bathymetry and lake. This information was used to record the longitude and latitude of each depth sounding on a real time map made in the field using the format of degrees decimal minutes. The map and field data were later converted to decimal degrees to be made into a digital contour map.

Discussion

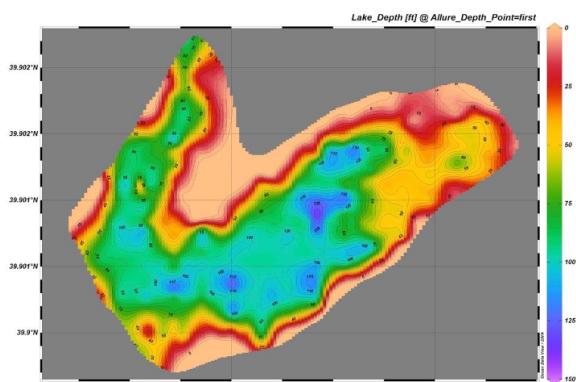


Figure 6. Contour map of Lake Allure in Quarryville, Pennsylvania. The peach color indicates the shore of the lake, and the deep blues and purples indicate the deepest sections of the lake. The deepest recorded location is 140 feet.

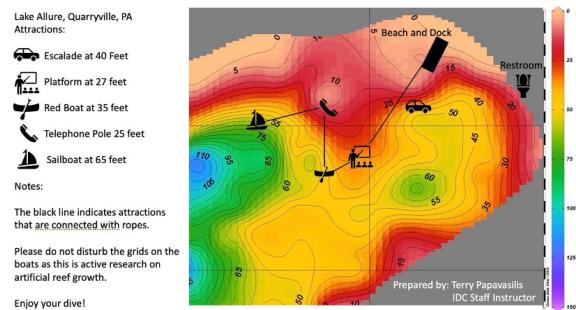


Figure 7. Map of the northeastern portion of Lake Allure featuring SCUBA diving attractions. The icons of the attractions are identified in the legend, and the black lines between the attractions represent ropes that are tied from one attraction to the other to provide a safety guideline for newer divers and in conditions of low visibility.

The divers enter the water at the beach, and there is a rope tied to the end of the dock that leads to a training platform at 25 feet. There is another rope from the platform to the shallow boat that then leads to the telephone pole and the sailboat. Currently, the deepest attraction is the sailboat, located in 65 feet of water. As Lake Allure continues to develop into a dive training facility, and new attractions are added, the map will be updated to reflect these changes.

There were several immediate uses of this map. First and foremost, SCUBA

divers and Public Safety Divers now have an accessible place for dive training. This map was converted into dive slates that measure 9 x 6 inches and were laminated to make them waterproof. Slates are important to SCUBA divers because it helps them identify points of interest as well as avoid areas that might be dangerous such as water that is too deep so that they can plan their dives safely. By making the slates waterproof, they can be referenced underwater to prevent divers from getting into dangerous situations.

The map of Lake Allure has immediate benefits that extended beyond the initial goal of benefiting local scuba divers. Lake Allure is one of the only dive training facilities in the Mid-Atlantic used for SCUBA Diver training serving members of the Pennsylvania, Maryland, Delaware, New Jersey, and New York dive communities. This mapping project serves as a model of how inland lakes can be mapped using a variety of instruments including remote operated vehicles, GPS, sonar, and computer software.

Future Directions

Research documenting the biodiversity and development of artificial reefs in Lake Allure commenced in September 2021 and will continue for one year. On a monthly basis, the shallow boat (35 feet) and the deep boat (65 feet) will be photographed to document how they transition into artificial reefs. In addition, four sample disks are taken from the shallow boat and four from the deep boat. They are analyzed for macro-organisms, and further microscopic analysis. This research will be presented at Made in Millersville in 2023 and will be the basis of a Biology Honors Thesis.



Figure 8. Author, Terry Papavasilis using SCUBA to visit the shallow boat at 35 feet to collect sample disks for further analysis of microorganisms and biodiversity of this artificial reef.

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