Influences of Nutrient Accumulation, Sedimentation Loading, and Organic Matter on Water Quality in Marion County

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Introduction

Rationale: The purpose of this study is to conduct research on the water quality status of Marion County Lake as well as summarizing results from previous experiments in order to recommend management strategies to promote public safety within the Marion community. The objectives of this report are: i) to assess nutrient accumulation, ii) to quantify sediment loading, and iii) to analyze the concentrations of organics by conducting a thorough limnological study of Marion County Lake.

Study Site: Marion County Park and Lake contains approximately 300 acres of land, 150 acres of water, and is surrounded by about 200 homes. The lake falls within the Upper Cottonwood sub-basin, and the associated drainage area is approximately 6.2 square miles.

Figure 1. Map of Marion County Lake Watershed showing the location of the lake in the southwest part of the drainage area.

Data Collection

In order to assess water quality, four samples from the lake were collected in April 2018. Additional data on lake water quality was obtained from the Kansas Department of Health and Environment.

Nutrient Accumulation

Lakes trap nutrients and sediments. Feedlots influence the movement of nutrients into a lake and site factors include: compaction beneath animal waste lagoons, how close feedlots are to the lake, and runoff and infiltration into the groundwater system. Phosphorus contributes to lake eutrophication and is a problem due to its immobile quality, but could only be transferred if runoff or erosion occurs. Nitrogen is mobile, meaning is it capable of moving farther into the soil profile, and also is a main requirement of algal growth.

Sediment Loading

Sedimentation and sediment loading are a clear problem in Kansas freshwater bodies. With the amount and rate of sedimentation and sediment loading depending on the climate, temperature, and trophic state, managing these concerns can be a daunting task. Through various management programs and practices, organizations can at the very least mitigate the amount of nutrients that end up in our water bodies.

Marion County Lake Water Quality Study

Table 1. KSU Soil Testing Lab Water Analysis Results

Lab # (s)	Sample Name	TSS mg/L	TDS mg/L	EC mS/cm	pH	Total N ppm	Total P ppm	NH4-N ppm	NO3-N ppm	Ortho P ppb
502794	1	19	244	0.35	8.00	0.95	0.02	0.04	0.15	144
502795	2	25	246	0.35	8.20	1.04	0.03	0.06	0.13	41
502796	3	35	258	0.37	8.12	0.96	0.03	0.09	0.10	10
502797	4	184	247	0.35	8.18	2.28	0.17	0.04	0.14	<5

Sample Analysis: At collection, the fourth sample was noted to have increased turbidity, foam, and algal growth in the surrounding areas. This was confirmed by the water analysis of increased total suspended solids, total nitrogen, and total phosphorus. These results indicate the possible addition of contaminants in the fourth location of the lake. All other samples were discovered to be in executable ranges in all other parameters.

Figure 2. Water sample map

Water Contaminants

Lake or reservoir trophic designation	TSI	Chlorophyll-a
Oligo-mesotrophic:	0-39	≤ 2.50 ug/L
Mesotrophic:	40-49	2.51-7.20 ug/L
Eutrophic:	50-63	7.21-30.0 ug/L
Hypereutrophic:	> 63	> 30.0 ug/L
Argillotrophic:	n/a	n/a

Figure 3. Trophic designation by concentration of chlorophyll-a (ug/L) in lake or reservoir water

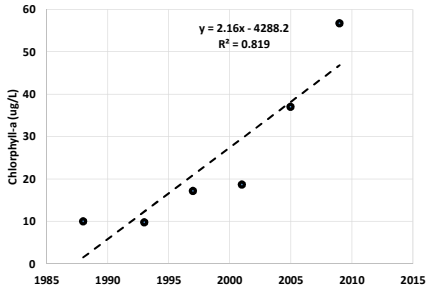

Figure 4. Chlorophyll-a concentration (ug/L) of water found in Marion County Lake from 1988 to 2009

Currently, the Lake is considered to be fully eutrophic, with a trophic state index of 56.39. The trophic state index (TSI) is derived from the chlorophyll-a concentration in lake waters. The chlorophyll-a in Marion County Lake has been increasing at an increasing rate since 1985 and has passed from the eutrophic level to the hypereutrophic level. Also, the total coliform content exceeds the USEPA standard for drinking water, while the total algal cell count suggests the potential formation of algal blooms in months of warm water temperature.

Conclusion

An interdisciplinary approach must be taken to rectify the current water quality problems in Marion County Park and Lake. Since the primary source of the eutrophication in the lake is nutrient contamination from agricultural operations, farm managers should implement the government-suggested BMP's regarding fertilizer application, tillage, and animal waste removal. Animal operations should be located a safe distance from the lake shore to avoid solid waste contamination. Nearby farmers should implement no-till cultivation to prevent erosion and runoff of soluble nutrients such as phosphorus and nitrogen. Surface water and lake sediment should be sampled frequently and according to a regulated procedure and sent to a lab to be processed to test for excess nutrients and toxins. Both farmers and governmental policy are responsible for solving environmental issues and supporting public health of communities.

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