# Estimating Average Depths of Ponds

**Claude E. Boyd,** *Department of Fisheries and Allied Aquacultures, Alabama Agricultural Experiment Station, Auburn University, AL 36849*

**James L. Shelton,** *Department of Fisheries and Allied Aquacultures, Alabama Agricultural Experiment Station, Auburn University, AL 36849*

*Abstract:* Average depths of 35 ponds were computed by reliable mapping techniques. Average depths were also estimated from maximum depths × 0.4, soundings made along several transects across ponds, and sounding made along a single S-pattern over ponds. Assuming that average depths by mapping were accurate, averages of relative errors by other procedures were: maximum depth × 0.4, 12.6%; transects, 9%; and S-pattern, 5.4%. The S-pattern required fewer soundings and was the most reliable. If mapping is not feasible, 12 to 24 soundings made along an S-pattern over a pond will provide a suitable value of average depth for computing pond volume.

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When ponds are constructed, areas are normally determined but volumes are seldom estimated. In pond management, it is sometimes necessary to treat waters with specific concentrations of certain chemicals. To do so requires information on pond volume. Because of the time and labor required to map ponds and compute their volumes, various techniques are used to estimate average depth and average depth is multiplied by area to obtain volume. The U.S. Department of Agriculture, Soil Conservation Service (1971) recommended maximum depth × 0.4 to approximate average depth. Soundings taken along transects or at random are sometimes averaged to provide estimates of average depths. Some workers simply assume from experience that most ponds in a region are of a certain average depth.

As part of a study of the hydrology of fish ponds, 35 ponds on the Auburn University Fisheries Research Unit were recently mapped (areas and depth contours) and volumes computed. Average depths obtained from the

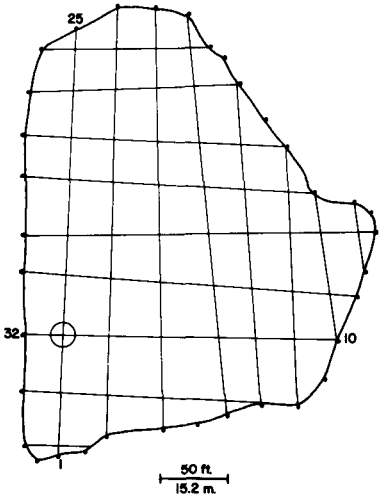


**Figure 1.** Illustration of sounding for mapping ponds. Position of stakes (dots) were established by transit readings and the outline drawn. Range poles were placed at stakes 1 and 25 and boat moved across pond while aligned between poles. Workers on shore aligned boat between stakes 32 and 10. Sounding was made at intersection in circle. Procedure was repeated until soundings were made at all intersections in grid.

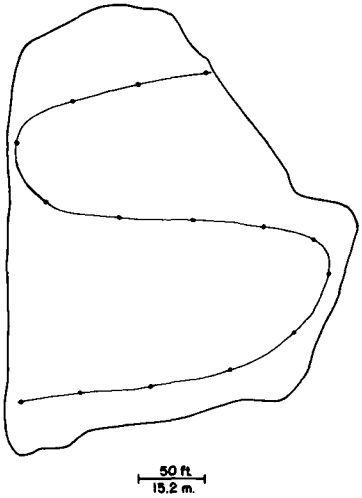


**Figure 2.** Illustration of sounding along S-pattern. Dots illustrate approximate location of sounding.

mapping effort were compared to average depths estimated by other procedures.

## Methods

Ponds are located on a 730 ha tract of land on the Piedmont Plateau near Auburn, Alabama. All ponds were constructed by earth-fill dams between 2 ridges to impound runoff. Terrain is hilly with average slopes of 5% to 10%.

The shorelines of ponds were surveyed with transit and stadia rod. The shorelines of ponds were drawn to scale and the positions of survey stakes were identified. The stakes used in the survey permitted establishment of a grid over the pond surface (Fig. 1). Range poles were placed at opposite ends of the pond and a boat with electric trolling motor was used to traverse the length of the transect between the 2 range poles. Workers on each side of the pond aligned themselves so that the transects across the pond could be established. These workers ascertained when the boat reached an intersection of two transects and a sounding was made with a 7.6-m rod calibrated to 3 cm. The traverse lines were established on the drawing and the depths at each intersection plotted. The number of transects varied from 6 to 22 depending upon pond area, and soundings per pond ranged from 36 to 171. Contours were drawn at 30-cm intervals. Volumes between contours were computed by an equation provided by Welch (1948) and their summation was taken as the pond volume. The average depth was computed as volume divided area.

Other methods for estimating average depth were: 0.4 × maximum depth, average of all soundings made along transects during survey, average of soundings made along transects including one zero depth value for each line, and average of soundings made along an S-pattern over ponds (Fig. 2). For the S-pattern, the number of soundings ranged from 10 to 22 per pond.

## Results and Discussion

Ponds had areas between 0.28 and 10.52 ha (Table 1) and volumes between 2,800 and 140,500 $m^3$. Average depths determined from mapping were from 0.77 to 2.49 m and maximum depths ranged from 1.8 to 6.4 m.

The mean of all average depths was 1.53 m with a standard deviation of 0.38 m. Obviously, the assumption of a single value for the average depth of ponds would be highly unreliable. The most shallow pond would be overestimated by 0.76 m and the deepest pond would be underestimated by 0.96 m.

**Table 1.** Areas of ponds for which average depths were estimated.

| Area (ha) | Number |
|---|---|
| < 0.5 | 4 |
| 0.51 to 1.0 | 11 |
| 1.1 to 2.0 | 10 |
| 2.1 to 3.0 | 2 |
| 3.1 to 4.0 | 2 |
| 4.1 to 5.0 | 1 |
| 5.1 to 6.0 | 2 |
| 6.1 to 10.6 | 3 |

**Table 2.** Reliability of 4 methods for estimating average depth of ponds as compared to average depth estimates by mapping techniques. Data were collected on 35 ponds.

| | Maximum depth x 0.4 | Transects without zero depth adjustments | Transects with zero adjustments | S-pattern |
|---|---|---|---|---|
| Range of error (m) | −0.37 to 0.52 | −0.12 to 0.46 | −0.30 to 0.03 | −0.15 to 0.30 |
| Average error (m) | 0.19 | 0.13 | 0.13 | 0.09 |
| Range of error[a] (%) | 0 to 37.5 | 0 to 20.0 | 1.2 to 20.0 | 0 to 14.8 |
| Average error (%) | 12.6 | 9.3 | 9.1 | 5.4 |

[a] $\text{Error} = \frac{\text{Value from mapping} - \text{Estimated value}}{\text{Value from mapping}} \times 100.$

Average depths estimated from 0.4 × maximum depth gave an average error (disregarding sign) of 0.19 m or 12.6% (Table 2). This procedure underestimated average depth in 28 of 35 ponds. Soundings along transects provided better estimates of average depth than those obtained from 0.4 × maximum depth. If 1 zero depth value was used at the end of each transect, the average error was 0.13 m or 9.1%. Without the zero depth adjustment, average error was 0.13 m or 9.3%. Volumes were overestimated 29 of 35 times without the zero depth adjustment and underestimated 32 of 35 times with the zero adjustment. The S-pattern for making soundings was the most reliable technique. The average error was 0.09 m or 5.4%. Overestimates were twice as common as underestimates by this procedure.

In practice, the transect technique would not require stakes and maps used here. Sounding could be made as a boat moved across the pond along several different transects, but a large number of soundings (50 to 100 or more) would be necessary. The S-pattern requires fewer soundings (12 to 24) and is more reliable. Differences between average depths of pond computed by mapping and by the S-pattern were plotted versus pond area, average depth, and maximum depth. No trends were noted, so the S-pattern for obtaining soundings should be applicable to all ponds.

## Literature Cited

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