HANSON

Dredging Investigation and Options for Lake Bloomington and Evergreen Lake

City of Bloomington
Water Department
Woodford & McLean County, Illinois

December 11, 2024 (revised February 11, 2025)

Hanson No. 24L0024.00

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February 11, 2025
Lic. Exp. November 30, 2025

ENGINEERING / PLANNING / ALLIED SERVICES

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Figures and Tables

1. Introduction

Hanson Professional Services Inc. (Hanson) has been contracted by the City of Bloomington Water Department (Bloomington) to evaluate options for improvements to the safe yield capacity of the Bloomington water supply. Bloomington identified potential deficiencies in the safe yield water inventory during an Interim Water Supply Plan study conducted in 2010. Bloomington has an existing water supply of approximately 20,500-ac.ft. split between Evergreen Lake (13,550-acres) and Lake Bloomington (6,950-acres).

Four options have been identified for further investigation based on evaluations and recommendations conducted as part of the Interim Water Supply Plan. The study alternatives are as follows:

1. Determine available volume, spillway capacity impacts, flood hazard risk, and permit requirements for raising the Evergreen Lake Dam. The evaluation includes identification of potential cost considerations for a dam raise including evaluating geotechnical stability of a spillway raise and providing structural concept plans if a raise is determined to be feasible during preliminary hydraulic and permitting investigations.
2. Evaluate permissibility of modifying the Mackinaw River Pumping Pool withdraw limits and request permit modification by USACE.
3. Identify potential location and storage volume available for an upstream feeder pool at Evergreen Lake.
4. Estimate potential capacity improvements from dredging options. The evaluation is to include identification of potential upland sediment storage, site dewatering, permitting requirements and planning.

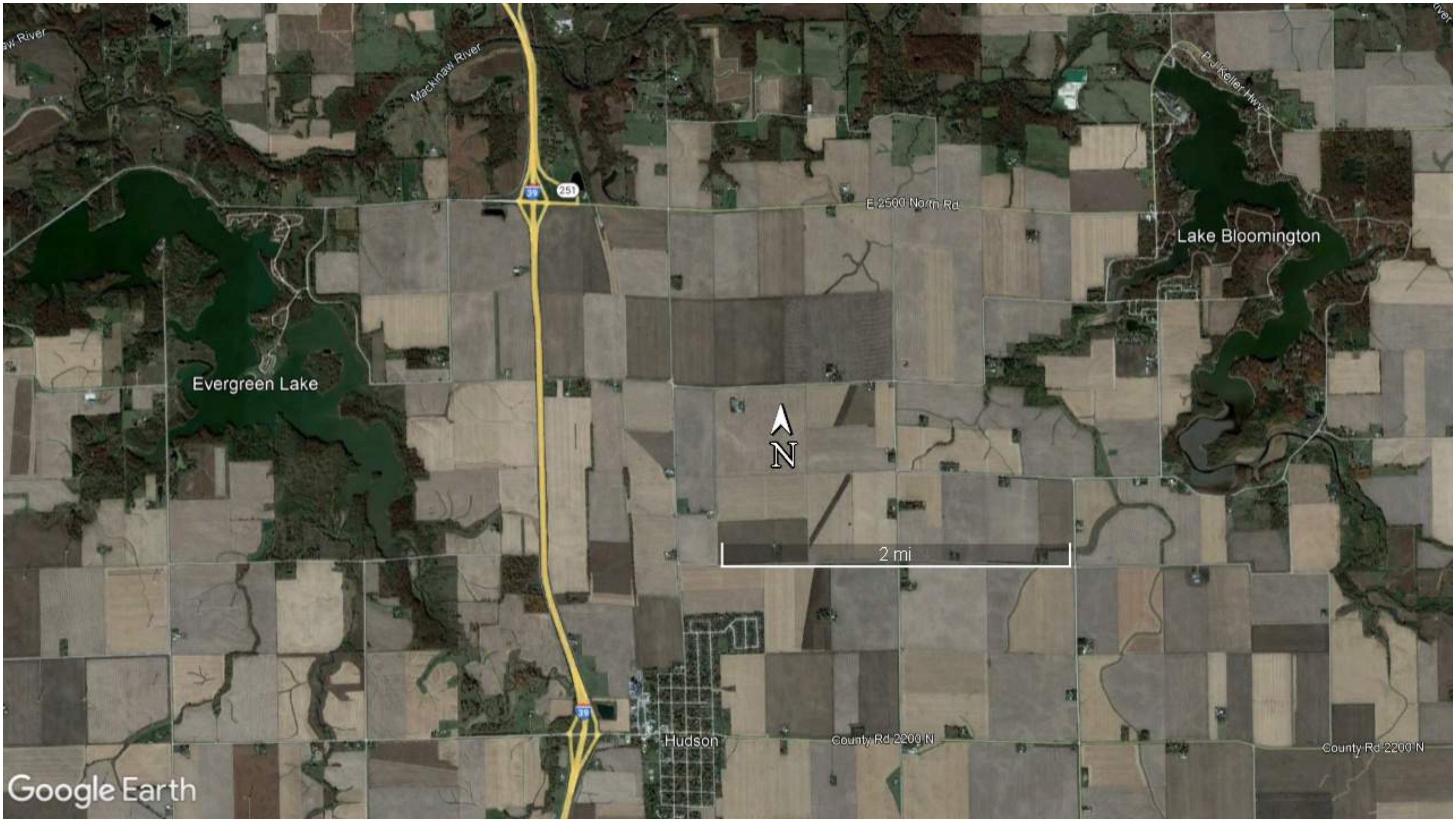
The first three options are covered in a separate Hanson report titled "Reservoir Capacity Improvement Investigation for Lake Bloomington and Evergreen Lake". The capacity improvements from dredging for both Lake Bloomington and Evergreen Lake are the subject of this report.

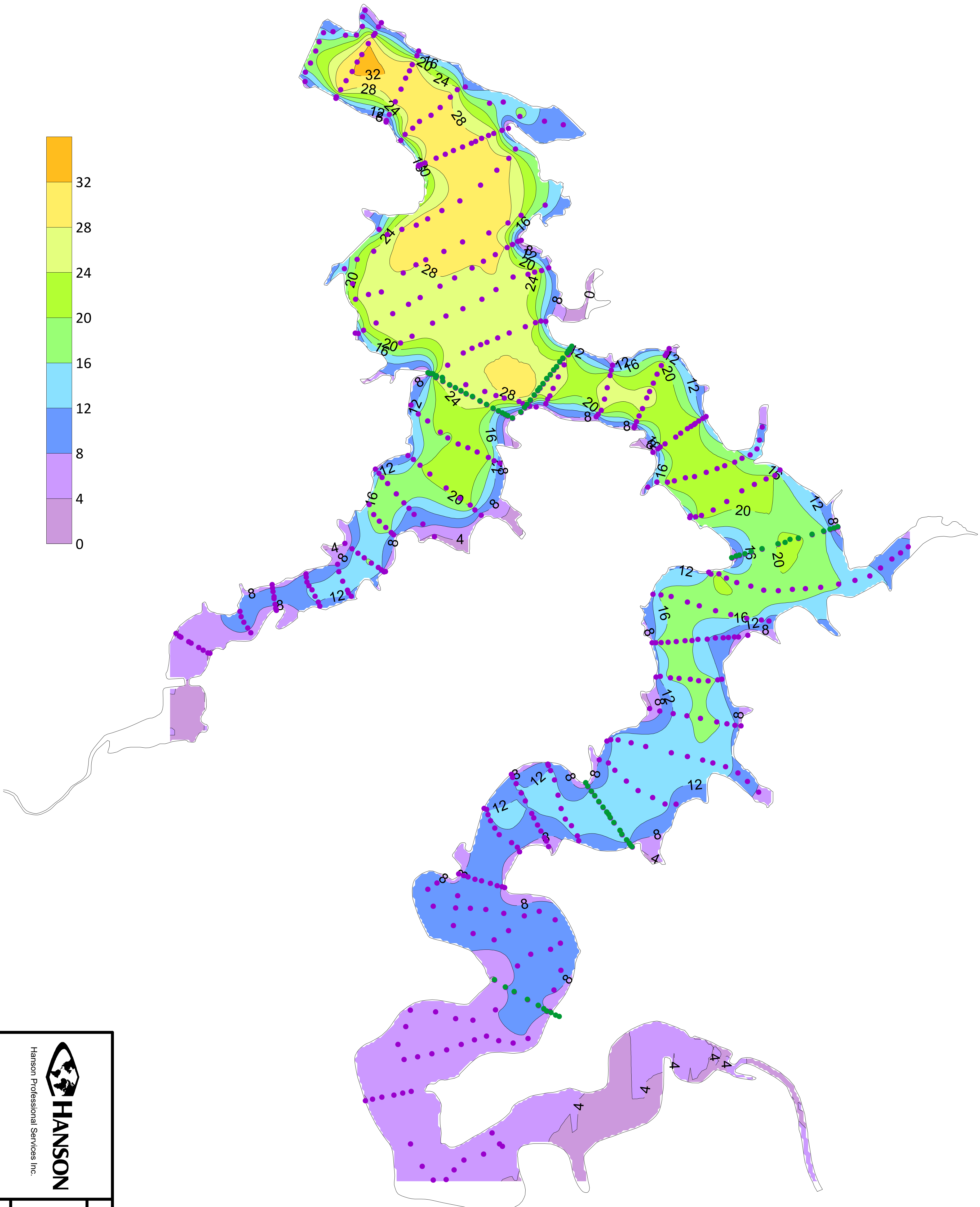
2. Previous Investigations

A couple of previous investigations have been conducted at both lakes that have added to the information collected as part of this study. Both Lake Bloomington and Evergreen Lake had topographic surveys done prior to construction and filling. Lake Bloomington's study added additional contour data to the 1929 USGS 15' topographic map. Improvements included augmenting the contour interval from 10 feet to 5 feet and surveying the Money Creek channel. Similarly, Evergreen Lake had a similar topographic survey performed in1964. Contour interval for this survey was every 5-feet, and the Sixmile Creek channel was also surveyed.

In 1999 Hanson did a survey to identify the lake bottom surface at several transects across both Lake Bloomington and Evergreen Lake. Multiple transects were performed at each lake. Results of the 1999 lake surveys are shown in Figure 2 (Lake Bloomington) and in Figure 3 (Evergreen Lake).

Figure 1. Site Location Map





SCALE: 1 inch equals 2000 feet

0 ft. 2000 ft. 4000 ft. 6000 ft. 8000 ft.

Explanation

- Hanson 1999 Survey Points
- Prairie Engineers 2024 Sonar Survey

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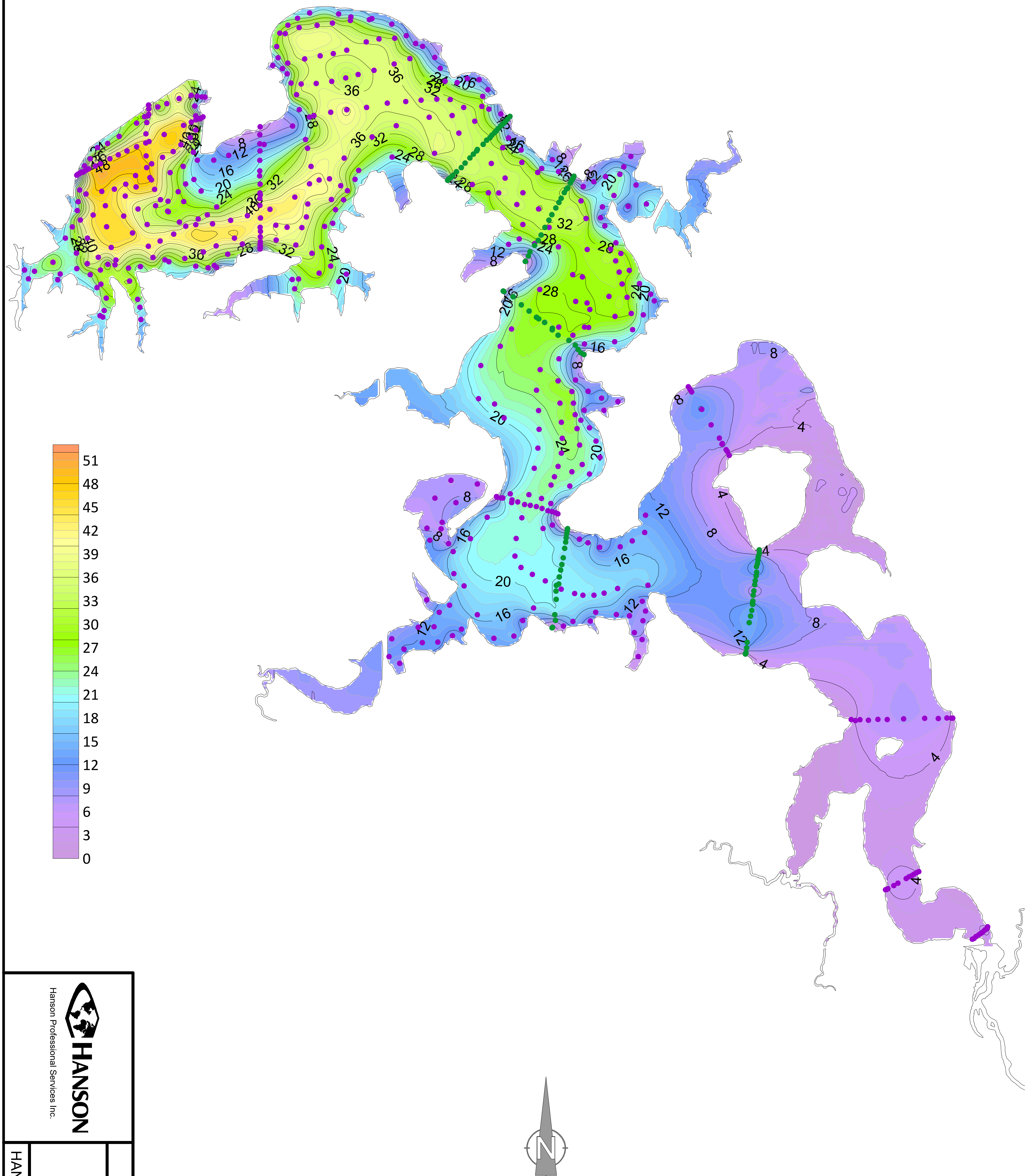
LAKE BLOOMINGTON 1999 BOTTOM
TOPO & TRANSECT LINES
BLOOMINGTON WATER DEPARTMENT
HUDSON, McLEAN COUNTY, ILLINOIS

HANSON NO. 24L0024.00

FIGURE 2



SCALE: 1 inch equals 2000 feet

0 ft. 2000 ft. 4000 ft. 6000 ft. 8000 ft.

Explanation

- Hanson 1999 Survey Points
- Prairie Engineers 2024 Sonar Survey

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Hanson Professional Services Inc.

EVERGREEN LAKE 1999 BOTTOM
TOPO & TRANSECT LINES
BLOOMINGTON WATER DEPARTMENT
HUDSON, McLEAN COUNTY, ILLINOIS

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FIGURE 3

3. 2024 Investigation

Hanson subcontracted with Prairie Engineers, P.C. to provide a dual channel sonar investigation at selected 1999 survey transects at Lake Bloomington and Evergreen Lake (see green symbol lines on Figure 2 and Figure 3). The dual channel sonar can have the ability to see both the sediment surface (high frequency sonar) and then penetrate through the sediment to show the original lakebed surface (low frequency sonar).

Hanson used the augmented topographic data (pre-construction surveys), the 1999 survey data, and the 2024 sonar data to evaluate the sediment thicknesses at five transect locations in each lake. The transect cross sections can be found in Appendix A (Lake Bloomington) and Appendix B (Evergreen Lake).

Hanson also calculated sedimentation rates using data from the 1999 survey at each of the selected transects. Average thicknesses along the selected transect are shown in Table 1. Based on these sediment thicknesses, Hanson estimates that Lake Bloomington has a siltation rate of approximately 1.34 inches per year, and Evergreen Lake has a siltation rate of approximately 0.57 inches per year. This does indicate that Lake Bloomington does have a higher sedimentation rate than Lake Evergreen. Lake Bloomington has existed twice as long as Evergreen Lake, but Lake Bloomington's sedimentation rate is still more than twice that of Evergreen Lake.

Table 1. Sediment Thickness from 1999 Hanson Survey

Lake Bloomington Transect	Thickness	Evergreen Lake Transect	Thickness
R29-R8	7.28	103-104	1.52
R7-R8	6.70	105-106	1.96
R12-R11	7.88	107-108	1.38
R16-R15	8.19	111-112	1.99
R19-R20	9.14	115-116	1.29
Average	7.84	Average	1.63
Geo Mean	7.79	Geo Mean	1.60

Note that the Prairie Engineers' 2024 survey adds an additional 1.5 to 2.0 feet at Lake Bloomington and around 1-foot additional sediment at Evergreen Lake.

4. Estimate of Probable Dredging Costs

Berini's (2024) report summarized the estimated costs to improve reservoir capacities at Lake Bloomington and Evergreen Lake. Hanson has taken those costs and broke the costs out per lake instead of lumping the efforts together. For the following calculations, Hanson is assuming that the 3 feet of material to remove at Evergreen Lake will be approximately 500,000 cu. yds. with the effort at Lake Bloomington, including the additional deep-water dredging will be approximately 3,000,000 cu. yds. The other costs items will either be shared between the two projects or be shared between the two projects.

Table 2. Lake Bloomington Hydraulic Dredging Probable Costs

Project Item	Minimum Cost	Maximum Cost
Land Acquisition (200 to 400 acres @ $10,000/acre	$2,000,000	$4,000,000
Sediment Dewatering Facility Construction (assumed)	$1,500,000	$2,500,000
Hydraulic Dredging ($10-$12/cu. yds.)	$30,000,000	$36,000,000
Mobilization/Demobilization (lump sum)	$1,000,000	$2,000,000
Site Maintenance and Post Project Reclamation	$1,000,000	$2,000,000
Engineering and Permitting (≈ 10%)	$3,550,000	$4,650,000
Project Totals (with contingencies or inflation)	$39,050,000	$51,150,000

Table 3. Evergreen Lake Hydraulic Dredging Probable Costs

Project Item	Minimum Cost	Maximum Cost
Land Acquisition (200 to 400 acres @ $10,000/acre	$2,000,000	$4,000,000
Sediment Dewatering Facility Construction (assumed)	$1,500,000	$2,500,000
Hydraulic Dredging ($10-$12/cu. yds.)	$5,000,000	$6,000,000
Mobilization/Demobilization (lump sum)	$1,000,000	$2,000,000
Site Maintenance and Post Project Reclamation	$1,000,000	$2,000,000
Engineering and Permitting (≈ 10%)	$1,050,000	$1,650,000
Project Totals (with contingencies or inflation)	$11,550,000	$18,150,000

Based on these probable costs, 3,000,000 cu. yds. (approximately 606 million gallons [Mgal]) of additional storage would cost between $0.0644/gal and 0.0844/gal at Lake Bloomington. These costs would increase with only 500,000 cu. yds. (approximately 101 Mgal) of additional storage would costs between $0.114/gal and $0.1797/gal for Evergreen Lake.

Table 4. Lake Bloomington Dry Mechanical Dredging Probable Costs

Project Item	Minimum Cost	Maximum Cost
Land Acquisition (100 to 200 acres @ $10,000/acre	$1,000,000	$2,000,000
Sediment Dewatering Facility Construction (assumed)	$1,500,000	$2,500,000
Mechanical Dredging ($25-$30/cu. yds.)	$4,343,150	$5,211,780
Mobilization/Demobilization (lump sum)	$1,000,000	$2,000,000
Site Maintenance and Post Project Reclamation	$1,000,000	$2,000,000
Engineering and Permitting (≈ 10%)	$884,315	$1,371,178
Project Totals (with contingencies or inflation)	$9,727,465	$15,082,958

Table 5. Evergreen Lake Dry Mechanical Dredging Probable Costs

Project Item	Minimum Cost	Maximum Cost
Land Acquisition (100 to 200 acres @ $10,000/acre	$1,000,000	$2,000,000
Sediment Dewatering Facility Construction (assumed)	$1,500,000	$2,500,000
Mechanical Dredging ($25-$30/cu. yds.)	$12,500,000	$15,000,000
Mobilization/Demobilization (lump sum)	$1,000,000	$2,000,000
Site Maintenance and Post Project Reclamation	$1,000,000	$2,000,000
Engineering and Permitting (≈ 10%)	$1,700,000	$2,350,000
Project Totals (with contingencies or inflation)	$18,700,000	$25,850,000

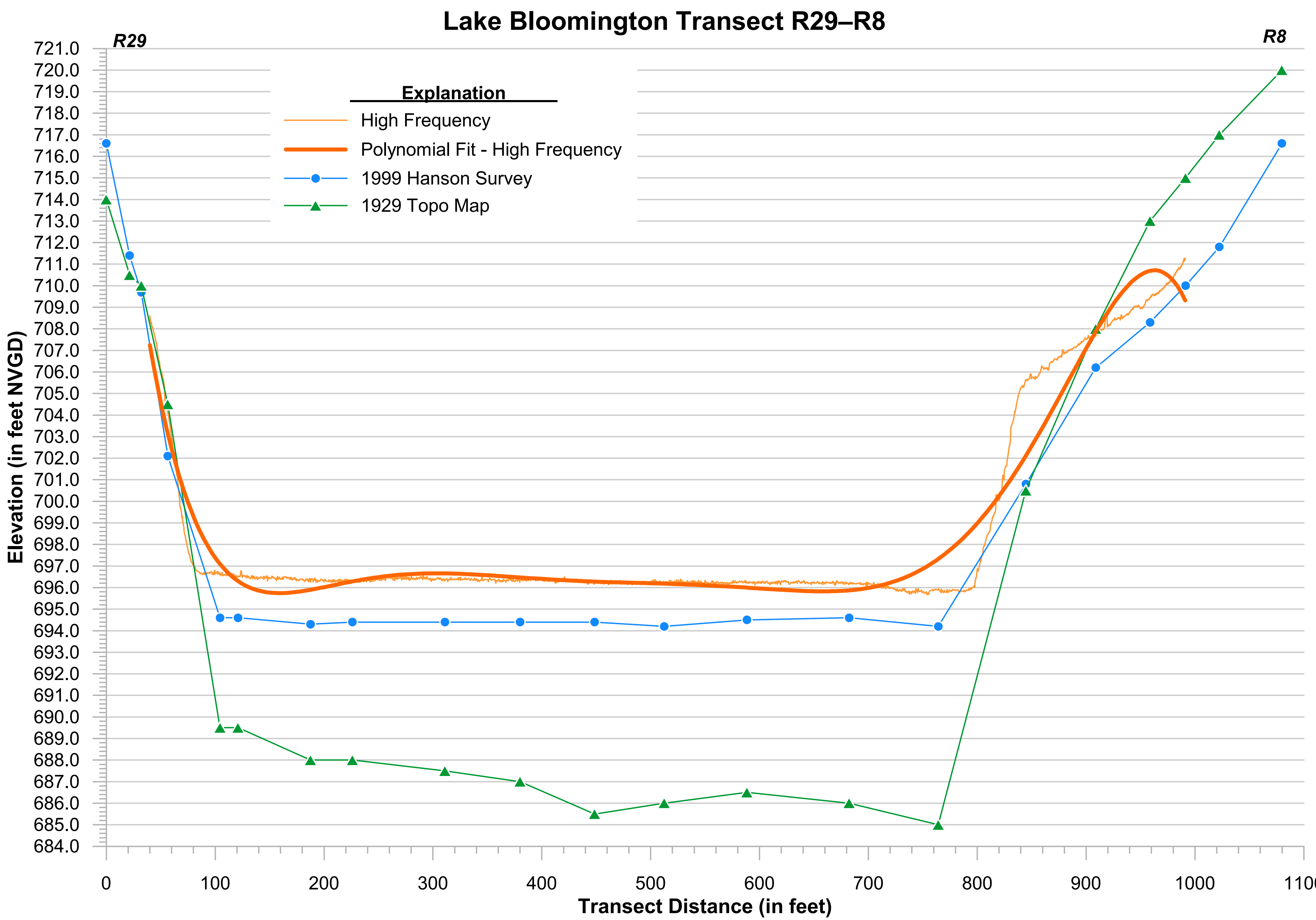
These probable costs for Lake Bloomington only cover an area of 173,726 cu. yds. (approximately 35.1 Mgal) of additional storage would costs between $0.2772 and $0.4298. Using the same approximately 500,000 cu. yds. (approximately 101 Mgal), the dry mechanical dredging costs would range from $0.1144 to $0.2559.

Table 6 summarizes the hydraulic versus mechanical dredging at each lake.

Table 6. Summary of Capacity Increase Options

	Lake Bloomington	Evergreen Lake
Hydraulic Dredging		
Million Gallons of Extra Storage (Mgal)	606	101
Estimated Minimum Costs	$39,050,000	$18,700,000
Estimated Maximum Costs	$51,150,000	$18,150,000
Minimum Cost per Million Gallons ($/Mgal)	$64,400	$179,800
Maximum Cost per Million Gallon ($/Mgal)	$84,400	$185,100
Safe Yield Capacity Increase over 18 mo. (MGD)	1.11	0.18
Mechanical Dredging		
Million Gallons of Extra Storage (Mgal)	174	101
Estimated Minimum Costs	$9,727,465	$11,550,000
Estimated Maximum Costs	$15,082,958	$25,850,000
Minimum Cost per Million Gallon ($/Mgal)	$277,200	$114,400
Maximum Cost per Million Gallon ($/Mgal)	$429,800	$255,900
Safe Yield Capacity Increase over 18 mo. (MGD)	0.32	0.18

Appendix A
Lake Bloomington Transect Cross Sections



Lake Bloomington Transect R29–R8
R29
R8
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1929 Topo Map
Elevation (in feet NVGD)
Transect Distance (in feet)
721.0
720.0
719.0
718.0
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716.0
715.0
714.0
713.0
712.0
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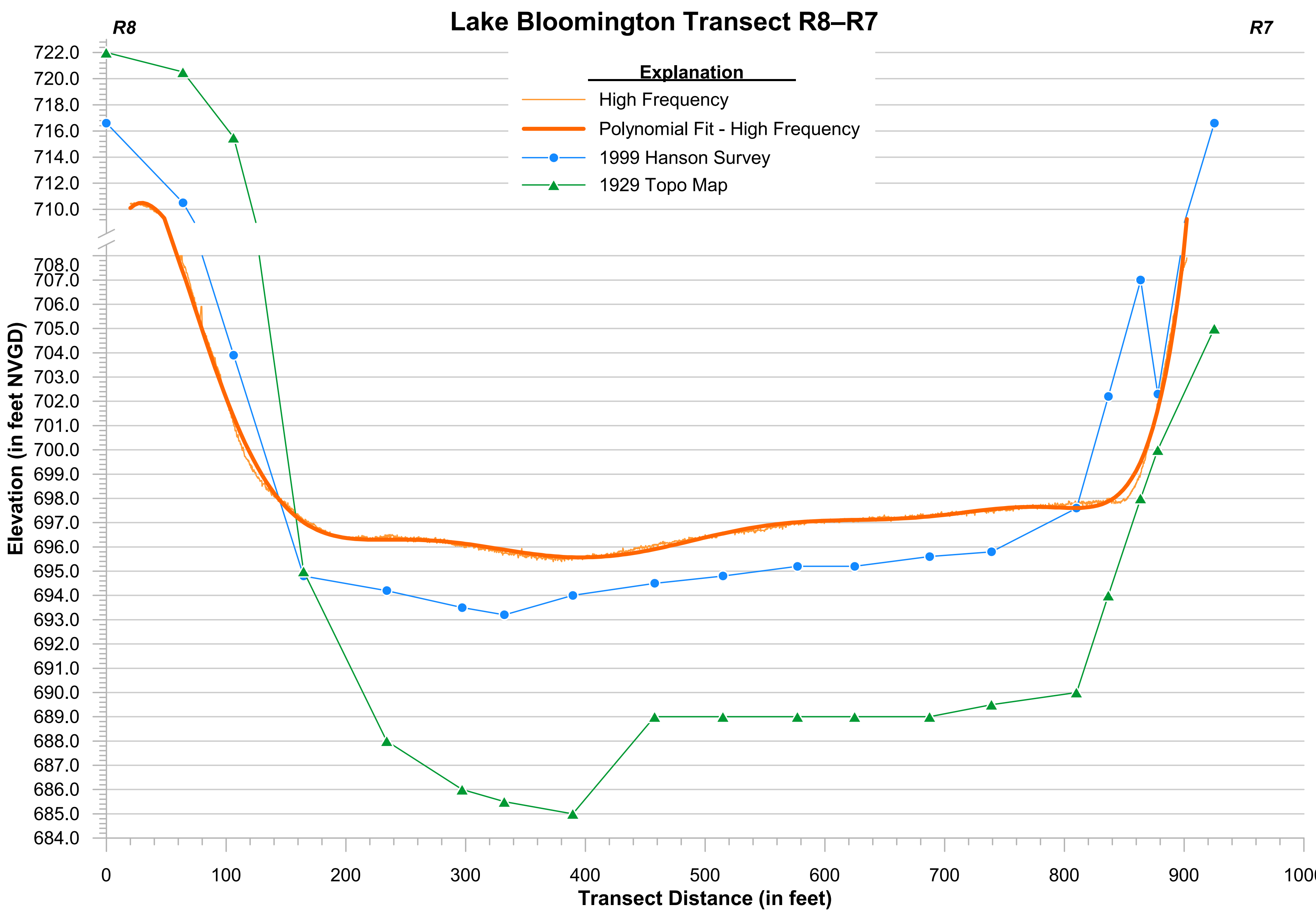

Lake Bloomington Transect R8–R7
R8
R7
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1929 Topo Map
Elevation (in feet NVGD)
722.0
720.0
718.0
716.0
714.0
712.0
710.0
708.0
707.0
706.0
705.0
704.0
703.0
702.0
701.0
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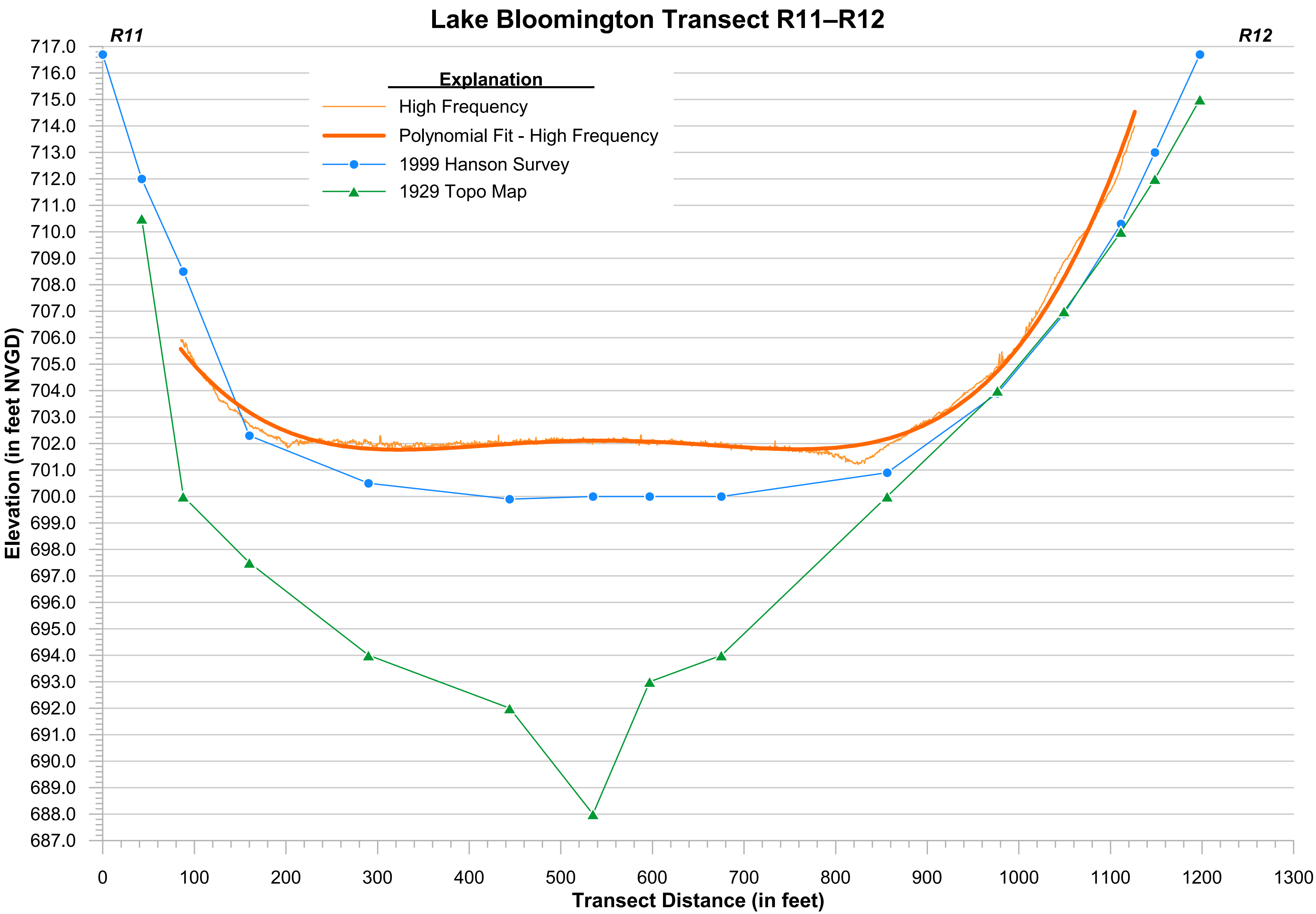
Transect Distance (in feet)



Lake Bloomington Transect R11–R12
R11
R12
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1929 Topo Map
Elevation (in feet NVGD)
Transect Distance (in feet)
717.0
716.0
715.0
714.0
713.0
712.0
711.0
710.0
709.0
708.0
707.0
706.0
705.0
704.0
703.0
702.0
701.0
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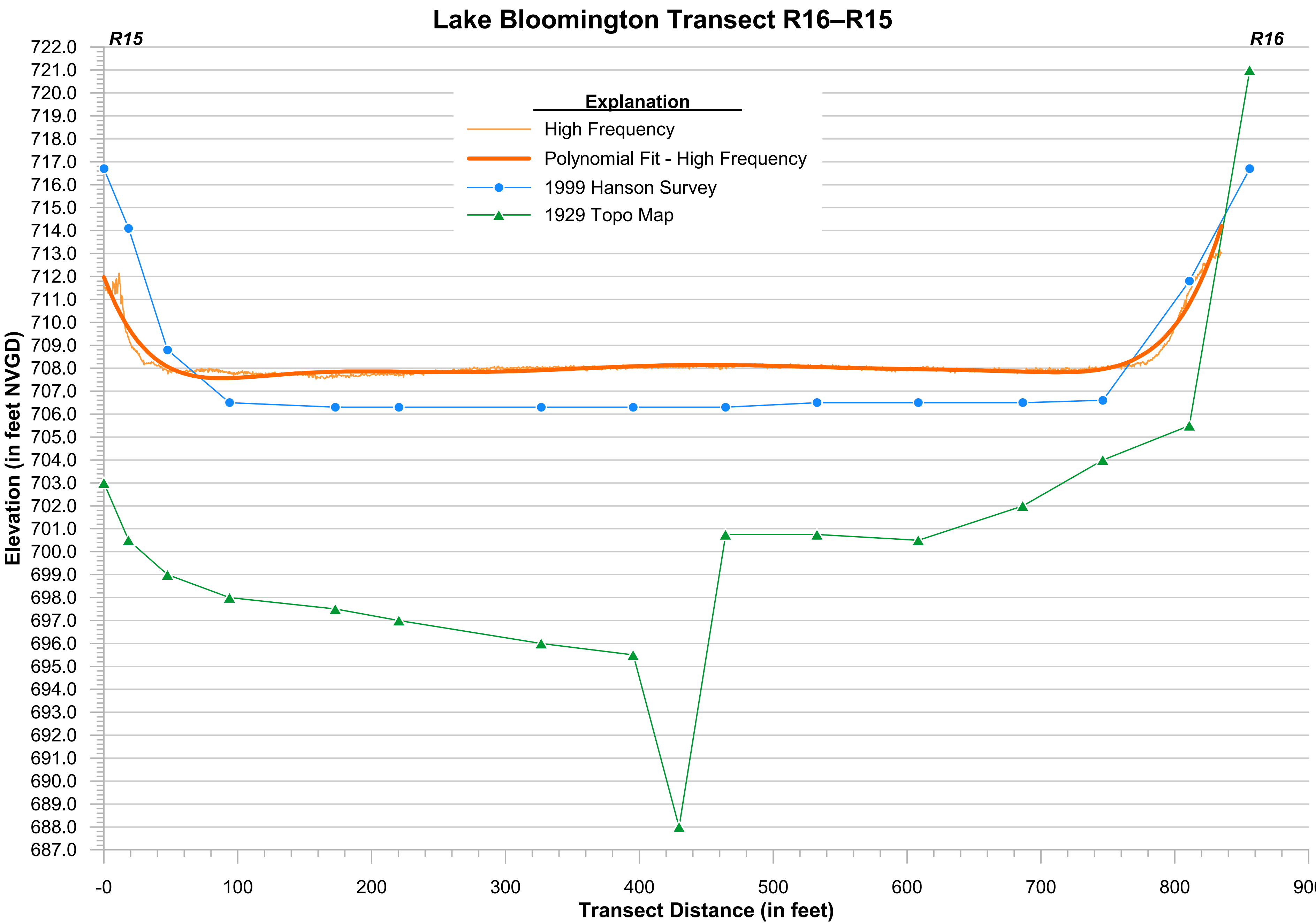

Lake Bloomington Transect R16–R15
R15
R16
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1929 Topo Map
Elevation (in feet NVGD)
722.0
721.0
720.0
719.0
718.0
717.0
716.0
715.0
714.0
713.0
712.0
711.0
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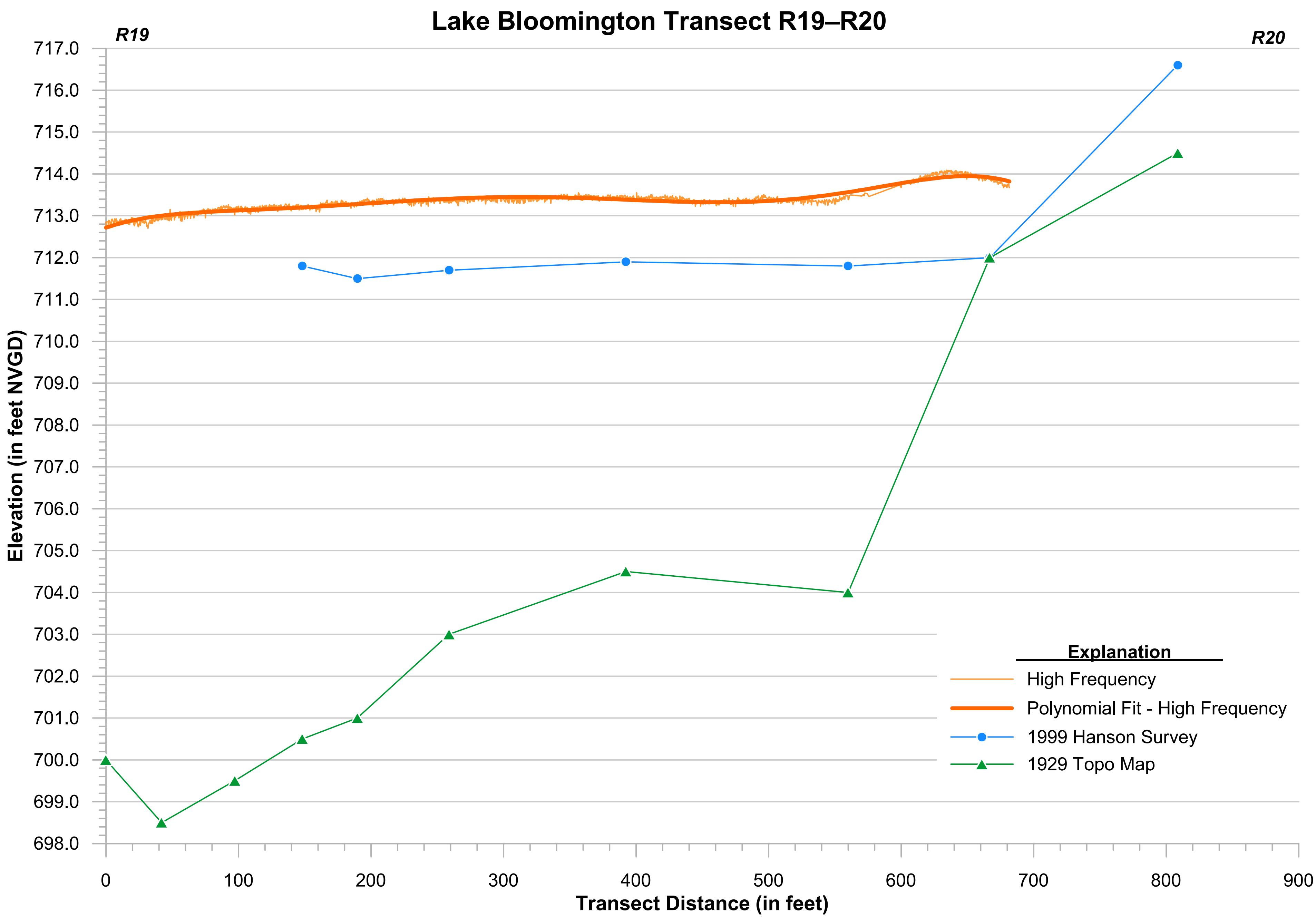
Transect Distance (in feet)



Lake Bloomington Transect R19–R20
R19
R20
Elevation (in feet NVGD)
717.0
716.0
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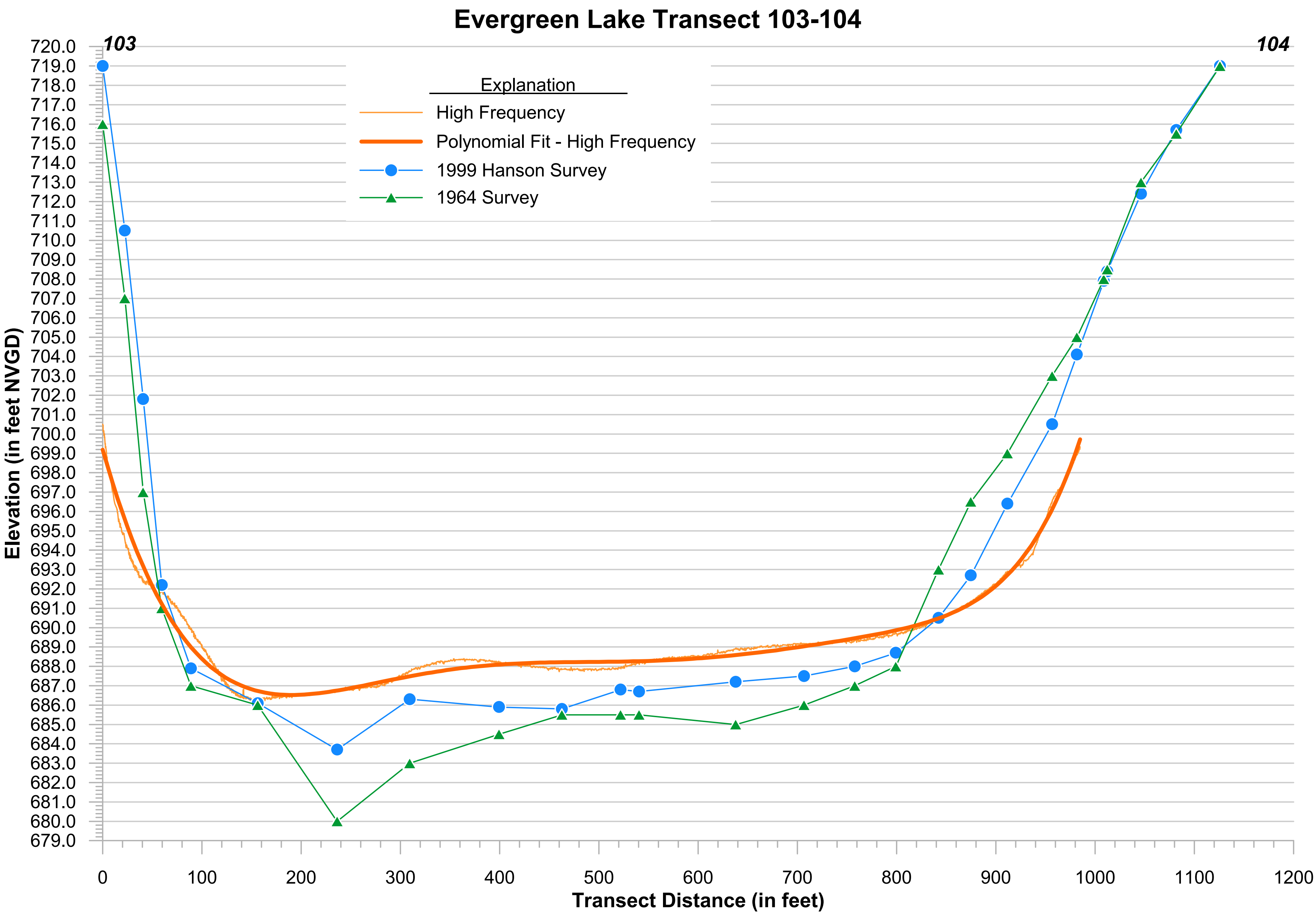
Transect Distance (in feet)
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1929 Topo Map

Appendix B
Evergreen Lake Transect Cross Sections


Evergreen Lake Transect 103-104
103
104
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1964 Survey
Elevation (in feet NVGD)
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719.0
718.0
717.0
716.0
715.0
714.0
713.0
712.0
711.0
710.0
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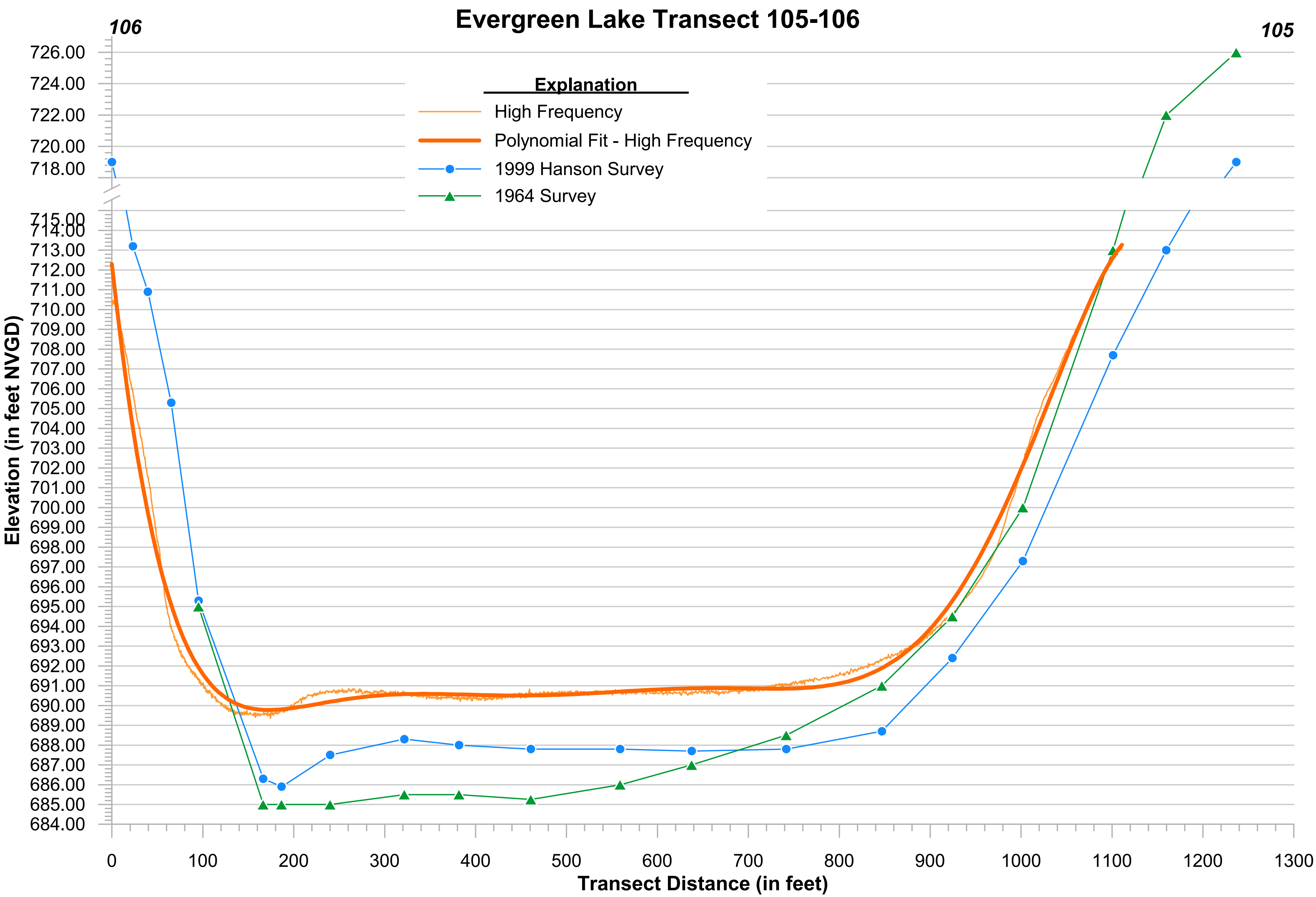
Transect Distance (in feet)



Evergreen Lake Transect 105-106
106
105
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1964 Survey
Elevation (in feet NVGD)
726.00
724.00
722.00
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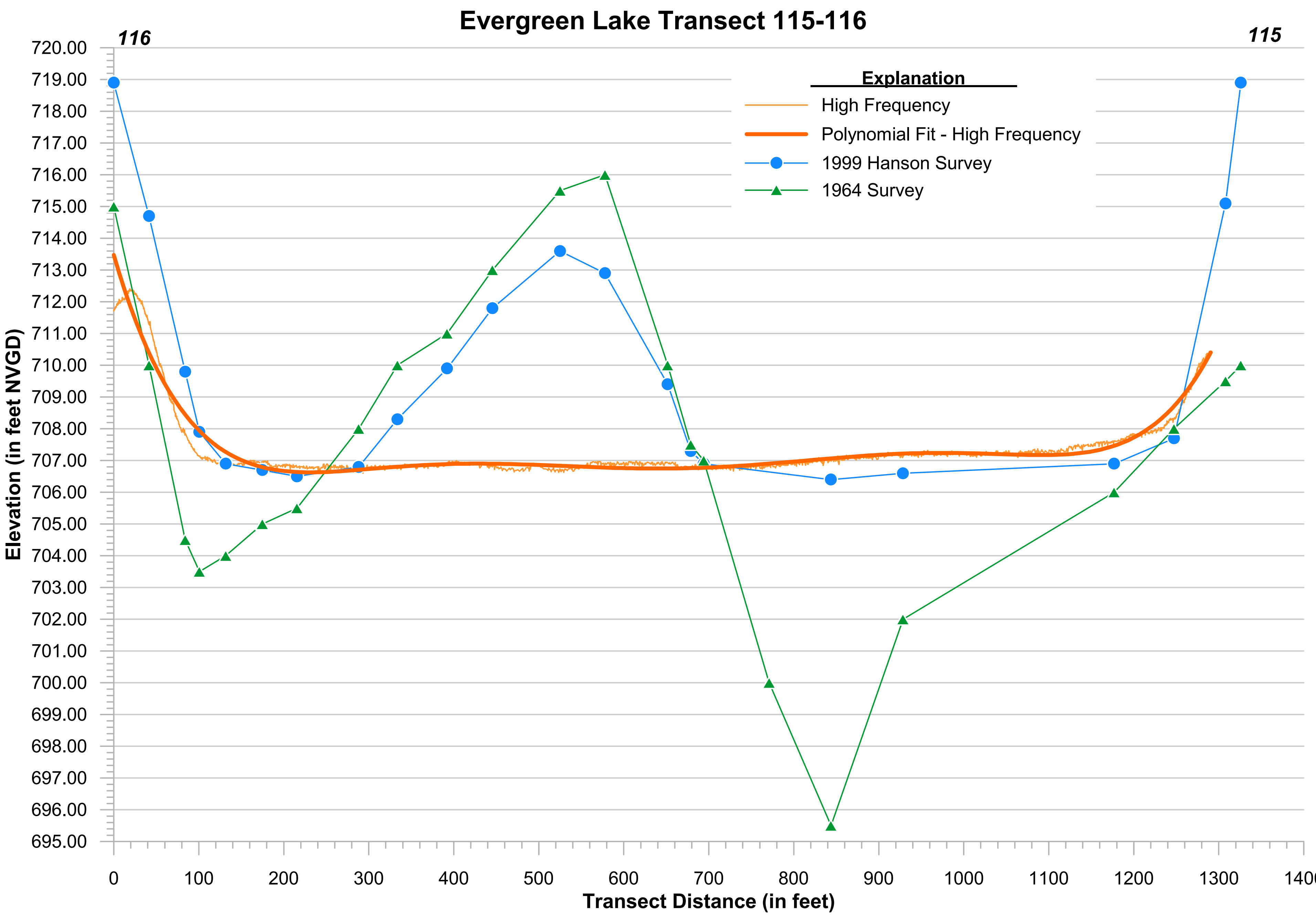
Transect Distance (in feet)


Evergreen Lake Transect 115-116
116
115
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1964 Survey
Elevation (in feet NVGD)
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719.00
718.00
717.00
716.00
715.00
714.00
713.00
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710.00
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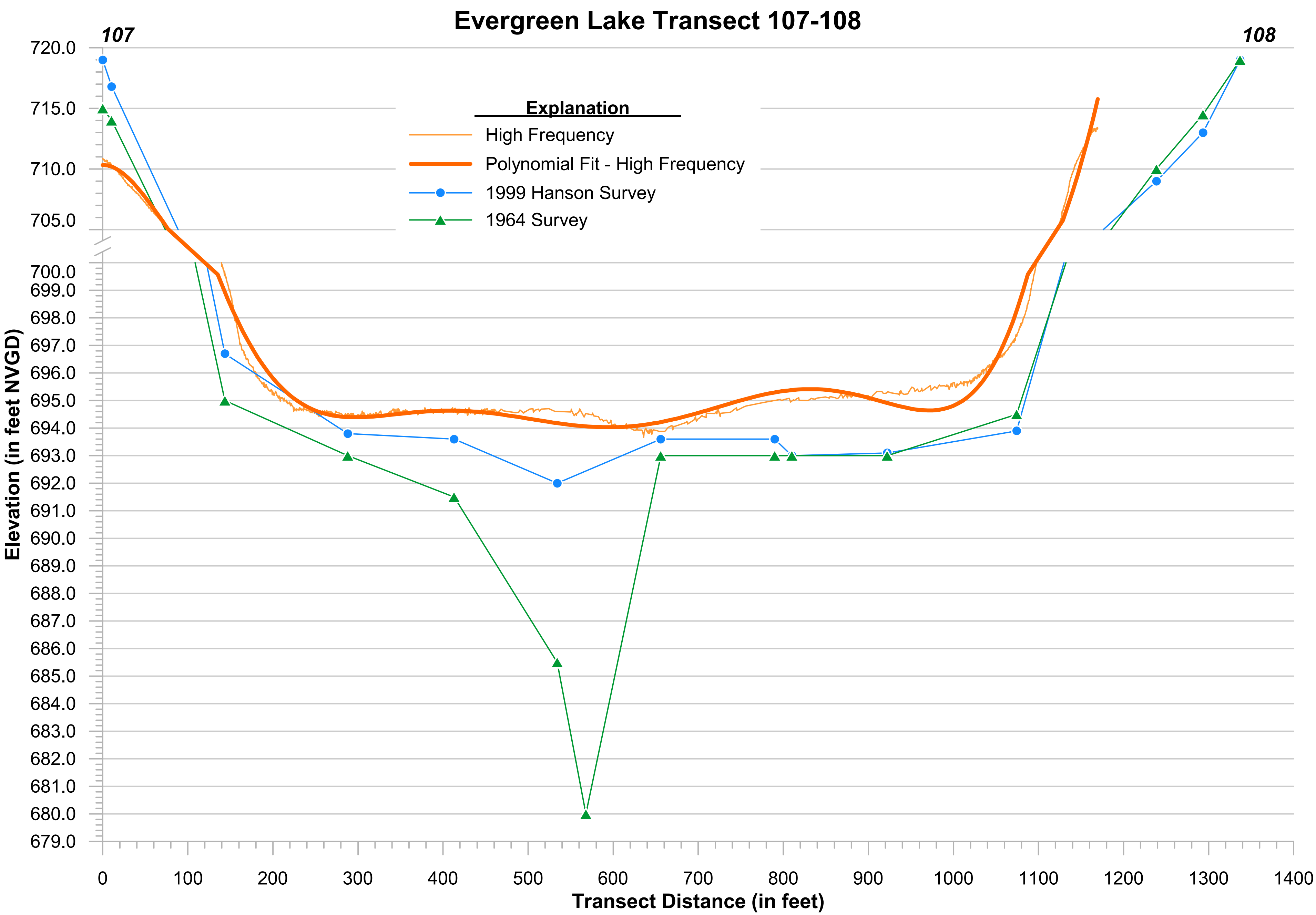
Transect Distance (in feet)



Evergreen Lake Transect 107-108
107
108
Explanation
High Frequency
Polynomial Fit - High Frequency
1999 Hanson Survey
1964 Survey
Elevation (in feet NVGD)
Transect Distance (in feet)
720.0
715.0
710.0
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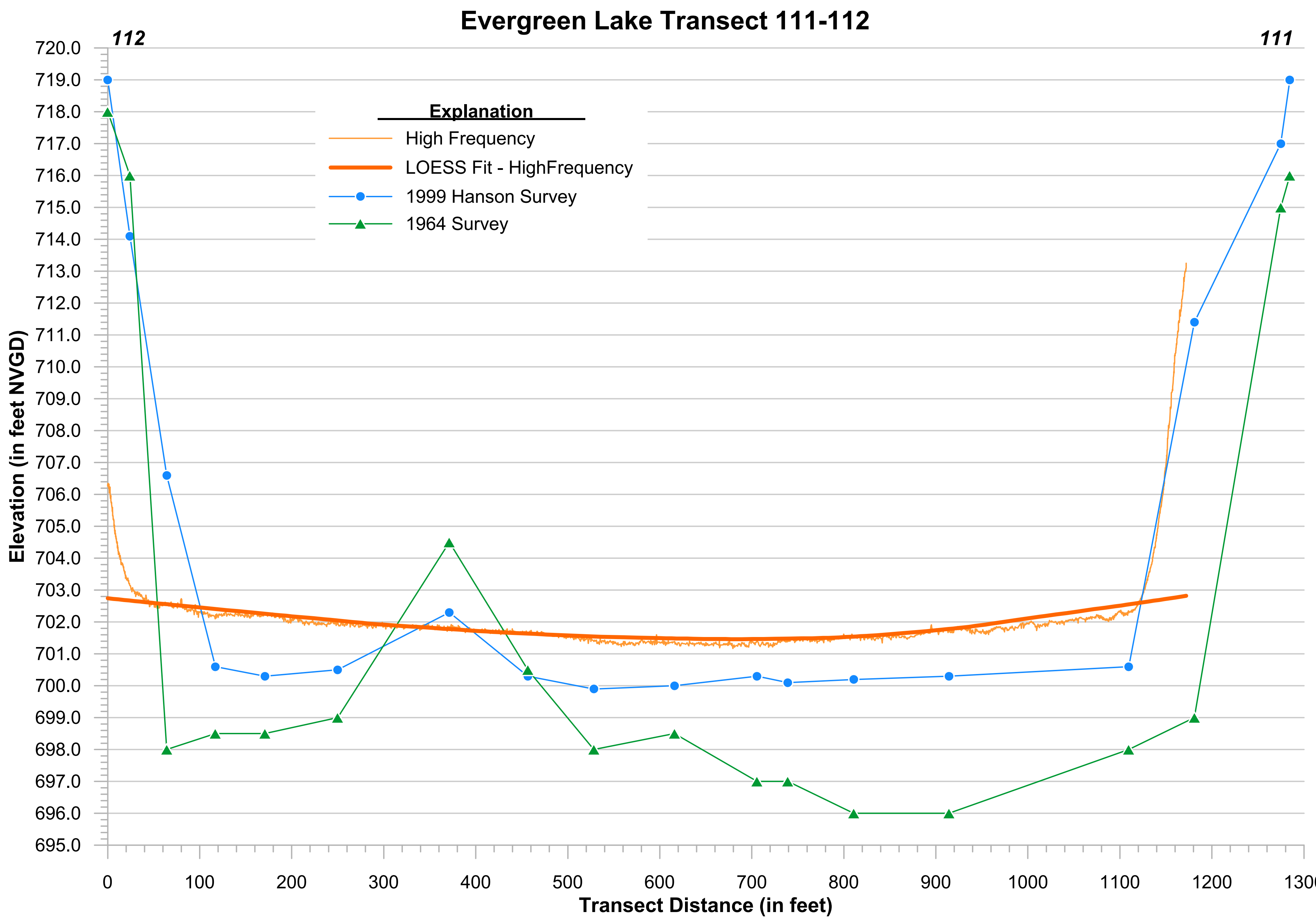

Evergreen Lake Transect 111-112
112
111
Explanation
High Frequency
LOESS Fit - HighFrequency
1999 Hanson Survey
1964 Survey
Elevation (in feet NVGD)
Transect Distance (in feet)
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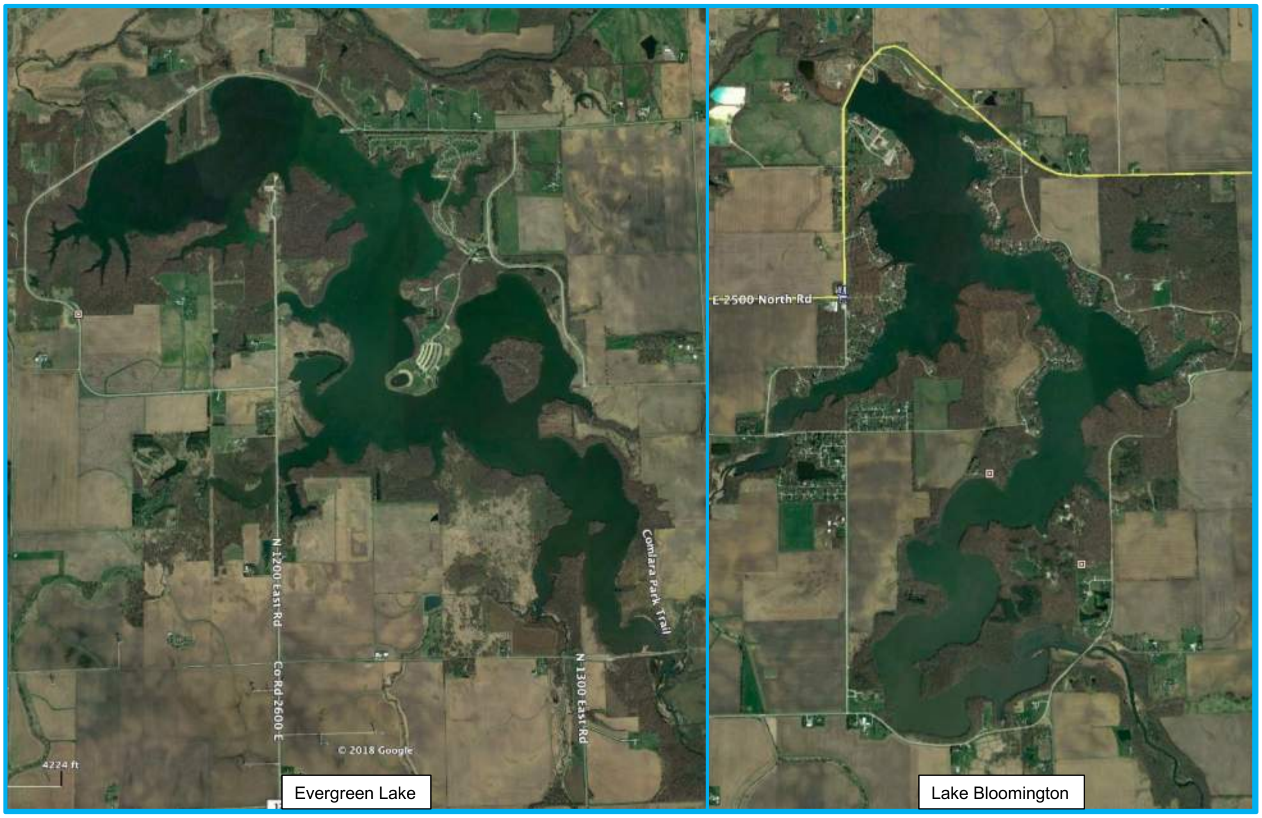
Appendix C
Berrini & Associates, LLC Capacity Improvement Evaluation

Lake Bloomington & Evergreen Lake Capacity Improvement Evaluation – Specifically Related to Dredging Options to Increase Safe Yield



Prepared for the City of Bloomington, IL

as a Sub-Consultant to Hanson Professional Services

by

Berrini & Associates, LLC

2701 Seacroft Rd., Springfield, IL 62711

December 7, 2024

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INTRODUCTION

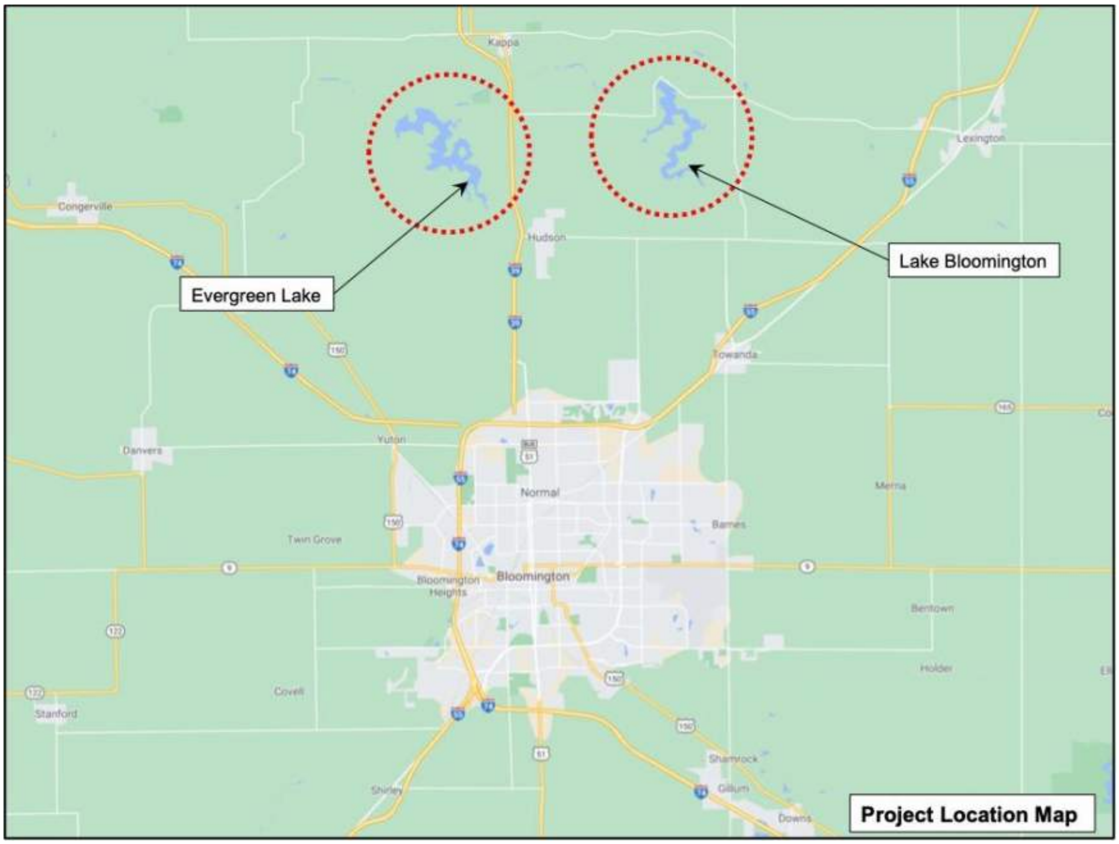
Lake Bloomington is located approximately 15 miles north of the city of Bloomington in McLean County and was constructed in 1929 by impounding Money Creek. Hickory Creek, a tributary of Money Creek, also drains into Lake Bloomington. It has a surface area of approximately 572 acres, a maximum depth of about 35 feet, an average depth of 12.9 feet, and an approximate storage capacity of 7,380 acre-feet. The lake was constructed to expand the city's water supply, and its primary use is as a water supply source for domestic, commercial, industrial, and agricultural purposes. It is also used for recreation and serves as a selling point for the residential developments that sprang up along its shores. Owned by the city of Bloomington, the lake's 43,248-acre watershed includes predominantly row crops, pasture, woodland, water and urban areas. The storage capacity was increased in 1957 by raising the dam 5 feet.

Evergreen Lake is located about six miles west of Lake Bloomington and serves as a supplemental water source. It was constructed in 1971 by damming Six-Mile Creek where it flows northward into the Mackinaw River. The topography of the watershed is characterized by gently rolling uplands with slopes leading to the shoreline, unlike the flat open farmland of the surrounding region. There are no industries in the 26,264-acre watershed, and the village of Hudson is the only community within the Evergreen Lake watershed. The lake has a surface area of approximately 700 acres at spillway level, a maximum depth of 48 feet, a mean of 17 feet, and an approximate storage capacity of 15,300 acre-feet. The predominant land use is row crops and other uses include small grains, pasture, alfalfa, residential development, and water. Water is generally withdrawn from Lake Evergreen when Lake Bloomington water levels reach five feet below the spillway level (Normal Pool) or when its water quality is better than that of Lake Bloomington.

The Bloomington water-supply system currently supplies people in the city of Bloomington, Hudson and Towanda Townships, and half of the population of Dale and Dry Grove Townships. The current average daily demand is approximately 14 million gallons, and the maximum daily pumping rate has varied from 18 to 20 million gallons per day (mgd). In an effort to meet both the short- and long-term supply needs, the city completed construction of the Mackinaw River Pumping Pool adjacent to Lake Evergreen in early 1990. When needed, river water can be pumped into Evergreen Lake. The raw water from Evergreen Lake can then be delivered directly to the water treatment plant on the shores of Lake Bloomington.

As a component of an overall Lake Bloomington & Evergreen Lake Capacity Improvement Evaluation being completed by Hanson Professional Services, this Report Section is specifically focused on available bathymetry and sediment depth maps to determine potential dredging options to increase the safe water supply yield for Lake Bloomington and Evergreen Lake. In addition to evaluating potential dredging options, potential upland sediment storage and dewatering site requirements will be summarized along with a concise summary of the anticipated Regulatory Permitting requirements for a large-scale lake dredging project. A location map is provided below in Figure 1.

Figure 1. Project Location Map



EVALUATION OF AVAILABLE LAKE BATHYMETRY AND SEDIMENT DEPTHS

The available lake bathymetry maps include surveys completed in 1999 (Hanson Professional Services) and in 2014 (Williams), in addition to partial surveys completed by the City of Bloomington and Northwater Consulting in 2020 that also included sediment depth measurements. Figures 2 and 3 provide bathymetry or water depth maps based on a 2014 survey (per City and County Websites). Recently updated bathymetry information was completed in October 2024 by Hanson Professional Services at select transect locations in deeper areas than those measured in 2020 to evaluate and compare current water and sediment depths to prior survey information.

The planning process for a lake dredging project should include the completion of a sedimentation survey to selectively measure existing water depths and the sediment deposition layer overlying the harder, original lake bottom. However, since measured sediment thickness data is only available for the upper ends of each lake, this analysis will make assumptions based on the actual measurements obtained in 2020 combined with available bathymetry data (Hanson, Williams). Generally, the entire lake may not require sediment thickness measurements if lake water depths exceed 10 feet if only safe recreational access restoration is required. However, sediment measurements in deeper water up to 15 feet or even 20 feet may be required if increased water supply capacity is targeted. Dredging in deeper water in inland lakes is uncommon and is typically more expensive due to equipment limitations and increased pumping requirements.

Figure 2. Evergreen Lake Bathymetry Map (McClean County Parks & Rec. Website)

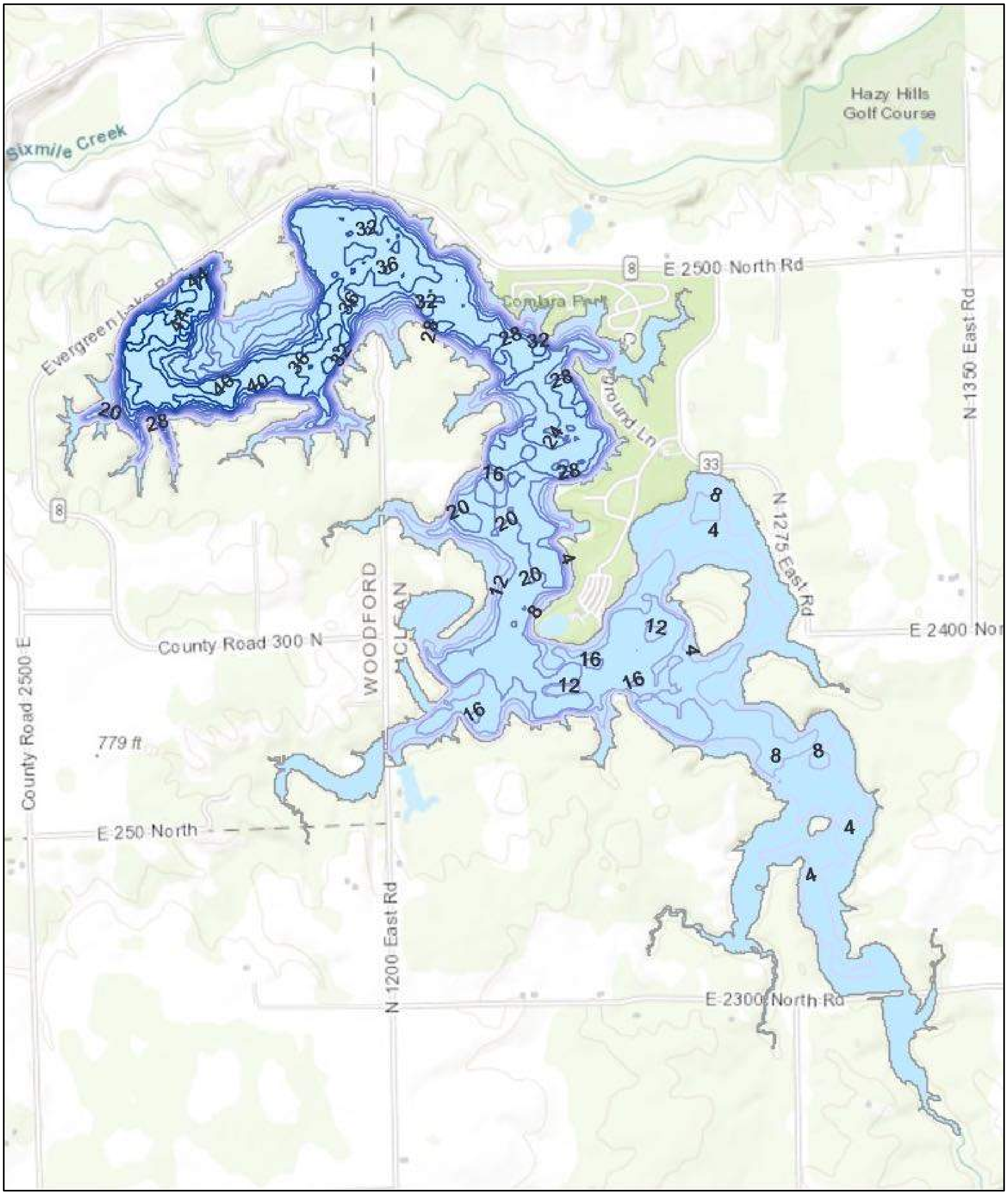
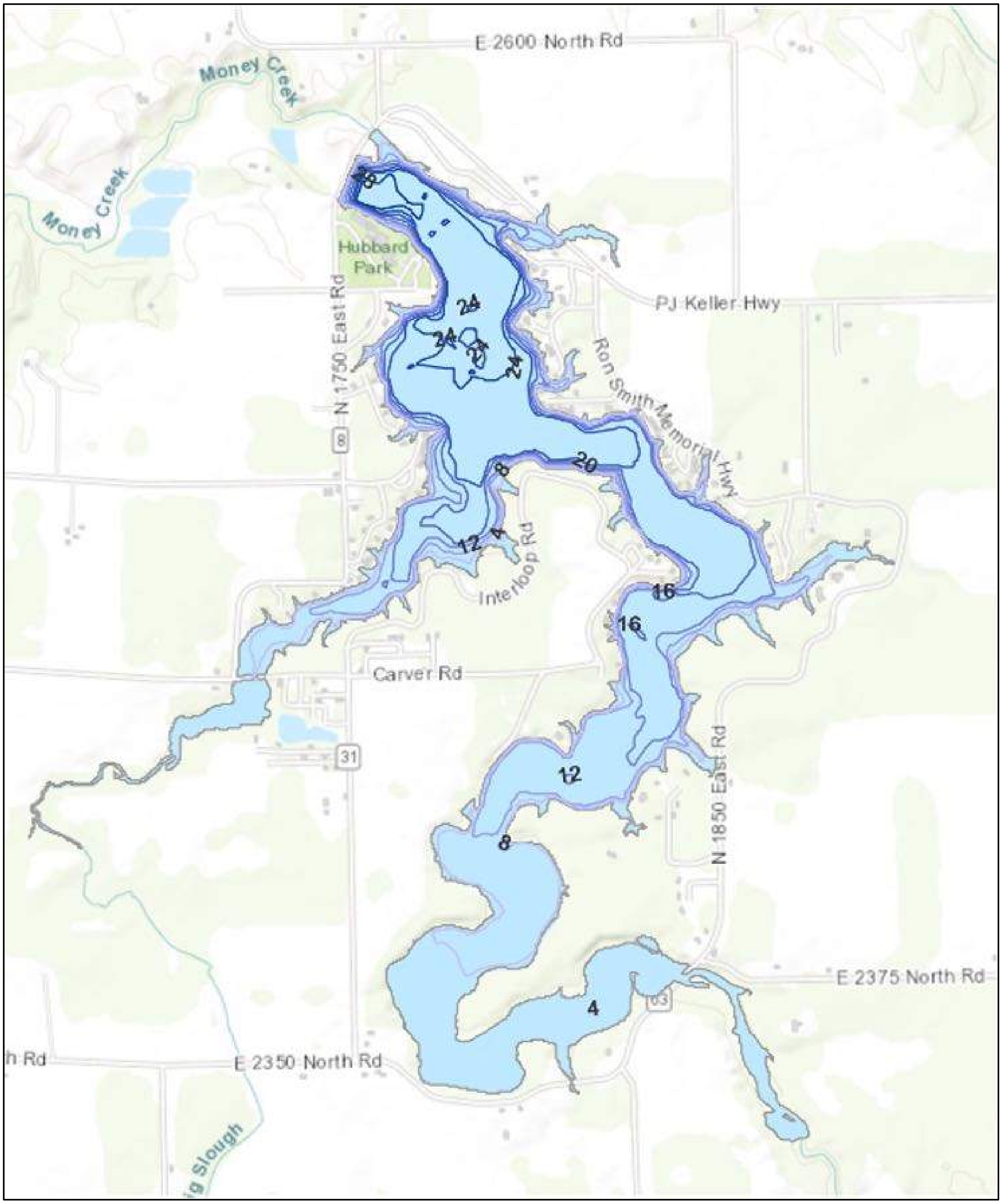


Figure 3. Lake Bloomington Bathymetry Map (Lake Bloomington Website)



Based on the available bathymetry maps, water depths from the inlet to the approximate mid-point of each lake ranges from 4 feet to 16 feet for Lake Bloomington and from 4 feet to 20 feet for Evergreen Lake. The deepest points of each lake reach approximately 44 feet for Evergreen Lake and 28 feet for Lake Bloomington.

The partial bathymetry updates recently completed (Hanson, 2024) indicated that Lake Bloomington has lost an average of two feet of water depth due to sedimentation when compared to 1999 data, whereas Evergreen Lake has only lost slightly more than one foot in the same time frame. After plotting cross sectional data in comparison to original 1929 lake bottom topography, the thickness of sediment increased in thickness to five feet or greater in the deeper areas of Lake Bloomington, whereas the thickness of sediment in Evergreen Lake was noticeably less in deeper areas outside (downstream) of the 2020 survey areas and generally ranged from two to three feet with some areas slightly greater. The thickest sediment measurements were typically observed within the original stream channel or thalweg for each lake. However, the material in the original channels were not factored in average thickness estimates since it is generally not feasible to efficiently remove old channel material by dredging.

Based on the partial 2024 bathymetry update, it can be inferred that the annual sedimentation rate in Lake Bloomington is greater than the annual rate in Evergreen Lake and that total accumulations in Evergreen Lake area may also be less than Lake Bloomington due to a more recent lake construction date (1929 for Lake Bloomington versus 1971 for Evergreen Lake).

Existing water depth and sediment measurements were completed in July 2020 by City of Bloomington staff in the upper ends of Lake Bloomington and Evergreen Lake, with assistance from Northwater Consulting (see Figure 4). Existing water depth and total depth measurements were obtained by determining the depth to the top of the soft sediment with a one-inch diameter aluminum range pole with a 6” diameter disk attached to the end to accurately determine the existing water depth. A separate range pole was then pushed through the soft sediment until the underlying hard bottom was reached to measure the total original lake depth and to determine the thickness of the soft, accumulated sediment. Both measuring poles were marked with 0.1 ft. and 1.0 ft. gradation markings for field accuracy. The survey measurements were obtained along designated transect lines crossing the lake, and the locations of each measured point were then recorded using a hand-held Trimble GPS receiver with sub-meter accuracy. The data was processed and then plotted as cross-sections so that a profile view of the existing sediment and the original lake bottom could be developed. The average end-area-method was then applied to each of the cross sections to calculate the quantity of accumulated sediment, the remaining water volume and the estimated percent volume loss of each lake segment within the study area.

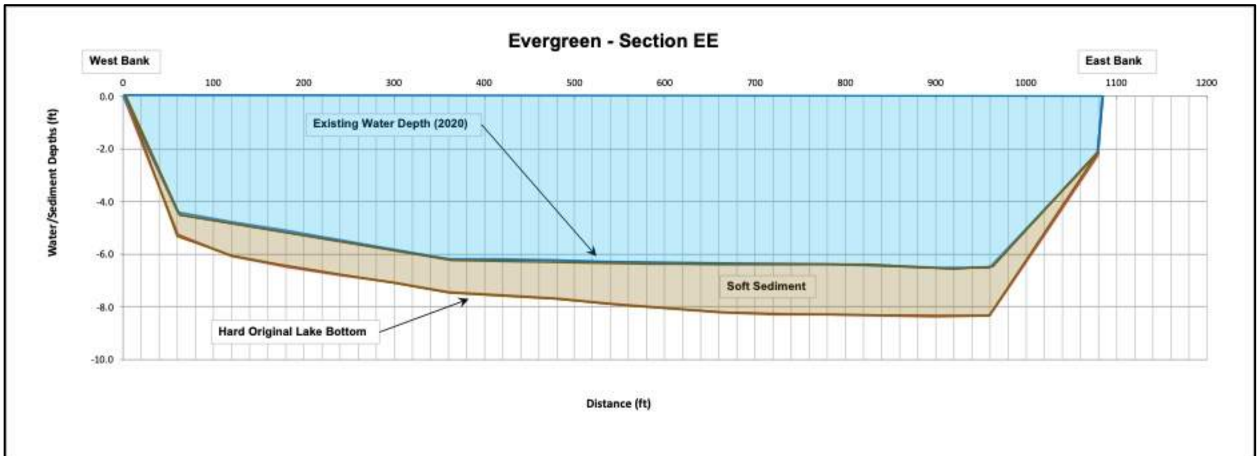
Figure 4. Location Map of 2020 Survey Areas within each Lake

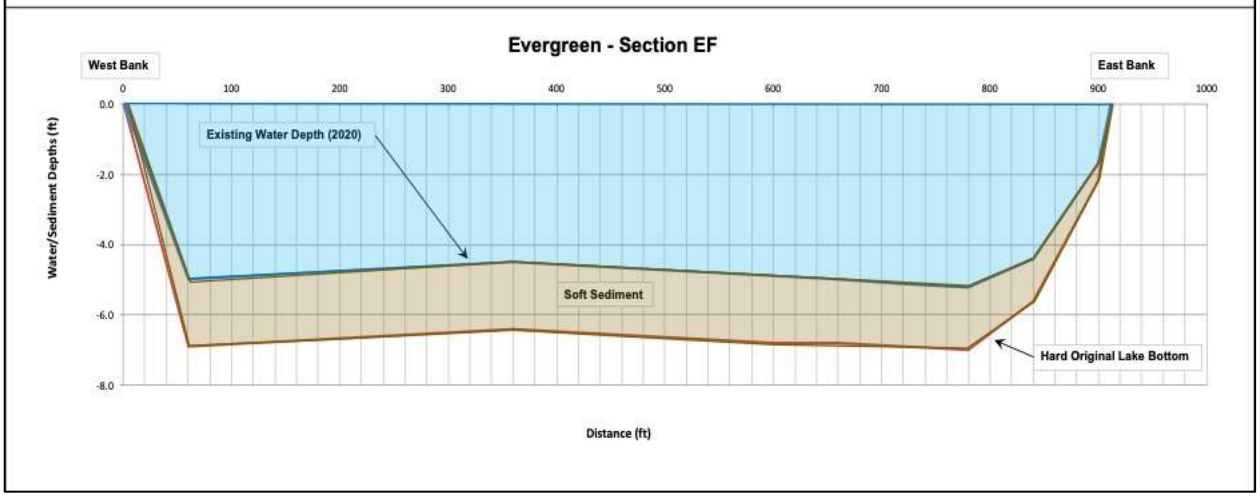
The results of the 2020 sedimentation survey for Lake Bloomington and Evergreen Lake indicate that approximately 93,060 cubic yards of sediment have been deposited within the upper end of Lake Bloomington and approximately 307,462 cubic yards of sediment has been deposited within the upper end of Evergreen Lake. These sediment volumes represent an approximate 36.1 percent and 29.2 percent water volume loss respectively within the surveyed areas. Select cross section views of each measured survey transect are provided below for reference.

The total estimated volume loss for Evergreen Lake ranged from 41.0% to 49.1% between the Inlet and Transect EH and rapidly decreased to 31.8% between Transects EH and EG and 28.6% between Transects EG and EF. The volume losses within the remaining survey area from Transect EF to EA ranged from 23.4% to 11.5%. The southwest cove inlet included volumes losses ranging from 29.0% to 35.6% from the inlet to Transect EK. Existing water depths throughout the surveyed area of Evergreen Lake were generally ranged from 2.0 to 4.0 feet throughout the upper end of the lake to the south of Transects EF and EK. Water depths increased to the north of Transect EE and ranged from 6.0 feet to a maximum depth of 15.0 feet at Transect EA. Sediment deposition ranged from 1.0 to 3.0 feet upstream (south) of Transect EE and from 1.0 to 2.0 feet in the deeper water going north towards Transect EA.

Figure 5. Evergreen Lake Sediment Depth Map (2020)

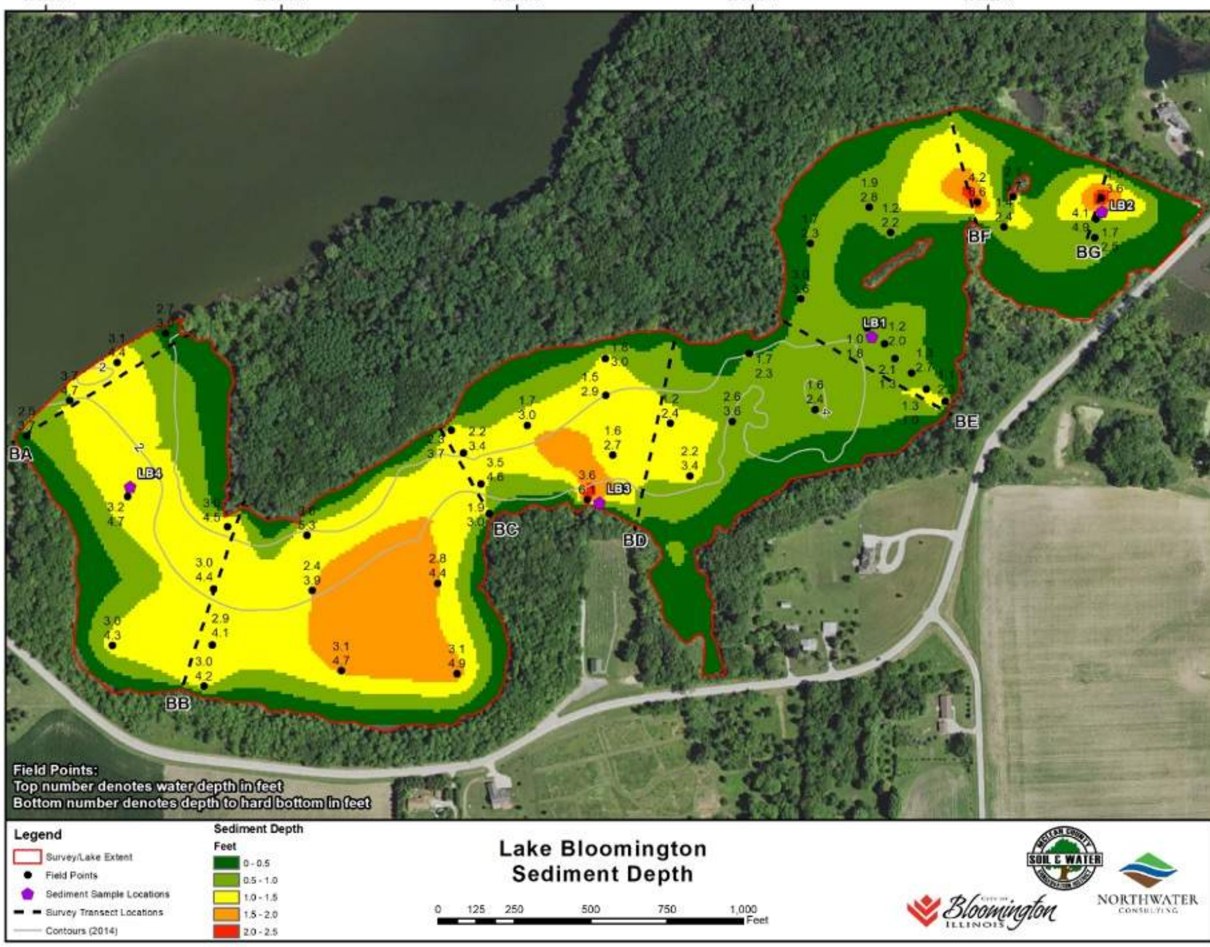
Figure 6. Typical Evergreen Lake Cross Sections (Northwater, 2020)





The total volume loss for Lake Bloomington ranged from 36.0% to 42.6 % for the furthest upstream area from inlet at the road bridge to Transect BC. Existing water depths throughout the surveyed area of Lake Bloomington were generally shallow and ranged from 1.0 to 4.0 feet with sediment deposition ranged from 1.0 to 2.0 feet with the average sediment thickness being closer to 1.0 feet. Although BA was the final transect for this survey, an additional measurement was obtained approximately 1,800 feet downstream (north) near the midpoint of both shorelines and found that the water depth was 5.7 feet with a hard underlying lake bottom depth of 7.4 and 1.7 feet of sediment.

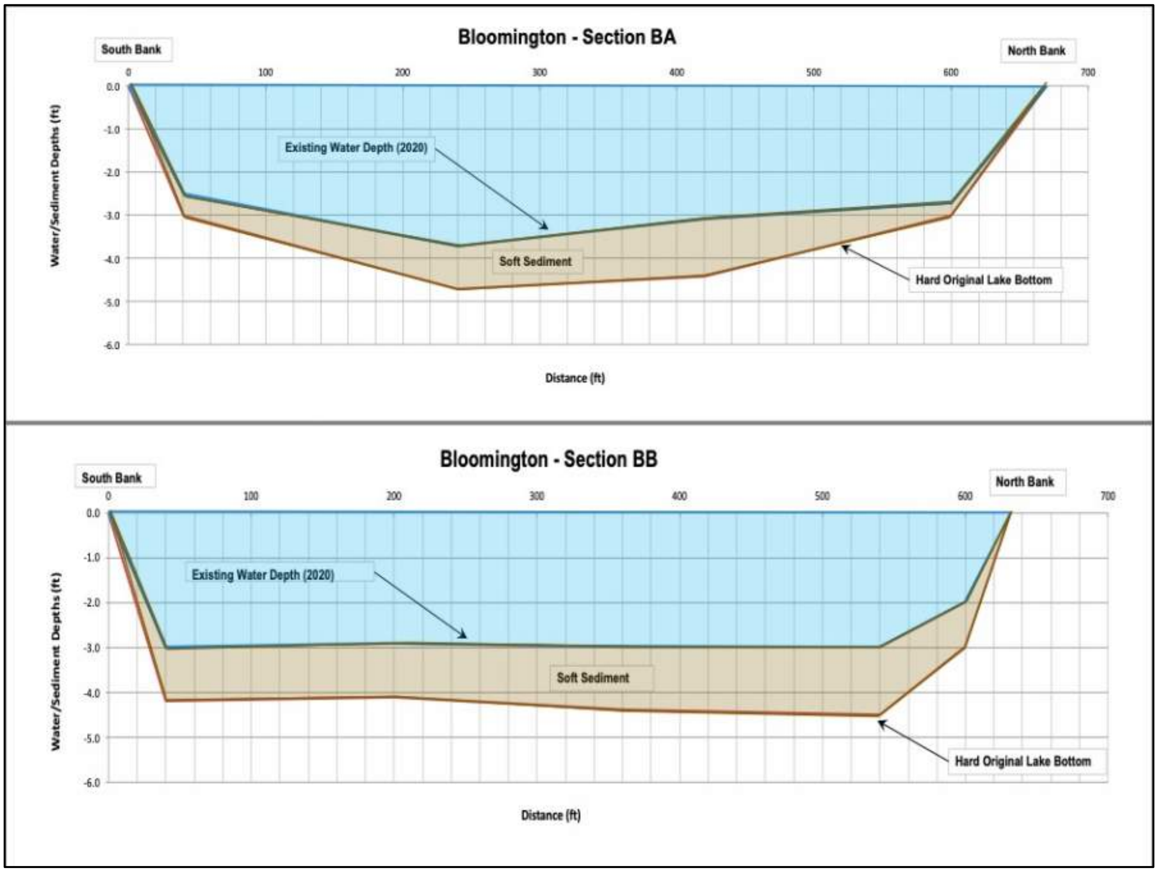
Figure 7. Lake Bloomington Sediment Depth Map (Northwater, 2020)



In addition to the water depth and sediment thickness measurements, a total of three sediment core samples were obtained from each lake and analyzed for various physical and chemical characteristics such as particle size, total solids, percent solids, organic content, ammonia N, total metals, Polychlorinated Biphenyls (PCBs), pesticides and settleability.

The sediment core sample analysis for the 2020 study included: particle size to #230 sieve, total solids (%), total organic content (%), Polychlorinated Biphenyls (PCBs), Pesticides and Total Metals analyzed as a solid in mg/kg. In addition to the physical and chemical characterization described above, a 4-hour supernatant test for lead, zinc, ammonia-nitrogen, total suspended solids (TSS) and total volatile solids (TVS) and a 24-hour supernatant test for TSS and Ammonia-N was completed for future permitting considerations in the event hydraulic dredging is implemented. Concentrations of chemical parameters from the sediment sampled from each lake can be classified as low to normal based on the Illinois EPA Classification of Lake Sediment (Table 6). The overall results of the analyses indicate that no restrictions are anticipated for the removal and placement of the sediment on upland locations.

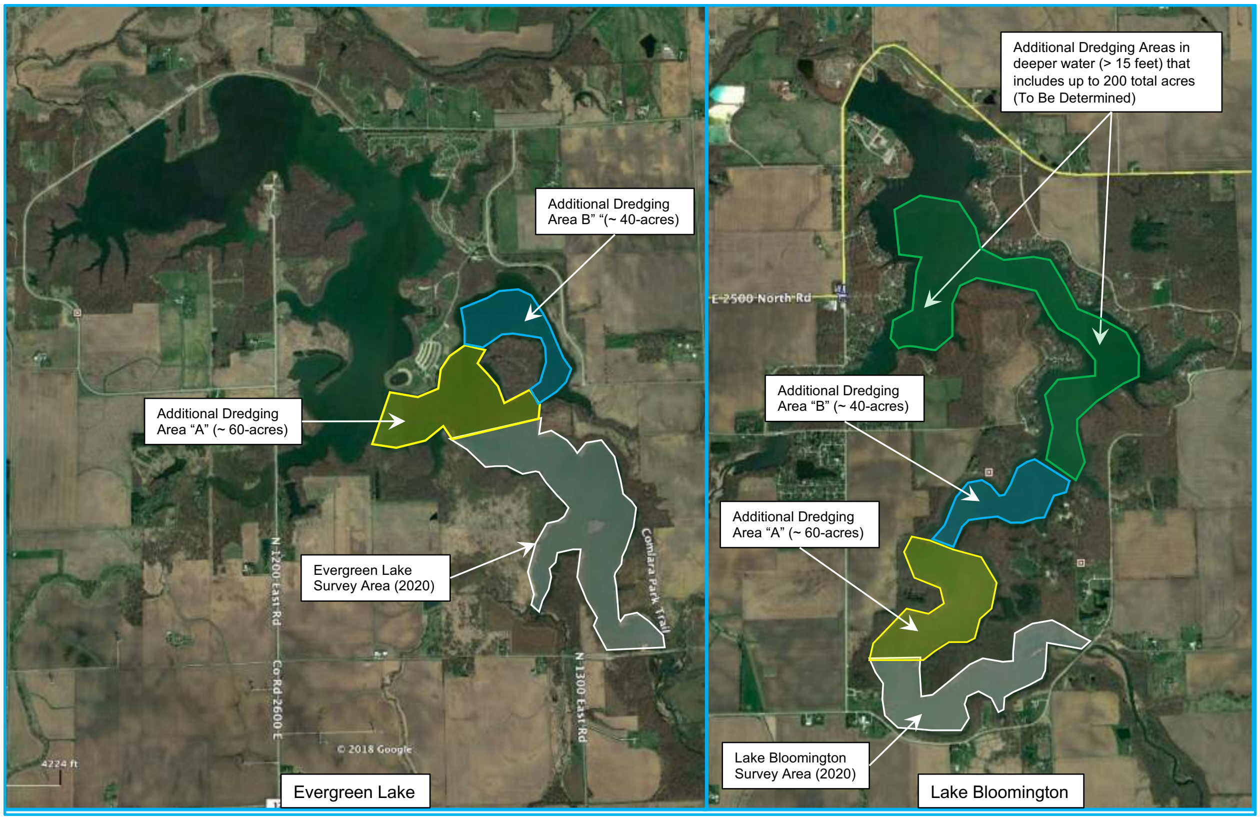
Figure 8. Typical Lake Bloomington Cross Sections (Northwater, 2020)



PRELIMINARY DREDGING AREAS AND QUANTITIES

Based on the available bathymetry and sediment depth data, an approximate 60-acre and an adjacent 40-acre polygon was selected for preliminary analysis in addition to the measured 2020 survey areas as shown below in Figure 9. The rationale included targeting contiguous areas in each lake with less than 15 feet of existing water depth to maximize on cost effectiveness and overall dredging efficiency. Although the designated dredging polygons can be extended further north into deeper water, an initial analysis of the measured sediment in the shallow upper ends combined with an approximate 100 total acre area in each lake was initially selected since accurate sediment measurements in deeper water were not available. Since the average soft sediment thickness at the downstream (northern) edge of each surveyed area is approximately two feet, it can be assumed that the targeted dredging polygons also contained an approximate two-foot average soft sediment thickness. Since available soil surveys indicate the presence of silt loam and silty clay loam soils throughout the underlying lakebed, it is feasible to include an additional one to two-foot dredge cut into the underlying, denser native soil for analysis purposes. Although a predominantly hard clay soil can be difficult to hydraulically dredge, past project experience confirms that a thin layer of the underlying soils present in both lakes can be cost effectively dredged and are thus included in the analysis.

Figure 9. Potential Dredging Areas for Water Capacity Improvement



As previously noted above, the 2020 sedimentation survey estimated that approximately 93,060 cubic yards of sediment has been deposited within the upper end of Lake Bloomington and approximately 307,462 cubic yards of sediment has been deposited within the upper end of Lake Evergreen.

Assumptions for preliminary analysis purposes:

~ 50 acres for Lake Bloomington (LB) and ~ 100 acres for Evergreen Lake (EL) for additional native cut analysis; The measured areas for additional deepening are located approximately 50 feet from the shoreline for estimating purposes and to avoid shoreline and littoral zone impacts.

~ 50 acres (LB) at 1,613.33 CY per acre-foot = 80,666 CY per vertical foot of dredge cut for the upper end of Lake Bloomington.

~ 100 acres (EL) of native cut would equal 161,333 CY per vertical foot of dredge cut for the upper end of Evergreen Lake.

For preliminary estimating purposes, an average one-foot native dredge cut was evaluated. This would add approximately 80,666 of additional volume to the upstream 2020 survey area for Lake Bloomington and 161,333 of additional volume to the upstream Survey Area for Evergreen Lake.

Therefore, the estimated dredging volume for the 2020 Survey areas would be (assuming a one-foot average additional native soil dredge cut):

Lake Bloomington = 93,060 CY plus 80,666 CY = 173,726 CY

Evergreen Lake = 307,462 CY plus 161,333 CY = 468,795 CY

For the additional downstream dredging polygons (Areas "A" and "B"), an average of 2.0 feet of soft sediment plus a minimum 1.0 foot of additional dredge cut into harder native soils would amount to a 3.0 ft. average dredge cut for each identified area. Therefore, an approximate 100-acre total additional dredge cut in each lake would amount to 483,999 cubic yards for each lake.

Based on this analysis of the shallow areas generally less than 15 feet of existing water depth, Lake Bloomington dredging would include an estimated 657,725 cubic yards of sediment and native soil removal and Evergreen Lake dredging would include 952,794 cubic yards of sediment and native soil removal and the total dredging volume for both lakes would be 1,610,519 cubic yards.

Since one cubic yard equals 201.974 gallons, dredging 657,725 cubic yards from Lake Bloomington would increase the lake storage capacity by 132,843,349 gallons and dredging 952,794 cubic yards from Evergreen Lake would increase lake storage capacity by 192,439,615 gallons. Therefore, the total increase in lake storage capacity for both lakes would be approximately 325,282,964 gallons.

Based on the partial bathymetry update that was recently completed (Hanson, 2024), the deeper areas of Lake Bloomington exhibited increased soft sediment deposition and may allow for larger dredging volumes to be realistically achieved with estimates of an average six (6) feet to be removed from to-be-determined 100-acre areas north of those presented in Figure 9. Since an average dredge-cut of three (3) feet for 100 acres is estimated to be 483,999 cubic yards as noted above, additional dredging in deeper 100-acre polygons would increase the volume per 100 acres to approximately 967,998 cubic yards. However, since the total sediment thickness in deeper areas did not significantly increase in Evergreen Lake, only Lake Bloomington will be considered for additional deep-water (> 15 feet) dredging. Therefore, each additional 100-acre dredging area in deeper portions of Lake Bloomington would increase lake capacity by 195.5 million gallons. Based on a preliminary analysis, it appears feasible to consider up to 200 additional dredging acres in the deeper areas of Lake Bloomington, to be considered in addition to the areas or dredging polygons identified in Figure 9 above.

If all areas shown and discussed above are dredged, including up to 200 acres in deeper portions of Lake Bloomington, a total of 3,546,515 cubic yards would be dredged and an estimated total capacity increase of 716,303,821 gallons would be achieved. It should be noted that these preliminary assumptions would require accurate sediment measurements as part of the Engineering Design Phase to confirm actual dredging limits and volumes.

A BRIEF SUMMARY OF POTENTIAL DREDGING METHODS

The primary means of dredging inland lakes and waterways include: 1) Total Lake Drawdown and Excavation (e.g. "Dry" Mechanical Dredging); 2) Wet Mechanical Dredging; and 3) Hydraulic Dredging. A brief description of these dredging methods is provided below.

Lake Drawdown and Excavation (Dry Mechanical Dredging)

In this approach, the lake would be completely or partially drained, the bottom materials would be allowed to dry out as much as possible, and appropriate low ground pressure earth-moving equipment would be brought in to remove the unwanted sediment. Figure 10 shows some representative lake drawdown and mechanical dry dredging operations.

Figure 10 – Lake Drawdown and Excavation Examples

A haul road may be required to provide access for heavy trucks into the lake or cove being dredged. In certain applications, this approach can be a viable alternative to other forms of dredging, but has a greater environmental impact, and can take the longest to complete due to unanticipated runoff events. The drained lake may be unsightly and would not be usable during the drying and excavation phase, which can last several weeks to several years. Typically, the sediment never truly dries; excavation occurs under muddy conditions.

This dredging method is also highly susceptible to weather conditions and even a small storm can affect the project schedule by re-wetting the sediments. Tributaries into the wetland cells must be re-routed through channels or using pumps and pipes. The tributary routing or bypass system must have the capacity to handle sudden runoff from major storms, otherwise the work area can be flooded. Once the project is complete, it may take several months or longer, depending on climatic conditions, for the lake to fill back to capacity. A fall drawdown and winter excavation can be considered due to frozen conditions, but cyclical weather trends can produce unanticipated rainfall coupled with milder temperature trends that could severely impact the working conditions and cause costly work stoppages.

Lake drawdown and mechanical excavation is not a suitable dredging method for consideration since Lake Bloomington and Evergreen Lake are public water supply lakes and a significant and extended drawdown would be required for such a large-scale dredging project. Not only would potential runoff events be necessary to effectively by-pass targeted dredging areas prior to and during construction, but the total extent of lake drawdown would likely be limited and the post-dredging runoff required for rapid re-filling may extend longer than planned. Therefore, lake drawdown and mechanical excavation in either lake is not recommended due to the significant impact and high risk.

Wet Mechanical Dredging

Wet mechanical dredging uses an excavator, dragline, or a clamshell to remove sediments. Dredging is conducted either from shore or from a barge in the water. Wet mechanical dredging often creates increased levels of turbidity (suspended sediment) within the water. Specialized "environmental" or closed clamshell buckets can be used to reduce the turbidity; however, these increase costs and add water to the dredged material and are not generally required unless the sediment is contaminated.

Wet mechanical dredging produces a plastic-to-fluid mud of varying consistency; the material can be handled and transported without dewatering although there is risk of spillage if the mud is too fluid. In addition, many facilities that accept dredged material for placement will not accept material with high water content. Mechanical dredging from shore is not considered feasible due to the environmental impacts of clearing and constructing a road at the water's edge around the reservoir, the potential impact to the shoreline and littoral habitat, the inability of this method to dredge the middle of the reservoir, and the high volume of truck traffic.

Therefore, wet mechanical dredging methods are better suited to smaller areas and sediment volumes due to typically higher unit costs than hydraulic dredging and is not considered to be feasible for a potential large-scale dredging project for Lake Bloomington and Evergreen Lake.

Figure 11 – Wet Mechanical Dredging Examples

Hydraulic Dredging

A hydraulic dredge (also called a cutter suction dredge) works like a floating vacuum. Figure 11 shows some examples of hydraulic dredges. The typical dredge used for lakes is about the size of a small houseboat, and consists of a diesel motor, pump, and small operator's cab. Smaller hydraulic dredges, suitable for use in ponds and coves, are available. These are about the size of a pontoon boat and can be more easily deployed for access to multiple ponds or hard to reach areas.

In hydraulic dredging, a boom with a rotating cutterhead or horizontal auger is lowered into the sediment to loosen the bottom material. A suction hose attached to the boom pulls in the loosened sediment and the sediment slurry is then pumped through a temporary HDPE (high density polyethylene) pipeline to an offsite location for temporary storage and dewatering. The dredge pipeline typically floats on the water surface and/or is laid on the ground surface to reach the dewatering site. Depending on the location and set-up of the dewatering area, there would also be a return line and/or an existing drainage way for the clear effluent water to gravity flow back to the lake after the solids are removed.

Figure 12 – Typical Hydraulic Dredges Suitable for Lakes

Hydraulic dredges typically generate less turbidity than mechanical dredges, and whatever turbidity is generated from the dredging activity can be controlled and isolated with floating turbidity curtains deployed at the downstream end of the dredging area. There is minimal disturbance of the lakeshore, and the main dewatering area does not have to be along the shoreline. Additionally, hydraulic dredging is completed during warm weather conditions at normal lake levels, which minimizes impacts to the wildlife community. However, there must be an access point to put the dredge into the water. Large hydraulic dredges can be lifted into the water with a crane, whereas many of the smaller dredges could be launched from a boat trailer. Hydraulic dredging operations also require a lakeside staging area where the pipeline pieces can be delivered and assembled, and to support the dredging operation.

A hydraulic dredge can pump the material in the pipeline a short distance. If the distance is greater than one mile, or involves pumping over any substantial hills, one or more booster pumps may be necessary. The booster pumps must be accessible for operations, fueling, and maintenance. The booster pump stations can be on land or on a barge in the water, depending on pipeline configuration and location of the dewatering site(s). Pipelines are typically placed on the surface, and although temporary, need to be solidly constructed to avoid leaks. The pipelines can be routed under roadways using cut and fill, jack and bore, or horizontal directional drilling techniques. Pipeline and pumping costs increase with distance, total elevation, number of roadway crossings, and if there are right-of-way issues or special permits required (e.g. stream crossings, wetland issues, etc.).

Hydraulic dredging is generally the least obtrusive of the available dredging methods for waterbodies. However, because hydraulic dredging relies on pumping water and sediment as a slurry at high velocities to move the sediment, some form of dewatering (e.g. separating the sediment from the water used to transport the sediment) is necessary.

Therefore, a future large-scale dredging project (greater than 1,000,000 cubic yards) for Lake Bloomington and Evergreen Lake would be most efficiently and cost effectively completed using appropriately sized hydraulic dredging equipment and pumping the dredged sediment into an earthen sediment storage and dewatering facility or impoundment (SDF). Due to the location and distance separating the two water supply lakes, a separate SDF for each lake is likely. The most feasible dredge type and size would be a rotating basket type cutterhead with a 14" to 16" diameter discharge pipe (see bottom two images in Figure 11 above), particularly since a layer of harder native soils will be included in the shallow area dredging.

SEDIMENT CHARACTERIZATION

In addition to understanding the distribution and magnitude of the accumulated sediment, it is also necessary to characterize the physical and chemical properties of the sediment, not only to satisfy various state and federal regulatory requirements, but to utilize in the planning and design process (see Figure 12 below). Depending on the method of sediment removal considered for a project (i.e., mechanical or hydraulic), analyses such as particle size distribution, water content, dry bulk density, settleability, nutrients and contaminants (i.e., metals, PCBs, pesticides, etc.) are vital to understand how the sediment will behave when handled, pumped, stored, dewatered, and reused.

Chemical analysis requirements generally depend on how the sediment will be dredged, dewatered and located for final placement or beneficial reuse. Hydraulic dredging typically incudes effluent return water that typically require supernatant or modified elutriate analyses (in mg/l) to simulate or predict the water quality characteristics of the discharge, whereas mechanical dredging may require various analyses as a solid (in mg/kg). It is always advisable to determine what the appropriate State regulatory agency (i.e. Illinois EPA) will require early in the project planning process.

As part of the 2020 Sediment Study, preliminary sediment core samples were obtained by City of Bloomington staff using a Wildco Hand Corer with a 20" sampling tube from three (3) representative locations distributed throughout the upper end of each lake to evaluate chemical and physical properties of the in-situ sediment for future permitting and design considerations.

Figure 12. Representative Sediment Sample Images

The sediment core sample analyses included: particle size to #230 sieve, total solids (%), total organic content (%), Polychlorinated Biphenyls (PCBs), Pesticides and Total Metals analyzed as a solid in mg/kg. In addition to the physical and chemical characterization described above, a 4-hour supernatant test for lead, zinc, ammonia-nitrogen, total suspended solids (TSS) and total volatile solids (TVS) and a 24-hour supernatant test for TSS and ammonia-nitrogen was completed for future permitting considerations in the event hydraulic dredging is implemented in the future. Concentrations of chemical parameters from the sediment sampled from each lake can be classified as low to normal based on the Illinois EPA Classification of Lake Sediment. The overall results of the analyses indicate that no restrictions are anticipated for the removal and placement of the sediment on upland locations. PCBs and pesticides were all below the laboratory detection limits, and all metals were well below "Illinois Pollution Control Board (IPCB) TACO Tier 1 Soil Remediation Objectives for Residential Properties" and "Illinois EPA Maximum Allowable Concentrations for Clean Fill".

PROJECT DESIGN AND REGULATORY PERMITS

Once preliminary planning data has been acquired and the extent of the sediment has been adequately quantified and characterized, optimum dredging methods can be determined, estimates of probable cost can be developed, potential storage and dewatering sites can be evaluated and selected, and tangible plans can be made to proceed. The effort of designing, permitting and developing bid plans and specifications can then proceed for implementation of the proposed sediment removal project.

The Regulatory Permitting requirements in Illinois, particularly with respect to the allowable level of total suspended solids and ammonia-N in the effluent discharge for a hydraulic dredging project, require a multi-agency Joint Application Permit process that includes a description of where the project is located and how it will be completed, whether wetlands may be impacted and a summary of the physical and chemical characteristics of the sediment to be removed. A large-scale hydraulic dredging project of this size would require an Individual Permit from the U.S. Army Corps of Engineers and the Illinois EPA. An Anti-Degradation Assessment for the EPA Section 401 Water Quality Certification would also be required. Additional requirements may include an EPA NPDES Stormwater Permit if land is disturbed, an ecological consultation to determine if any threatened and endangered species may be present, a Phase 1 Archeological Survey to confirm that no significant cultural resources will be impacted, and an Illinois DNR Dam Construction and Operating Permit depending on the storage impoundment size, capacity, and proximity to infrastructure. Additional local and county permits may also be required.

The design phase of the project will generally include selection and acquisition of an appropriately sized parcel of land to construct a sediment storage and dewatering facility, preferably in a level, upland location with no wetlands present. The method of dredging can be a factor in sediment storage site selection, but hydraulic dredging is generally more efficient and cost-effective than mechanical excavation for larger sized projects, particularly when the watershed is extensive or where the lake is used as a public water supply source.

When a sediment storage and dewatering facility (SDF) is required for a hydraulic dredging project, a topographic survey and a geotechnical investigation must be completed to design the earthen impoundment, which often can require a Dam Construction and Operating Permit to ensure that the temporary impoundment is designed with a sufficient safety factor. If an earthen impoundment breaches suddenly due to poor design and construction methods, the resulting breach wave can be quite destructive and can impact public property and safety.

The optimum sediment storage site location is generally located within proximity to the targeted dredging area and is situated on upland ground with adequate land area and suitable soil for constructing earthen perimeter berms for containment. However, when an optimum site is not available, sediment can be pumped hydraulically for several miles or more with appropriate dredging equipment and booster pumps. Generally, the cost of dredging increases when the distance to the sediment storage and dewatering site is further from the lake.

A large-scale dredging project for Evergreen Lake and Lake Bloomington may require several hundred total acres or more to accommodate the necessary storage and dewatering operations. Figure 13 provides aerial images of representative earthen sediment dewatering facilities. For example, a 3.1 million cubic yard hydraulic dredging project at Lake Springfield utilized approximately 360 acres for the SDF (see top right photo in Fig. 13) and a 10 million cubic yard project in Decatur utilized an existing 400-acre SDF by building higher earthen perimeter dikes. For reference, the two bottom photos in Figure 13 were both about 45 acres in size and stored approximately 500,000 cubic yards each (i.e. Paris West Lake and Wonder Lake).

Figure 13. Examples of Sediment Storage and Dewatering Facilities

SUMMARY AND RECOMMENDATIONS

As observed and described in the pages above, the preliminary information and data indicates that removing as much as 3.56 million cubic yards of sediment and soil from both lakes is feasible and that such an effort would restore approximately 716.3 million gallons of total reservoir storage capacity that has been lost due to ongoing lake sedimentation.

Initial analysis of the shallow areas generally less than 15 feet of existing water depth for both lakes indicates that dredging would include an estimated 657,725 cubic yards of sediment and native soil removal from Lake Bloomington and 952,794 cubic yards of sediment and native soil removal from Evergreen Lake, and the total dredging volume for both lakes would be approximately 1,610,519 cubic yards.

Since one cubic yard equals 201.974 gallons, dredging 657,725 cubic yards from the shallow upper end of Lake Bloomington would increase the lake storage capacity by 132,843,349 gallons and dredging 952,794 cubic yards from the shallow upper end of Evergreen Lake would increase lake storage capacity by 192,439,615 gallons. Therefore, the total increase in lake storage capacity for the shallow upper ends of both lakes would be approximately 325,282,964 gallons.

A partial bathymetry survey recently completed (Hanson, 2024), shows that deeper areas of Lake Bloomington exhibit increased soft sediment deposition and may allow for increased dredging volumes per acre to be realistically achieved with estimates of an average six (6) feet to be removed from to-be-determined 100-acre areas north of those presented in Figure 9. Since an average dredge-cut of three (3) feet for 100 acres is estimated to be 483,999 cubic yards as noted above, additional dredging in deeper 100-acre polygons would increase the volume per 100 acres to approximately 967,998 cubic yards. However, since the total sediment thickness in deeper areas did not visibly increase in Evergreen Lake, only Lake Bloomington was considered for additional deep-water (>15 feet) dredging. Therefore, each additional 100-acre dredging area in deeper portions of Lake Bloomington would increase lake capacity by 195.5 million gallons. Based on a preliminary analysis, it appears feasible to consider up to 200 additional dredging acres in the deeper areas of Lake Bloomington, to be considered in addition to the shallow area dredging polygons identified in Figure 9 above. Therefore, if all areas shown are dredged, including up to 200 acres in deeper portions of Lake Bloomington, a total of 3,564,515 cubic yards would be dredged and an estimated total capacity increase of 716,303,821 gallons would be achieved.

Based on historical project data and recent dredging costs, a project of this size and scale would likely range in cost from $10 to $12 per cubic yard dredged, plus the cost for the land required for sediment storage and dewatering, in addition to the costs for engineering design, permitting and construction of the facility. For a project that would include approximately 3.5 million cubic yards of hydraulic dredging, a preliminary estimate of probable cost is provided in Table 1 below:

Table 1. Preliminary Estimate of Probable Cost

1.	Land Acquisition (assume 200 to 400 acres at $10,000/acre)	$2 to $4 Million
2.	Sediment Dewatering Facility Construction, assume:	$3 to $5 Million
3.	Hydraulic Dredging 3.5 million cubic yards ($10 to $12/CY)	$35 to $42 Million
4.	Mobilization and Demobilization (Lump Sum)	$1 to $2 Million
5.	Engineering and Permitting (~ 10 %)	$3 to $4 Million
6.	Site Maintenance and Post Project Reclamation	$1 to $2 Million
	Total (not including contingencies or inflation)	$45 to $59 Million

The preliminary cost of restoring approximately 716.3 million gallons of lost storage capacity by hydraulically dredging 3.5 million cubic yards of lake sediment is estimated to range from $45 to $59 Million, or $0.064 to $0.084 dollars per gallon ($64,000 to $84,000 per million gallons) of restored capacity, not including any contingencies or inflationary costs.

Although large scale dry mechanical dredging is not recommended for either lake due to their being public water supply lakes, a preliminary analysis of a partial 10-foot drawdown and dry dredging project for Lake Bloomington could include an approximate excavation area that would include the 50-acre area of the 2020 Survey plus the 60-acre Area A shown in Figure 9. Although a risk of re-inundation of the potential work area and a lack of rainfall after work is completed is always a risk, a preliminary analysis indicates that these two areas could include an estimated 173,726 cubic yards in the 50-acre 2020 Survey area and an estimated 290,400 cubic yards in the 60-acre Area A.

If the partial drawdown can be maintained until completion, the estimated 464,126 cubic yards of excavated sediment could provide up to 93.7 million gallons of restored reservoir capacity. However, in addition to the high risk involved, the typical cost of such an effort would likely cost from $25 to $30 per cubic yard or more including hauling to an appropriate upland storage site for drying, grading and stabilization. An impoundment would still be required to contain the wet sediment, but the earthen perimeter dikes would not have to extend upwards as high as a hydraulic dredging project would require.

Therefore, a partial dry mechanical dredging project in the shallow portion of Lake Bloomington would likely cost between $11.6 to $13.9 million for the dredging and hauling portion plus an additional $4 to $6 million for engineering, permitting, land acquisition, berm construction and site reclamation for a total preliminary estimate of $15.6 to $19.9 million. A partial dry dredging project for the shallow upper end of Lake Bloomington, if successfully completed would likely cost from $166,500 to $212,400 per million gallons of restored capacity.

However, based on prior project experience, it is likely that all the anticipated work may not be completed in one season and costs may likely be higher than indicated due to a variety of factors such as re-flooding of the work area, equipment access issues across original creek channels and irregular bottoms, and a potentially extended re-filling time after excavation is completed. Since the preliminary cost range is more than double the estimated cost of a complete hydraulic dredging project per million gallons, combined with the environmental and climatic risks briefly described above, a large-scale dry mechanical dredging project is not recommended for the purpose of reservoir capacity increase.

In addition to the above recommendations, a brief analysis was conducted to evaluate how the aggressive implementation of Watershed Best Management Practices would benefit both lakes by reducing soil erosion and associated sediment/nutrient loads. According to the Draft Watershed

Plan (2020), annual sediment loads were estimated to be approximately 21,278 tons/year for Lake Bloomington and 14,076 tons/year for Evergreen Lake.

If a 40 percent reduction is achieved for both lakes, the annual sediment load would be reduced by approximately 14,000 tons or an estimated 25,900 cubic yards of annual sediment deposition (measured in-situ). This reduction in sediment deposition would preserve approximately 5.23 million gallons of storage capacity annually or 52.3 million gallons over a 10-year period, in addition to reducing phosphorus loads and improving water quality. Therefore, it is highly recommended that implementing Best Management Practices as recommended in the current Watershed Plan should be prioritized.

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