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LITTLE SWAN LAKE

WATERSHED MANAGEMENT STUDY

Little Swan Lake
Warren County, Illinois

October 2018

Prepared for:

LITTLE SWAN LAKE
SILTATION COMMITTEE

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TABLE OF CONTENTS

1.0 Introduction 1
1.1 Project Location 1
1.2 Scope of Work 1
1.3 Pertinent Lake/Dam Information 1
2.0 Review of Past Data Sources 2
2.1 CWI Report, 2003 3
2.2 Bryan Hartman Data, 2015 3
3.0 Geotechnical Analysis 4
3.1 Methodology 4
3.2 Results 4
4.0 Erosion/Sedimentation Calculations 4
4.1 Modified Universal Soil Loss Equations 5
4.1.1 Rainfall-Runoff Erosivity 5
4.1.2 Soils Erodibility 6
4.1.3 Slope Length Factor 6
4.1.4 Cover-Management Factor 7
4.1.5 Practice Support Factor 7
4.2 Watershed Average MUSLE Results 7
4.3 Single Event MUSLE Calculations 8
4.4 MUSLE Conclusions 9
4.5 Comparison of Bathymetric Surveys 9
4.6 Bathymetric Survey Conclusions 10
4.7 Limitations 11

5.0 Alternatives/Recommendations 11
5.1 Alternative 1 – No Action 11
5.1.1 Description 11
5.1.2 Cost Estimate 11
5.2 Alternative 2 – “Low Cost” Watershed Improvements 11
5.2.1 Description 12
5.2.2 Cost Estimate 15
5.3 Alternative 4 – Wetland and/or Sedimentation Basin Development 15
5.3.1 Description 15
5.3.2 Cost Estimate 16
5.3.3 Cost Estimate 18
5.4 Alternative 4 – Dredge 19
5.4.1 Description 19
5.4.2 Cost Estimate 19
5.5 Summary and Final Recommendations 20
Appendix A Laboratory Data
Appendix B Maps
Appendix C Additional Information
Appendix D Wetland Funding
Appendix E Sources

1.0 INTRODUCTION

1.1 Project Location

Little Swan Lake is located in Warren County, Illinois; Sections 19, 20, and 30 in Township 8 North, Range 1 West and Sections 24 and 25 in Township 8 North, Range 2 West. The nearest municipality is Avon, IL, located approximately 4.75 miles East of the Lake. The lake, its dam, and its appurtenances are owned, operated, and maintained by The Little Swan Lake Club. The lakeshore is surrounded by residential homes; as such, the lake's primary purpose is residential development and recreation.

1.2 Scope of Work

Little Swan Lake is a man-made reservoir located in a rural part of West Central Illinois. Like many man-made reservoirs, Little Swan Lake has experienced significant sediment deposition since its construction in 1968. 37 years of siltation led to a dredge study/project in 2003-2004, however, as early as 2015 it became evident that a large amount of additional sediments had entered the lake and that additional dredging may be necessary. Prior to authorizing additional dredging, Klingner & Associates, P.C. was retained by the Little Swan Lake Siltation Committee to perform a series of watershed management tasks. The main purpose of these tasks were to determine the possible sources of silt entering the lake, the total expected silt load, the expected siltation rate, and possible alternatives to reduce future sedimentation (among other items). The final Scope of Work included:

1.) Topographic survey of the dam
2.) Bathymetric survey of the lake bottom
3.) Geotechnical analysis of the lake bottom sediment
4.) Dam inspection
5.) Stakeholder Inventory Development
6.) Development of a Watershed Management Plan

1.3 Pertinent Lake/Dam Information

Date Constructed……………………………………………………………….. 1968

National Inventory of Dams ID Number………………………………………. IL00469

Dam Type………………………………………………………………………. Earthen

Top of Dam Elevation…………………………………………………………. 666.0 FT

Dam Height……………………………………………………………………. 49 FT

Dam Length……………………………………………………………………….958 FT

Lake Area…………………………………………………………………….....230 AC +/-

Normal Lake Storage…………………………………………………………….3172 AC-FT

Maximum Lake Storage………………………………………………………… 5423 AC-FT

Watershed Area………………………………………………………………… 5675 AC

Open Water……………………………………………………………………245 AC (4.3%)

Developed Area…………………………………………………………….581 AC (10.2%)

Forest…………………………………………………………………………..268 AC (4.8%)

Pasture…………………………………………………………………………391 AC (6.9%)

Cultivated Crops………………………………………………………….4190 AC (73.8%)

Watershed to Lake Area Ratio…………………………………………………..25:1

Average Watershed Slope……………………………………………………….24 FT/MI

Primary Watershed Soil Type…………………………………………………….. Silty Loam

Principal Spillway Type…………………………………………………………. Concrete Drop Box

Principal Spillway Size………………………………………………………….. 10 FT x 6.25 FT

Principal Spillway Elevation (Normal Pool)………………………………………656 FT

Emergency Spillway Type…………………………………………………… Trapezoidal, Grass-Lined Channel

Emergency Spillway Size………………………………………………………. 80 FT Bottom Width

Emergency Spillway Elevation……………………………………….............. 660 FT

2.0 REVIEW OF PAST DATA SOURCES

Little Swan Lake provided Klingner with their available past studies, reports, maps, plans, and pertinent correspondence. This information was reviewed to provide historic context and the backround information necessary to determine how the lake and its dam has changed over time. It also provided the information necessary to perform certain calculations, such as historic siltation rates and the inflows and outflows from the lake. The primary historic sources used in this review were the “Little Swan Lake Sedimentation Survey and Management Plan, CWI (2003)” (Appendix C.1) and the Bryan Hartman Bathymetric Survey, (2015) (Appendix B.6). This information is briefly described below. Other sources of data used in this report can be seen in Appendix E.

2.1 CWI Report, 2003

In 2003, The Little Swan Lake Club retained Cochran & Wilken, Inc. (CWI) to perform a bathymetric survey and sedimentation calculations in preparation for a future dredging project. In that study CWI used GPS and a sounding pole to obtain a series of eleven (11) cross sections. These cross sections were intended to map the lake bottom at that time, which could be compared with the design cross sections developed from the original Little Swan Lake Grading Plan (Appendix A.1). The difference in these cross sections provided the estimated amount of sediment deposition, or 174,226 cubic yards. The report recommends that at least 103,388 cubic yards of sediment be removed. The report also recommends that additional riprap be placed along the lake’s shoreline to prevent further shoreline erosion. As a result of this Report, Little Swan Lake did pursue a dredge project. However, the amount of silt removed from the lake is unknown.

2.2 Bryan Hartman Data, 2015

Bryan Hartman, P.L.S performed volunteer supplemental bathymetric survey services in 2015 due to concerns that sediment deposition had significantly increased since 2003. Mr. Hartman used GPS and depth sounding equipment to map the entirety of the lake bottom. The dense network of bathymetric survey points were converted into Digital Terrain Models (DTM’s), in which a variety of analyses could be completed, including comparisons with past/future bathymetric surveys and comparisons with the original lake contours.

3.0 GEOTECHNICAL ANALYSIS

3.1 Methodology

As part of Klingner's Scope of Work, three soil samples were taken from the bottom of Little Swan Lake in order to characterize the sediment materials. The samples were taken at three different locations within the upper third of the lake. Samples were collected using a geoprobe. The material was then transferred to collection buckets and transported to the Klingner Geotechnical Lab in Hannibal, MO. Once in the lab, two specific tests were performed, a Sieve Analysis/Particle Size Distribution Test and Atterburg Limits Test.

3.2 Results

The Atterburg Limits Test determines the material classification of the sediments which, in turn, helps dredging contractors understand what types of materials are to be removed. The sediments found at the bottom of Little Swan Lake were different at the three different sample locations. The first was Silty Sand (ML), the second was Lean Clay (CL), and the third was Organic Clay (OH). While distinctly different, these soil types are not unexpected for a man-made lake bottom. Silts and Clays have very small particle sizes which are able to settle out when the watershed's tributaries enter the lake and the water velocity drastically decreases. These soil types are also common in the watershed, and we expect to see similar soil types in the watershed as we would the lake bottom.

The Particle Size Distribution Test further breaks down the soil type into their percentages of large grain (primarily sands) and fine grain (silts and clays) sediments. As previously stated, the majority of the sediments were fine grained silts and clays. However, soil sample No. 1 did have a slightly larger amount of sand, 16% versus 3% and 1% for Samples No. 2 and No.3, respectively. This is not unexpected as Sample No. 1 is the furthest upstream in the lake, and the heavier sand materials are the first to drop out of suspension. As you move downstream, it is expected that the amount of sands would decrease and the particle sizes would become smaller. This is what we see in Samples No. 2 and No.3.

4.0 EROSION/SEDIMENTATION CALCULATIONS

Erosion and sedimentation calculations were performed in two distinct manners: theoretical or "expected" rates of sedimentation and actual measured rates of sedimentation. By combining these two methods, we were able to form a relatively accurate picture of the sediment deposition concerns at Little Swan Lake. The theoretical rates of siltation were developed by applying the Modified Universal Soil Loss Equations (MUSLE). The actual measured siltation rates were calculated by comparing the Klingner Bathymetric Survey (2018) with the historic bathymetric surveys completed in 2003 and 2011.

4.1 Modified Universal Soil Loss Equations

The Modified Universal Soil Loss Equations are intended to estimate average annual soil loss. They were initially developed for agricultural watersheds in the United States; however, their application have since been greatly expanded. These equations are widely used in the engineering, agricultural, and environmental fields. The equations aggregate a series of measurable watershed qualities to develop the average annual soil loss expected for that watershed in a given year. The Modified Universal Soil Loss Equation can be seen in Equation 1 below:

$$Equation\ 1: \quad A = R * K * LS * C * P$$

$$\underline{Where:}$$

$$A = Average\ Annual\ Soil\ Loss\ (Tons/Ac/Yr)$$

$$R = Rainfall - Runoff\ Erosivity\ Factor$$

$$K = Soil\ Erodibility\ Factor$$

$$LS = Slope\ Length\ and\ Steepness\ Factor$$

$$C = Cover\ Management\ Factor$$

$$P = Support\ Practice\ Factor$$

For the purpose of this study, it was important to understand not only the total expected amount of sediments entering the lake, but also what portions of the watershed were most susceptible to erosion. In order to make this determination, the MUSLE was applied geospatially using ArcGIS (the standard geospatial analysis software) and the methodology provided in “Soil Erosion Assessment Using GIS and Revised Universal Soil Loss Equation, Kim (2014)”. The end result of this analysis is a Soil Loss “Heat Map,” which details which parts of the watershed are most susceptible to erosion. This map can be used to determine which parts of the watershed would most benefit from soil conservation practices. Each variable in the MUSLE, and how that variable was calculated, is described in the subsections below.

4.1.1 Rainfall-Runoff Erosivity

Rainfall-Runoff Erosivity is a measure of the erosive force and intensity of rainfall. These values have been computed using rainfall records from across the United States and are compiled in Rainfall Erosivity Maps Published by the USGS and NRCS, among other State and Federal Agencies. However, many of these maps are not available geospatially; as such, a relationship developed in “Evaluation of the Relationships

Between the RULSE R-Factor and Mean Annual Precipitation, Kurt Cooper, (2011)" was used in our analysis. This relationship is as follows:

$$Equation\ 2: \quad R = 1.24 * P^{1.36}$$

$$\underline{Where:}$$

$$P = The\ Average\ Annual\ Precipitation\ (in)$$

Average annual precipitation from 1960 to 2001 was geospatially compiled by The Blackland Research Center at Texas A&M University System in Temple, TX. The data was developed with the intention to support USDA-NRCS Nationwide Conservation Efforts. In the southern part of Warren County, IL, the average annual precipitation was 37 inches, which results in an R-Factor of 168.

4.1.2 Soils Erodibility

Soil erodibility (K) is a measure of the susceptibility of soil particles to detach and be transported by water. K is high when erodibility is high. Loose silt materials have the highest K values and densely packed clays have the lowest K values. K values are estimated by the The United States Department of Agriculture (USDA) based on their extensive network of soil survey information. This data is available geospatially via the USDA Web Soil Survey. The Soil Erodibility Map can be seen in Appendix B.1.

4.1.3 Slope Length Factor

The slope length factor is a single figure that encompasses both the length of slopes within the watershed and the steepness of slopes within the watershed. As the slope length and slope steepness increase, so does the slope length factor. In our calculations, the slope length factor was calculated using the Unit Stream Power Erosion and Deposition (USPED) method. In ArcGIS, flow direction and flow accumulation grids were developed and combined with the watershed slope using the USPED shown in equation 3 below:

$$Equation\ 3: \quad (Flow\ Accumulation\ Grid * [Cell\ Resolution]/22.1)^{0.4} * \left(\frac{Sin(Degree\ of\ Slope * 0.01745)}{0.09}\right)^{1.4} * 1.4$$

While the Slope Length Factor is used in the MUSLE equations, it is easier to interpret a map of slope steepness. The slope map of the watershed can be seen in Appendix B.2.

4.1.4 *Cover-Management Factor*

The Cover Management Factor is a measure of the effectiveness of crop/vegetation cover in preventing soil loss. The development of this factor starts with the National Land Cover Database, 2011 (NLCD). This geospatial database was developed by Multi-Resolution Land Characteristics Consortium and uses remote sensing to characterize the land cover of the nation into 20 distinct cover types. The NLCD land use map can been seen in Appendix B.3. This land cover type can be converted into a C factor using the methodology developed in “Design Hydrology and Sedimentology for Small Catchments, Haan Barfield,and Hayes (1994).” This conversion from NLCD classification to Cover-Management Factor can be seen in Table 1 below.

Table 1. Cover-Management Factors Based on NLCD Classification

NLCD Value	NLCD Description	Cover-Management Factor
11	Open Water	0
21	Developed, Open Space	0.003
22	Developed, Low Intensity	0.013
23	Developed, Medium Intensity	0.2
24	Developed, High Intensity	0.45
31	Barren Land	1
41	Deciduous Forest	0.003
42	Evergreen Forest	0.003
43	Mixed Forest	0.003
52	Shrub/Scrub	0.009
71	Grassland/Herbaceous	0.013
81	Pasture/Hay	0.003
82	Cultivated Crops	0.003
90	Woody Wetlands	0.001
95	Emergent Herbaceous Wetlands	0.003

4.1.5 *Practice Support Factor*

The Practice Support Factor takes into account conservation practices such as plowing and tillage. We know that some conservation practices are occurring in the watershed, however, the extent of conservation practices and the effectiveness of these practices are unknown. Therefore, it was assumed that no conservation practices were used, which equating to a Practice Support Factor of one (1).

4.2 Watershed Average MUSLE Results

The end result of the geospatial MUSLE exercise is a soil erosion “Heat” map, seen in Appendix B.4. The map highlights areas that are more highly prone to erosion in red and areas less prone to erosion in green. Soil erosion in the 5675-acre watershed ranged from 0.01

tons/ac/year to over 10 tons/ac/year. The average soil loss across the entirety of the watershed was 0.5 tons/ac/year. By using this average value and the area of the watershed, it was determined that the watershed should theoretically produce 2,500 tons of sediment per year which would be eventually captured by Little Swan Lake.

By comparison, Table 2 below shows the average annual soil loss per land use in Illinois according to USDA's National Resource Inventory.

Land use	Average Soil Loss (T/Ac/Yr)
Crop Land	3.95
CRP/Forest	0.29
Pasture Land	1.07

Using the soil loss above and the known landuses of The Little Swan Lake Watershed, an average soil loss of approximately 3 tons/ac/yr was calculated. Comparing the MUSLE results for the Little Swan Lake Watershed, we expect soil erosion less than the typical statewide values.

4.3 Single Event MUSLE Calculations

The Universal Soil Loss Equations were developed to estimate soil loss on an average annual basis; however, revisions to the equations and the methodology allow for the Universal Soil Loss Equations to be applied for a single rainfall event. To calculate the sediment for a single event, Klingner used the methodology as provided in "Use of the Revised Universal Soil Loss Equations on an Event-By-Event Basis, Kelsey (2001)." The event of interest occurred on May 15th, 2009, where, according the Little Swan Lake Operation Records, over 6 inches of rain fell in 24 hours. This led to the only overtopping of the emergency spillway noted in the five (5) year record provided to Klingner. The distribution/intensity of this event was determined by analyzing the 15 minute rainfall records at the three nearest rainfall gages: Monmouth, IL; Yates City, IL; and Marietta, IL. The Rainfall-Runoff Erosivity Factor (R-Factor) as described in Equation 1 is replaced with Equation 4 below:

$$Equation\ 4\!:\ R = \sum E * I_{30}(10^{-2})$$

$$Where:$$

$$R = Rainfall - Runoff\ Erosivity\ Factor$$

$$E = Total\ Storm\ Kinetic\ Energy$$

$$I_{30} = Maximum\ 30 - min\ Rainfall\ Intensity$$

The May 15th, 2009 storm event was independently analyzed for two purposes; first, it was the largest storm event Little Swan Lake has experienced in recent memory and second, the storm occurred in the midst of construction of the back nine holes of the Swan Lake Golf Club. It is believed that during the event, the 75-acre construction site was either entirely or partially disturbed. It is also believed that no erosion control measures were in place at the time of the event (i.e. no hay bales, silt fence, mulching, etc.). The project was located directly adjacent to the headwaters of Little Swan Lake. Therefore, it was assumed that all sediments from this event immediately entered the Lake. In addition to a change in the R-Factor, the other primary change in the MUSLE calculations was the change in the Cover Management Factor. This factor was set to 1.0 to reflect bare/disturbed earth. This exercise resulted in an estimated 12.75 tons of sediment/acre or 970 total tons of sediment from this site alone. That's approximately 40 percent of the expected annual total sediment load.

4.4 MUSLE Conclusions

The MUSLE calculations are intended to provide Little Swan Lake with the theoretical expected sediment load in order to anticipate and prepare for future sediment mitigation projects, dredging projects, and other lake management decisions. General conclusions from this exercise are as follows:

1.) Soil loss in the watershed ranged from 0.01 to over 10 tons/ac/yr
2.) The Average Annual Soil loss for the watershed was approximately 0.5 tons/ac/yr
3.) This compares to a stateside average of approximately 3 tons/ac/yr
4.) Total sediment load per year was calculated at approximately 2500 tons/yr
5.) The May 15th, 2009 rainfall event produced approximately 12.75 tons/ac or a total or approximately 970 tons.

4.5 Comparison of Bathymetric Surveys

4.5.1.1 CWI Bathymetric Survey

As described in Section 2.1 in 2003, CWI performed bathymetric survey and sediment calculations to estimate the total amount of sediment that had entered the lake since its construction in 1968. At that time, CWI estimated the total amount of sediment to be 174,226 cubic yards or approximately 178,600 tons. Using this value and the number of years since the lake's construction, we estimated that the rate of siltation from 1968 to 2003 was 4950 ton/yr or 0.8 tons/ac/yr. After the 2003 CWI study, an unknown quantity of material was dredged from the lake. As such, the survey information from CWI could not be compared to future surveys.

4.5.1.2 Hartman – Klingner Bathymetric Surveys

As described in Section 2.2 in 2015, Bryan Hartman performed a complete bathymetric survey of Little Swan Lake using GPS and Sonar equipment. A similar methodology was employed by Klingner in 2018. By comparing the water depths/lake bottom elevations from the 2015 Hartman Survey and 2018 Klingner Survey, we can determine the siltation rate from 2015 to 2018, as well as the movement of sediment along the bottom of the lake. Appendices B.5 through B.7 show the approximate lake depths using the Hartman Survey, Klingner Survey, and the difference between the two surveys, respectively. The difference in the two surveys only amounted to an additional 510 cubic yards or 525 tons. Given the limited nature of the Klingner Survey (upper third of the lake only), it is probable that the total amount of siltation experienced over the three (3) year time gap is actually greater. The most significant result from this comparison of surveys was the movement of sediments along the lake bottom. As can be seen in Appendix B.7, the water depth has actually slightly increased in the uppermost portions of the lake, but decreased in the lower portions of the lake. One explanation of the migration of sediments is that the rate of siltation occurring prior to 2011 was greater than the rate of siltation experienced between 2011 and today. The large amount of sediment deposition that occurred prior to 2011 first accumulated at the upper reaches of the lake, but has since begun to migrate towards the lake's center. Since the rate has begun to decrease, the sediments moving downstream are not being replaced as quickly with new sediments, which may explain why the lake bottom on the upper end of the lake is actually slightly deeper today than it was in 2011.

4.6 Bathymetric Survey Conclusions

Using the three available bathymetric surveys along with the original lake bathymetry, it was possible to estimate the real time sediment deposition experienced since 1968. Sediment deposition from 1968 to 2003 averaged 0.8 tons/ac/ft. While greater than our theoretical average of 0.5 tons/ac/year, it is within a realistic tolerance. This provides a level of confidence in the MUSLE calculations. Additionally, the survey results indicate that sometime between 2003 to 2015 there was an increase in the sedimentation rate which lead to an above average silt deposition in the upstream portions of the lake. Since that time, that large deposit has been shown to be migrating to the center of the lake. While it could not be determined with certainty that the construction of the back nine of the Swan Lake Golf Club caused the increased rate, it seems reasonable that its construction in combination with record rainfall contributed to a short term siltation rate increase. It is likely that since that adverse event, siltation rates have returned to a more "normal" state.

The most recent bathymetric survey (Klingner, 2018) was also used to determine the total quantity of sediment deposition in the lake's upper third since 1968. This was done by comparing the Klingner survey to a digitized version of the original design's lake bottom contours (Appendix B.8). Using the two datasets, it was estimated that approximately 110,000 cubic yards of sediment would need to be removed to return the lake to its original design.

4.7 Limitations

Soil losses computed with the Universal Soil Loss Equations are estimated values, not absolute. The accuracy of the predicted soil loss will depend on the accuracy of its inputs. Input data was available in a wide variety of densities and accuracies, which is therefore reflected in the final soil loss calculations. Survey data and survey calculations were also limited given the survey boundary and the density/accuracy of the survey points. Unless otherwise indicated, all calculations should be considered approximate.

5.0 ALTERNATIVES/RECOMMENDATIONS

As part of the Little Swan Lake Siltation Study, Klingner developed a series of alternatives for the consideration of the Little Swan Lake Siltation Committee and the Little Swan Lake Board. These alternatives are intended to be realistic options given the constraints of the Board and its constituents. If the Board decides to pursue one of these options, a more detailed description and cost estimate would need to be developed for the selected alternative.

5.1 Alternative 1 – No Action

5.1.1 Description

If no action is taken on the sediment deposition of Little Swan Lake, we should expect siltation rates to continue at their current calculated amounts of 0.5-0.8 tons/ac/yr. This on top of the sediment deposition that has already occurred. The majority of this sedimentation is likely to occur in the lake's headwaters, as has been experienced since the lake's construction. In this area, sedimentation has already caused boating difficulties which would continue until a point where boating and fishing on the west end of the lake would be made impossible. Since the lake's primary purpose is to provide lakeshore property and recreational opportunities to its landowners, this option does not seem viable.

5.1.2 Cost Estimate

No direct financial cost; however, a loss of property values and loss of recreational opportunities would be expected.

5.2 Alternative 2 – "Low Cost" Watershed Improvements

No amount of investment will completely eliminate sediments from entering Little Swan Lake, however by applying some low cost, common sense practices, Little Swan Lake can reduce the amount of sediments and lengthen the amount of time between potential, future, dredging projects. This sediment reduction would be in addition to increasing the water quality, creating fish and wildlife habitat, screening noise, stabilizing shorelines, and increasing the lakes aesthetic value.

5.2.1 Description

This alternative includes lower-cost watershed improvements which may extend the time period required between dredging operations. Due to their low cost, the cost-benefit ratio of applying these practices is expected to exceed 1. These lower-cost improvements may include the following:

1.) Rock (Riprap) Check Dams in the small ditches and swales leading to the lake
    a. Check dams help reduce ditch and channel velocities, prevent erosion, and trap sediments. They do this by creating low velocity areas upstream of each dam causing heavier sediments to drop out of suspension. Check dams are relatively inexpensive and easy to install and maintain. Check dams should only be installed in areas where the channel slope does not exceed 10% and the contributing watersheds do not exceed 10 acres. Height, width, spacing, and other design considerations will be dependent on specific site conditions.

Figure 1. Example Rock Check Dam (https://stormwater.pca.state.mn.us/index.php?title=Sediment_control_practices_-_Check_dams_(ditch_checks,_ditch_dikes))

2.) Buffer strips and/or riprap protection surrounding the lake
    a. Wind and boat wake wave wash can disturb the lake shore and cause shoreline erosion and sloughing of the banks. This erosion has the potential to contribute to the lake's sediment deposition rate. Two methods of combating shoreline erosion are riprap stabilization and naturally vegetated buffer strips. Most properties surrounding the lake seem be using riprap relatively effectively. However, those properties not utilizing one of these techniques should be strongly encouraged to do so. Both methods help stabilize the shoreline;

however, buffer strips have the added benefit or reducing runoff from adjacent land (and thus removing sediments), creating fish and wildlife habitat, screening boat noise, and creating aesthetic appeal. Any width of buffer can be effective, but a minimum 25 feet is typically recommended. Buffer vegetation should consist of native species with deep root systems.

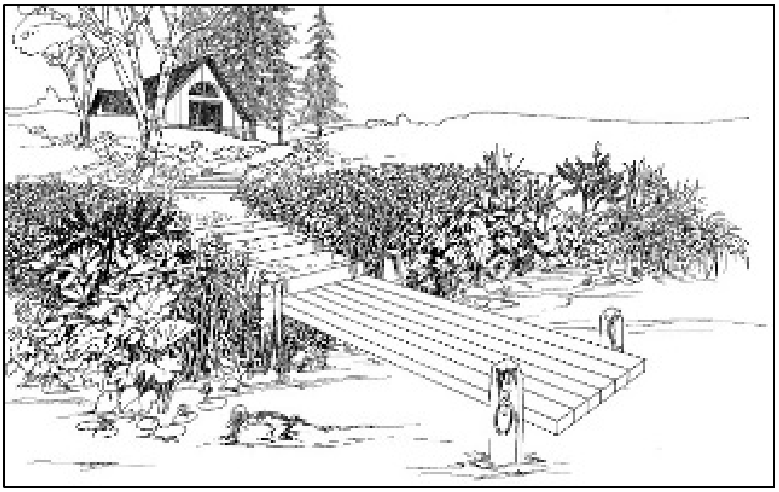


Figure 2. Example of potential vegetative buffer strips (http://www.epa.state.il.us/water/conservation/lake-notes/shoreline-buffer-strips/shoreline-buffer-strips.pdf)

3.) Increased enforcement of erosion mitigation requirements, particularly during all construction activities within the Little Swan Lake HOA
   a. In accordance with the Little Swan Lake Building and Construction Rules-Building Codes and Regulations, Sections 12, "Any new construction on waterfront properties or adjacent to any natural drainage that flows into Little Swan Lake must have a silt fence installed prior to construction. This silt fence shall remain in place until landscaping and lawn growth is sufficient enough to stop any erosion of loose soil that would enter the lake and drainage way." This provision should be maintained and fully enforced. It could also be expanded to allow the use of earthen barriers or straw bales. Additionally, Little Swan Lake may wish to consider additional construction provisions, including:
      i. Preserving natural vegetation and maintaining a green belt of native plants between the site and the shore or drainage ditch running into the lake
      ii. Avoiding open construction sites and lengthy construction times
      iii. Limiting construction during periods of typically high rainfall
      iv. Prohibiting the use of topsoil or dredge operations in boat dock construction activities
      v. Requiring storm drain inlet protections
      vi. Mulching and/or application of blanket stabilization measures (prior to establishment of vegetation)

Construction activities can be a major source of sediment. By applying and strongly enforcing lakeshore construction rules, preventable and unnecessary siltation of the lake can be significantly reduced. Properly managed construction sites can reduce sediments 75 to 99 percent over construction sites that apply no erosion control measures.

Figure 3. Example of properly applied mulch at a construction site (https://stormwater.pca.state.mn.us/index.php?title=File:Mulch_stabilized_slope_2.jpg)

4.) Support for and communication with NRCS and farmers within the watershed to promote wise agricultural and forestry practices

a. The most effective way to manage lake sedimentation is to keep soil on the land and never allow it to erode in the first place. This can only be done with proper land-use practices that prevent soil erosion and limit soil movement. Although it's the most effective, this may be the most difficult practice to adopt since Little Swan Lake does not have direct control over land management outside of its Home Owners Association.

In communications with the NRCS (Appendix C.3), it is clear that some upland landowners are utilizing best conservation practices. However, the majority are not actively involved in NRCS or Soil Conservation Service Programs. Little Swan Lake should continue to maintain working relationships with their local NRCS employees and upland landowners in order to strongly encourage the use of these best management practices. These practices may include, but are not limited to:

i.) Strip cropping and contour plowing
ii.) Land grading and terracing
iii.) Efficient crop harvesting and the removal of crop residues
iv.) Installation of soil stabilization structures and sediment traps

v.) Prevention of overgrazing
vi.) Maintaining buffer strips along waterways

Areas indicated in Red on the Soil Loss “Heat Map” may be areas where conservation practices would provide the most benefit.

5.2.2 Cost Estimate

Riprap Check Dam……………………………………………………………….$1,400 (Ea)

Estimated 24 Total Dams……………………………………………… $33,600

Total……………………………………………………………………………… $33,600

Vegetative buffers, increased construction constraints, and support for watershed conservation practices are not anticipated to have direct cost to the Little Swan Lake Association unless a cost share program for one or more of these ventures is pursued. However, these modifications may marginally increase the cost of construction activities and shoreline protection projects. This cost burden would fall on the individual land owner and would likely take landowner buy in and action from the Little Swan Lake Board. These options would also require active board member engagement in order to monitor and enforce shoreline and construction activities and communicate with upland landowners.

5.3 Alternative 4 – Wetland and/or Sedimentation Basin Development

5.3.1 Description

Little Swan Lake may have the unique opportunity to potentially partner with a nearby local municipality to construct wetlands along the upper tributaries of the lake. The municipality has a permit which requires them to create or restore wetlands to compensate for 1.5 acres of wetland impacts. The amount of acres to be created or restored will be based upon the location of the chosen mitigation site. If a wetland were to be created under this partnership at Little Swan Lake, the US Army Corps of Engineers (USACE) would require creation of 3.38 acres of forested wetland. Wetlands provide a number of beneficial services to both people and wildlife. Wetlands protect and improve water quality, store floodwaters, provide wildlife habitat, and offer recreational opportunities. Wetlands improve water quality by retaining or transforming excess nutrients (i.e. from ag run-off) and by trapping heavy metals, slowing water movement, and allowing sediment to settle out of the water column. The trapping of sediment should be of special interest to Little Swan Lake. A partnership between the municipality and Little Swan Lake would provide a unique cost-sharing opportunity to meet the current and future needs of both entities.

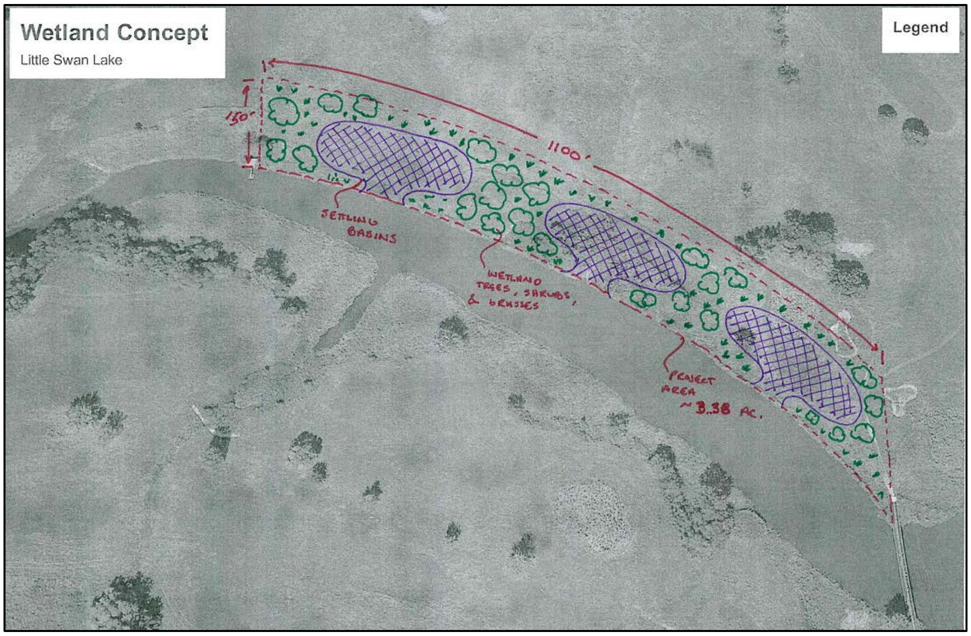


Figure 4. Potential Wetland Concept

5.3.2 Cost Estimate

Wetland…………………………………………………………………………$100,000-150,000

Land Acquisition………………………………………………………$17,000

Engineering & Design……………………………………………….. $15,000-22,500

Permitting………………………………………………………………...$5,000

Construction…………………………………………………………...$48,000-90,500

Legal Fees………………………………………………………………. $5,000

Annual Monitoring and Reporting………………………………….. $10,000

Total……………………………………………………………………………. $200,000-300,000*

* This total would potentially be shared with the municipality in need of wetland mitigation. The terms of the cost share would be directly negotiated between Little Swan Lake and the municipality.
* Actual cost will vary based on detailed Engineering and Design.

The wetland cost shown above are the total costs of wetland construction. If this scenario is pursued a portion of this cost would be funded by the municipality. The exact cost share would be dependent on negotiations between Little Swan Lake and the municipality. Additional funding and grant opportunities for the creation and maintenance of wetlands are available through several State and Federal Agencies. These grants may make it possible to further reduce the cost associated with wetland development and maintenance and/or allow Little Swan

Lake to expand the wetland beyond 3.38 acres. A list of these funding sources can be seen in Appendix D.

Similar to wetlands, sedimentation basins are a very effective way to reduce and control the amount of sediments entering the lake. They act as impoundments which store water and allow sediments to fall out of suspension prior to entering the main body of the lake. Figures 5 and 6 below show the application of a sediment basin on a similar lake in Northwestern Illinois.

Figure 5. Sediment Basin Located on a Large Lake in Rural NW Illinois – Aerial View

Figure 6. Sediment Basin Located on a Large Lake in Rural NW Illinois - View from Dam

The cost share and grant opportunities are not available for sediment basins, as they are for Wetlands, due to their lack of environmental and ecological benefits. In addition, land acquisition and extensive permitting would be required. However, they are the most effective and direct way to reduce the amount of sediment entering the lake. Sediment basins provide the added benefit of redirecting future dredging operations from the main body of the lake to the sediment basins. While the basins may require more frequent cleanout (every 15 to 20 years), they would be cheaper and easier to dredge and would continuously keep the main body of the lake open to boating and recreational opportunities. Potential locations for sediment basins can be seen in Figure 7 below. Little Swan Lake has the option to pursue Basin 1A, Basin 1B, Basin 1A and 1B, or Basin 2. Ease of land acquisition and the Little Swan Lake budget will likely dictate the feasibility of this alternative.

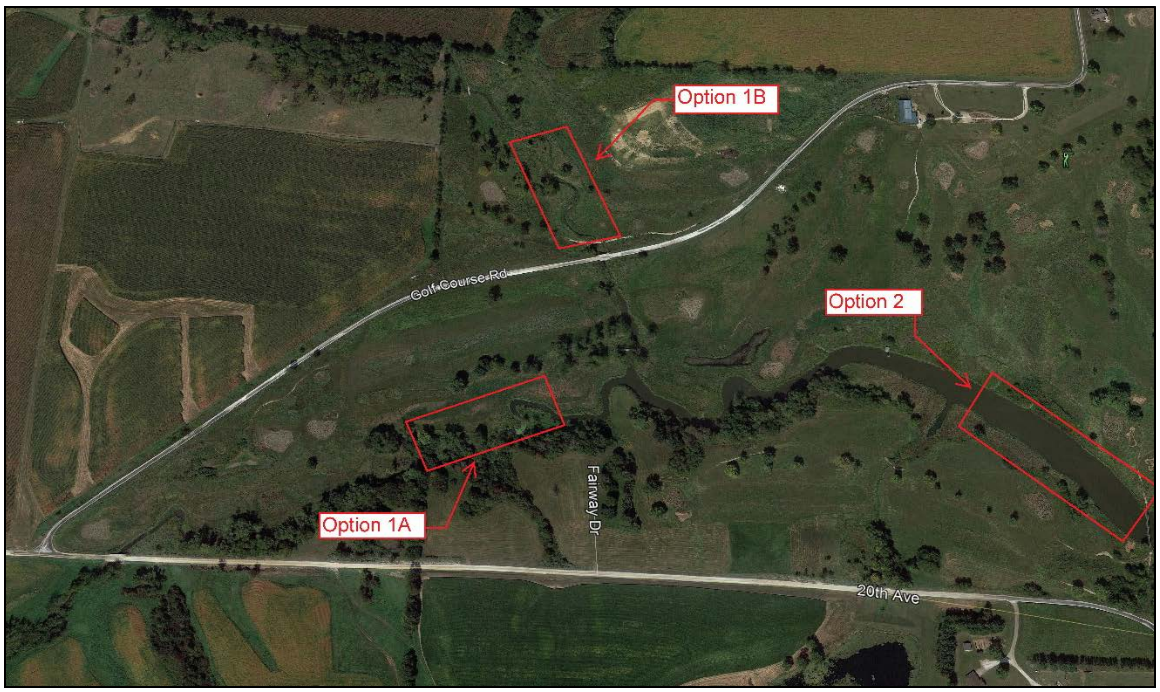


Figure 7. Possible Locations for the Installation of Sediment Basins.

5.3.3 Cost Estimate

Single 30 Ac-ft Sediment Basin

Mobilization/Demobilization…………………………………………………..$50,000

Excavation…………………………………………………………………...$75,000

Earthen Fill and Compaction………………………………………………$25,000

Spillway Pipes……………..………………………………………………..$135,000

Cast-in-Place Concrete for Drop Box and Headwalls………………………$10,000

Riprap……………………………………………………………………………….. $10,000

Land Acquisition………………………………………………………………….$15,000

Permitting…………………………………………………………………….....$10,000

Engineering/Design………………………………………………………….... $35,000

Contingency (10%)…………………………………………………………… $30,000

Total……………………………………………………………………………………….. $395,000*

* Actual cost will vary based on detailed Engineering and Design.

5.4 Alternative 4 – Dredge

5.4.1 Description

In order to maintain a boating depth throughout the lake, dredging is required for the upper third of the lake where bathymetric measurements were made. This can be done in conjunction with the preventative measures discussed in Alternatives 2 and 3 in order to maximize the dollars spent on dredging, or can be done independently. Sedimentation calculations, shown in Section 4.1.6, estimated 110,000 cubic yards of sediment needs to be removed in order for the lake to be returned to its original design. This option would restore boating and recreational activities for those homeowners living along the upper third of the lake. However, it would do nothing to reduce the amount of sediment entering the lake, which would be expected to continue at a rate of 0.5 to 0.8 tons/ac/yr. This would be considered a temporary fix and would require Little Swan Lake to commit to dredging the lake an average of every 25 to 35 years. A lesser amount could be dredged under this alternative, however dredging would be required again more quickly.

5.4.2 Cost Estimate

Mobilization/Demobilization……………………………………………………..$50,000

Hydraulic Dredging ($5/CY)…………………………………………………… $550,000

Construction of Dredge Spoil Site (10-20 acres)…………………………….. $200,000

Permitting and Monitoring……………………………………………………......$20,000

Engineering (15%)…………………………………………………………….....$123,000

Contingency (10%) ……………………………………………………………….$82,000

Total………………………………………………………………………………… $1,025,000

5.5 Summary and Final Recommendations

Sediment deposition problems are a common occurrence in man-made reservoirs. The manner in which they are constructed disrupt natural drainage and act as large, efficient settling basins for sediments. They are more susceptible to sedimentation than natural lakes due to their inability to "flush" during large flood events. Excessive sediments are a serious threat to lakes for multiple reasons, including:

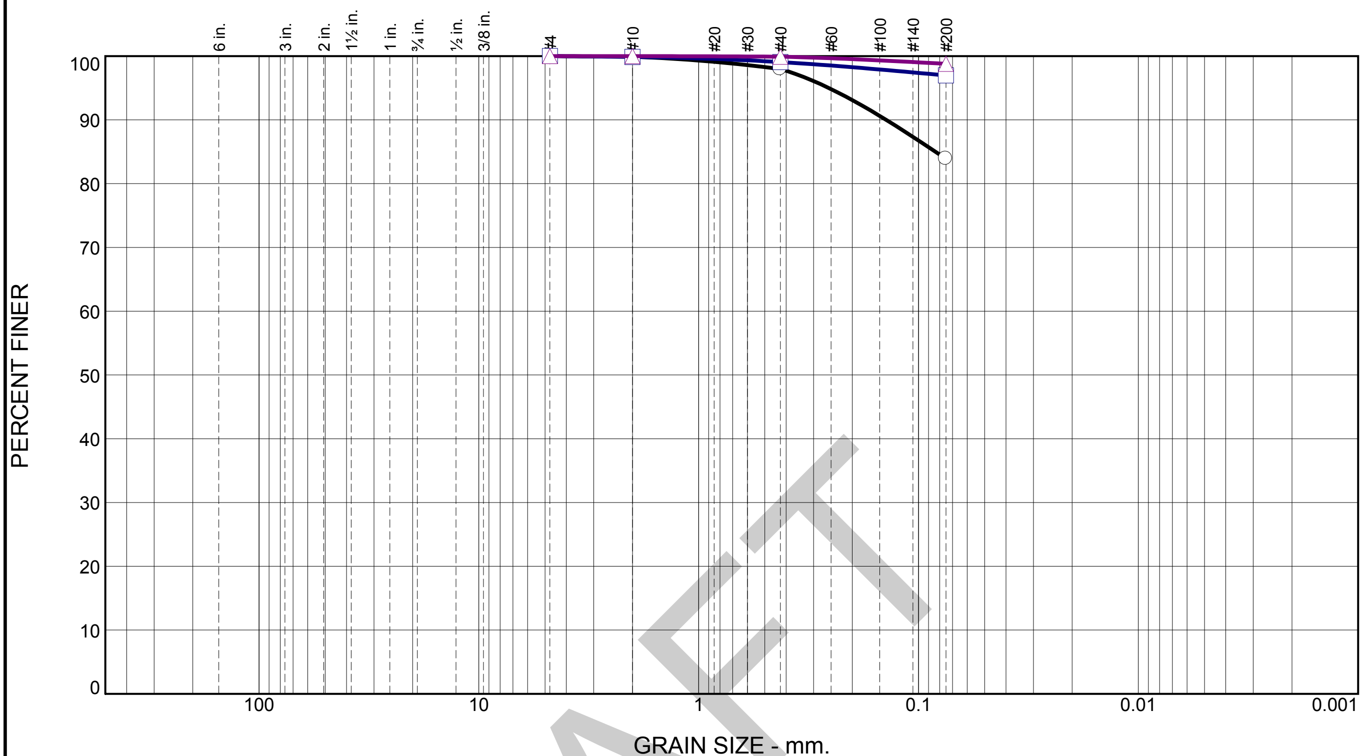
1.) Loss of lake storage
2.) Reduced water clarity and decrease light penetration
3.) Increase in water temperatures
4.) Lower dissolved oxygen levels
5.) Smothering of fish eggs and bottom dwelling life forms
6.) Excessive algae blooms
7.) Promotion of fish kills
8.) Inhibiting of recreational boating, swimming, and fishing
9.) Impairing natural beauty
10.) Decreased property values

It is recommended that Little Swan Lake pursue preventative measures designed to lengthen the time between dredge projects. As can be seen in the dredging cost estimate, dredging projects are expensive. By investing in preventative measures such as check dams, construction management techniques, buffer strips, wetlands and sediment basins, Little Swan Lake can capture a portion of the total sediment prior to their entering the lake and extend the required time between dredge projects. Increasing this timeline, even a few years has the potential to save Little Swan Lake hundreds of thousands of dollars in dredging costs. Alternatives 2 and 3 have varying degrees of costs and benefits. The ultimate decision on which preventative to pursue will be dependent on the ability to acquire the necessary land for projects and the budget allotted toward their construction/implementation.

In order to maintain the lake to a level expected by its landowners, we recommend Little Swan Lake also pursue dredging the lake to remove the sediments that have already accumulated. If the full 110,000 cubic yards of dredging required to return the lake to its original design conditions is not financially feasible, a lesser dredging project may be pursued. However, it is recommended that a minimum channel depth of 8 feet be achieved in order to maintain full boating and recreational access for Little Swan Lake landowners. If a lesser dredge project is pursued it should be noted that a future dredge project will be required sooner than if the full amount of sediments were removed. In the long run, this more frequent dredging would be a more expensive option. Dredging does not need to occur immediately, and Little Swan Lake may wish to install preventative measures prior to initiating a dredge project. If Alternatives 2 through 4 are pursued by Little Swan Lake, it is recommended that a competent licensed professional engineer be retained for design, permitting, bidding, and construction services.

APPENDIX A
LABORATORY DATA

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0	0	16	84		ML	A-4(6)	26	33
□	0	0	3	97		CL	A-7-6(25)	22	45
△	0	0	1	99		(OH)	A-7-6(40)	28	62

SIEVE inches size	PERCENT FINER ○	□	△
GRAIN SIZE			
D_{60}			
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100	100	100
#10	100	100	100
#40	98	99	100
#200	84	97	99

Material Description

○ Silt with Sand (ML), Brown mottled Gray

□ Lean Clay (CL), Gray, Silty

△ Organic Clay (OH), Brown mottled Gray, Silty

REMARKS:

○ As Rec'd Moisture = 25.7%

□ As Rec'd Moisture = 34.1%

△ As Rec'd Moisture = 90.9%

○ Location: Sample #1 (5/14/2018) Sample Number: 1

□ Location: Sample #2 (5/14/2018) Sample Number: 2

△ Location: Sample #3 (5/14/2018) Sample Number: 3

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

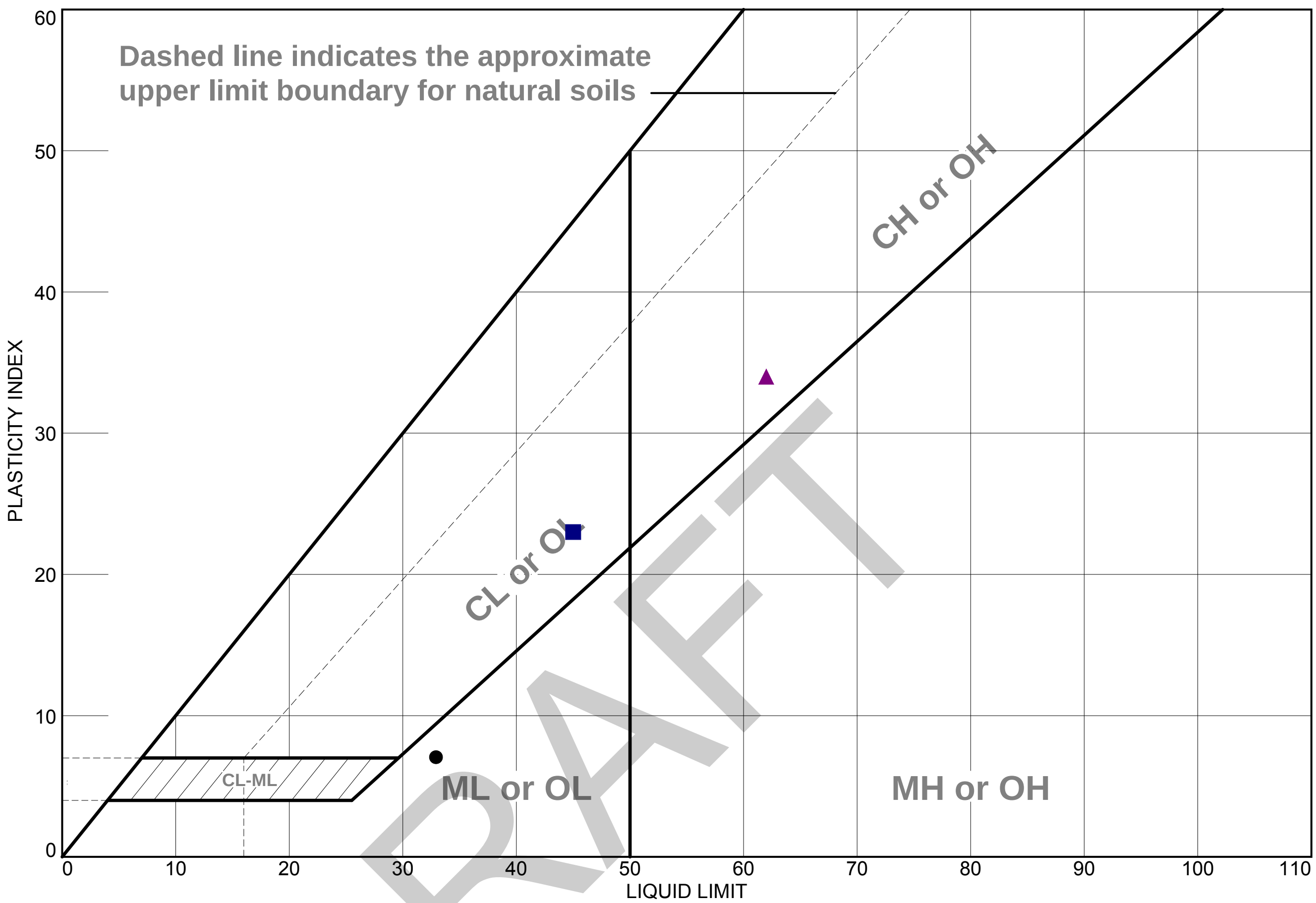
Client: Little Swan Lake

Project: Little Swan Lake - Siltation Project

Project No.: 18-3036 Figure

Tested By: BJS **Checked By:** BJS

ATTERBERG LIMITS TEST REPORT (ASTM D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silt with Sand (ML), Brown mottled Gray	33	26	7	98	84	ML
■	Lean Clay (CL), Gray, Silty	45	22	23	99	97	CL
▲	Organic Clay (OH), Brown mottled Gray, Silty	62	28	34	100	99	(OH)

Project No. 18-3036 **Client:** Little Swan Lake

Project: Little Swan Lake - Siltation Project

●**Location:** Sample #1 (5/14/2018) **Sample Number:** 1

■**Location:** Sample #2 (5/14/2018) **Sample Number:** 2

▲**Location:** Sample #3 (5/14/2018) **Sample Number:** 3

Remarks:

●As Rec'd Moisture = 25.7%

■As Rec'd Moisture = 34.1%

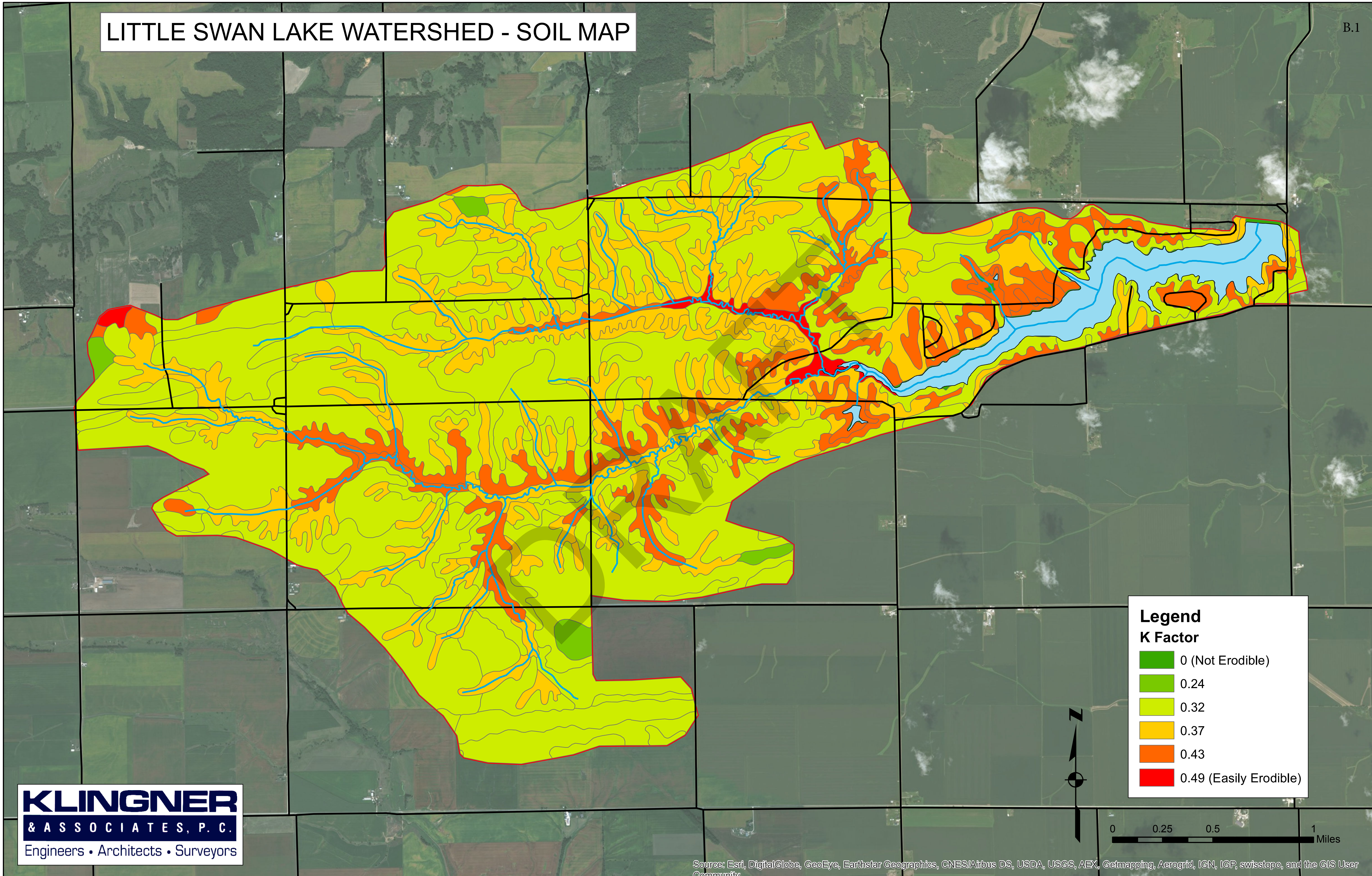
▲As Rec'd Moisture = 90.9%

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

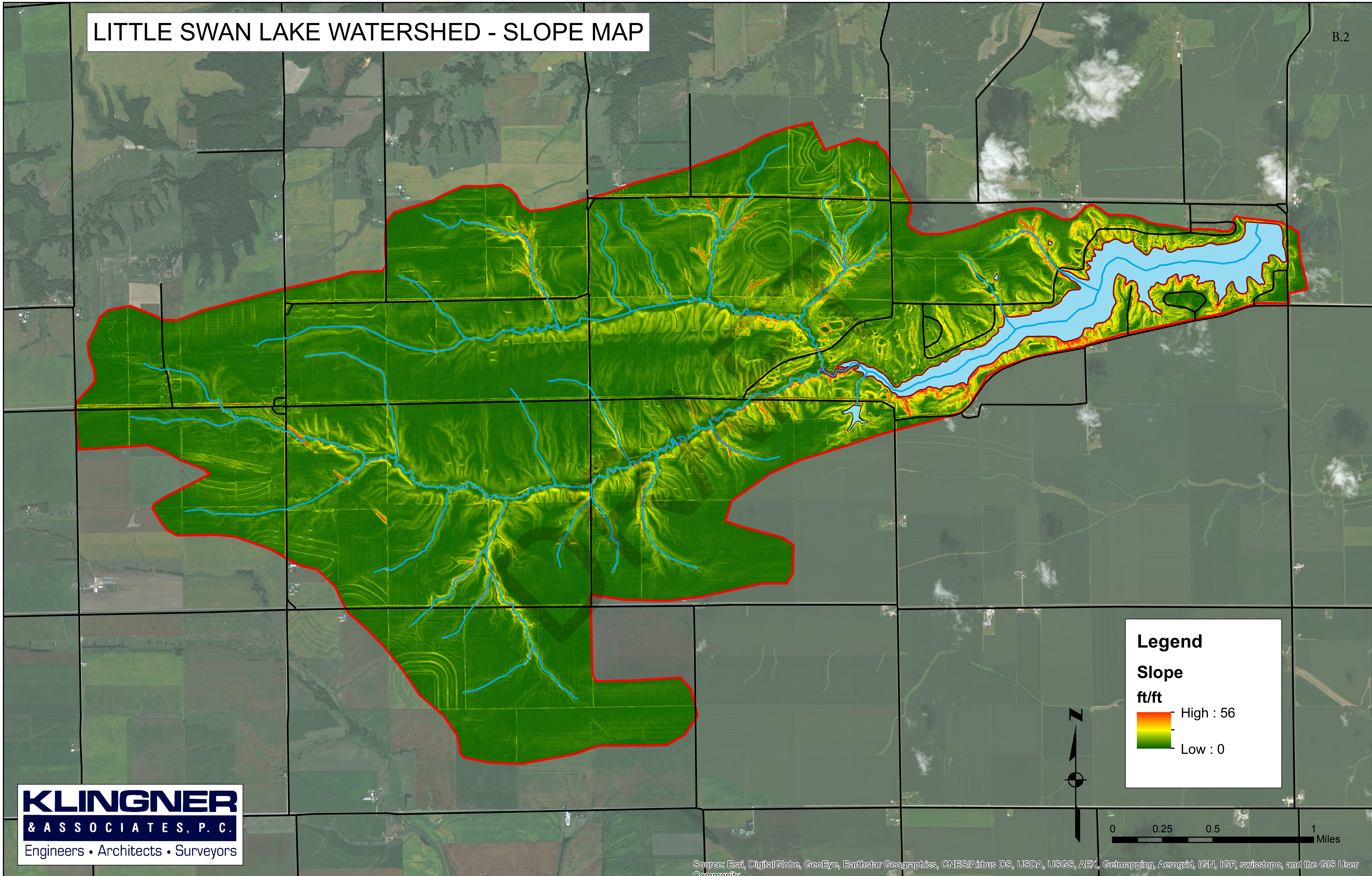
Figure

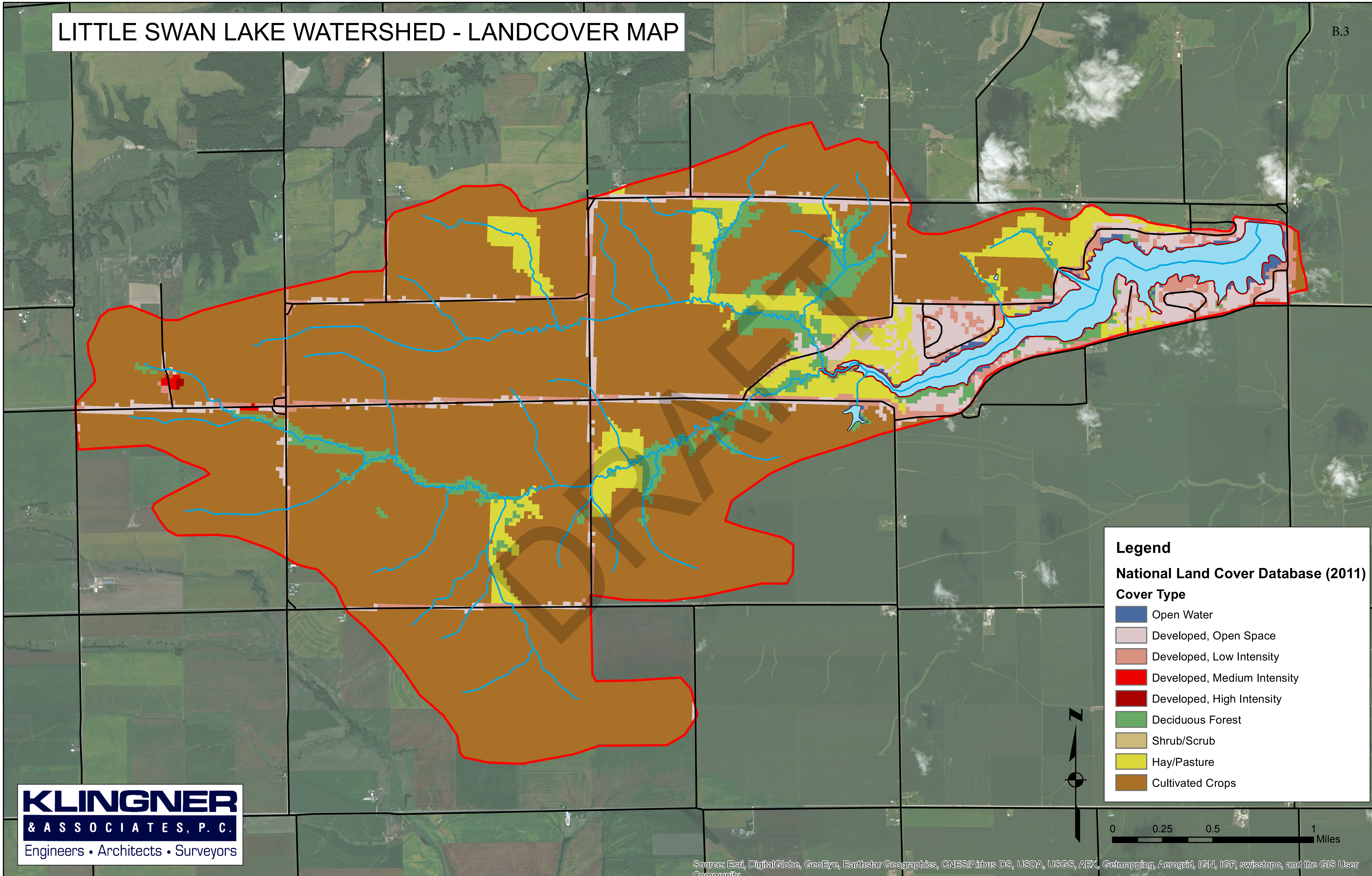
Tested By: BJJ **Checked By:** BJS

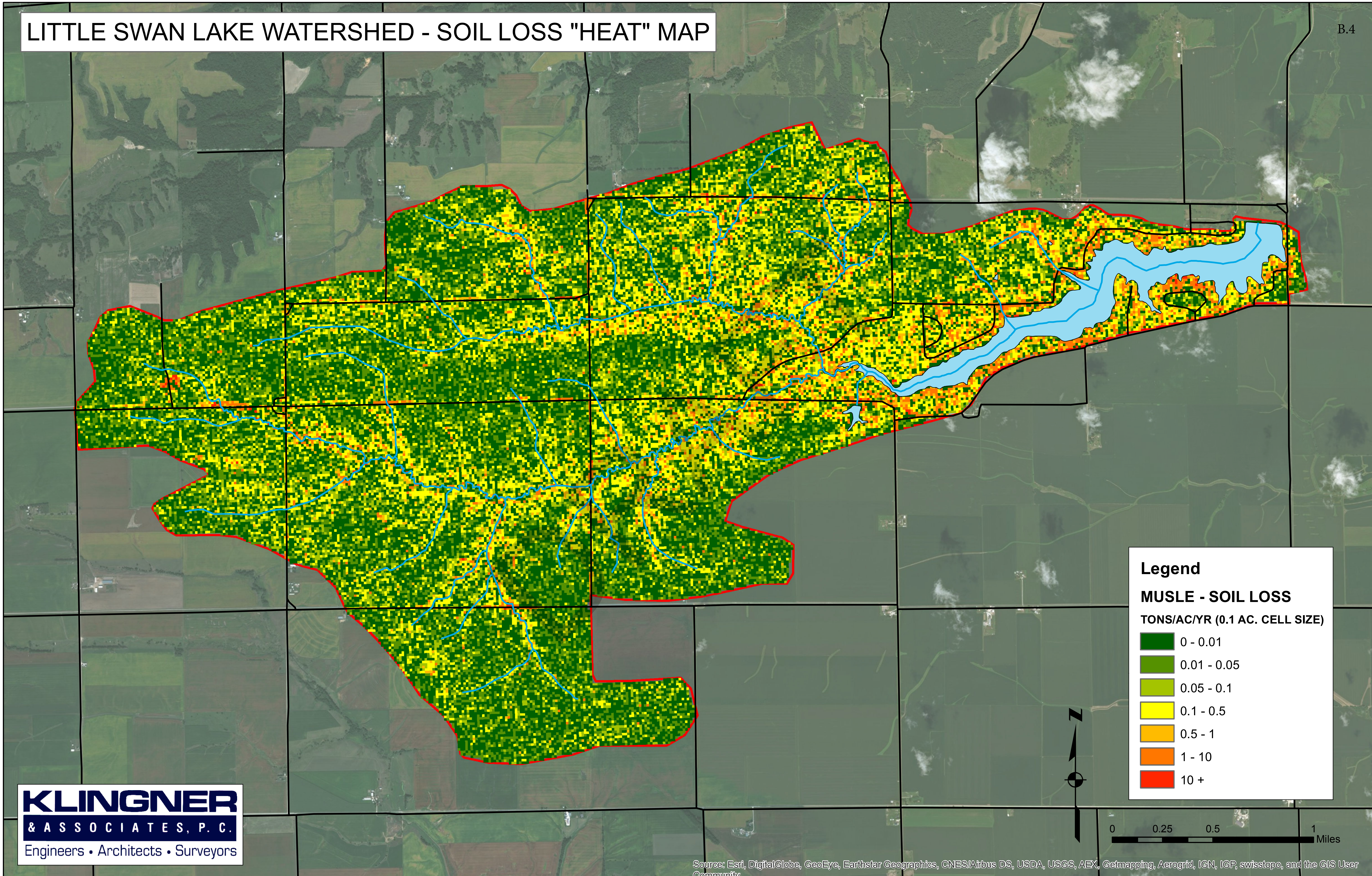
APPENDIX B
MAPS



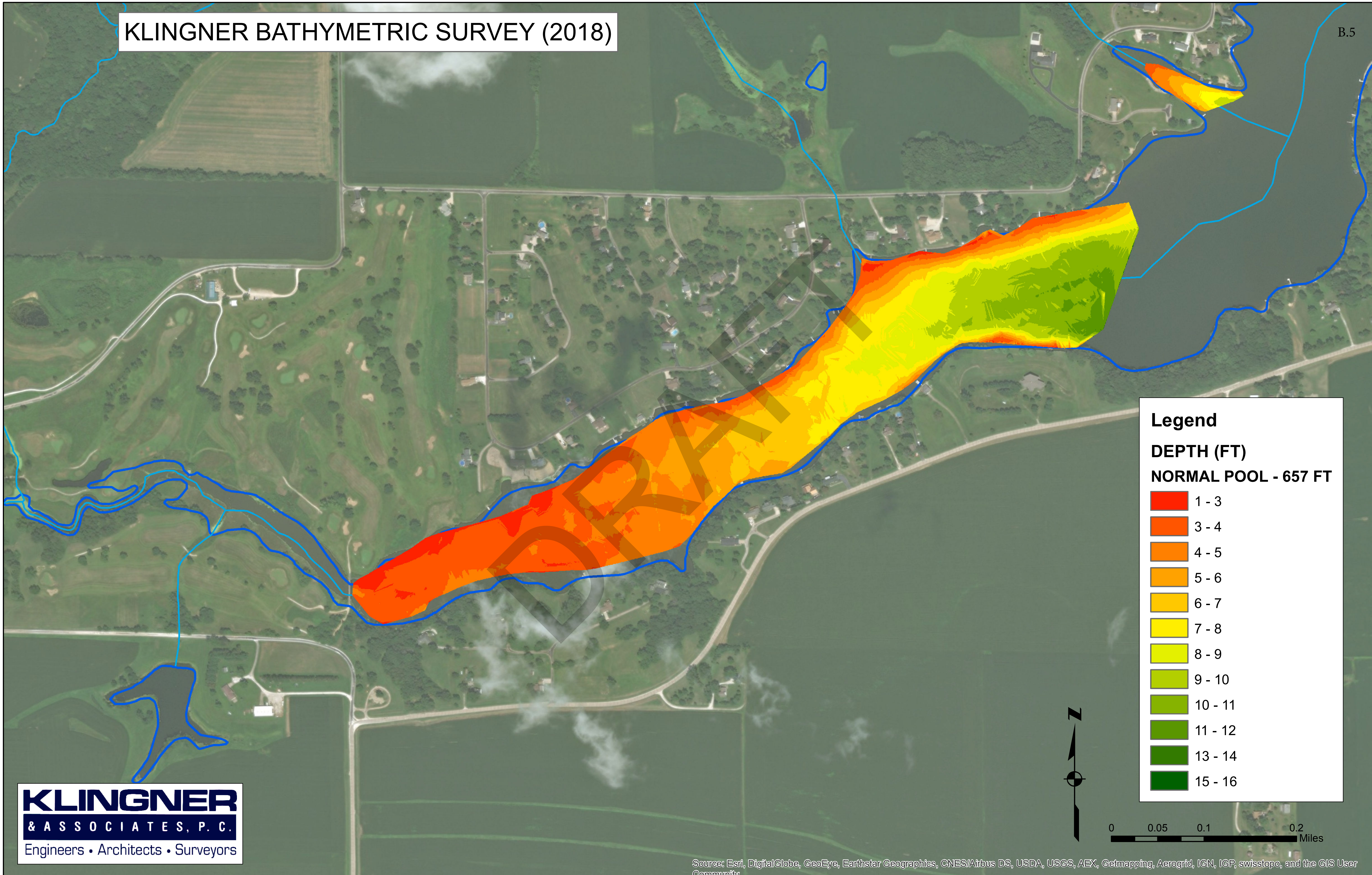
B.1
LITTLE SWAN LAKE WATERSHED - SOIL MAP
DRAFT
Legend
K Factor
0 (Not Erodible)
0.24
0.32
0.37
0.43
0.49 (Easily Erodible)
N
0
0.25
0.5
1
Miles
KLINGNER
& ASSOCIATES, P. C.
Engineers • Architects • Surveyors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


LITTLE SWAN LAKE WATERSHED - SLOPE MAP
B.2
Legend
Slope
ft/ft
High : 56
Low : 0
0
0.25
0.5
1
Miles
KLINGNER
& ASSOCIATES, P. C.
Engineers • Architects • Surveyors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


LITTLE SWAN LAKE WATERSHED - LANDCOVER MAP
B.3
DRAFT
Legend
National Land Cover Database (2011)
Cover Type
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Deciduous Forest
Shrub/Scrub
Hay/Pasture
Cultivated Crops
N
0
0.25
0.5
1
Miles
KLINGNER & ASSOCIATES, P. C.
Engineers • Architects • Surveyors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

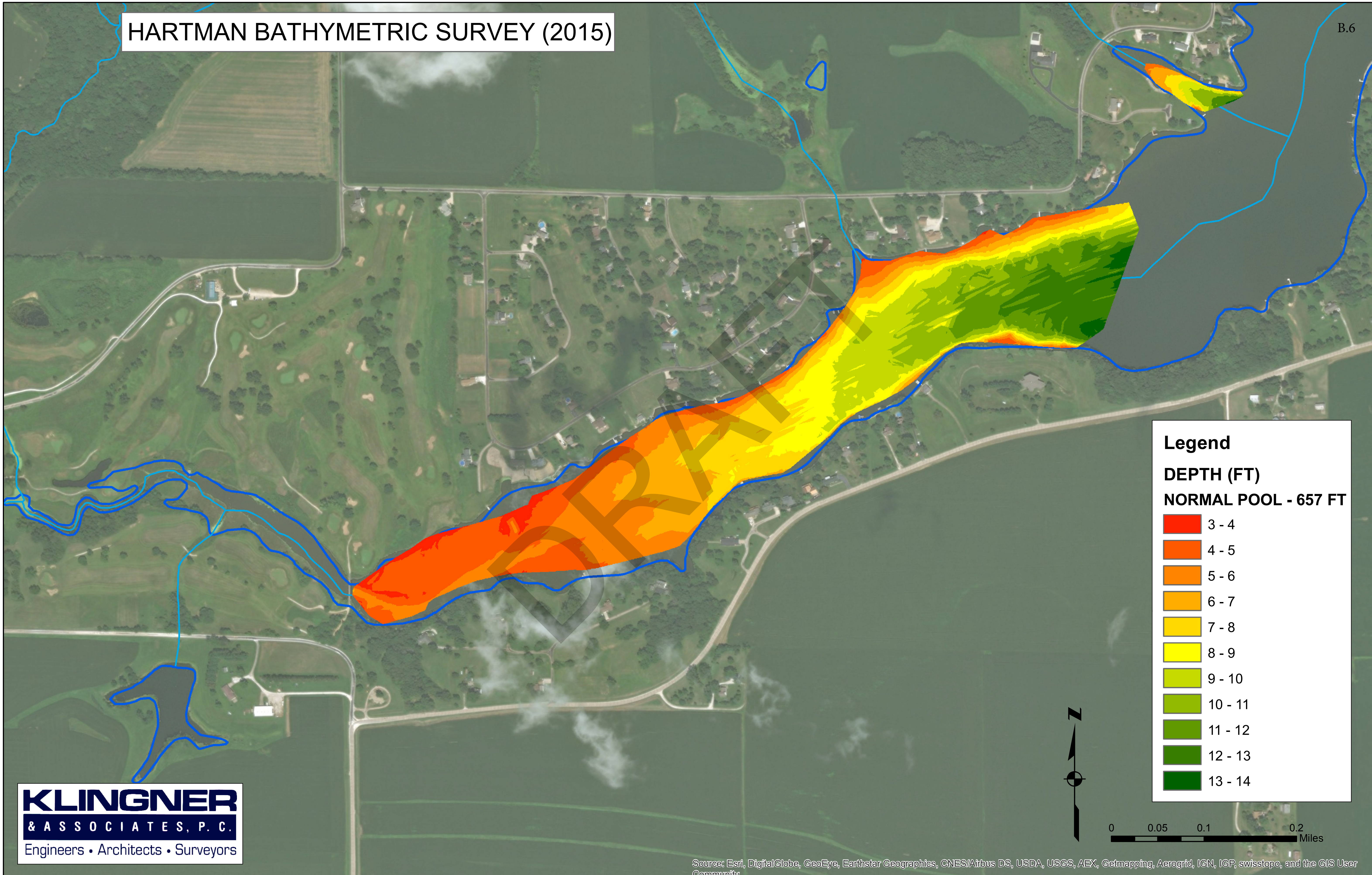


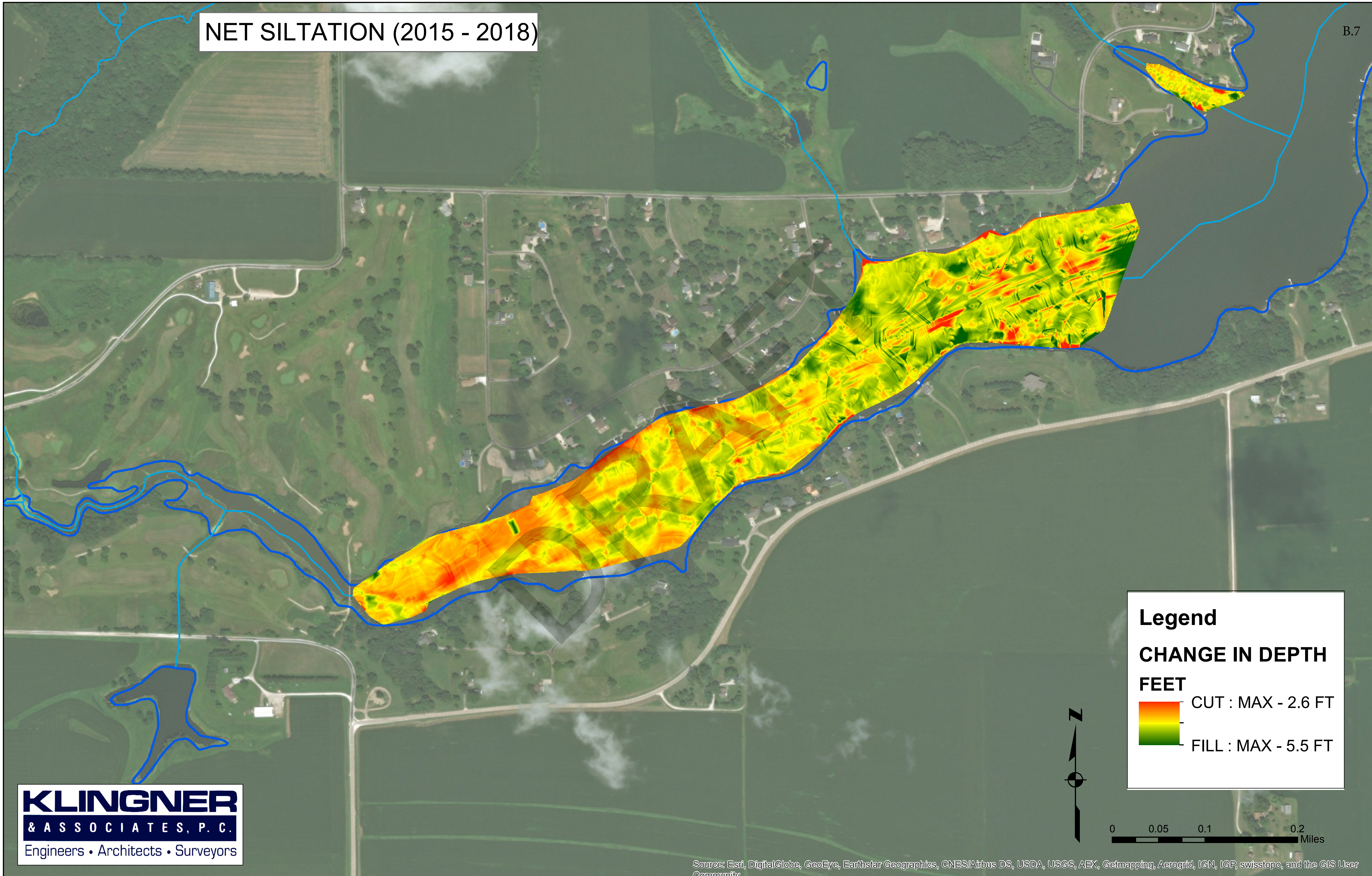
LITTLE SWAN LAKE WATERSHED - SOIL LOSS "HEAT" MAP
B.4
Legend
MUSLE - SOIL LOSS
TONS/AC/YR (0.1 AC. CELL SIZE)
0 - 0.01
0.01 - 0.05
0.05 - 0.1
0.1 - 0.5
0.5 - 1
1 - 10
10 +
N
0 0.25 0.5 1 Miles
KLINGNER & ASSOCIATES, P. C.
Engineers • Architects • Surveyors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



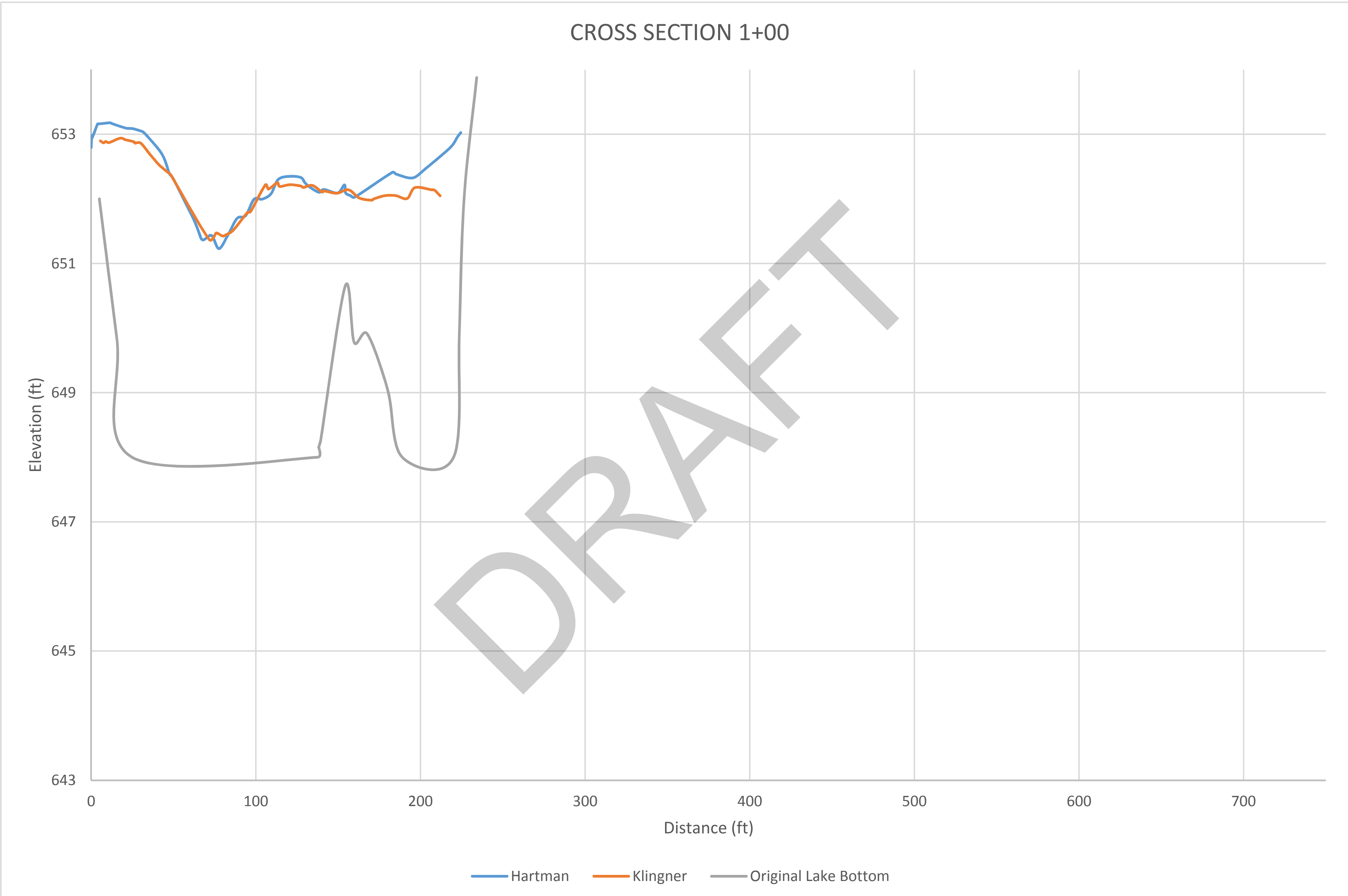
KLINGNER BATHYMETRIC SURVEY (2018)
B.5
DRAFT
Legend
DEPTH (FT)
NORMAL POOL - 657 FT
1 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
13 - 14
15 - 16
N
0 0.05 0.1 0.2
Miles
KLINGNER & ASSOCIATES, P. C.
Engineers • Architects • Surveyors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

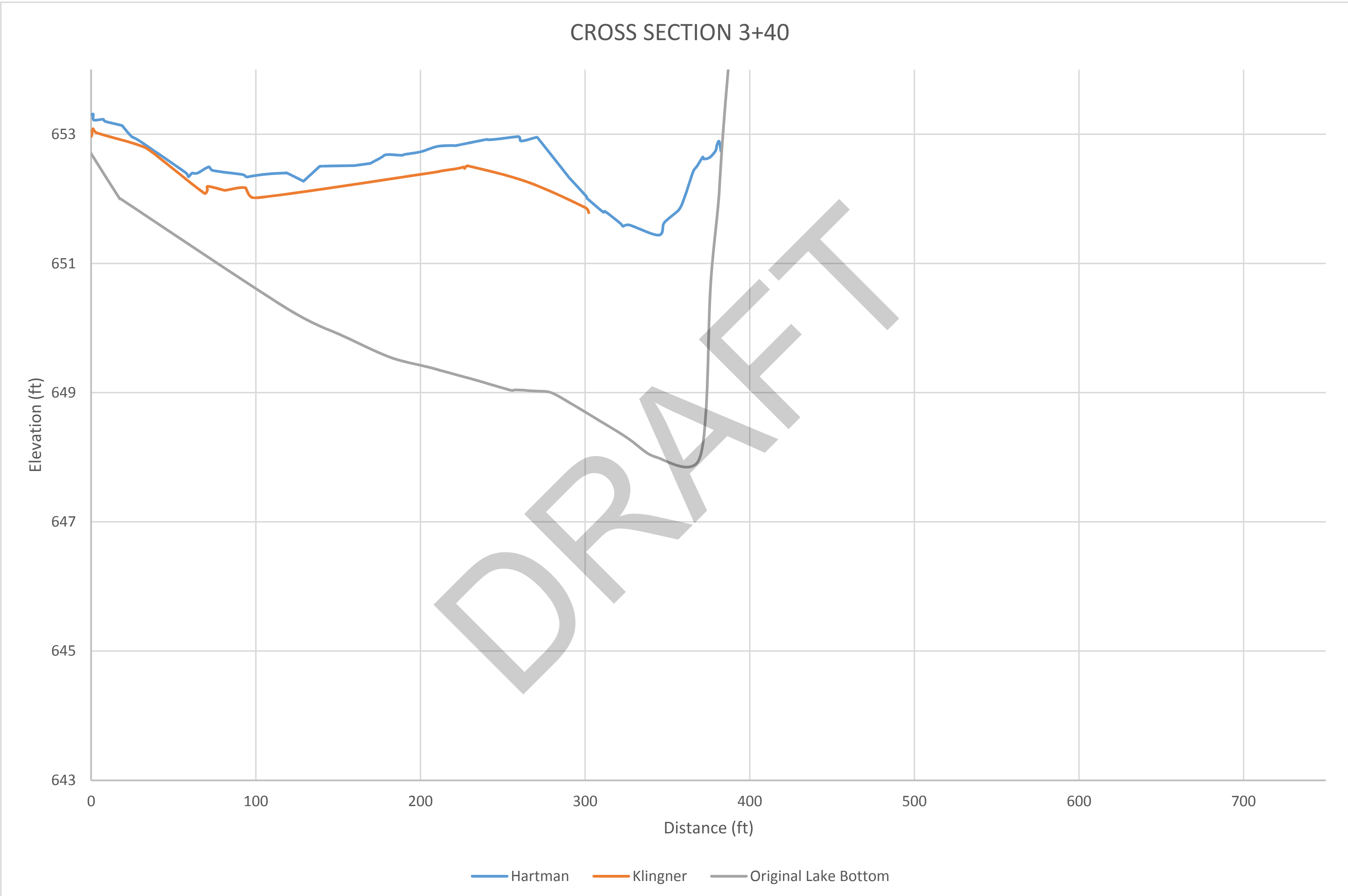
HARTMAN BATHYMETRIC SURVEY (2015)



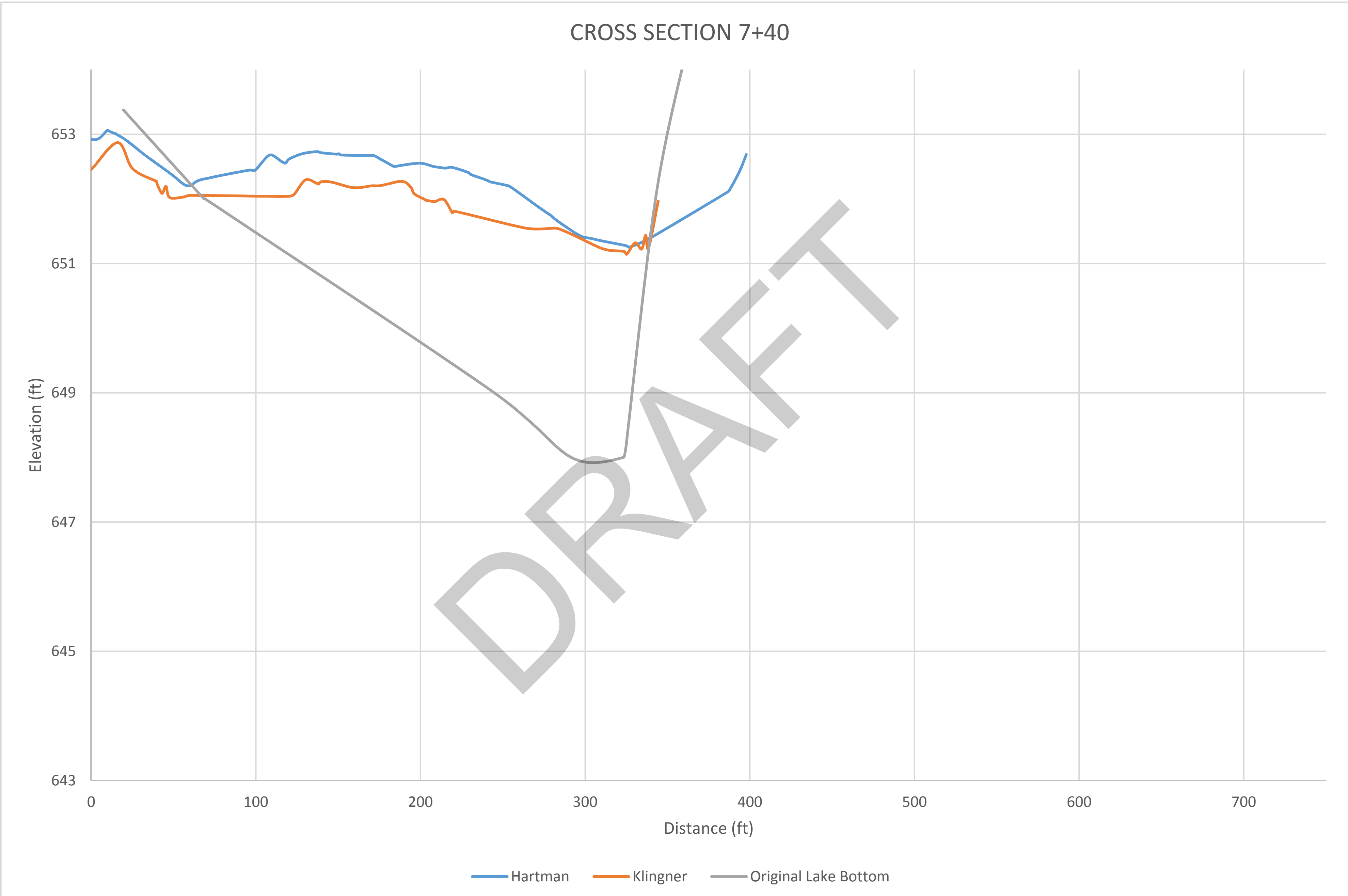

NET SILTATION (2015 - 2018)
B.7
Legend
CHANGE IN DEPTH
FEET
CUT : MAX - 2.6 FT
FILL : MAX - 5.5 FT
N
0
0.05
0.1
0.2
Miles
KLINGNER
& ASSOCIATES, P. C.
Engineers • Architects • Surveyors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

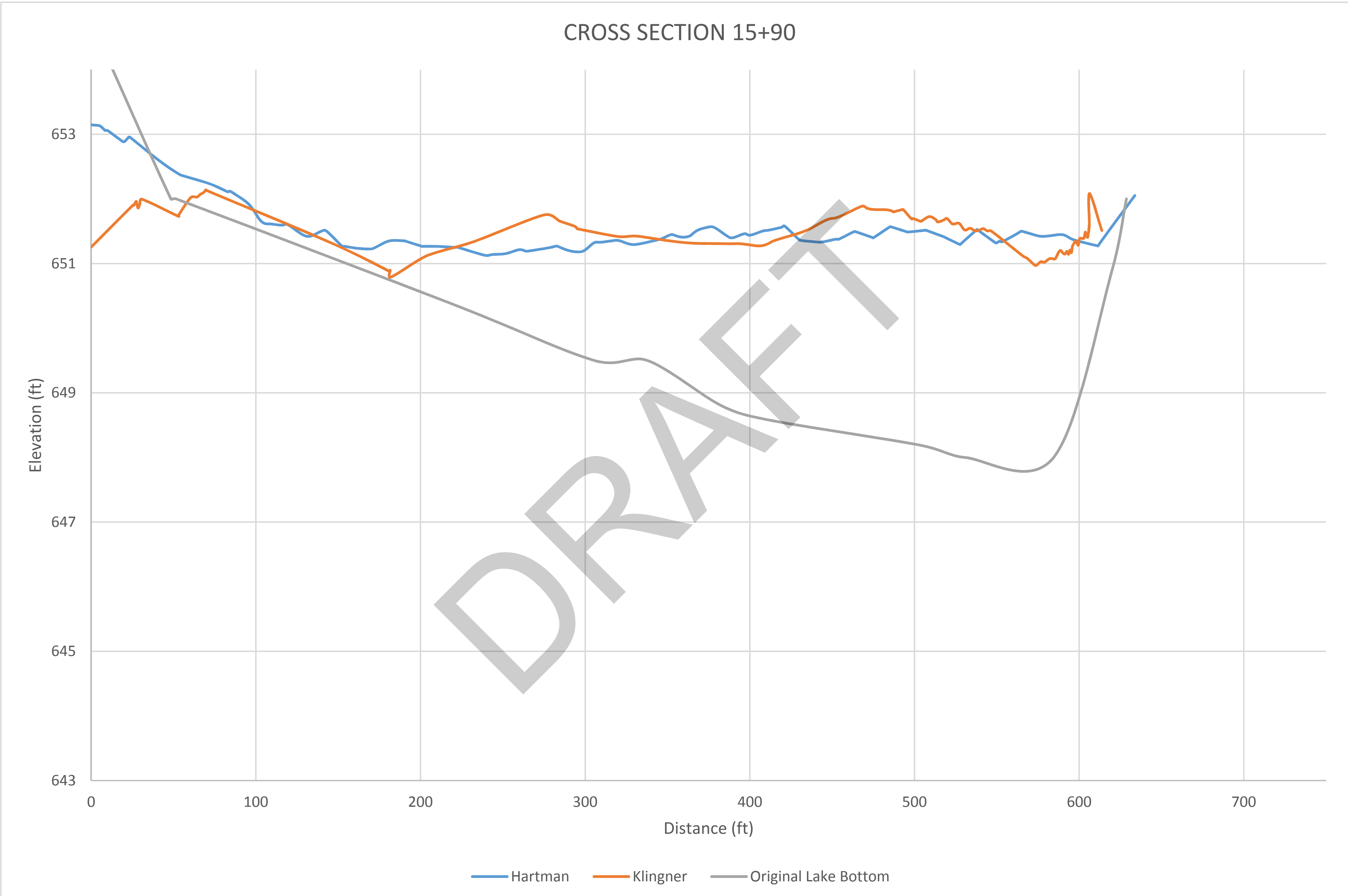

LITTLE SWAN LAKE - CROSS SECTION LOCATIONS
B.8
3+00B
4+00B
44+80
33+50
24+90
15+90
7+40
3+40
1+00
N
0
0.05
0.1
0.2
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

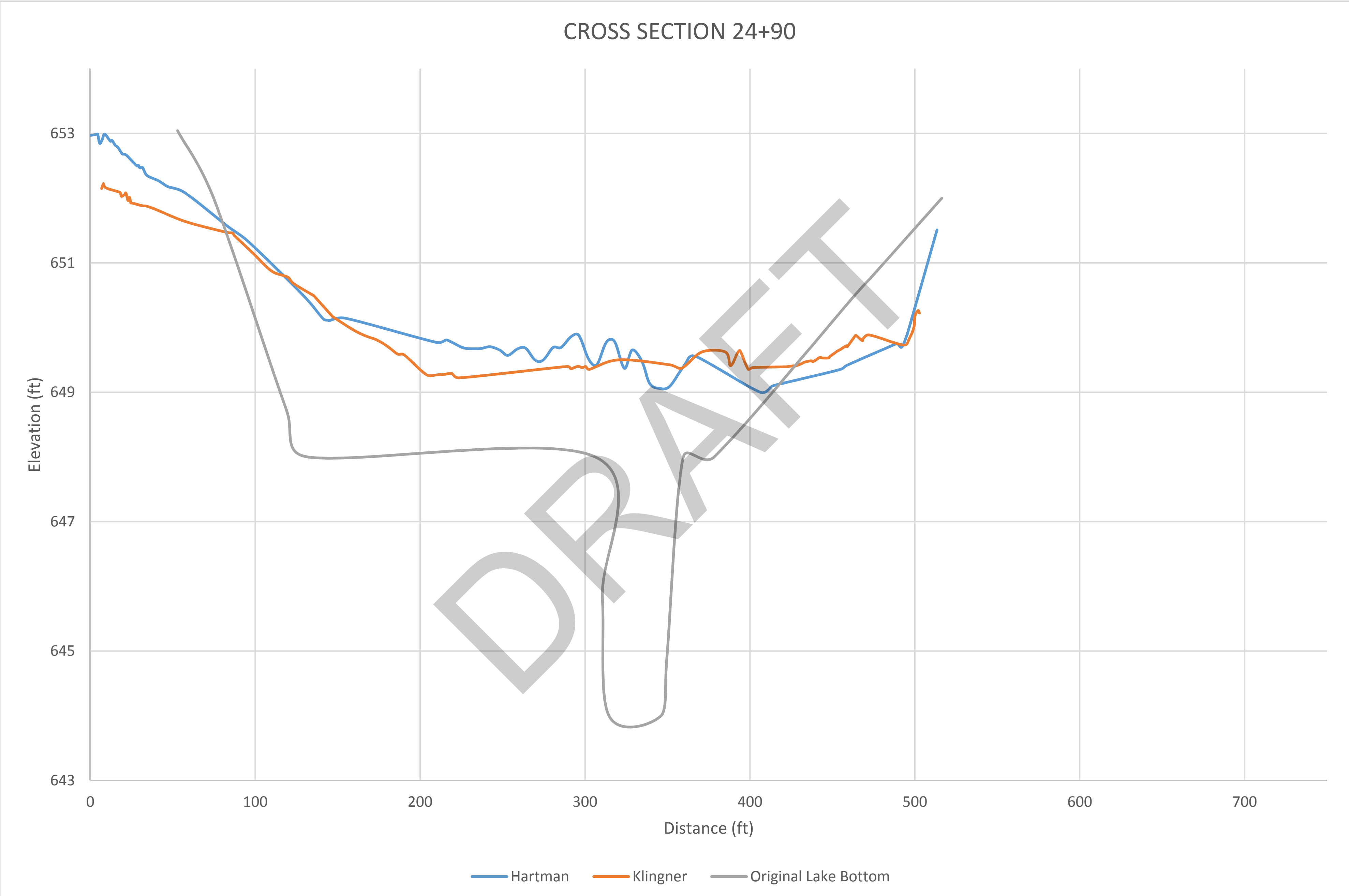

CROSS SECTION 1+00
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT

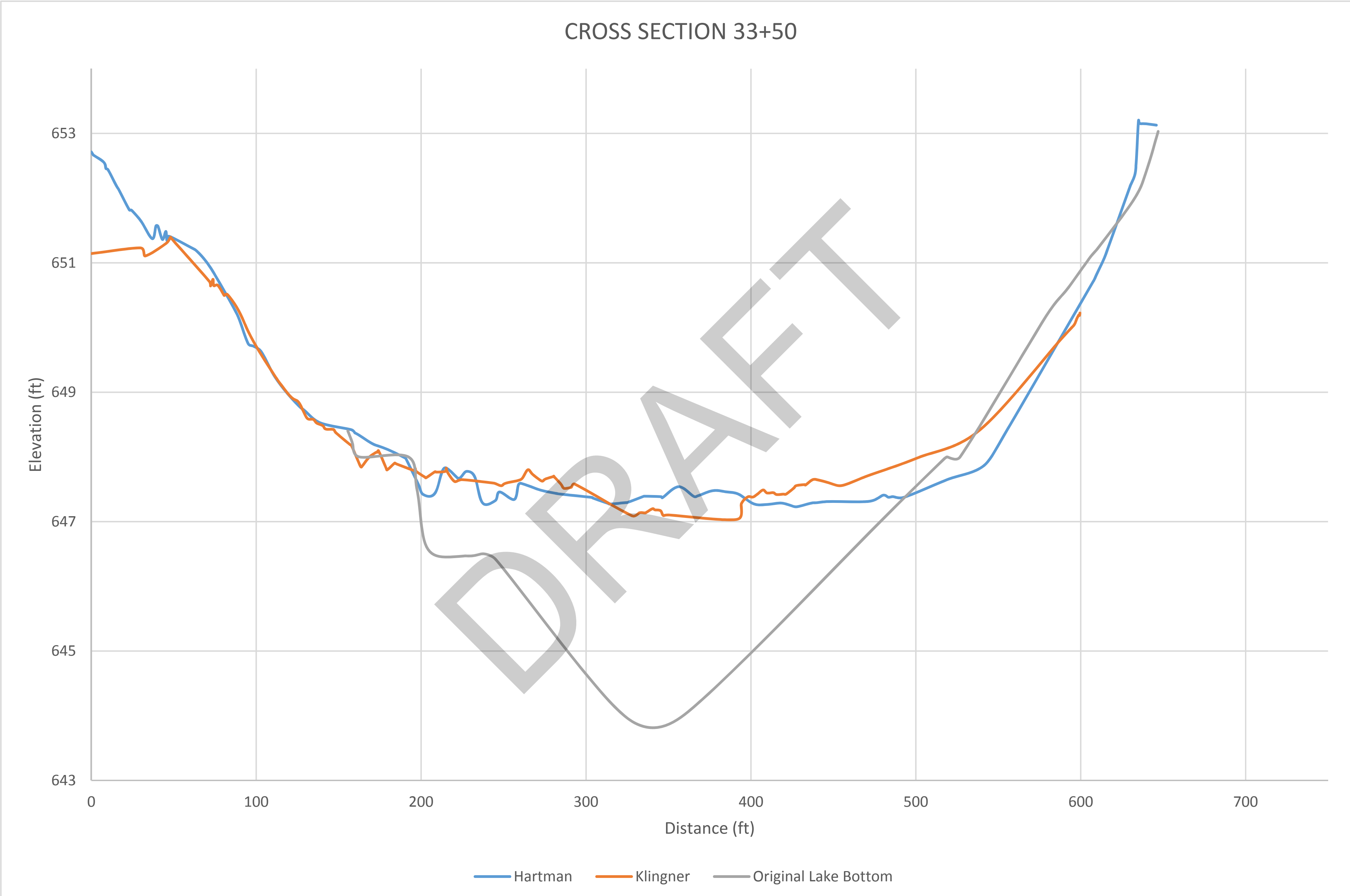


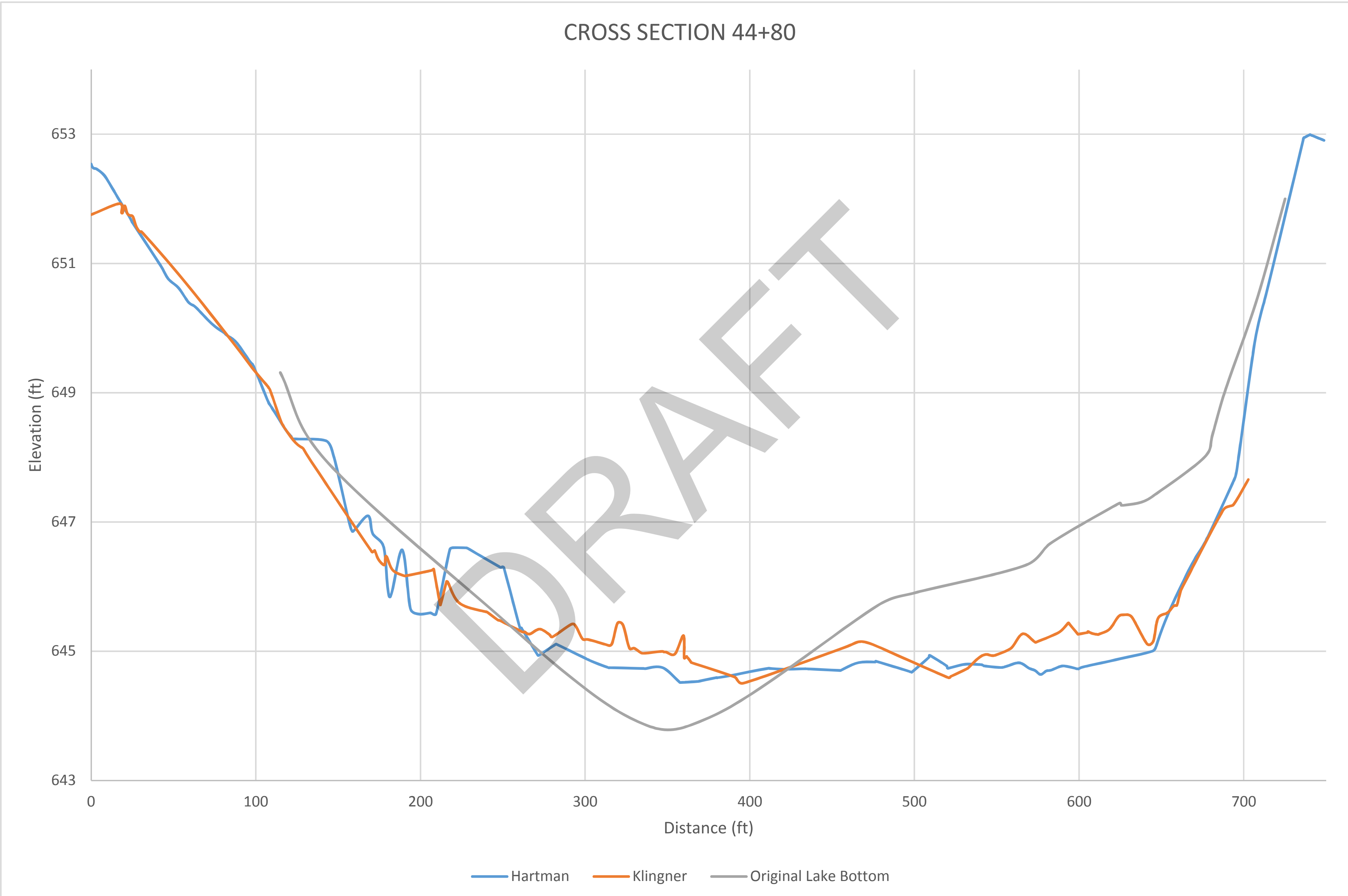
CROSS SECTION 3+40
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT

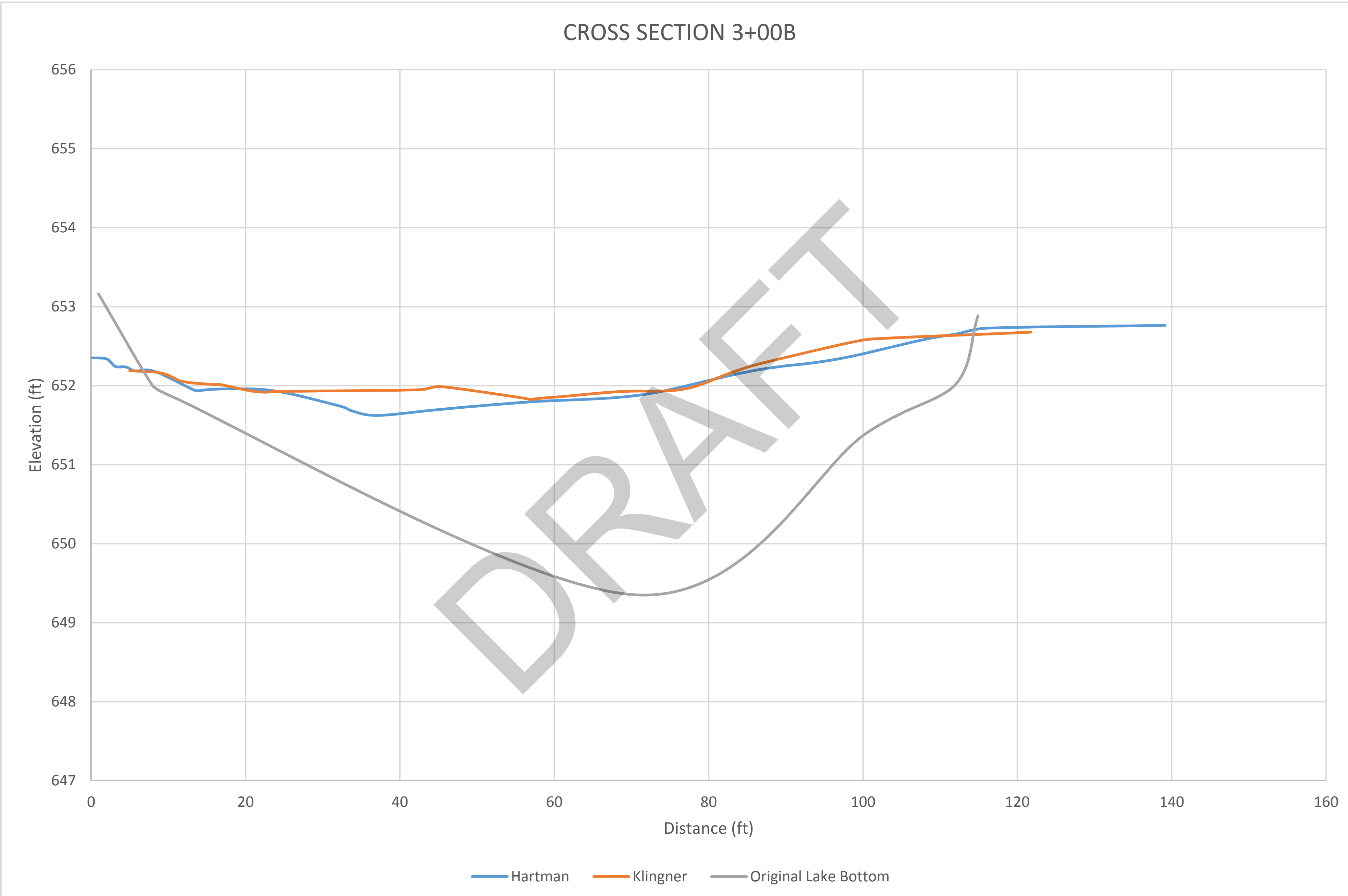

CROSS SECTION 7+40
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT

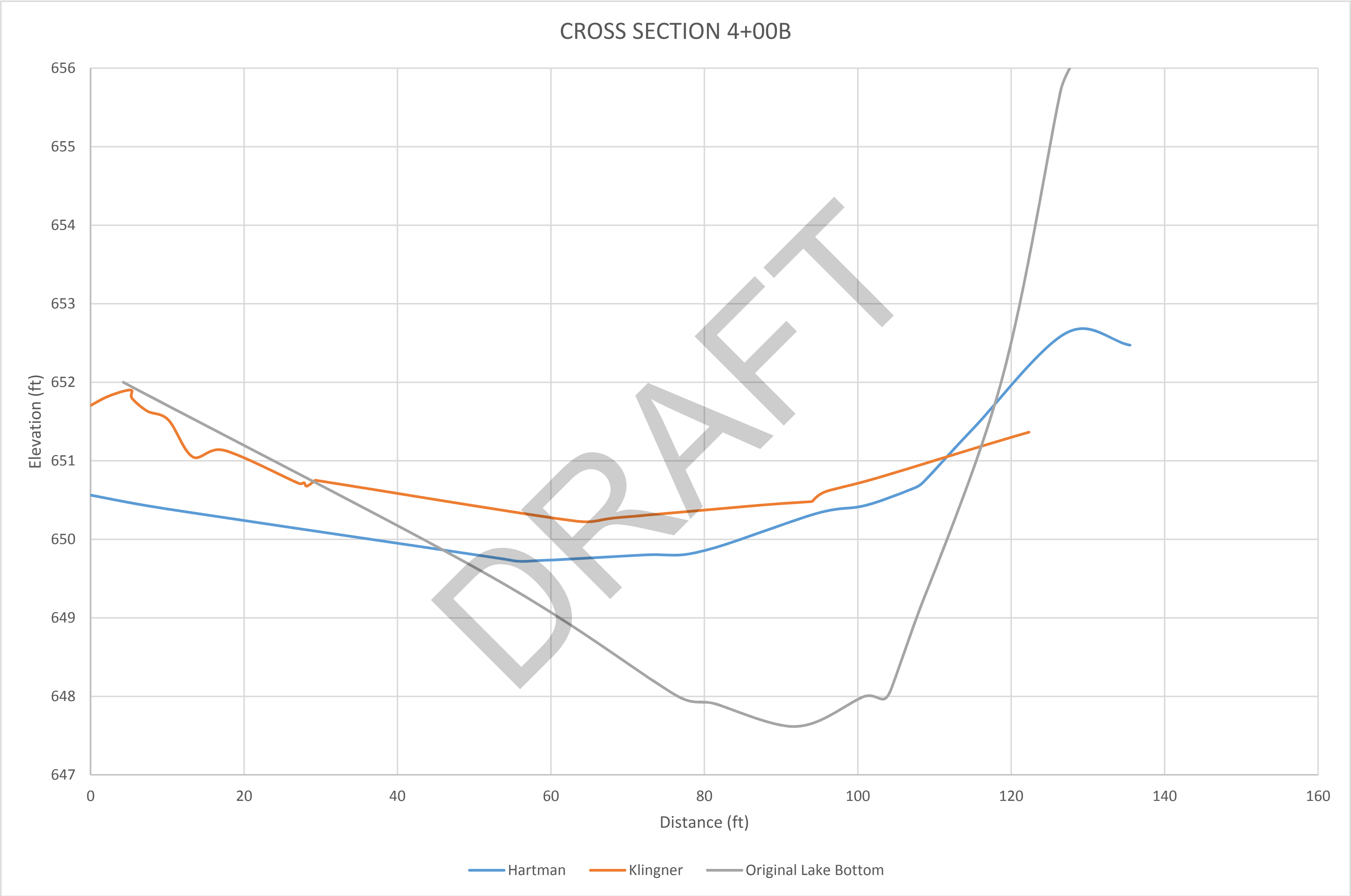

CROSS SECTION 15+90
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT


CROSS SECTION 24+90
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT


CROSS SECTION 33+50
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT


CROSS SECTION 44+80
Elevation (ft)
653
651
649
647
645
643
0
100
200
300
400
500
600
700
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT


CROSS SECTION 3+00B
656
655
654
653
652
651
650
649
648
647
Elevation (ft)
0
20
40
60
80
100
120
140
160
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT



CROSS SECTION 4+00B
Elevation (ft)
656
655
654
653
652
651
650
649
648
647
0
20
40
60
80
100
120
140
160
Distance (ft)
Hartman
Klingner
Original Lake Bottom
DRAFT

APPENDIX C
ADDITIONAL INFORMATION

Little Swan Lake Sedimentation Survey and Management Plan

Final Report

August 7, 2003

Prepared for the:
Little Swan Lake Association

Cochran & Wilken, Inc.
5201 South Sixth Street Road
Springfield, IL 62703-5143

Table of Contents

Introduction	1
Scope of Work	1
Sedimentation Survey	2
Summary and Recommendations	7

List of Tables

Table 1.	Results of Sedimentation Survey	4
Table 2.	Estimate of Probable Sediment Removal Costs	9

List of Figures

Figure 1.	Little Swan Lake and Surrounding Watershed	2
Figure 2.	Sediment Survey Location Map	3
Figure 3.	Cross Section Locations	5
Figure 4.	Sediment Survey Cross Sections	6
Figure 5.	Shoreline Stabilization with Riprap	10

Appendix

Laboratory Results for Sediment Core Samples

Introduction

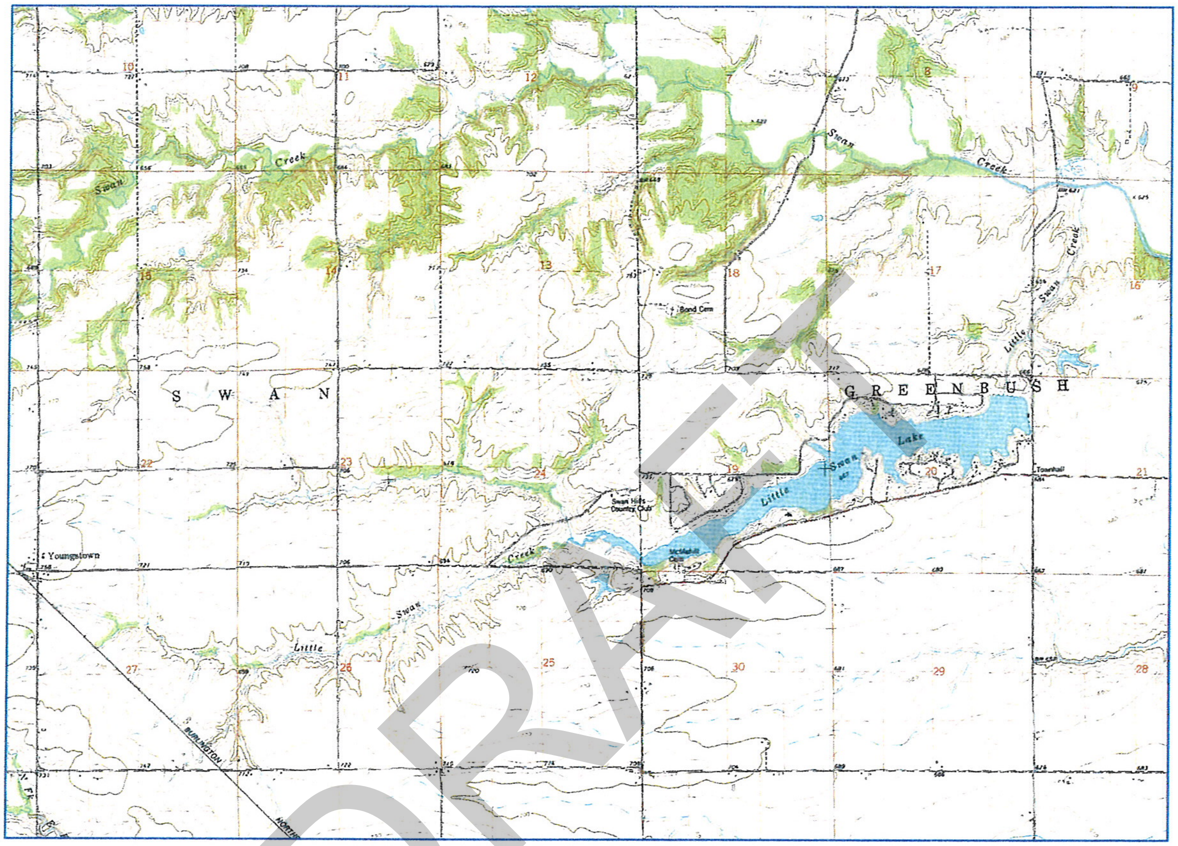
Little Swan Lake is a 250.0 surface acre lake located approximately 4.3 miles west of Avon in Warren County, Illinois that is managed by the Little Swan Lake Association (see Figure 1). The lake is primarily an impoundment that was constructed in 1967 with an earthen embankment dam across Little Swan Creek. It discharges from a drop inlet spillway that discharge into Little Swan Creek, which flows into Swan Creek. The watershed or drainage area consists of approximately 5,700 acres of upland agricultural, forest and residential lands. The normal pool elevation of the lake is considered to be 657.0 with an estimated storage volume 2,000 acre-feet or 65.2 million gallons. The maximum depth is 31 feet near the dam and the average water depth is approximately eight (8) feet. As a result of 36 years of soil erosion in the watershed, sediment deposition in the upper end of the lake has contributed to shallow water depths in many areas.

Scope of Work

The scope of work included a sedimentation survey to determine the water depths and sediment quantities, and an evaluation of shoreline erosion conditions and stabilization options. The sedimentation survey included the upper west end of the lake and the north-side cove located approximately mid-lake. This survey included the use of a Global Positioning System (GPS) system and a sounding pole to obtain measurements of the existing water depth and the thickness of the soft accumulated sediment at a sufficient number of locations for constructing accurate cross sections of the existing and original lake bottom.

This information made it possible to determine the extent of sedimentation throughout the lake, and to quantify the sediment accumulation in terms of total cubic yards and projected restoration needs. In addition to the development of cross sections to show an existing (depth to top of accumulated silt) and original (depth to hard lake bottom) profile of the lake, two sediment core samples were obtained in order to characterize the sediment for future dredging considerations. The results of the sedimentation survey and the shoreline evaluation were used to develop this report, which includes recommendations and estimated costs for prioritized sediment removal and shoreline stabilization options.

Figure 1. Little Swan Lake and Surrounding Watershed



Sedimentation Survey

In May of 2003, Cochran & Wilken, Inc. completed a lake sedimentation survey in order to determine the impact of sediment throughout Little Swan Lake. The lake was divided into two separate areas (Sub-area "A" and Sub-Area "B") in order summarize the degree of sediment impairment in the most impacted areas of the lake. The lake is primarily fed by Little Swan Creek, which enters at the far west end. This area is shown in Figure 2 as Sub-Area "A". The one additional area that was determined to be susceptible to sediment deposition is located on the north side of lake at the approximate mid-point. This small bay is downstream of an un-named creek, which primarily drains agricultural land and is shown in Figure 2 as Sub-Area "B".

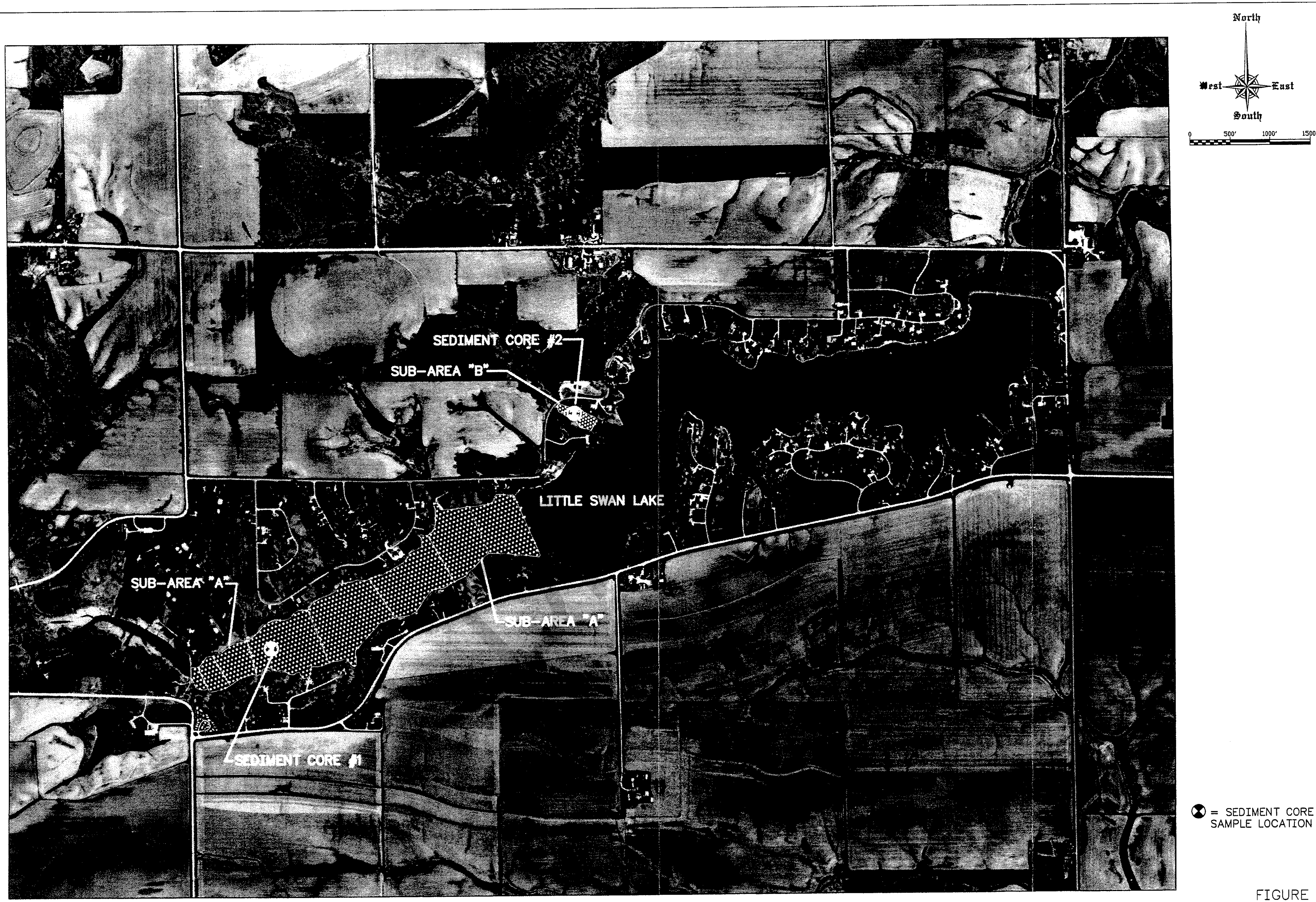


FIGURE 2
SEDIMENT SURVEY LOCATION MAP

The actual sedimentation survey was completed using an Ashtech Global Positioning System (GPS) to record the horizontal location of each measurement. Water depth and sediment measurements were obtained using a one-inch diameter aluminum range pole with 0.1-foot gradation markings. Existing water depths were measured by lowering the range pole into the water at each sounding point until the top of the soft sediment was reached. The range pole was then pushed through the soft sediment until the hard, original lake bottom was reached in order to determine the original water depth and the thickness of the accumulated sediment.

The measurements obtained at the top of the existing silt and at the bottom of the silt where the hard original lake bottom was located were used to develop separate cross sections to graphically depict the accumulated sediment. The cross section locations are shown in Figure 3 and the plotted cross sections are shown on Figure 4. According to the survey results, the estimated volume of accumulated sediment presently deposited within the study area is 174,226 cubic yards, which consists of 170,785 cy in Sub-Area "A" and 3,440 cy in Sub-Area "B". The results of the survey are summarized in Table 1.

Table 1. Results of Sedimentation Survey

Sediment Survey Area	Original Volume (cu. yds)	Existing Volume (cu. yds)	Total Sediment (cu. yds.)	Total Volume Loss (%)
Sub-Area "A"				
1	3,076	1,342	1,733	56.4%
2	16,413	7,822	8,591	52.3%
3	29,200	15,822	13,378	45.8%
4	103,149	65,371	37,378	36.6%
5	147,100	108,633	38,467	26.2%
6	163,177	130,258	32,919	20.2%
7	128,756	106,792	21,964	17.1%
8	154,758	138,803	15,955	10.3%
Subtotal "A"	**745,629**	**574,844**	**170,785**	**22.9%**
Sub-Area "B"				
9	671	310	361	53.8%
10	3,896	2,304	1,593	40.9%
11	5,990	4,503	1,487	24.8%
Subtotal "B"	**10,557**	**7,117**	**3,440**	**32.6%**
Total "A" & "B"	**756,186**	**581,960**	**174,226**	**23.0%**

FIGURE 3
CROSS SECTION LOCATIONS

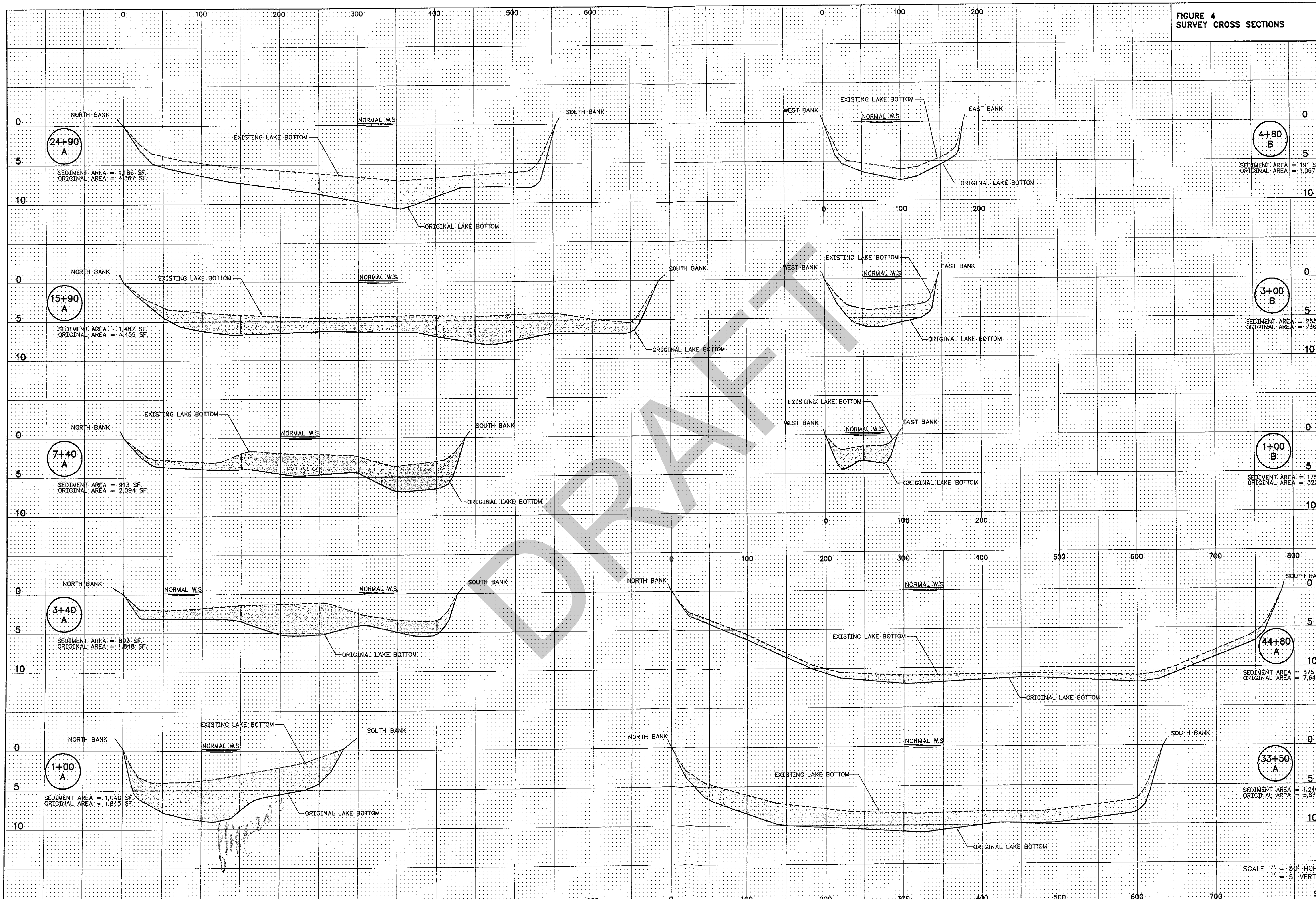


FIGURE 4
SURVEY CROSS SECTIONS
DRAFT
24+90 A
SEDIMENT AREA = 1,186 SF.
ORIGINAL AREA = 4,367 SF.
NORTH BANK
NORMAL W.S.
EXISTING LAKE BOTTOM
SOUTH BANK
ORIGINAL LAKE BOTTOM
4+80 B
SEDIMENT AREA = 191 SF.
ORIGINAL AREA = 1,067 SF.
WEST BANK
EAST BANK
15+90 A
SEDIMENT AREA = 1,487 SF.
ORIGINAL AREA = 4,459 SF.
3+00 B
SEDIMENT AREA = 255 SF.
ORIGINAL AREA = 730 SF.
7+40 A
SEDIMENT AREA = 913 SF.
ORIGINAL AREA = 2,094 SF.
1+00 B
SEDIMENT AREA = 175 SF.
ORIGINAL AREA = 322 SF.
3+40 A
SEDIMENT AREA = 893 SF.
ORIGINAL AREA = 1,848 SF.
44+80 A
SEDIMENT AREA = 575 SF.
ORIGINAL AREA = 7,646 SF.
1+00 A
SEDIMENT AREA = 1,040 SF.
ORIGINAL AREA = 1,845 SF.
33+50 A
SEDIMENT AREA = 1,246 SF.
ORIGINAL AREA = 5,879 SF.
SCALE 1" = 50' HORZ.
1" = 5' VERT.
SH.2

The results of the sedimentation Survey show that sediment deposition has been greatest in the upper end of the lake where Little Swan Creek enters at the golf course bridge and gradually decreases east of the inlet point. Lake segments #1 and #2 have lost more than 50 percent of their original water depth and segments 3 through 8 have lost gradually decreasing percentages. This gradually sloping delta deposit is typical of reservoirs with predominantly silt and clay sized sediment particles, which is directly related to water velocity, particle size and settling rates.

A shoreline evaluation of the perimeter of the lake was also completed in order to make observations of the existing shoreline conditions and to make recommendations for future shoreline stabilization efforts. In general, the majority of the shoreline has been adequately stabilized with various methods such as sheet pile seawall, timber, broken concrete, rip rap, etc. In those areas that have not been physically stabilized, it was observed that minimal erosion and undercutting has occurred.

Summary and Recommendations

The findings and results of our sedimentation survey allow us to provide the following conclusions and recommendations to the Little Swan Lake Association. Sediment deposition has reduced water depth and has contributed to degraded water quality and habitat throughout the lake system. An estimated 174,226 cubic yards of sediment was measured within the study area, which was determined as result of actual measurement and observation. The areas of the lake east of the study area were deeper than dredging would realistically have to reach, combined with rapidly decreasing sediment deposition. A realistic water depth for a dredging project to remove sediment to is generally considered to be a maximum depth of eight to ten feet, or when hard original bottom is reached. This less costly approach minimizes the sediment removal quantity, restores water depths to a recreationally acceptable level and improves water quality by minimizing turbidity and sediment resuspension in shallow water.

The recommended dredging limits include all of Sub-Area "A" from the west end of the lake (at the wooden golf cart bridge) to cross section 39+00 and all of Sub-Area "B". The lake bottom east of station 39+00 was found to be deeper than 10 feet and the thickness of the sediment deposit was rapidly decreasing. This option would include the removal of approximately 158,271 cubic yards of sediment. An alternative option that can be considered if funding and/or available upland storage space is limited includes Sub-Area "A" from the golf cart bridge to cross section 24+90, where existing water depths reach a maximum of 7.0 feet and sediment thickness is approximately 2.0 to 3.5 feet. This reduced quantity option would include the removal of approximately 103,388 cubic yards of sediment.

The sediment should be removed from the lake by hydraulic dredging and placed in an upland containment and dewatering site, preferably in an agricultural field with a topographic draw that would allow water to gravity flow back to the lake while dredging. There appears to be several suitable sites located near the northwest end of the lake. The ideal site would provide at least 20 acres of usable space to construct an earthen sediment retention and dewatering facility. The reduced dredging option would only require a minimum of 13 acres of usable space. This agricultural land would benefit from the reclaimed topsoil when the dried sediment is graded properly after the dredging project is complete.

The following table summarizes the various work tasks that would be required and the estimated costs for completion. An estimate of probable dredging project costs is provided in Table 2. Land acquisition costs have not been included in this summary since it is not clear what arrangements may be secured until a project is initiated. It is likely that a short-term lease arrangement that includes site reclamation may be the most cost effective approach. For a project of this size, two to three years are a normal time period to allow for sufficient drying time to allow for site grading.

The preliminary estimate of probable cost for the recommended dredging option, which extends out as far as cross section 39+00 in Sub-Area "A", from $819,312 to $949,060 and the alternate approach reduced dredging option ranges from $592,615 to $703,741. The probable cost range for site reclamation is $40,000 to $60,000 and would likely be completed two to three years after dredging. More accurate estimates of probable cost can be determined prior to actual project implementation during the engineering design phase.

Table 2. Estimate of Probable Sediment Removal Costs

Sediment Removal Work Task	Total Dredging Quantity	Estimated Cost
Dredging – (Area "A" to 39+00 & Area B")		
Hydraulic Dredging – 158,271 cy @ $2.50 to $2.75/cy	158271	$ 395,678 - $ $435,245
Dredge Mobilization		$ 60,000 - $ 80,000
Construct Retention Pond (20 acre site)		$ 180,000 - $ 220,000
Polymer or Flocculent during dredging		$ 12,000 - $ 15,000
Subtotal		$ 647,678 - $ 750,245
Contingency (10%)		$ 64,768 - $ 75,025
Subtotal incl. Contingency		$ 712,445 - $ 825,270
Engineering and Permitting (15%)		$ 106,867 - $ 123,790
Total Estimated Cost for Dredging to 10' Max.		**$ 819,312 - $ 949,060**
Reduced Dredging – (Area "A" to 24+90 and Area "B")		
Hydraulic Dredging – 103,388 cy @ $3.00 to $3.25/cy	103,388 cy	$ 258,470 - $ 284,317
Dredge Mobilization		$ 60,000 - $ 80,000
Construct Retention Pond (13 acre site)		$ 140,000 - $ 180,000
Polymer of Flocculent during dredging		$10,000 - $12,000
Subtotal		$ 468,470 - $ 556,317
Contingency (10%)		$ 46,847 - $ 55,632
Subtotal incl. Contingency		$ 515,317 - $ 611,949
Engineering and Permitting (15%)		$ 77,298 - $ 91,792
Total Estimated Cost for Reduced Dredging Option		**$ 592,615 - $ 703,741**
Probable Site Reclamation Cost (both Options)	1 L.S.	$ 40,000 - $ 60,000

Our scope of engineering services for a future dredging and lake restoration project would include design, permitting, bid document preparation and coordination of potential bidders. The following list of contractors has been included for informational purposes.

Mid-America Dredging
P.O. Box 168 RR 3
Macomb, IL 61455

Inland Dredge Company, Inc.
3011 Knollcrest Drive
Burlington, WI 53105

C & C Dredging Services
225 Oakwood Rd, Unit C
Lake Zurich, IL 60047

Southwind Construction Co.
14649 Highway 41 North
Evansville, IN 47711

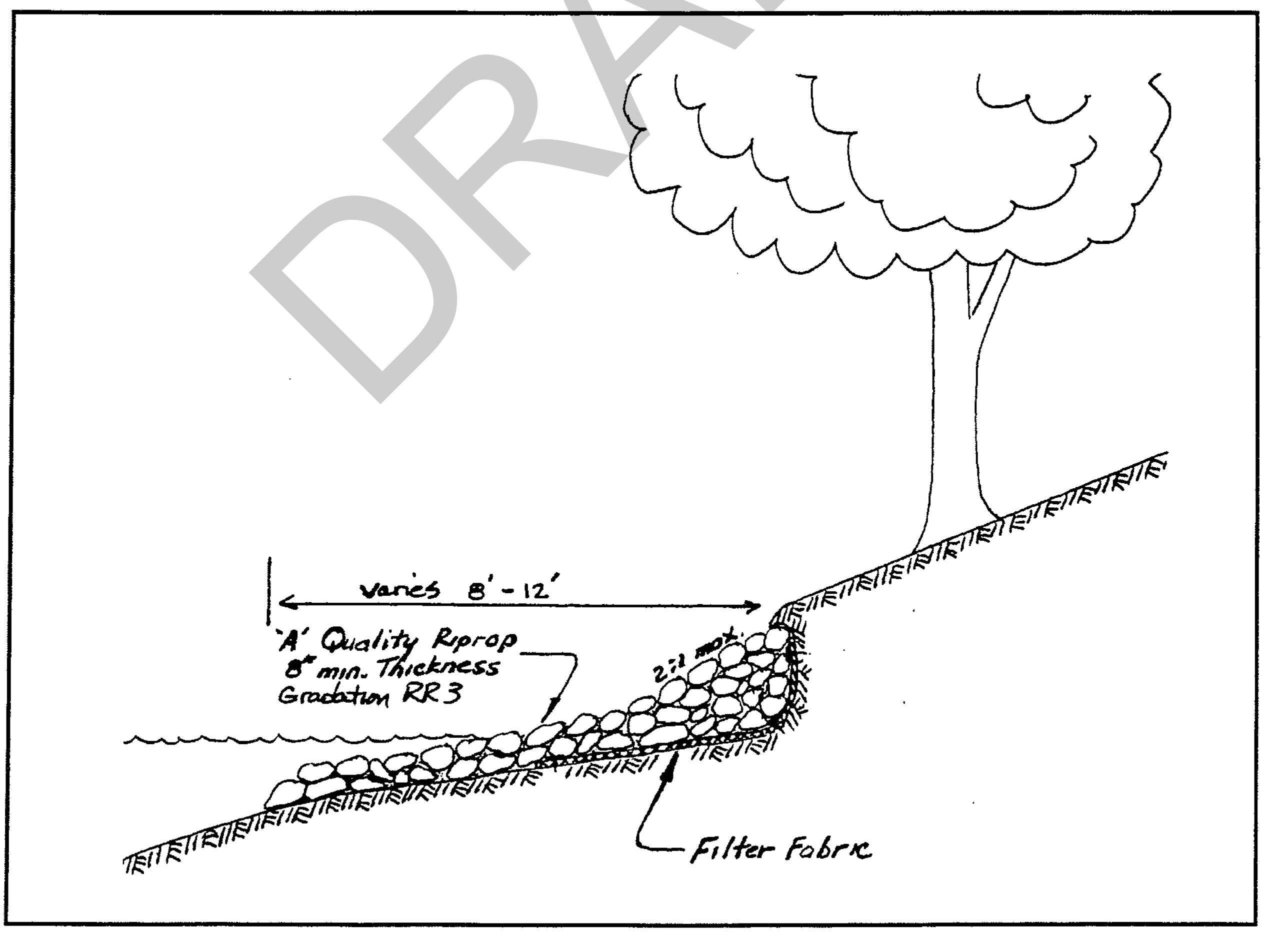
Tennant's Industrial Dredging
3130 North 21st Street
Terra Haute, IN 47804

L.W. Matteson, Inc.
#1 South Point
Burlington, IA 52601

<u>Shoreline Stabilization</u>

In general, shoreline erosion has been controlled in most areas of the lake. However, there are several minor unstabilized areas that may benefit from an effective method of shoreline stabilization. The following figure shows a typical riprap installation using gradation RR3 sized stone (4" to 8" diameter). The riprap should be installed on a layer of non-woven Geotextile filter fabric that is pinned down and covered with a minimum 12" thick layer of "A" quality (IDOT classification) stone. It is important to place the riprap at the bank of the shoreline at a maximum 2:1 (two ft. horizontal to one ft. vertical) slope for stability and longevity. Representative photographs of eroded areas of the Lake Arlann shoreline are attached in Appendix B.

Figure 5. Shoreline Stabilization with Rip Rap



APPENDIX

Laboratory Results of Sediment Core Samples

An Analytical Testing Laboratory

Prairie Analytical Systems, INCORPORATED

1265 Capital Airport Drive
Springfield, IL 62707-8490

Phone: 217-753-1148
FAX: 217-753-1152

July 17, 2003

Mr. Peter Berrini
Cochran & Wilkin, Inc.
5201 South Sixth Street
Springfield, IL 62703

RE: Little Swan Lake PAS Order No.: 0306131

Dear Mr. Peter Berrini:

Prairie Analytical Systems, Inc. received 3 samples on 6/26/03 1:45:00 PM for the analyses presented in the following report.

All applicable quality control procedures met method specific acceptance criteria.

This report shall not be reproduced, except in full, without the prior written consent of Prairie Analytical Systems, Inc.

If you have any questions, please feel free to call me at (217) 753-1148.

Sincerely,

Tony D. Slaughter

Tony D. Slaughter
Project Manager

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	Core #1
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	6/24/03 11:00:00 AM
Lab ID:	0306131-001A	**Matrix:**	SOLID

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PH ANALYSIS		**SW9045C**				Analyst: **RMN**
pH	6.82	0.01		pH Units	1	6/30/03
PARTICLE SIZE ANALYSIS		**D422**				Analyst: **RMN**
Gravel (>4.75 mm)	0	0.01		%	1	7/2/03
Sand, Coarse (4.74 - 2.00 mm)	0	0.01		%	1	7/2/03
Sand, Medium (1.99 - 0.425 mm)	0.14	0.01		%	1	7/2/03
Sand, Fine (0.424 - 0.075 mm)	3.42	0.01		%	1	7/2/03
Silt (0.074 - 0.005 mm)	75.2	0.01		%	1	7/2/03
Clay (<0.005 mm)	15.7	0.01		%	1	7/2/03
Colloids (<0.001 mm)	5.57	0.01		%	1	7/2/03
PERCENT MOISTURE ANALYSIS		**D2216**				Analyst: **RMN**
Percent Moisture	39.7	0.01		wt%	1	6/30/03

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	4 hr. Supernatant
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	
Lab ID:	0306131-001B	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
METALS ANALYSIS		**SW6020**		**(SW3005A)**		Analyst: **MCL**
Lead	0.007	0.006		mg/L	3	7/3/03 4:57:00 PM
Zinc	0.048	0.004		mg/L	2	7/15/03 3:10:00 PM
TOTAL SUSPENDED SOLIDS ANALYSIS		**M2540 D**				Analyst: **RMN**
Total Suspended Solids	282	25.0		mg/L	1	7/2/03
TOTAL VOLATILE SOLIDS ANALYSIS		**M2540 E**				Analyst: **RMN**
Suspended Volatile Solids	U	25.0		mg/L	1	7/2/03
AMMONIA ANALYSIS		**M4500-NH3 F**				Analyst: **RMN**
Ammonia (as N)	3.45	0.100		mg/L	1	7/7/03

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	24 hr. Supernatant
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	
Lab ID:	0306131-001C	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS ANALYSIS		**M2540 D**				Analyst: **RMN**
Total Suspended Solids	206	25.0		mg/L	1	7/2/03
AMMONIA ANALYSIS		**M4500-NH3 F**				Analyst: **RMN**
Ammonia (as N)	5.50	0.100		mg/L	1	7/7/03

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	48 hr. Supernatant
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	
Lab ID:	0306131-001D	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS ANALYSIS		**M2540 D**				Analyst: **RMN**
Total Suspended Solids	198	25.0		mg/L	1	7/2/03
AMMONIA ANALYSIS		**M4500-NH3 F**				Analyst: **RMN**
Ammonia (as N)	4.12	0.100		mg/L	1	7/7/03

DRAFT

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	Core #2
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	6/24/03 11:00:00 AM
Lab ID:	0306131-002A	**Matrix:**	SOLID

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PH ANALYSIS		**SW9045C**				Analyst: **RMN**
pH	6.88	0.01		pH Units	1	6/30/03
PARTICLE SIZE ANALYSIS		**D422**				Analyst: **RMN**
Gravel (>4.75 mm)	0	0.01		%	1	7/2/03
Sand, Coarse (4.74 - 2.00 mm)	0	0.01		%	1	7/2/03
Sand, Medium (1.99 - 0.425 mm)	0.16	0.01		%	1	7/2/03
Sand, Fine (0.424 - 0.075 mm)	6.02	0.01		%	1	7/2/03
Silt (0.074 - 0.005 mm)	85.4	0.01		%	1	7/2/03
Clay (<0.005 mm)	8.28	0.01		%	1	7/2/03
Colloids (<0.001 mm)	0.14	0.01		%	1	7/2/03
PERCENT MOISTURE ANALYSIS		**D2216**				Analyst: **RMN**
Percent Moisture	35.0	0.01		wt%	1	6/30/03

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	4 hr. Supernatant
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	
Lab ID:	0306131-002B	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
METALS ANALYSIS		**SW6020**		**(SW3005A)**		Analyst: **MCL**
Lead	0.007	0.006		mg/L	3	7/3/03 5:05:00 PM
Zinc	0.054	0.004		mg/L	2	7/15/03 3:17:00 PM
TOTAL SUSPENDED SOLIDS ANALYSIS		**M2540 D**				Analyst: **RMN**
Total Suspended Solids	452	25.0		mg/L	1	7/2/03
TOTAL VOLATILE SOLIDS ANALYSIS		**M2540 E**				Analyst: **RMN**
Suspended Volatile Solids	U	25.0		mg/L	1	7/2/03
AMMONIA ANALYSIS		**M4500-NH3 F**				Analyst: **RMN**
Ammonia (as N)	5.20	0.100		mg/L	1	7/7/03

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	24 hr. Supernatant
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	
Lab ID:	0306131-002C	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS ANALYSIS		**M2540 D**				Analyst: **RMN**
Total Suspended Solids	156	25.0		mg/L	1	7/2/03
AMMONIA ANALYSIS		**M4500-NH3 F**				Analyst: **RMN**
Ammonia (as N)	4.07	0.100		mg/L	1	7/7/03

Prairie Analytical Systems, Inc.

Date: *17-Jul-03*

CLIENT:	Cochran & Wilkin, Inc.	**Client Sample ID:**	48 hr. Supernatant
Lab Order:	0306131	**Tag Number:**	
Project:	Little Swan Lake	**Collection Date:**	
Lab ID:	0306131-002D	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS ANALYSIS		**M2540 D**				Analyst: **RMN**
Total Suspended Solids	90.0	25.0		mg/L	1	7/2/03
AMMONIA ANALYSIS		**M4500-NH3 F**				Analyst: **RMN**
Ammonia (as N)	3.21	0.100		mg/L	1	7/7/03

Prairie Analytical Systems, Inc.

Qualifiers :

B - Analyte detected in the associated method blank.

E - Value above quantitation range.

H - Analysis performed past holding time.

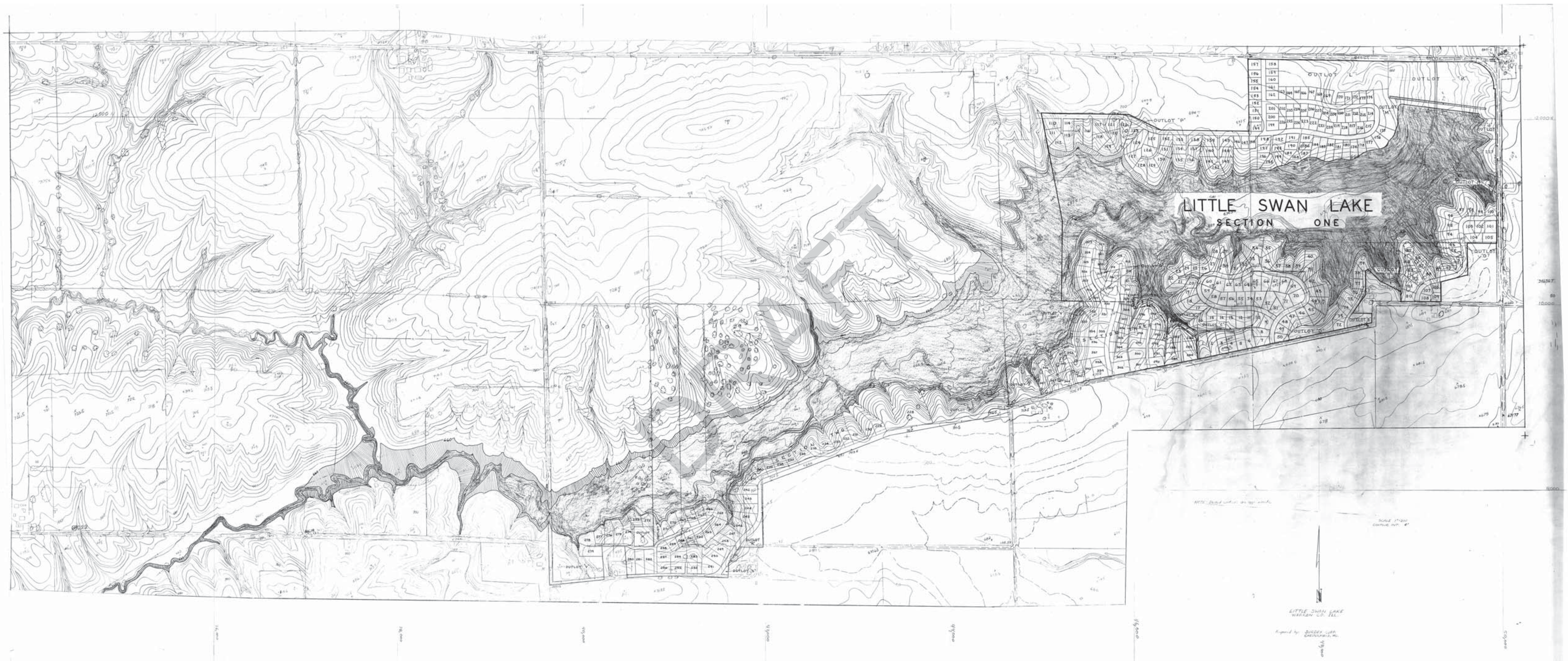
HT - Sample received past holding time.

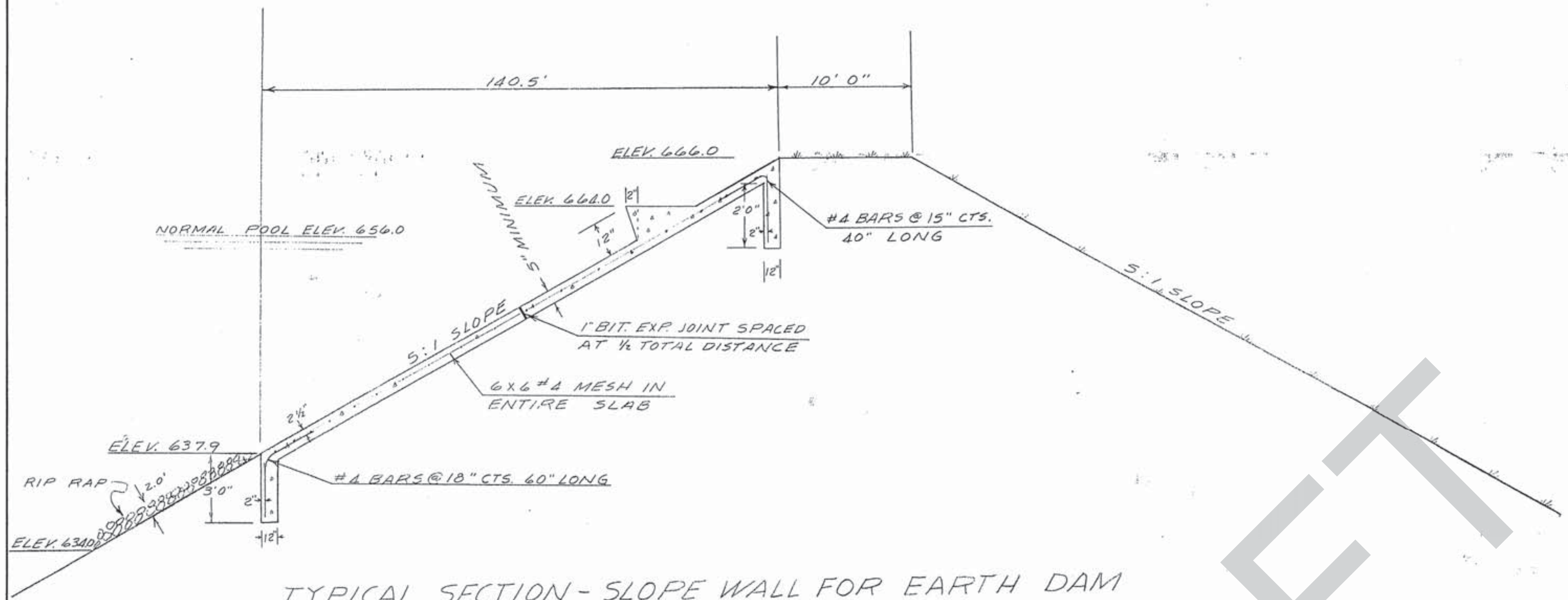
J - Analyte detected between RL and MDL.

R - RPD outside acceptance limits.

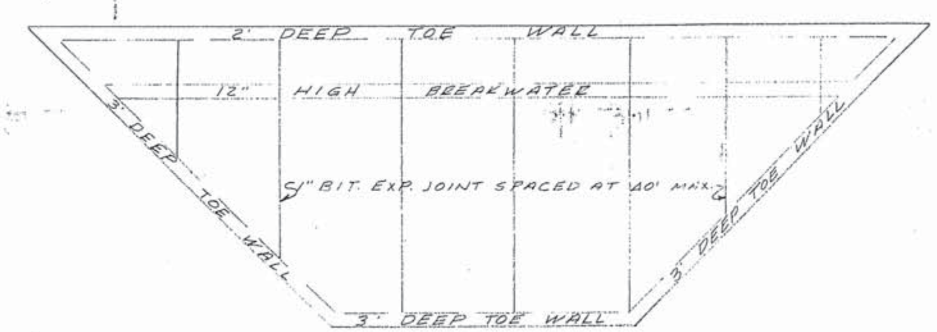
S - Spike recovery outside acceptance limits.

U - Analyte not detected (i.e. less than RL or MDL).


LITTLE SWAN LAKE
SECTION ONE
OUTLOT "L"
OUTLOT "K"
OUTLOT "P"
LITTLE SWAN LAKE
WARREN CO. ILL.



TYPICAL SECTION - SLOPE WALL FOR EARTH DAM
(NOT TO SCALE)



PLAN VIEW - SLOPE WALL

BILL OF MATERIAL

ITEM	UNIT	QUANTITY
SLOPE WALL 5"	SQ. YD.	12,937
#4 REINFORCEMENT BARS 60"	LBS.	2590
#4 REINFORCEMENT BARS 40"	LBS.	1870

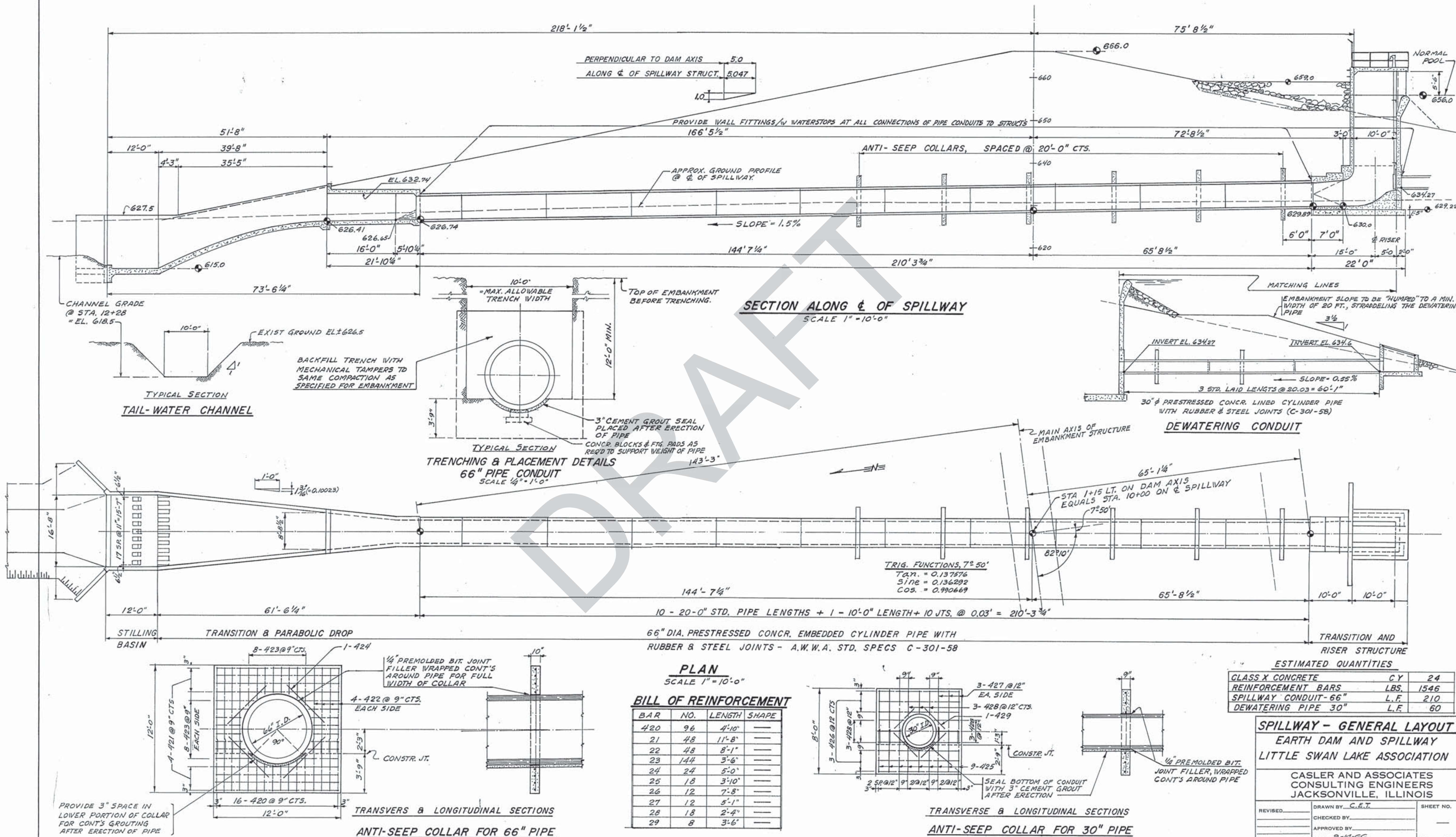
NOTE:

SLOPE WALL SHALL BE CONSTRUCTED AND MEASURED FOR PAYMENT IN ACCORDANCE WITH SECTION 83 OF THE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" ADOPTED JANUARY 2, 1958 OF THE STATE OF ILLINOIS.

SLOPE WALL DETAIL
FOR
LITTLE SWAN LAKE
WARREN COUNTY, ILLINOIS

CASLER AND ASSOCIATES
CONSULTING ENGINEERS
JACKSONVILLE, ILLINOIS

REVISED PLH 12-21-66
DRAWN BY PLH
CHECKED BY
APPROVED BY
DATE 12-1-66
SHEET NO. —
OF ___ SHEETS



BILL OF REINFORCEMENT

BAR	NO.	LENGTH	SHAPE
420	96	4'-10"	——
21	48	11'-8"	——
22	48	8'-1"	——
23	144	3'-6"	——
24	24	5'-0"	——
25	18	3'-10"	——
26	12	7'-8"	——
27	12	5'-1"	——
28	18	2'-4"	——
29	8	3'-6"	——

ESTIMATED QUANTITIES

CLASS X CONCRETE	CY	24
REINFORCEMENT BARS	LBS.	1546
SPILLWAY CONDUIT - 66"	L.F.	210
DEWATERING PIPE 30"	L.F.	60

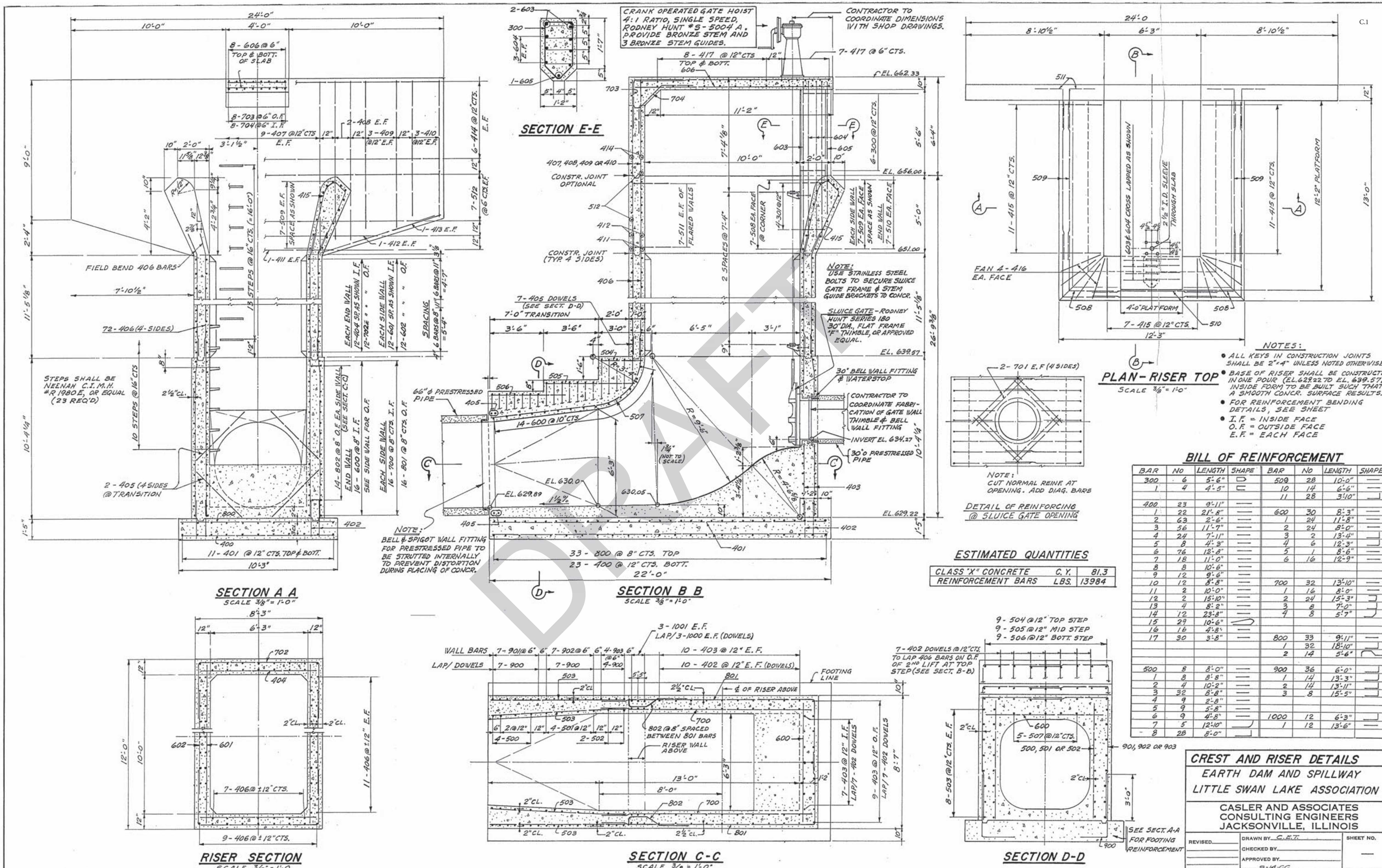
SPILLWAY - GENERAL LAYOUT

EARTH DAM AND SPILLWAY

LITTLE SWAN LAKE ASSOCIATION

CASLER AND ASSOCIATES
CONSULTING ENGINEERS
JACKSONVILLE, ILLINOIS

REVISED ______ DRAWN BY C.E.T. SHEET NO. ____
CHECKED BY ______
APPROVED BY ______
DATE 9-14-66 OF ____ SHEETS



NOTES:

- ALL KEYS IN CONSTRUCTION JOINTS SHALL BE 2"×4" UNLESS NOTED OTHERWISE.
- BASE OF RISER SHALL BE CONSTRUCTED IN ONE POUR (EL. 629.22 TO EL. 639.57) INSIDE FORM TO BE BUILT SUCH THAT A SMOOTH CONCR. SURFACE RESULTS.
- FOR REINFORCEMENT BENDING DETAILS, SEE SHEET
- I.F. = INSIDE FACE
  O.F. = OUTSIDE FACE
  E.F. = EACH FACE

ESTIMATED QUANTITIES

CLASS "X" CONCRETE	C.Y.	81.3
REINFORCEMENT BARS	LBS.	13984

BILL OF REINFORCEMENT

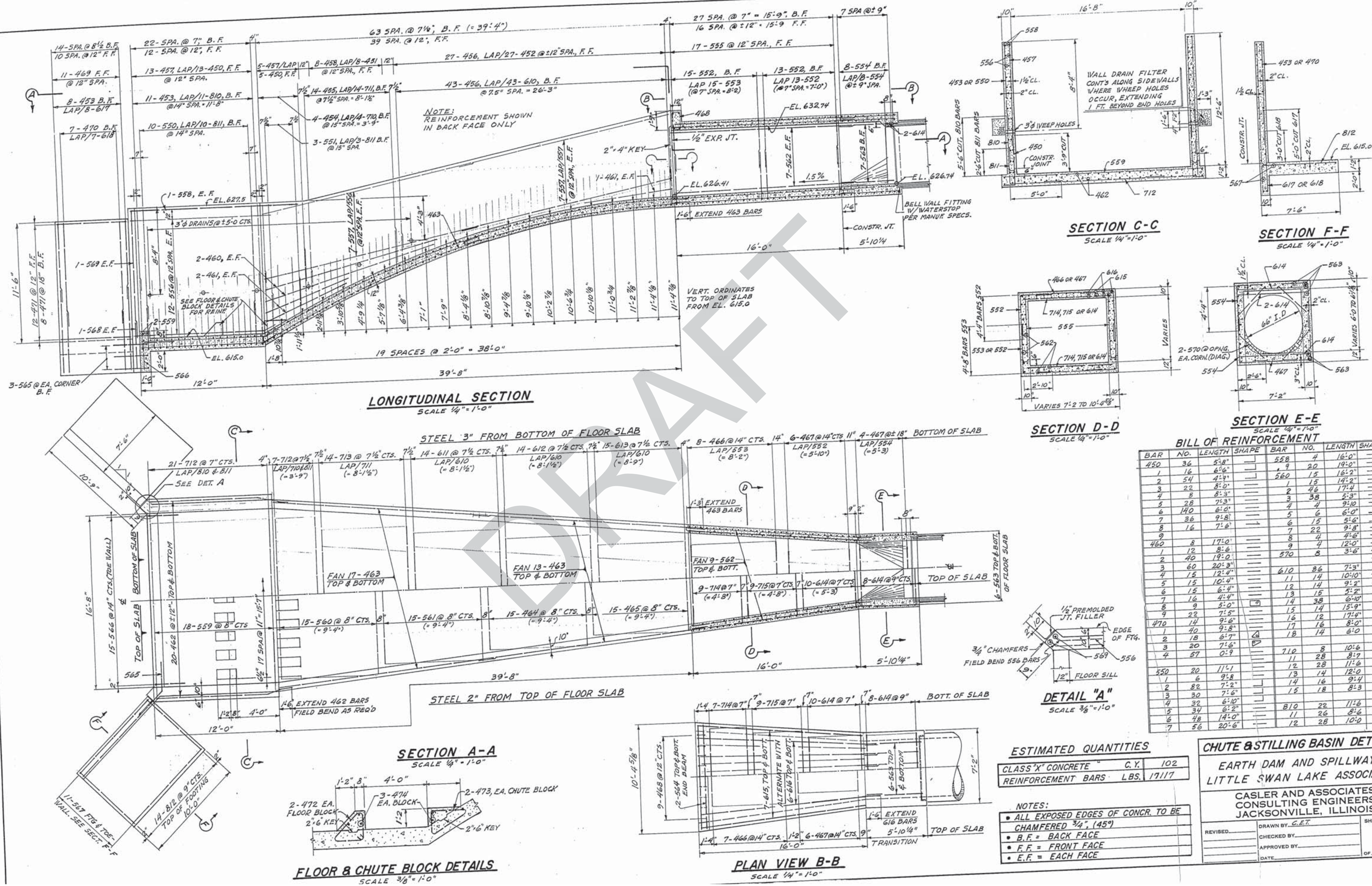
BAR	NO	LENGTH	SHAPE	BAR	NO	LENGTH	SHAPE
300	6	5'-6"	⊃	509	28	10'-0"	—
1	4	4'-5"	⊏	10	14	6'-6"	—
				11	28	3'-10"	⌋
400	23	9'-11"	—				
1	22	21'-8"	—	600	30	8'-3"	—
2	63	2'-6"	—	1	24	11'-8"	—
3	56	11'-7"	—	2	24	8'-0"	—
4	24	7'-11"	—	3	2	13'-4"	⌋
5	8	4'-3"	—	4	6	12'-3"	⌋
6	76	12'-8"	—	5	1	8'-6"	—
7	18	11'-0"	—	6	16	12'-9"	—
8	8	10'-6"	—				
9	12	9'-6"	—				
10	12	8'-8"	—	700	32	13'-10"	—
11	2	10'-0"	—	1	16	8'-0"	—
12	2	15'-10"	—	2	24	15'-3"	⊐
13	4	8'-2"	—	3	8	7'-0"	⌋
14	12	23'-8"	—	4	8	5'-7"	⌋
15	29	10'-6"	⊃				
16	16	4'-8"	—				
17	30	3'-8"	—	800	33	9'-11"	—
				1	32	18'-10"	⌋
				2	14	5'-6"	⌒
500	8	8'-0"	—	900	36	6'-0"	⌋
1	8	8'-8"	—	1	14	13'-3"	⌋
2	4	10'-2"	—	2	14	13'-11"	⌋
3	32	8'-8"	—	3	8	15'-5"	⌋
4	9	2'-8"	—				
5	9	5'-8"	—				
6	9	4'-8"	—	1000	12	6'-3"	⌋
7	5	12'-10"	⌋	1	12	13'-6"	—
8	28	8'-0"	⌋				

CREST AND RISER DETAILS

EARTH DAM AND SPILLWAY
LITTLE SWAN LAKE ASSOCIATION

CASLER AND ASSOCIATES
CONSULTING ENGINEERS
JACKSONVILLE, ILLINOIS

REVISED
DRAWN BY C.E.T.
CHECKED BY
APPROVED BY
DATE 9-14-66
SHEET NO.
OF ___ SHEETS



BILL OF REINFORCEMENT

BAR	NO.	LENGTH	SHAPE	BAR	NO.	LENGTH	SHAPE
450	36	5'-8"	⌟	558	4	16'-0"	—
1	16	6'-6"	⌟	9	20	19'-0"	—
2	54	4'-9"	⌟	560	15	16'-2"	—
3	22	8'-0"	—	1	15	14'-2"	—
4	8	8'-3"	—	2	46	17'-4	—
5	28	7'-3"	—	3	38	5'-3"	—
6	140	6'-0"	—	4	4	9'-10	—
7	36	9'-8"	—	5	6	6'-0"	
8	16	7'-6"	→	6	15	5'-6"	⌟
9				7	22	9'-8"	—
460	8	17'-0"	—	8	4	4'-6"	—
1	12	8'-6	—	9	4	12'-0"	—
2	40	19'-0	—	570	8	3'-6"	—
3	60	20'-3"	—				—
4	15	12'-4"	—	610	86	7'-3"	⌟
5	15	10'-4"	—	11	14	10'-10"	—
6	15	6'-4"	—	12	14	9'-2"	—
7	16	4'-4"	—	13	15	5'-2"	—
8	9	5'-0"	▭	14	38	6'-10"	—
9	22	7'-5"	—	15	14	15'-9"	—
470	14	9'-6"	—	16	12	17'-4"	—
1	40	9'-8"	—	17	16	8'-0"	—
2	18	6'-7"	△	18	14	6'-0	—
3	20	7'-6"	▷				
4	57	0'-9	—	710	8	10'-6	⌟
			—	11	28	8'-7	⌟
550	20	11'-1	—	12	28	11'-6	—
1	6	9'-8	—	13	14	12'-0	—
2	82	7'-2"	⌟	14	16	9'-4	—
3	30	7'-6"	⌟	15	18	8'-3	—
4	32	6'-10"	⌟				—
5	34	6'-2"	—	810	22	11'-6	⌟
6	48	14'-0"	—	11	26	8'-6	⌟
7	56	20'-6"	—	12	28	10'-0	⌟

ESTIMATED QUANTITIES

CLASS "X" CONCRETE	C.Y.	102
REINFORCEMENT BARS	LBS.	17117

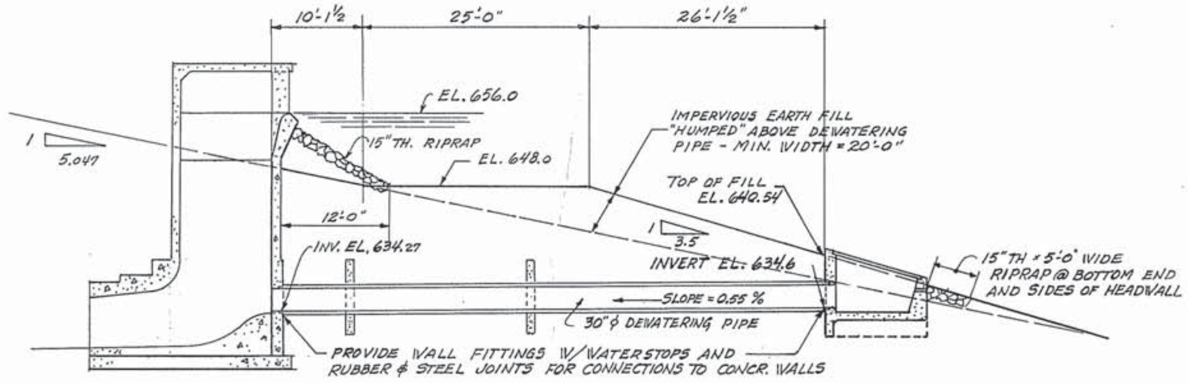
NOTES:
- ALL EXPOSED EDGES OF CONCR. TO BE CHAMFERED 3/4". (45°)
- B.F. = BACK FACE
- F.F. = FRONT FACE
- E.F. = EACH FACE

CHUTE & STILLING BASIN DETAILS

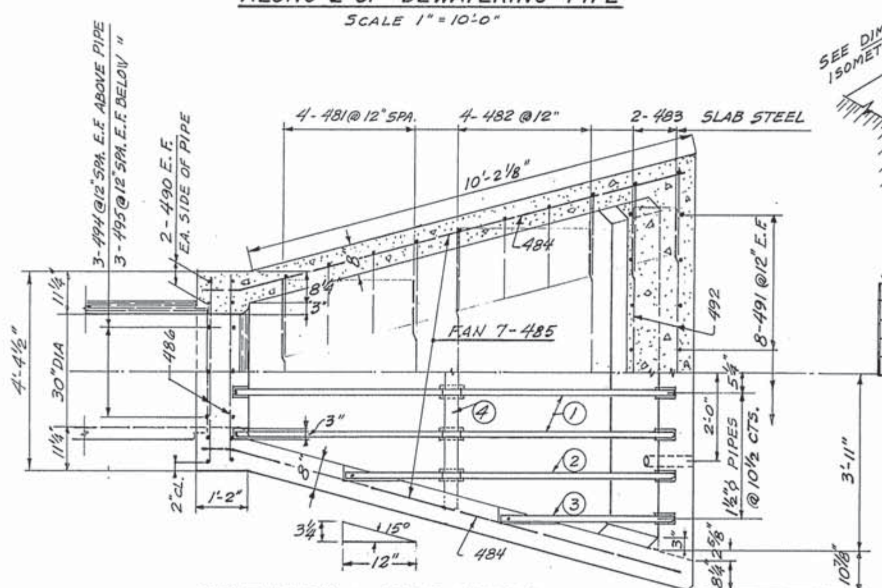
EARTH DAM AND SPILLWAY
LITTLE SWAN LAKE ASSOCIATION

CASLER AND ASSOCIATES
CONSULTING ENGINEERS
JACKSONVILLE, ILLINOIS

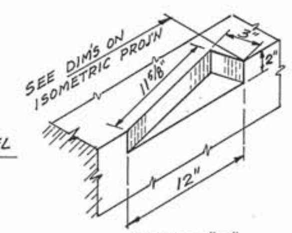
REVISED
DRAWN BY C.E.T.
CHECKED BY
APPROVED BY
DATE
SHEET NO.
OF SHEETS



LONGITUDINAL SECTION
ALONG ℄ OF DEWATERING PIPE
SCALE 1" = 10'-0"



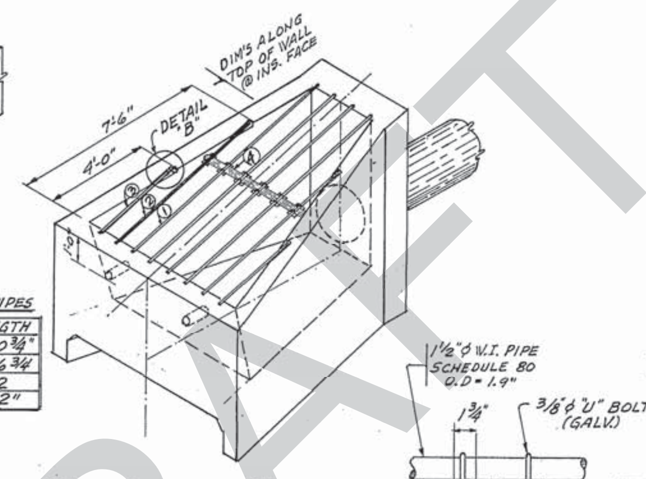
HALF PLAN & HALF SECTION A-A



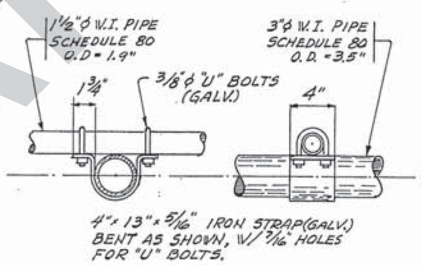
DETAIL "B"

List of Thrash-Rack Pipes

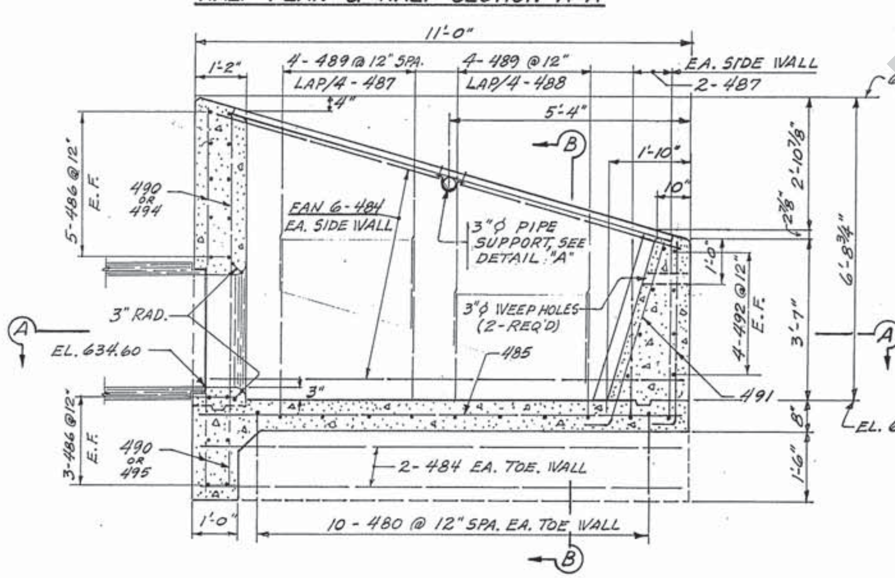
MARK	NO.	DIA.	LENGTH
(1)	4	1½"	10'-0¾"
(2)	2	"	7'-6¾"
(3)	2	"	4'-2
(4)	1	3"	6'-2"



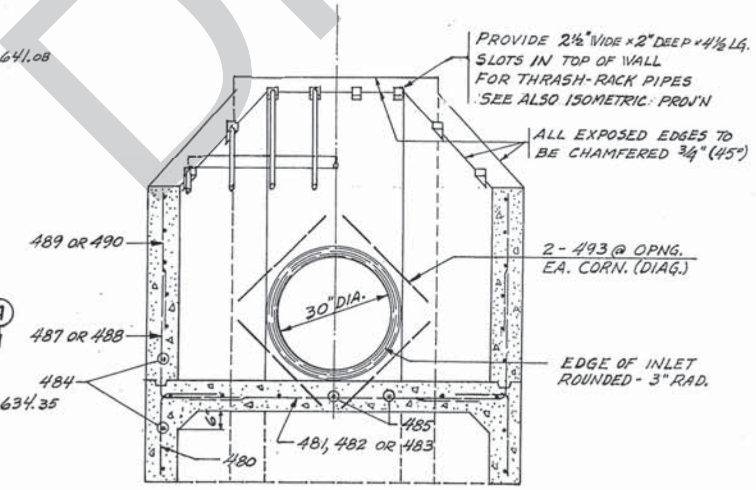
ISOMETRIC PROJECTION
HEADWALL & THRASH-RACK



DETAIL "A"



LONGITUDINAL SECTION



SECTION B-B

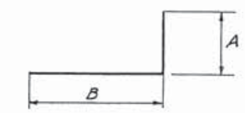
HEADWALL DETAILS
SCALE ½" = 1'-0"

HEADWALL
BILL OF REINFORCEMENT

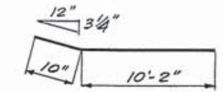
BAR	NO.	LENGTH	SHAPE
480	20	3'-8"	⌐
81	4	4'-4"	—
82	4	6'-6"	—
83	2	7'-6"	—
84	12	11'-0"	—
85	7	10'-8"	—
86	16	4'-1"	—
87	12	5'-10"	⌐
88	8	4'-8"	⌐
89	16	3'-8"	—
490	8	8'-5"	—
91	16	4'-6"	⌐
92	8	8'-7"	—
93	8	3'-1"	—
94	6	3'-4"	—
95	6	2'-3"	—

ESTIMATED QUANTITIES

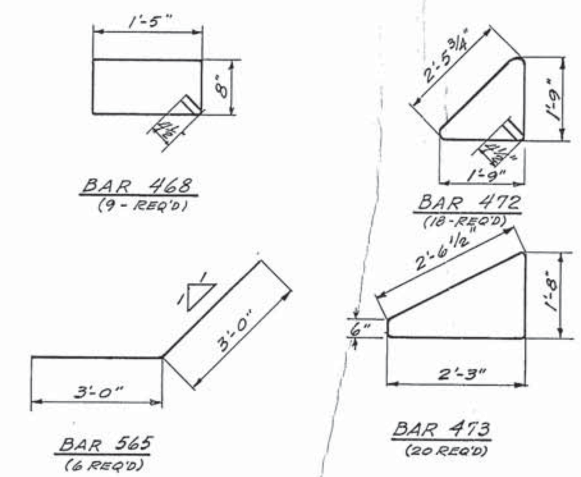
CLASS X CONCR. C.Y.	8
REINFORCEMENT BARS, LBS	560

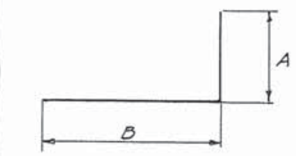


BAR	A	B
480	1'-10"	1'-10"
487	4'-0"	1'-10"
488	2'-10"	1'-10"
491	3'-10"	0'-8"



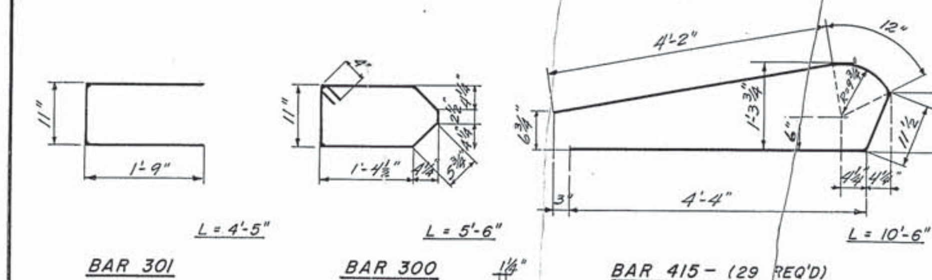
BAR 484

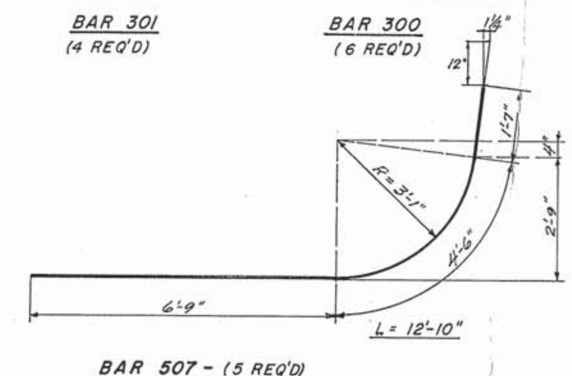


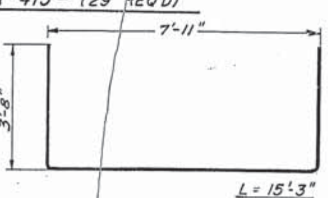


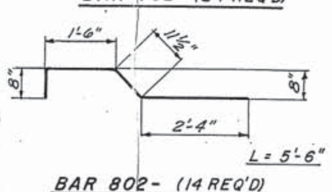
BAR	A	B
450	1'-0"	4'-8"
451	1'-0"	5'-6"
452	1'-0"	3'-9"
552	2'-10"	4'-4"
553	2'-10"	4'-8"
554	2'-6"	4'-4"
566	2'-9"	2'-9"
610	3'-6"	3'-9
710	4'-6"	6'-[illegible]"
711	4'-0"	4'-7"
810	5'-0"	6'-6"
811	3'-6"	5'-0"
812	2'-10"	7'-2"

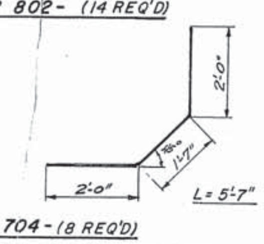
BENDING DETAILS
FOR
CHUTE & STILLING BASIN REINFORCEMENT

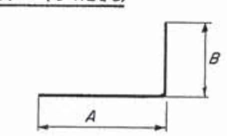












BAR	A	B	NO	LENGTH
508	4'-0"	4'-0"	28	8'-0"
511	2'-4"	1'-6"	28	3'-10"
603	11'-1"	2'-3"	2	13'-4"
604	10'-0"	2'-3"	6	12'-3"
703	3'-6"	3'-6"	8	7'-0"
801	13'-8"	5'-2"	32	18'-10"
900	4'-3	1'-9"	36	6'-0"
901	7'-11"	5'-4"	14	13'-3"
902	8'-7"	5'-4"	14	13'-11"
903	10'-1"	5'-4"	8	15'-5"
1000	4'-6"	1'-9"	12	6'-3"

TABLE OF "L" SHAPED BARS

BENDING DETAILS
FOR
RISER STRUCTURE REINFORCEMENT

HEADWALL & BAR DETAILS
EARTH DAM AND SPILLWAY
LITTLE SWAN LAKE ASSOCIATION

CASLER AND ASSOCIATES
CONSULTING ENGINEERS
JACKSONVILLE, ILLINOIS

REVISED
DRAWN BY C.E.T.
CHECKED BY
APPROVED BY
DATE
SHEET NO.
OF SHEETS

USDA

United States Department of Agriculture

July 25, 2017

RE: Little Swan Lake

Dear Mrs. Adams,

Due to workload I took the watershed coming into the lake and divided it into priorities of A through D.

Priority A: Consisted of 10 farms that have no conservation practices such as waterways, terraces or dry dams. These farms were considered critical as no erosion control has been implemented.
Priority B: Consisted of 7 farms that had one or two conservation practices installed and the preliminary inventory indicated that more could be installed.
Priority C: Consisted of 19 farms that had several conservation practices installed from prior cost share programs or landowners installed them on their own. Some of these practices need to be redone so they would work as they were intended.
Priority D: Consisted of 11 farms that were either non-highly erodible, flatter topography with no needs of conservation practices.

Currently it is our estimate that there are 160,613 feet of grass waterways that could be installed equally 111 acres of new grass waterways. Existing in the watershed is 131 acres of grass waterways, 55,829 feet of terraces, and 61 dry dams. Some of the cropland is no tilled with the remaining acres mulch till. Agronomic practices that could be installed would be cover crops, field borders, filter strips, converting mulch till fields to no till. All of these suggestions involve economics.

I have concerns that there were only eight landowners that attended the meetings, therefore I am not sure there will be the interest from them to install additional conservation practices on their land. Economics is another issue that will play a huge role, the cost share programs are not what they use to be in the past. The staff would be very happy to work with the landowners specifically at the immediate upper end of the watershed where is comes into the lake, if there is interest from them. All of our programs are voluntary and we would welcome any of them to come visit with us.

I am not sure where to go from here, outside of the public meetings no one has come into the office to discuss erosion concerns in that specific watershed, the interest is not there at this point. There needs to be "buy in" from everyone to have a successful watershed plan and in this case I just don't see it yet. If I can help you in the future please let me know, the staff is always here to assist.

Sincerely,

Cathy Olson
District Conservationist
Henderson-Knox-Warren
cathy.olson@il.usda.gov

Little Swan Lake Resource Concerns from November 9, 2016

Lake Concerns:

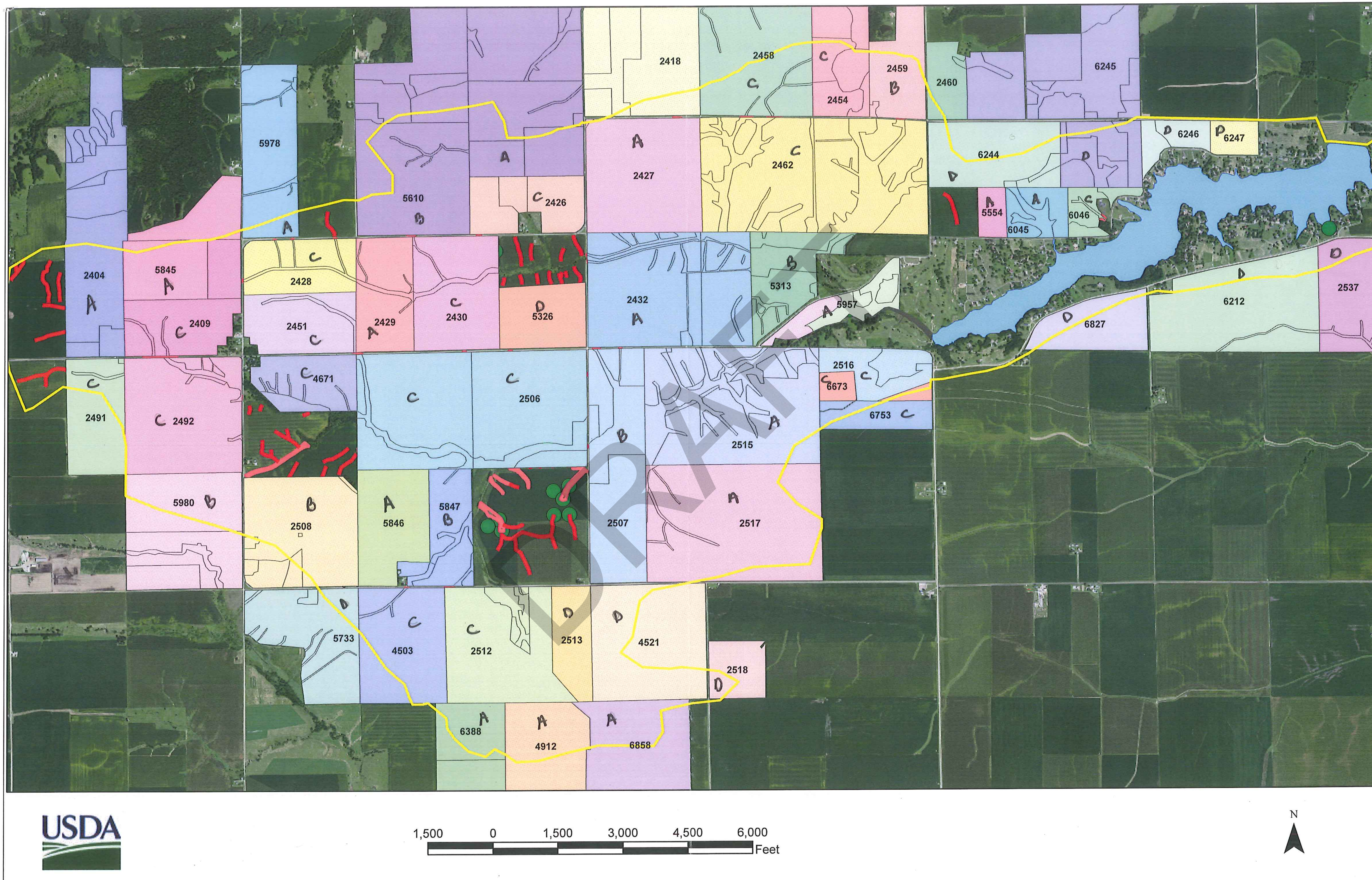
1. **Shoreline protection is an issue, stop the shoreline from eroding away, what is the best way to protect the shorelines**
2. **Use of catch basins above the lake specifically at the west end and the areas it is coming in from under the roads.**
3. More residents need to take advantage of when the lake decreases levels to do maintenance
4. Concerns with the level that the lake is decreasing to, leaves mud at the west end to look at all winter.
5. No wake zone on the lake needs to be followed.
6. How will dredging affect the ecology?
7. Where is the dredge material going to be placed?
8. **Algae issues at the lake, not bad in 2016 but was in 2014 and 2015**

Watershed surrounding the Lake:

1. Landowners doing good things on their farms to protect erosion from going into the lake but the neighbor is not.
2. **Sedimentation into the Lake specifically at the west end needs to be decreased.**
3. **Solve erosion from coming into the lake.**
4. Decrease silt being transported from the creek coming into the Golf Course Area.
5. **Cropland erosion filling in the creek—possible dam? (Kramer Drive, lot 387-388)**
6. Pasture/Grazing issues, runoff coming from those location into the Lake.
7. Stop or decrease the sediment first.
8. Landowners do want to stop the erosion and keep the soil on their land.
9. Evidence of practices on the cropland, do they need to be re-done, rebuilt to fully function as they should.

****Items in Red were high priority with 5 or more marks**

****Items in Blue were medium priority with 2 marks.**



2418
2458
2454
2459
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6245
5978
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6046
2404
5845
2409
2428
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2491
2492
4671
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2513
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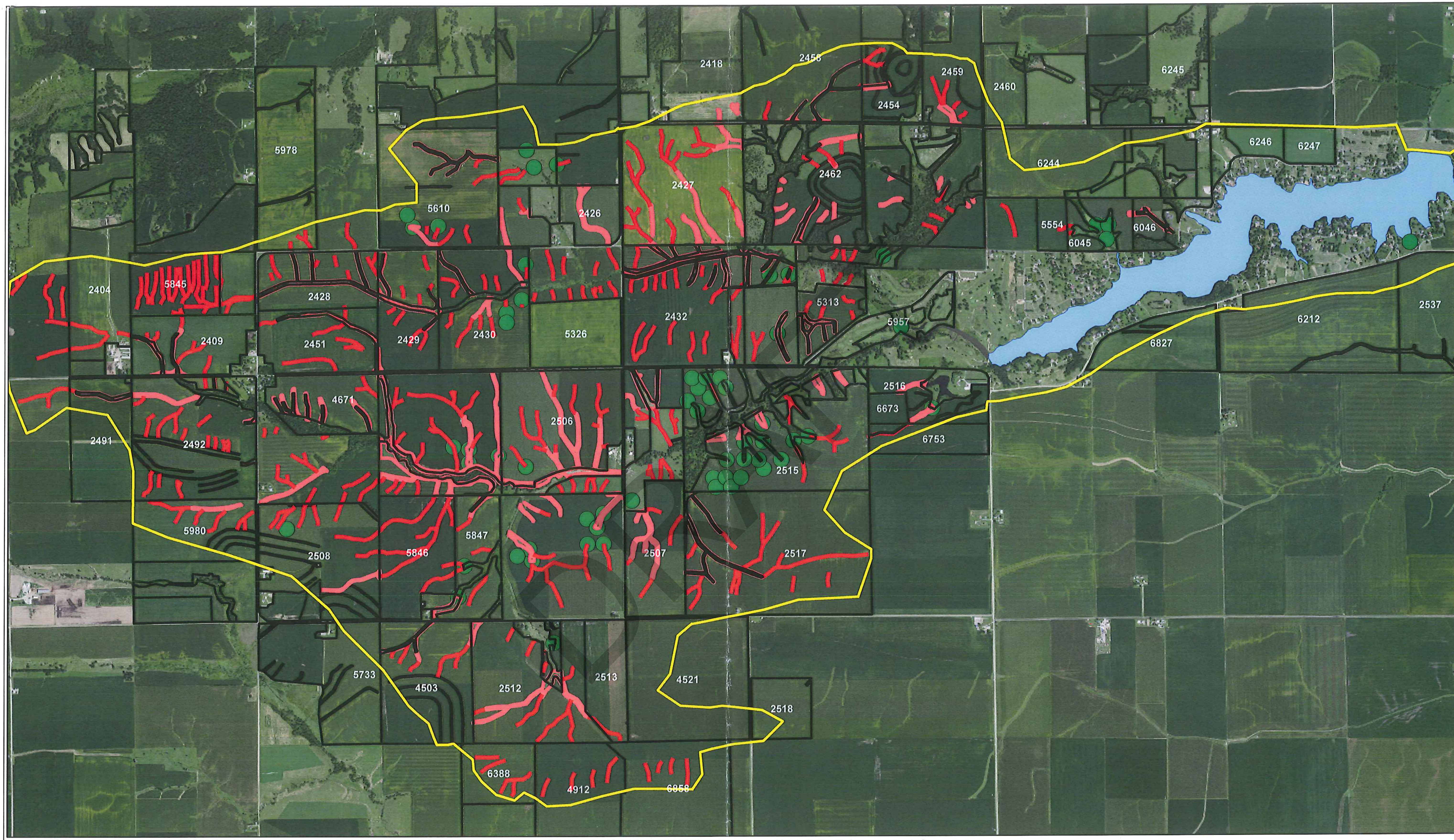
4,500
6,000
Feet
N

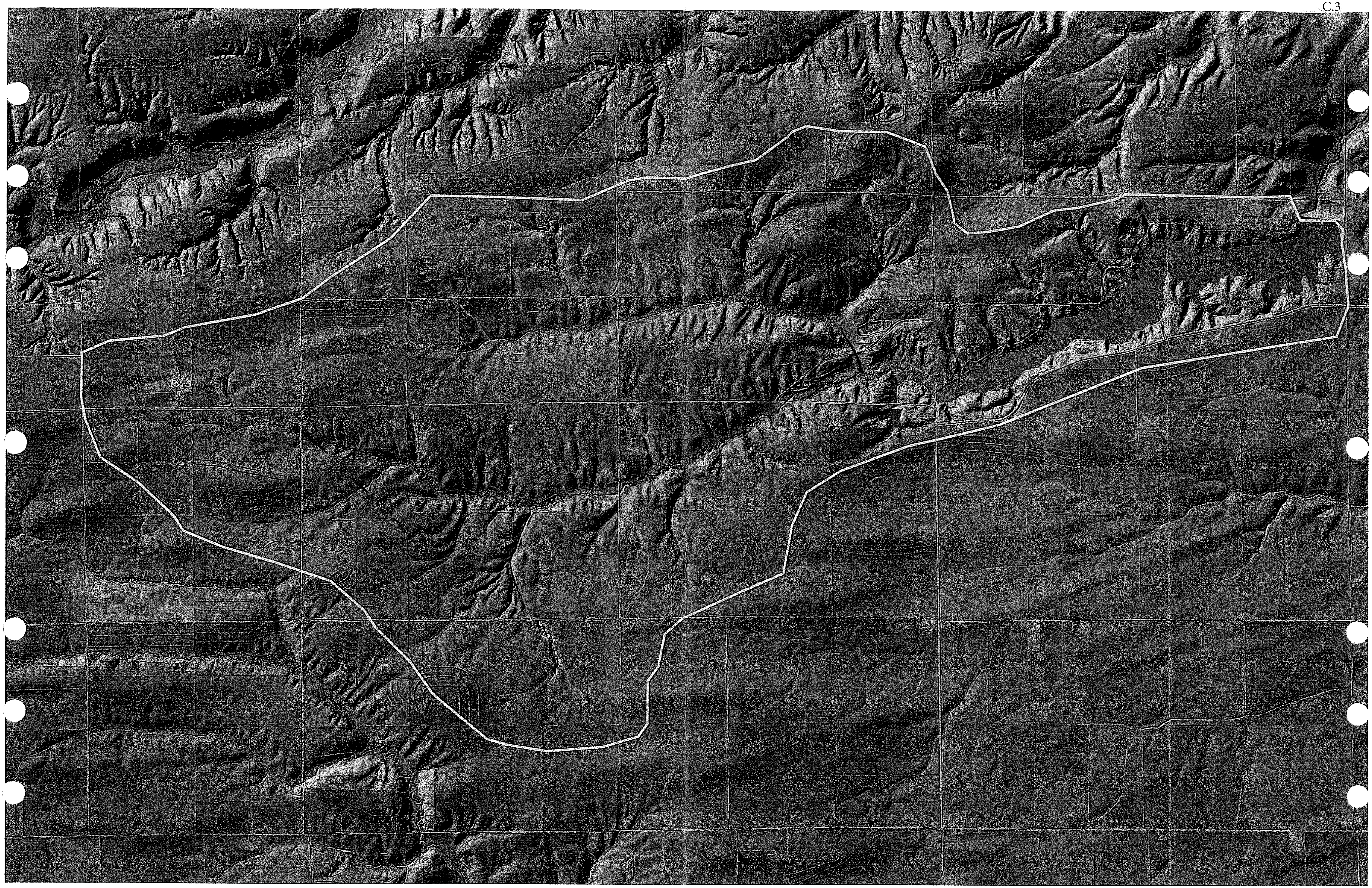


USDA

1,500 0 1,500 3,000 4,500 6,000 Feet

N


Little Swan Lake 230.0 acres
Drainage Area for Little Swan Lake 5430 acres



APPENDIX D
WETLAND FUNDING

Potential Funding Streams:

1. City of Nauvoo Partnership: The City of Nauvoo is required by the Corps of Engineers to create forested wetlands for previously impacting wetlands. It appears there could be a unique cost-sharing/partnership opportunity for Little Swan Lake and Nauvoo to team up and develop wetlands which would help Nauvoo meet their mitigation requirements, while also reducing silt and improving the water quality of Little Swan Lake. We have had preliminary discussion with the Corps of Engineers and they are open to the idea. They would have to approve a mitigation plan before the project could begin, but the City of Nauvoo would be very interesting in beginning a dialog.

2. Wetland Mitigation Banking: This would involve creating a wetland at your site and having it certified as a Mitigation Bank; wetland “credits” can then be sold (we have seen upwards of $50,000/acre) to entities needing wetland mitigation credits. This option would require up front and close coordination with USACE/EPA & other regulatory agencies throughout process and it may take years before credits are ready to sell. Therefore, there would not be funds available up front for construction, but rather income down the road to potentially pay off any loans/bonds, etc. that may be required.

3. Ducks Unlimited (North American Wetlands Conservation Act (NAWCA) Grant), Standard or Small Grant:

    a. Standard Grant: Requires a 1:1 cost sharing. The application is a lengthy, formal federal application process. (Grant is considered a small grant if under $100,000.). Requires wetland establishment and adequate uplands buffer. We are currently awaiting additional information from DU.

4. Illinois Clean Energy Community Foundation Grant: (Community Stewardship Challenge Grant) No money is available for construction, etc.; however, after construction (of a wetland, for example), IF the homeowner’s group is a non-for profit, AND the site would be open to the public, money would be available for maintenance/up-keep of that natural area (i.e. tree replacement plantings, maintenance of water control structures, etc). It is a cash-donation match grant; they provide $3 for every $1 raised by the NFP over an 18-month grant period, not to exceed $21,000 from the foundation. Further research would be required to see if this is a viable option if there was a partnership with Nauvoo in place.

5. NRCS Conservation Programs :

    a. Conservation Stewardship Program (CSP): There may be a potential for owners of upland farmland (upgradient to the lake) to install conservation activities which could help land erosion/sediment. This would be an annual payment to farmers who implemented eligible practice during a 5 year contract (funds don’t go to Little Swan Lake).

6. IDNR Grants: (These programs are currently on hold due to lack of funding but will likely be restarting in the near future). These could potentially assist in purchasing land upstream of the lake as needed to develop a wetland or basin for sediment control.

   a. Open Space Lands Acquisition and Development Grant/Land & Water Conservation Programs – These programs provide a cost reimbursement up to 50% (90% for distressed communities) of project cost. Max is $750k for acquisition, $400k for development/renovation projects. Examples: acquisition of land for new park sites or park expansion, interpretive trail signage, wetland observation decks, water quality basins with native plantings, interpretive prairie gardens, etc.
   b. Park and Recreational Facilities Construction (PARC) Grant Program: Funds can be used for site work, acquisition for open space/conservation purposes to protect floodplains, wetlands, natural areas, etc. Program is a cost reimbursement up to 75% of project costs (except local governments, up to 90%).

APPENDIX E
SOURCES

KLINGNER & ASSOCIATES, P.C.
Engineers • Architects • Surveyors

"Sediment Control Practices - Check Dams (Ditch Checks, Ditch Dikes)." Tanners Lake - Alum Injection for Phosphorus Removal - Minnesota Stormwater Manual, stormwater.pca.state.mn.us/index.php?title=Sediment_control_practices_-_Check_dams_(ditch_checks,_ditch_dikes).

"General Principles for Erosion Prevention and Sediment Control at Construction Sites in Minnesota." Tanners Lake - Alum Injection for Phosphorus Removal - Minnesota Stormwater Manual, stormwater.pca.state.mn.us/index.php?title=General_principles_for_erosion_prevention_and_sediment_control_at_construction_sites_in_Minnesota.

Kelsey, Kurt. "Use of the Revised Universal Soil Loss Equation on an Event-By-Event Basis." College of Natural Resources, University of Steven Point, doi: 2001

Helfrich, Louis A. "Guide to Understanding and Managing Lakes: Part 1 (Physical Measurements)." *Virginia Cooperative Extension*, Publication 420-538, doi: 2009

Cooper, Kurt. "Evaluation of the Relationship between the RUSLE R-Factor and Mean Annual Precipitation." *Colorado State University Library*, doi: 12/01/2011

Kim, Yongsik. "Soil Erosion Assessment Using GIS and Revised Universal Soil Loss Equation (RUSLE)." *University of Texas-Austin Library*, doi: 12/05/2014

Wischmeier, W.H., and Smith D.D. "Predicting Rainfall Erosion Losses – A Guide to Conservation Planning." *U.S. Department of Agriculture, Agriculture Handbook No. 537*. doi: 1978

U.S. Department of Agricultures. 2015. *Summary Report: 2012 National Resources Inventory*, Natural Resources Conservation Service, Washington, DS, and Center for Survey Statistics and Methodology, Iowa State, Ames, Iowa. http:/www.nrcs.usda.gov/technical/nri/12summary

Additional Technical Information Provided from:

Illinois Stream Stats: https://streamstats.usgs.gov/ss/

USDA Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

USACE National Inventory of Dams: http://nid.usace.army.mil/cm_apex/f?p=838:12