Water Quality in Sheboygan County Lakes

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This report describing water quality in Sheboygan County lakes is for the use of home buyers and realtors who may be interested in properties on or near the lakefront. The focus is to compare the relative water quality of different lakes within the county using information gathered during lake monitoring from 2001-2004.

Several measures of water quality are taken seasonally on Sheboygan County lakes. Information is gathered and combined from two sources: 1) baseline monitoring by Department of Natural Resources biologists and 2) Self-Help Lake Monitoring by volunteers. The latter group consists of members of the general public living on or near area lakes. They make significant contributions to natural resource monitoring and conservation and their efforts are essential for maintaining the water quality of lakes in the county.

Secchi disk depth and concentrations of phosphorous and chlorophyll are water quality variables consistently measured in lake monitoring. Secchi depth (i.e., the greatest depth at which a black and white painted disk lowered into the water remains visible) describes water clarity. Secchi depths ≥10 feet indicate relatively good water clarity. Total phosphorous values describe the nutrients available in the water for use in primary production (photosynthesis by algae and aquatic plants). Chlorophyll *a* concentrations are a measure of algal growth in a lake.

Values for each of these variables may change between seasons. Typical ranges and their corresponding Trophic State Index (TSI) values indicating overall water quality are listed in Table 1. The TSI uses water quality variables to describe the relative water quality of a lake. Index values range from 0 to 100; < 40 indicates **oligotrophic** conditions (low nutrients, clear water, generally free of algae blooms and abundant aquatic plant growth, and are capable of supporting a fishery of large game fish), 40-50 indicates **mesotrophic** conditions (increased nutrient levels and productivity, favorable water clarity with abundant plant growth and an increase in fish abundance and diversity, occasional algal blooms and subsequent oxygen depletion), and > 50 indicates **eutrophic** conditions (nutrient rich, highly productive water with the potential for intense algal blooms and nuisance aquatic plant growth). Eutrophic lakes can support large fish populations, but are susceptible to oxygen depletion. Figure 1 provides a general illustration of the different trophic states for lakes. The pH of a lake also is often measured in water quality sampling. The pH values in Sheboygan County lakes (7.4-8.67) overlapped the range (7.5-8.8) commonly found in southeastern Wisconsin lakes and pose no problems for aquatic life.

Figure 1. Trophic states of lakes depicting the natural aging process

OLIGOTROPHIC
- Clear water, low productivity
- Very desirable fishery of large game fish

MESOTROPHIC
- Increased production
- Accumulated organic matter
- Occasional algal bloom
- Good fishery

EUTROPHIC
- Very productive
- May experience oxygen depletion
- Rough fish common

Table 1. Trophic classification of Wisconsin lakes based on measures of water clarity, total phosphorous, and chlorophyll a *(adopted from Lillie and Mason, 1993).*

Trophic level	TSI	Secchi depth (ft)	Total phosphorous ($\mu g \cdot l^{-1}$)	Chlorophyll *a* ($\mu g \cdot l^{-1}$)
Oligotrophic	0	>12	<3	<2
	40	8	10	5
Mesotrophic	41	6	18	8
	50	6	27	10
Eutrophic	51	5	30	11
	100	<4	>50	>15

Five Sheboygan County lakes were sampled during spring, summer, and fall of 2001-2004. For each lake, summary results and Trophic State Index values by water quality variable are found in Tables 2 and 3.

Table 2. Summary statistics for water quality measurements in Sheboygan County lakes, 2001-2004.

Lake	average secchi (ft)	secchi range (ft)	avg. pH	pH range	avg. total phosphorous ($\mu g\cdot l^{-1}$)	total phosphorous range ($\mu g\cdot l^{-1}$)	avg. chlorophyll ($\mu g\cdot l^{-1}$)	chlorophyll range ($\mu g\cdot l^{-1}$)
Crystal	16.3	8.0-27.0	8.1	7.6-8.6	11.2	6.0-19.0	2.9	1.6-6.0
Ellen	9.2		8.5		11.0		2.6	
Big Elkhart	9.2	5.0-11.0	8.1	8.1	10.0	9.0-22.0	2.7	1.7-8.2
Little Elkhart	10.9	6.2-14.5	7.8	7.4-8.1	20.0	15.0-28.0	6.6	3.9-18.5
Random	4.7	1.5-8.5	8.0	7.6-8.7	22.6	2.0-35.0	7.2	1.0-9.5

Note: Ellen Lake data consisted of one sampling date.

Table 3. Trophic State Index values for Sheboygan County lakes, 2001-2004.

Lake	TSI average secchi	TSI average total phosphorous	TSI average chlorophyll	Trophic Status
Crystal	20	47	43	Oligo/mesotrophic
Ellen	28	47	41	Mesotrophic
Big Elkhart	28	48	42	Oligo/mesotrophic
Little Elkhart	26	51	49	Mesotrophic
Random	39	52	49	Eutrophic

Water clarity was highest in Crystal Lake, with an average secchi disk depth of 16.3 feet. Ellen, Little Elkhart and Big Elkhart Lakes exhibited good water clarity, with average secchi disk depths ranging from 9.2 feet to 10.9 feet. Random Lake had the poorest water average water clarity (4.7 feet). Phosphorous levels were relatively high in all lakes sampled, with highest levels in Little Elkhart and Random Lakes. Phosphorous and chlorophyll *a* levels in Random Lake were, at times, up to 2-3 times higher than in other county lakes sampled.

Random Lake is classified as a drainage lake, where a portion of its water is provided from a stream inlet and discharges to Silver Creek on the north end of the lake. This feature could result in increased nutrient loading to the lake and may account for its eutrophic state. The remainder of the lakes in this document are classified as seepage lakes and their main water source is from groundwater discharge, which would explain the better water clarity and lower nutrient concentrations.

Phosphorus inputs need to be reduced to both Little Elkhart and Random Lakes to improve water quality. Abundant native plant populations exist in Little Elkhart Lake. These plants help maintain water clarity by using phosphorus to build their cells. As the

phosphorus is utilized by aquatic plants, less phosphorus is available for algae and non native aquatic plants such as Eurasian Water Milfoil. Random Lake contains a large population of the non native Eurasian Water Milfoil and often exhibits algae blooms, fueled by the high phosphorus levels.

Water quality was generally good in the Sheboygan County lakes sampled during the past four years, in comparison to other southeast Wisconsin counties. Lakes with the best water quality included Crystal and Big Elkhart.   Random Lake exhibited the worst water quality of the five lakes tested.

Crystal and Big Elkhart Lakes exhibited excellent water clarity, lower levels of total phosphorus and are not typically prone to algae blooms. Little Elkhart and Ellen lakes are mesotrophic (medium nutrient). Water quality is generally good, with high water clarity, balanced fish populations, reasonable native plant growth and only occasional algae blooms. Random Lake is a eutrophic lake (high nutrient) with poor water clarity and excessive plant growth. The fishery of Random Lake is dominated by overabundant and slow growing bluegill and black crappie. Largemouth bass, northern pike, walleye and musky are present in fair numbers and all are generally in good condition with regard to size.

Ellen, Crystal, and Big Elkhart Lakes do have zebra mussels, with the number being highest in Elkhart Lake. Elkhart Lake has had zebra mussels since 1989. Zebra mussels were found in Lake Ellen and Crystal Lake after 2000 and their populations are not as robust as Big Elkhart Lake.

Lake residents and other boaters should exercise caution to prevent zebra mussels from damaging personal property or spreading to other area lakes. Prevention steps are found on the DNR website at http://www.dnr.wi.gov/invasives/action_water.htm. Additional water quality data as well as information on lake ecology can be found on the DNR website at http://www.dnr.state.wi.us/org/water/fhp/lakes/selfhelp/index.htm.