



# Soil Assessment of Marion County Lake Shoreline Buffer Zone

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Kansas State University, Manhattan, KS | Natural Resources and Environmental Science Capstone



## Introduction:

Marion County Lake is a 150-acre lake located within a 300-acre park in Allen County. Local residents frequent the area to participate in a variety of recreational activities ranging from fishing to boating to camping. As time has gone on, it has been apparent that a Lake Management Plan needs to be established and continually expanded upon in order to provide boundaries and goals for the uses of the lake. Currently, multiple issues surround the lake that need to be addressed with this plan.

Primarily, eutrophication and blue algae blooms have occurred during the summer months, making the area unsightly and potentially dangerous for people to participate in the aforementioned recreational activities. Additionally, the influx of geese within SE Kansas has led to a large population of the birds residing within the park. Seen as a pest, these geese are also unsightly, and can deter residents to take full advantage of the lake.

In the future, these issues need to be addressed via a management plan to effectively optimize the beauty and accessibility of the area, encouraging Kansans to experience the outdoors and nature both on the lake and in the surrounding areas.

## Objectives:

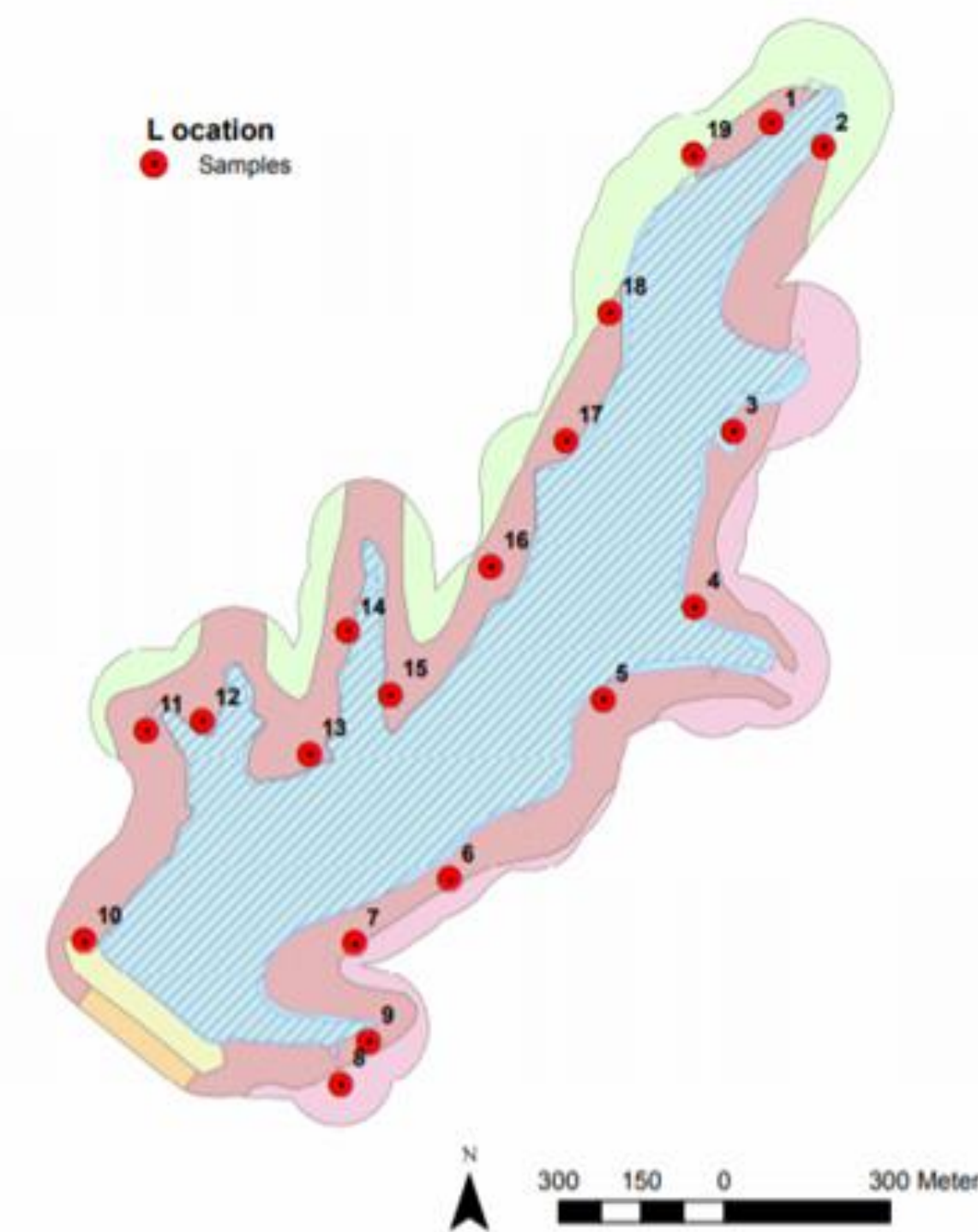
- Provide baseline shoreline soil characteristics for future lake management use
- Create maps analyzing various components of buffer system, in particular soil class and texture, as well as nutrient and organic matter levels
- Develop Best Management Practices (BMPs) to be used by Marion County Lake
- Provide recommendations for tallgrass prairie grasses to be installed along the buffer zone of the lake

## Methodology:

- Collected 19 soil samples around Marion County Lake
- Samples collected were within 10 meters of the lakeshore perimeter in accessible locations
- Used a slide hammer to retrieve 58.9 cm<sup>3</sup> soil cores with a 5 cm diameter, approximately 15 cm length
- Samples were divided between 3 cm depth soil core partitions to perform in-lab bulk density tests by our team
- The remainder of the soil samples were sent to the K-State Agronomy Soil Testing Lab to perform tests to determine:
  - pH
  - Organic Matter Content
  - NO<sub>3</sub>-N
  - Phosphorus
  - Potassium
  - NH<sub>4</sub>-N
  - Soil Texture Class

## Sample Collection Locations:

Marion County Lake Soil Sample Sites



- Sample cores were retrieved within buffer zones surrounding the entirety of the lake, save directly adjacent to the dam
- Particularly within coves and inlets of lake
- Locations primarily had moderate to high slopes, potential runoff capabilities in extreme weather events
- Once soil core was taken, smart phone was used to record exact GPS location of each site

## Soil Test Results:

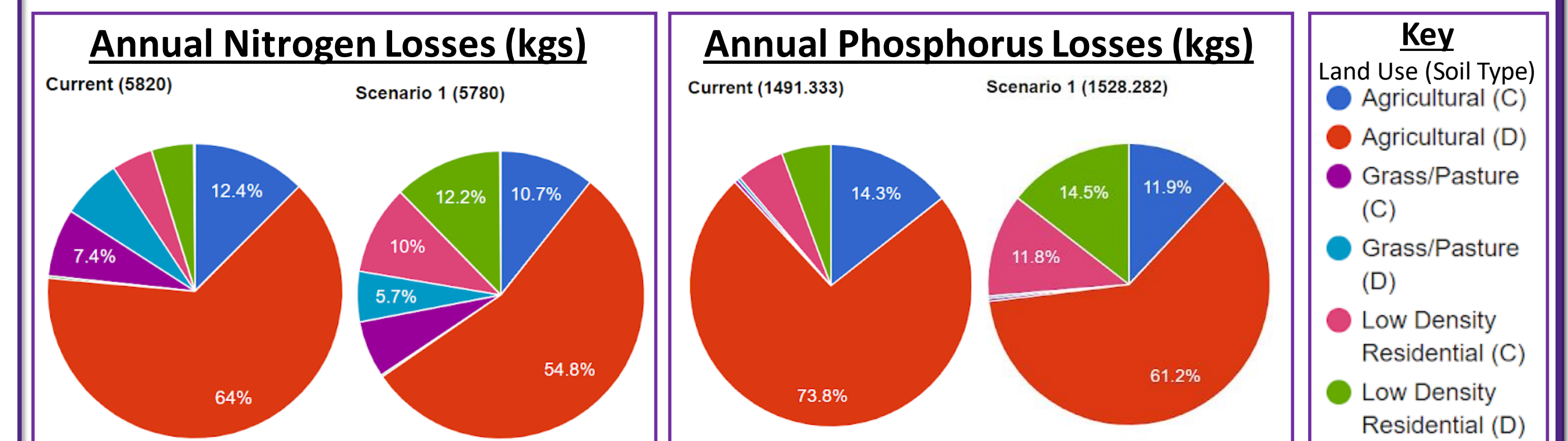
Sample	pH	OM LOI %	NO <sub>3</sub> -N (ppm)	P-M (ppm)	K (ppm)	NH <sub>4</sub> -N (ppm)	Soil Classification
1	7.7	6	3.9	17	402	4.3	Silty clay loam
2	7.7	6.3	3.7	32	306	4.7	Silty clay loam
3	6.8	7.6	4.1	4	362	19.8	Silty clay loam
4	7.7	9.2	10.1	4	323	8.1	Silty clay loam
5	7.9	8.6	4	4	273	3.4	Silt loam
6	8.1	7.2	5.2	3	337	3.4	Silt loam
7	7.8	10	4.4	4	257	4.3	Silt loam
8	7.8	8.2	11.7	4	305	6.2	Silty clay loam
9	8	5.6	2.4	3	253	6.2	Silt loam
10	8	8.2	6.4	4	248	4.4	Loam
11	8.1	7.1	3.3	2	226	4.6	Silty clay loam
12	7.8	6.2	3.3	4	405	6.6	Silty clay loam
13	7.5	7.3	2.6	18	518	4.9	Silty clay loam
14	6.9	8.5	6.8	3	406	4.3	Silty clay loam
15	8	6.1	3.6	4	292	3.5	Silt loam
16	7.8	6.1	12.5	4	444	4.5	Silty clay loam
17	7.8	7.3	14.8	6	526	3.9	Clay loam
18	7.7	8.5	9.8	4	448	5.2	Silty clay loam
19	6.8	7.8	18.3	21	530	6.1	Silt loam

## Soil Composition Analysis:

According to both the Soil Testing Lab soil test results, multiple dynamics of the current soil conditions could indicate the proper future amendments to the soil in order to effectively establish prairie grasses along the buffer zone of the lake. The high rates of pH could potentially restrict nutrient availability and stunt plant growth. High rates of K indicate that plants will not need to be fertilized with K, and any near future fertilizer applications should avoid incorporating K as to not risk toxicity. Generally, the low rates of both forms of N as well as P suggest that fertilizer applications could increase the establishment rate of the plants, however due to the high runoff potential, direct rather than broadband applications should be made.

## L-THIA Analysis and Results:

To determine the land-use that contributes excess nutrients that in turn impact the lake's health, Purdue's Long-Term Hydrologic Impact Analysis (L-THIA) was used to estimate the runoff and nonpoint source pollution associated with the land use and soil type of the area of interest. Completed based on the sub-watershed with Marion County Lake as the basin, the L-THIA model was based on 2 differing scenarios- "Current": the USGS most recent land use and "Scenario 1": 15% of the current land dedicated to grassland/pasture, forests, and agricultural land was evenly split and converted into low- and high-density residential areas.



Overall, a majority of the excess nutrients in Marion County Lake are from the agricultural land to the north of the basin. In the coming years, as development around the lake increases, there will be higher amounts of nutrient transport that will spur the algae events. Nitrogen and phosphorus are both limiting factors toward blue-green algal blooms that have been a major issue for Marion County Lake. L-THIA modeling showed that this nutrient contribution would only continue to grow as the watershed continues to develop towards more residential-based land cover.

## Recommendations:

Our recommendation for the Marion County Park and Lake Management is to plant native, tall prairie grasses along the shoreline of Marion County Lake. This will serve to catch excess nutrients contributing to blue-green algal blooms and reduce future erosion. In addition, this will indirectly deter geese nesting and enhance the overall aesthetic appearance of the lake. The following native grasses could be used for this tall grass buffer zone: big bluestem, little bluestem, switchgrass, barnyard grass, Indian grass, and purple top grass.

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