

Residence Time of Sheboygan Lake

WBIC: 58900

11.7 days

Residence time equation:

$$T_r = \frac{V}{I} * 0.504$$

where T_r is residence time in days, V is volume in acre-feet, I is inflow in cubic feet per second, and 0.504 is a conversion factor.

Volume, V

A detailed survey of Sheboygan Lake (sometimes referred to as Sheboygan Marsh) was conducted to investigate the feasibility of a lake drawdown (Nicholson, 2015). The survey produced a table of lake volumes (Figure 1) paired with stage intervals of 1 foot from elevation 900' to 914'. Full Service Level of the dam is 906'. Using the table in Figure 1, the volume of the lake at that level is estimated to be 2,881 acre-ft.

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
900.00	10.000	0.000	0.000
901.00	34.000	22.000	22.000
902.00	537.000	285.500	307.500
905.00	618.000	1,732.500	2,040.000
906.00	1,065.000	841.500	2,881.500
907.00	3,904.000	2,484.500	5,366.000
908.00	6,695.000	5,299.500	10,665.500
909.00	8,424.000	7,559.500	18,225.000
910.00	9,666.000	9,045.000	27,270.000
911.00	10,465.000	10,065.500	37,335.500
912.00	11,059.000	10,762.000	48,097.500
913.00	11,457.000	11,258.000	59,355.500
914.00	11,513.000	11,485.000	70,840.500

Figure 1 Lake volumes for stage intervals of 1 foot, screenshot taken from Nicholson, 2015, page 57.

Inflow, I

The best estimate of inflow into Sheboygan Lake originated from a SWAT model in support of the Northeast Lakeshore TMDL (expected publication in 2022) that was calibrated to a continuous

streamflow monitoring site approximately 3 miles upstream of the lake. The average summer (months June, July, and August) inflow was estimated to be 124 cubic feet per second. The inflow includes all subbasins that contribute anywhere upstream from the dam.

$$\frac{2881 \text{ acre} \cdot \text{ft}}{124 \text{ ft}^3 \cdot \text{s}^{-1}} * 0.5042 = \mathbf{11.7 \text{ days}}$$

Prepared by:

Aaron Fisch
Dept. of Natural Resources
Environmental Mgt. Division
Water Evaluation Section
Aaron.Fisch@wisconsin.gov

References

Nicholson, Brian. (2015). "Sheboygan Marsh enhancement project: dam replacement feasibility analysis". Prepared by Ducks Unlimited with funding from USFWS Coastal Program.