



INDIANA DEPARTMENT OF
NATURAL RESOURCES

Lake Manitou Dam and Spillway Upgrade



Rochester Indiana

1828 to 2017



Project Background

Location: Rochester Indiana, Central Northern Indiana.

Primary purpose, At Construction:

Hydropower mill operations;

Recently:

Recreational use only

Dam: completion date 1827

Height: 10 feet

Dam length 400 feet

Maximum storage 3,875 Ac-Ft

Surface area 775.0 acres

Crest width: 10 feet

Drainage area 44.2 square miles

Owner: City of Rochester,

1992 maintance agreement with IDNR

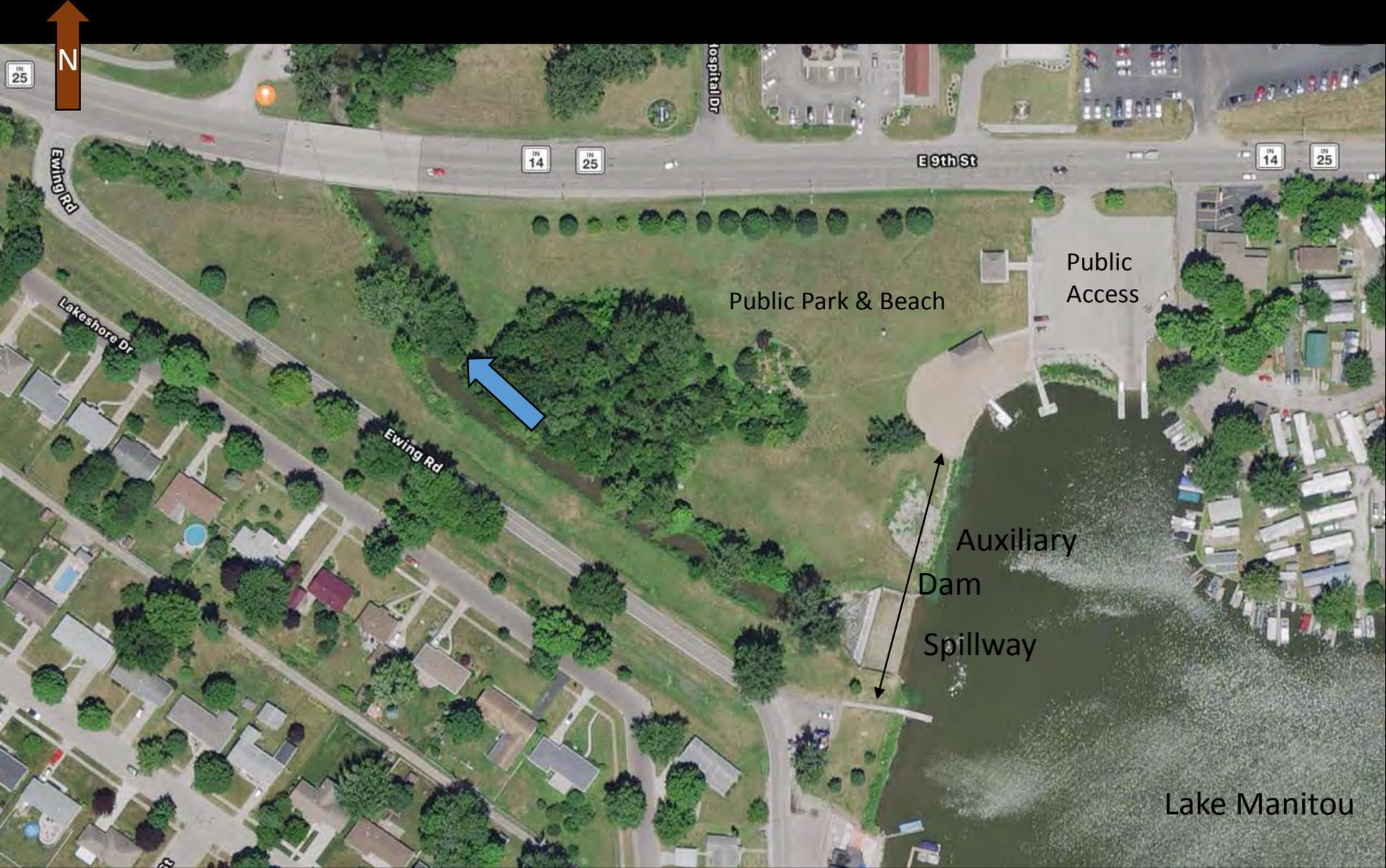


Lake Manitou Dam, 190 Years, History

LAKE MANITOU AND TIPTONVILLE

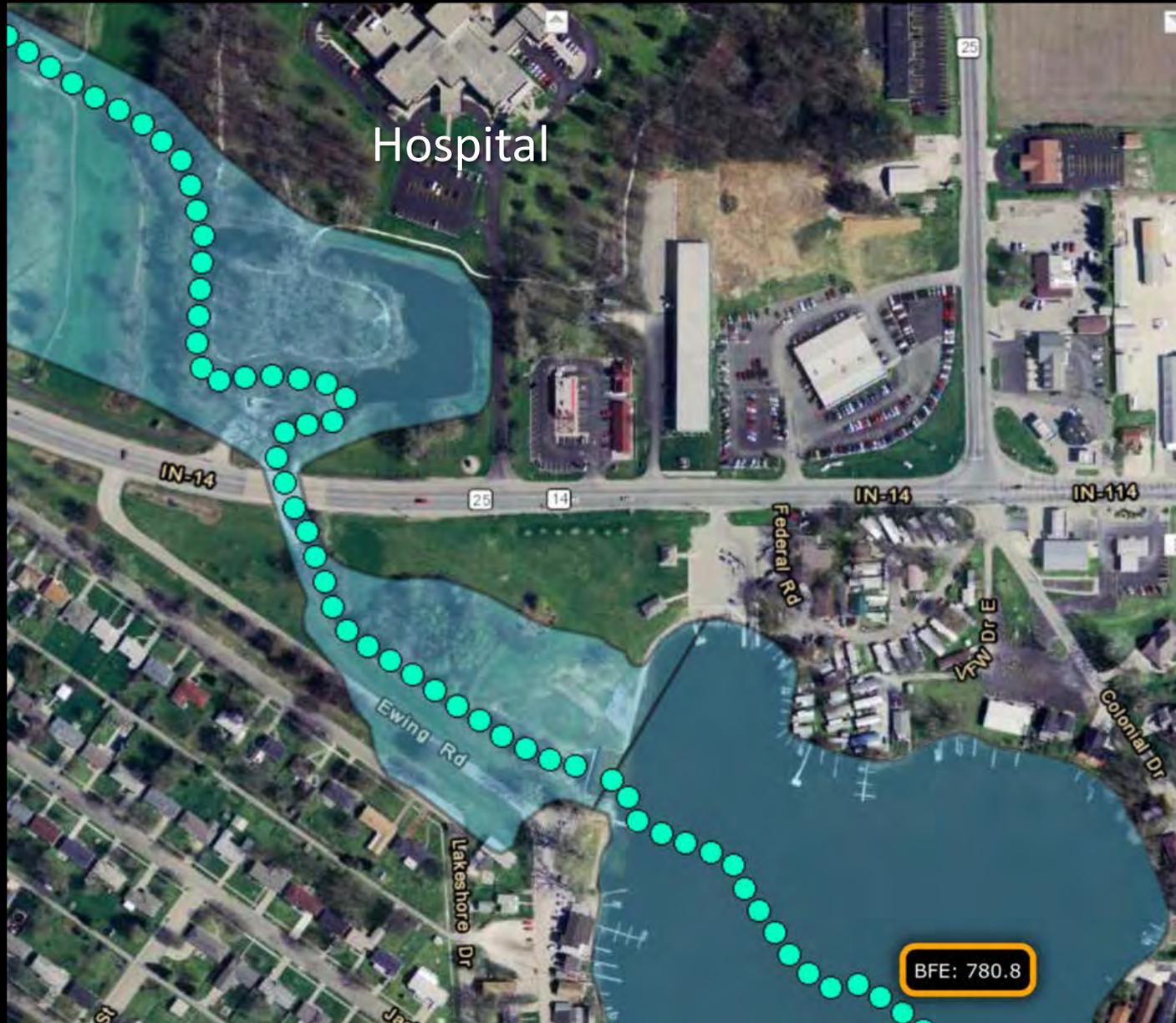
On this site in the summer of 1827, a grist mill was constructed by the U.S. government to grind corn for the Potawatomi Indians under terms of an 1826 treaty. To obtain water power, a dam was built near its present location. This flooded the area surrounding five lakes and formed Lake Manitou of 775 acres. Near the mill were erected a blacksmith shop, trading post and houses for miller and blacksmith. It was the first white settlement of the wilderness that became Fulton county in 1836. Samuel Milroy, builder, named the village Tiptonville in honor of Gen. John Tipton, Indian agent for the region. The dam, mill and village fell into disuse after the Potawatomi were removed to Kansas in 1838. Lake Manitou, also Manatau or Manitau, derives its name from the Potawatomi word used both for "good spirit" and "evil spirit". The Indians, who fished and hunted in this area for 150 years, believed the lake's waters held a monster fish or serpent of supernatural powers. Early settlers knew the lake as Devil's Lake.

Key Elements Reference Map



Indiana Floodplain Information Portal

indnr.maps.arcgis.com



Flood of Record*

Flood Event: August 18 – 23, 1990

Crest 780.87, NGVD '29 = 780.46' NAVD '88

Secondary Event, December 1990

Crest 780.04' NGVD'29 = 779.63' NAVD'88

Court Established level is 778.41' NGVD '29 = 778.0' NAVD '88

Weir Design Level (average of preexisting) 778.12' NGVD '29 = 777.71' NAVD '88

Auxiliary Spillway Design Level 779.71' NGVD '29 = 779.3' NAVD '88

Crest of North Embankment 780.5' NAVD '88

**Design and NFIP maps are based on the NAVD '88 Datum*

USGS data records and Court Establishment are based on NGVD '29 Datum. 0.41' larger value than NAVD '88

Agreement, City of Rochester and IDNR

February 1991

City of Rochester and the Department of Natural Resources.

The Department “assumes the sole responsibility for the revisions, maintenance, and repair of the control section and the repair of the adjoining embankments of the structure.” Further, the Department “will design, construct and fund the necessary revisions... [for] a control section and adjoining embankments.”

The City agrees to be responsible for all annual routine maintenance..... In the agreement the City is also to provide ingress and egress to the Department.

Response: Winter 1991-1992 Repairs Recent History



IEAP, Compiled, 2014, Presented to the City Summer of 2015

Indiana Office of Community and Rural Affairs Grant

LAWSON-FISHER ASSOCIATES, P.C.
 525 WEST WASHINGTON AVENUE
 SOUTH BEND, INDIANA 46601

Job #: 201341.00 Sheet: 1 of 1
 Designed by: SKM Date: 11/1/2013
 Checked by: _____ Date: _____

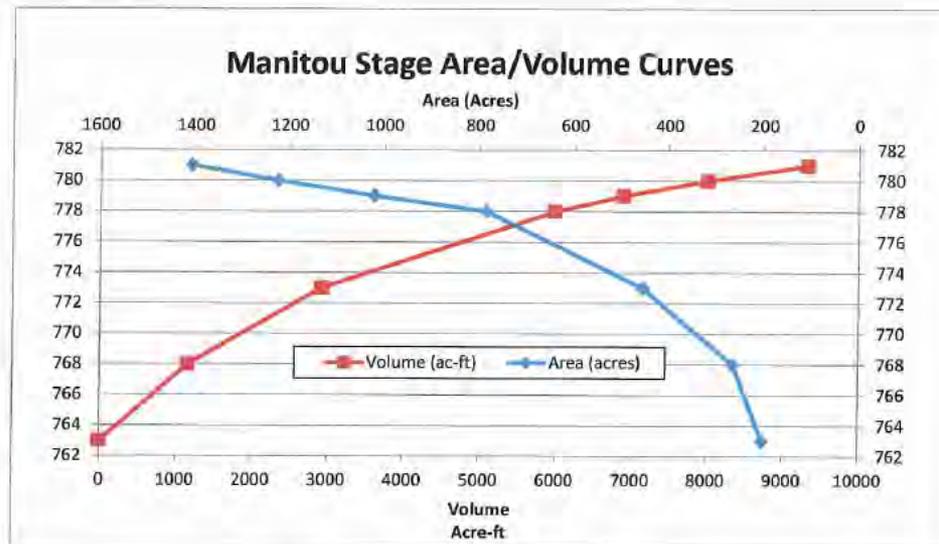
Project: Lake Manitou Dam - Inundation Mapping Subject: Stage-Storage Calculations

Lake Manitou Dam Stage-Storage Data

Elevation	Area (acres)	ΔV (ac-ft)	Volume (ac-ft)
763.00	201.30	0.00	0.00
768.00	263.10	1157.56	1157.56
773.00	453.90	1770.96	2928.51
778.00	785.00	3059.70	5988.21
779.00	1020.90	900.37	6888.58
780.00	1223.80	1120.82	8009.40
781.00	1405.90	1313.80	9323.20

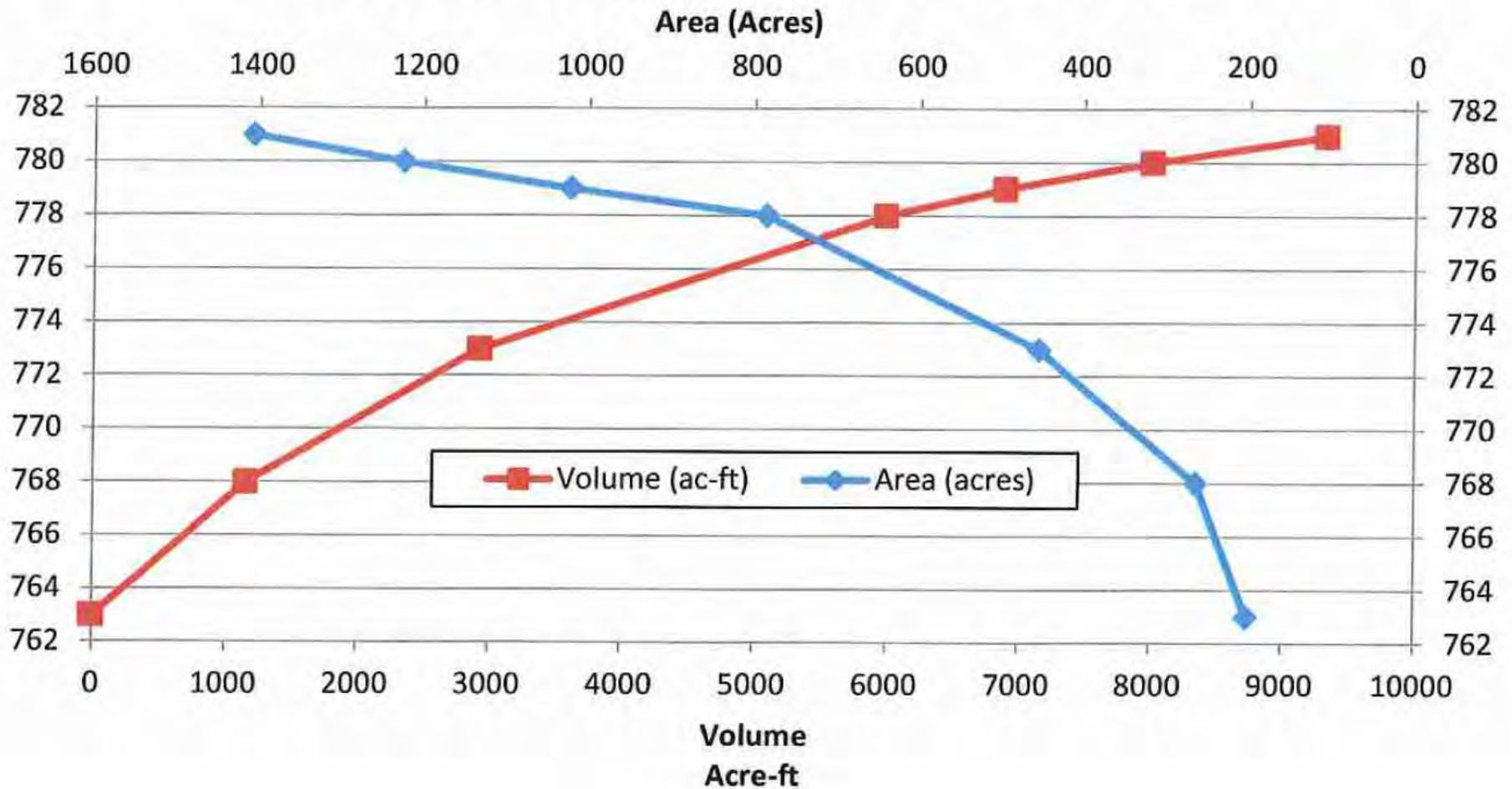
(Embankment Crest)

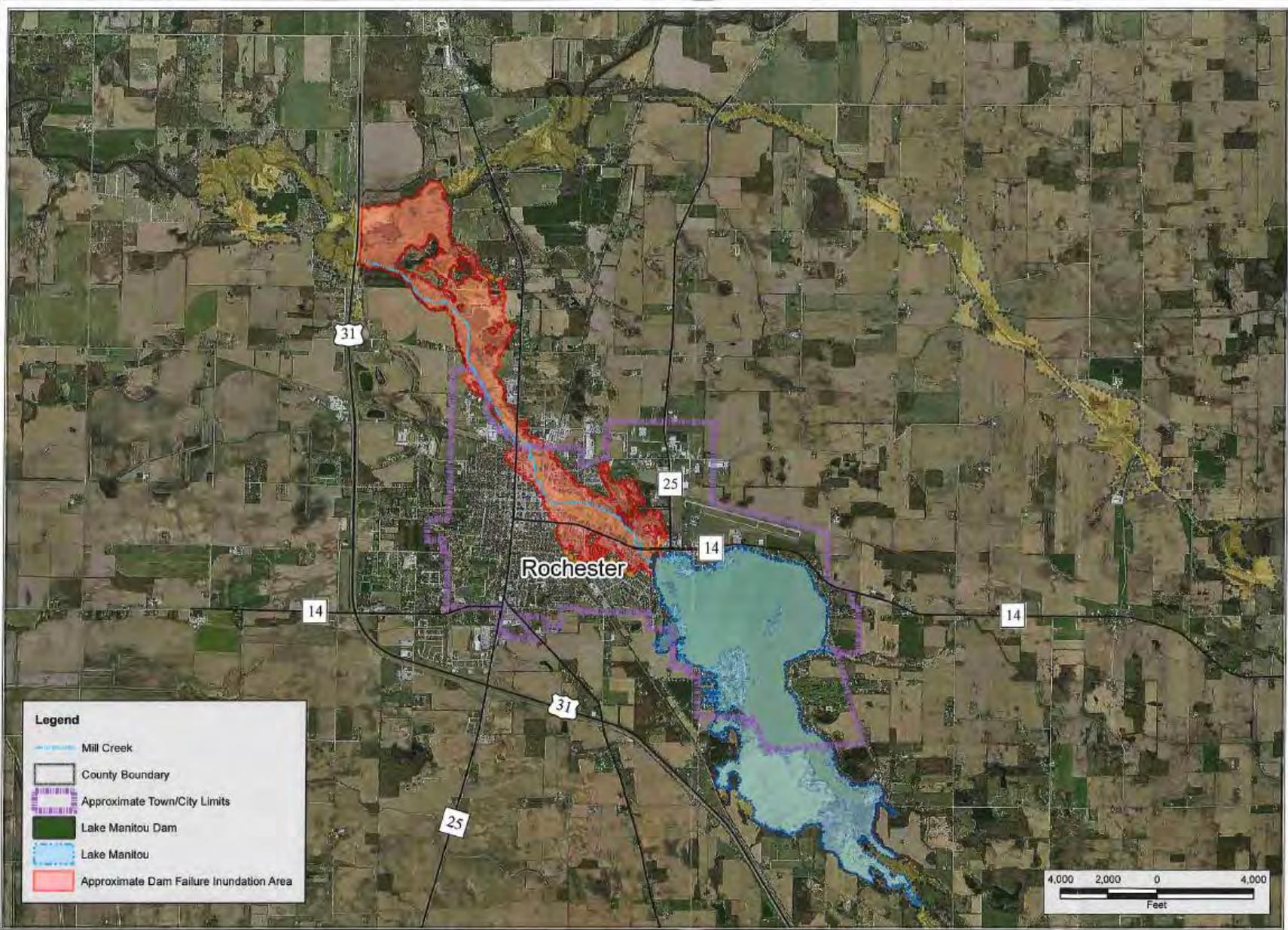
By Conic Method: $\Delta V_{12} = \frac{h}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$



IEAP, breach analysis completed in 2014 and presented to the City in the 2015

Manitou Stage Area/Volume Curves





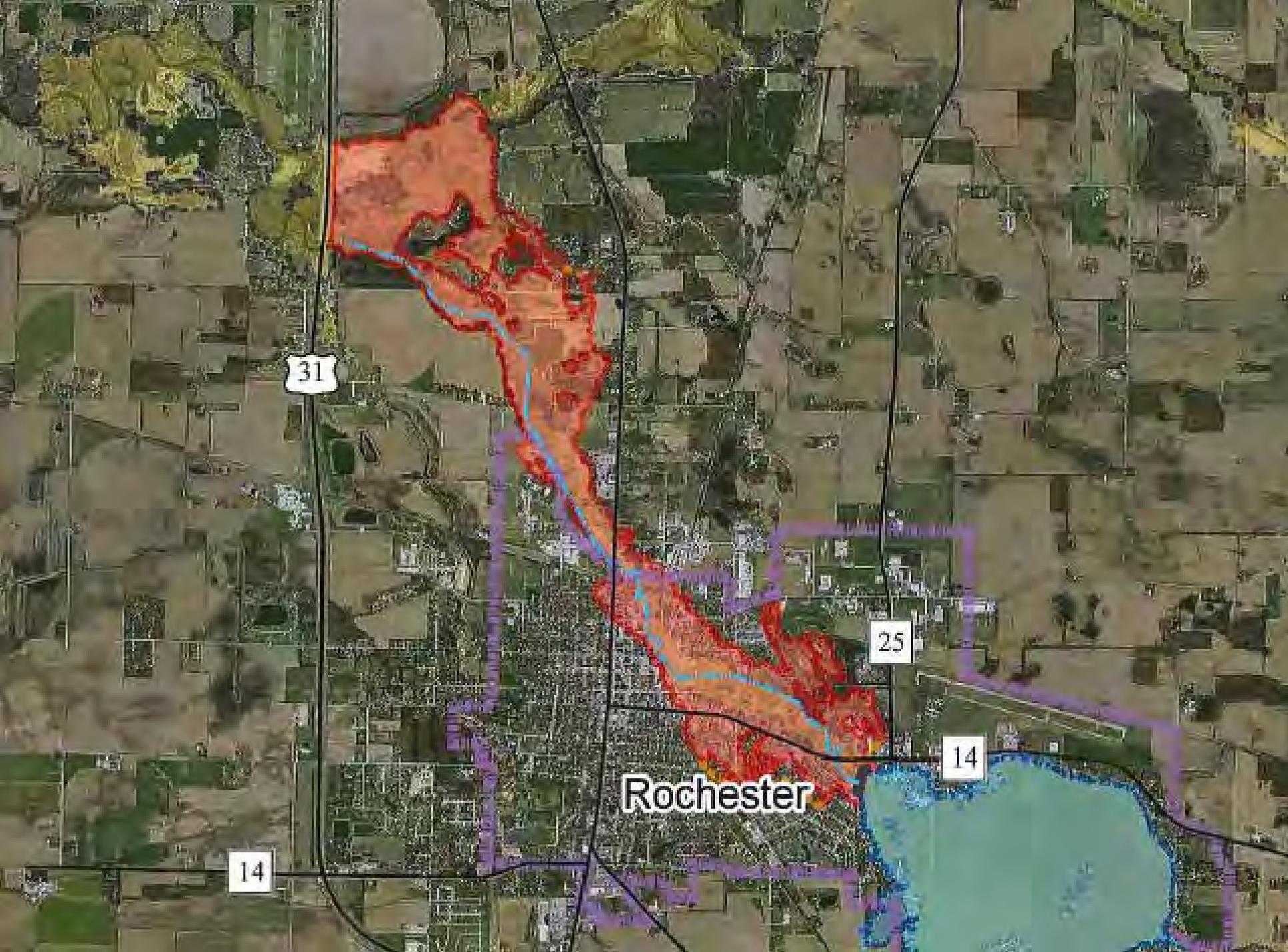
Legend

-  Mill Creek
-  County Boundary
-  Approximate Town/City Limits
-  Lake Manitou Dam
-  Lake Manitou
-  Approximate Dam Failure Inundation Area



LFAW
 LAWSON FISHER ASSOCIATES P.C.
 525 W WASHINGTON AVENUE
 SOUTH BEND, INDIANA 46601
 PH. (574) 234-3167

Figure 3
 201341.00
 April 2014



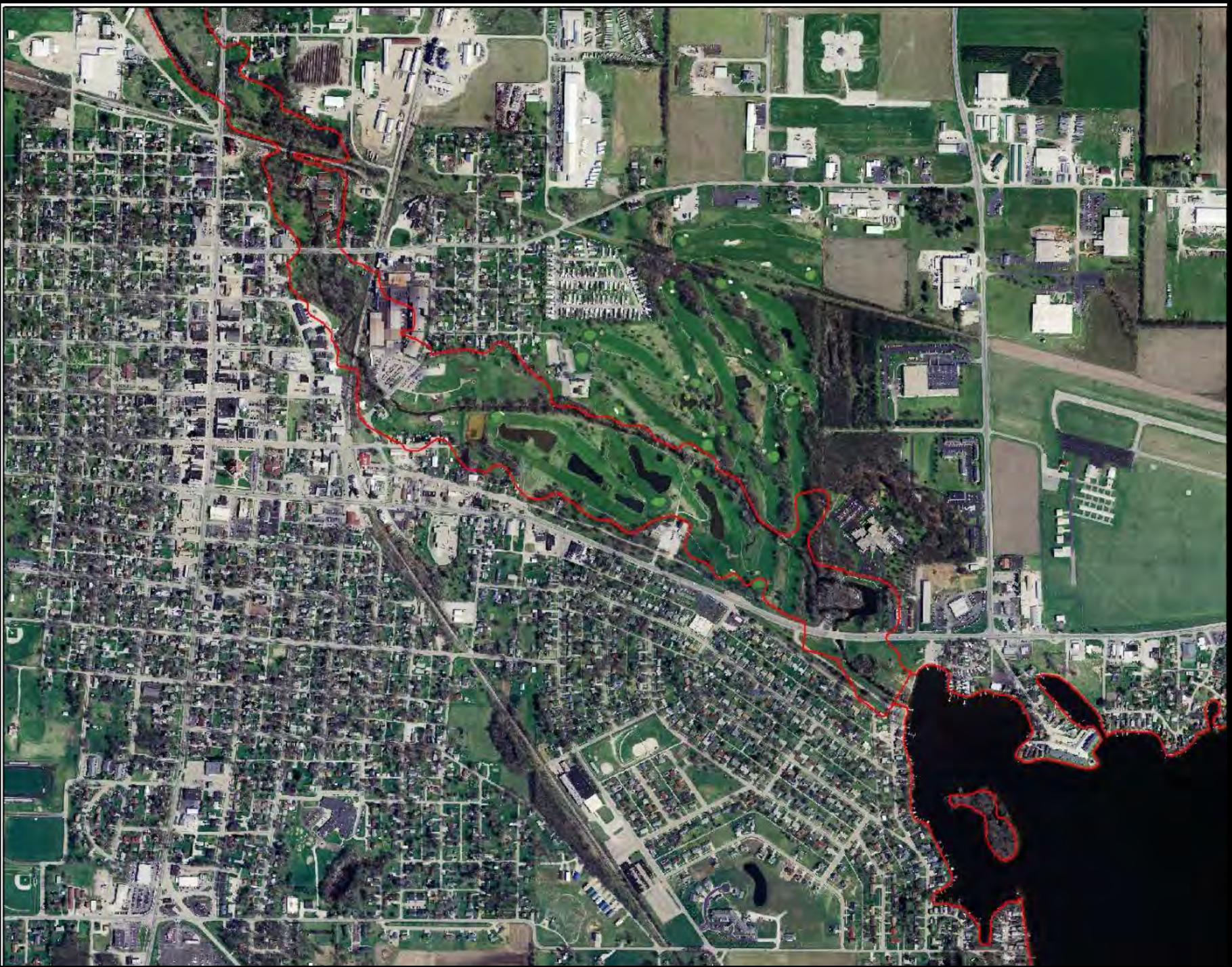
31

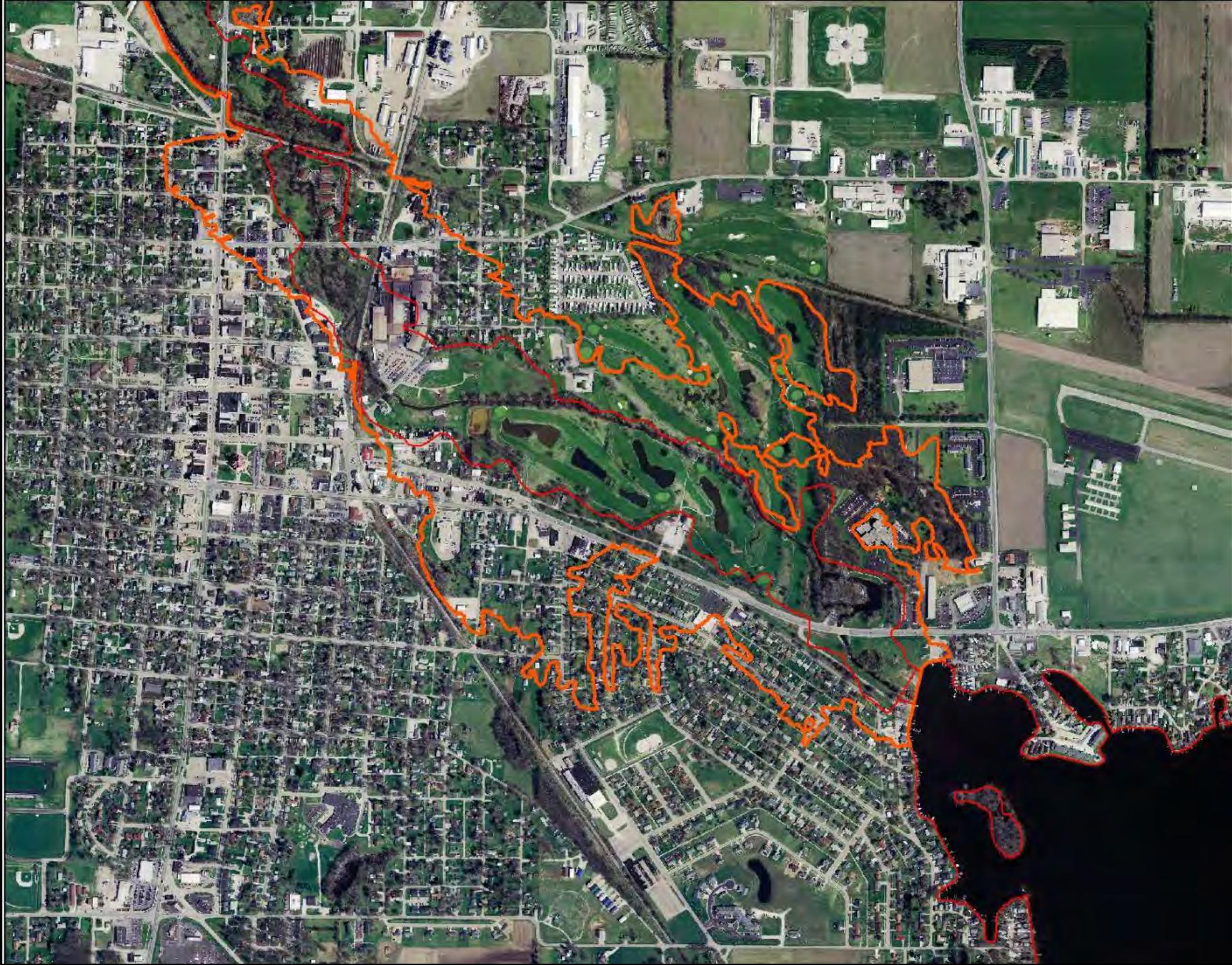
25

14

Rochester

14





2015 Brush Clearing

North Embankment, Before



Auxiliary Spillway

Spillway
North fence

2015 Brush Clearing

North Embankment, After



August 2015, Before Brush Clearing,
During Geotechnical Data Collection



April 2016, After Brush Clearing,



August 2015, Before Brush Clearing,
During Geotechnical Data Collection



September 2015, After Brush Clearing



September 2015, After Brush Clearing

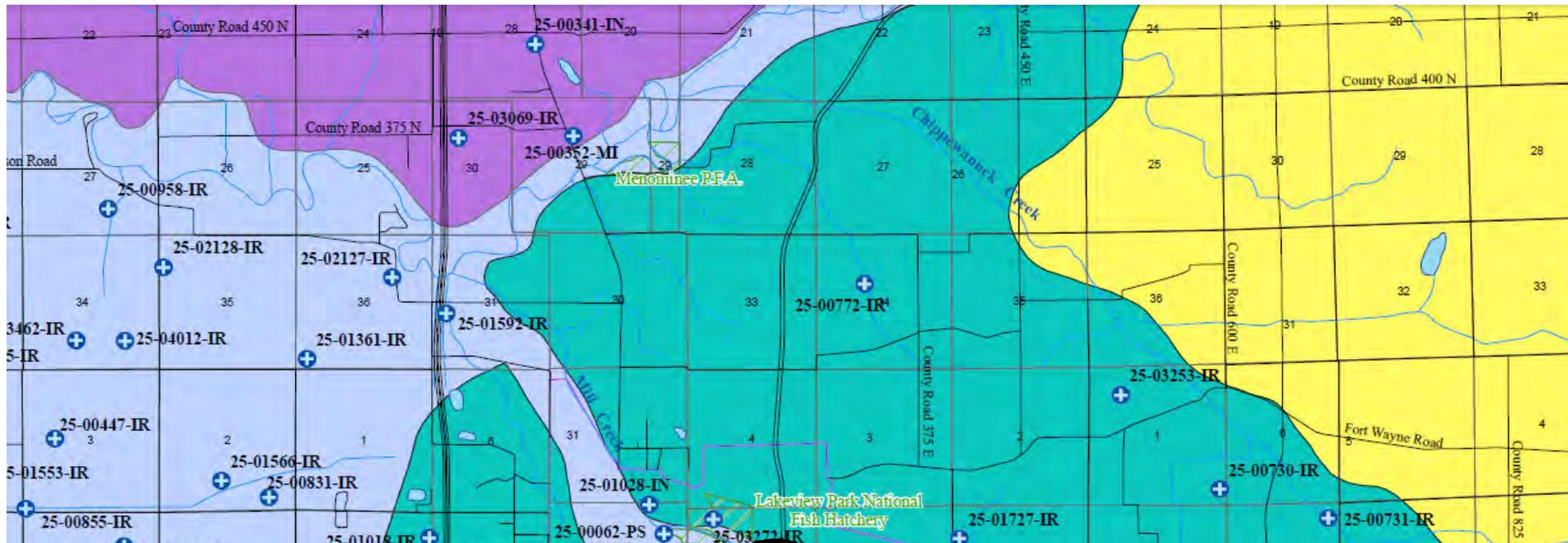


September 2015, After Brush Clearing



September 2015, After Brush Clearing





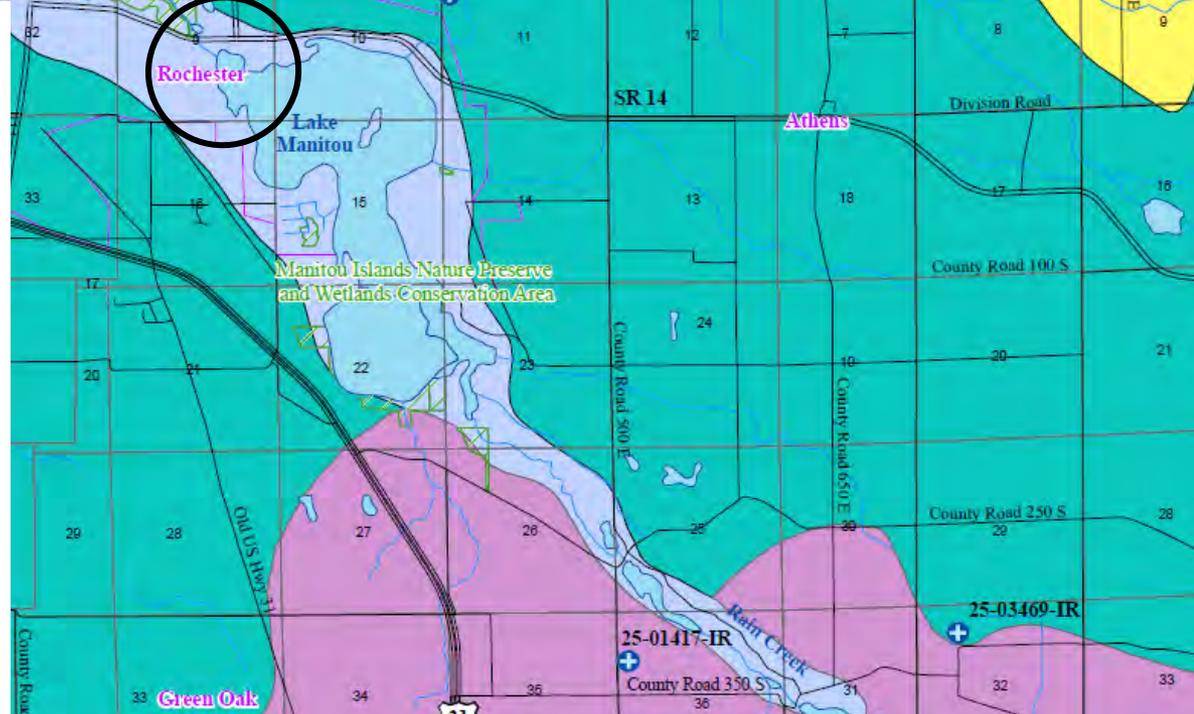
 **Wabash River and Tributaries
Outwash Aquifer System**

The Wabash River and Tributaries Outwash Aquifer System is the most prolific aquifer system mapped in Fulton County. The system is made up of thick, glacially derived outwash deposits along a broad outwash plain in the central part of the county. The system also includes valley train and recent alluvial deposits along Rain Creek to the south, Lake Manitou southeast of Rochester and the Tippecanoe River floodplain to the north.

Well depths range from 25 to 156 feet below surface with up to 110 feet of continuous sand and gravel. However, typical well depths are 50 to 85 feet. In places, aquifer materials are capped by silt or sandy clay ranging from 10 to 30 feet thick. In addition, aquifer sand and gravel deposits may include discontinuous clay, sandy clay or gravelly clay deposits 5 to 25 feet thick.

The Wabash River and Tributaries Outwash Aquifer System is capable of meeting the needs of domestic and high-capacity users. Domestic wells are commonly 10 to 60 gpm with static water levels commonly 4 to 20 feet below surface. Some flowing wells are reported. There are 44 registered significant ground-water withdrawal facilities (53 wells) in the outwash system in Fulton County. Well yields range from 80 to 2000 gpm.

Areas that lack overlying clay or silt deposits are highly susceptible to contamination. However, where overlying clay or silt deposits are present the system is moderately susceptible to surface contamination.

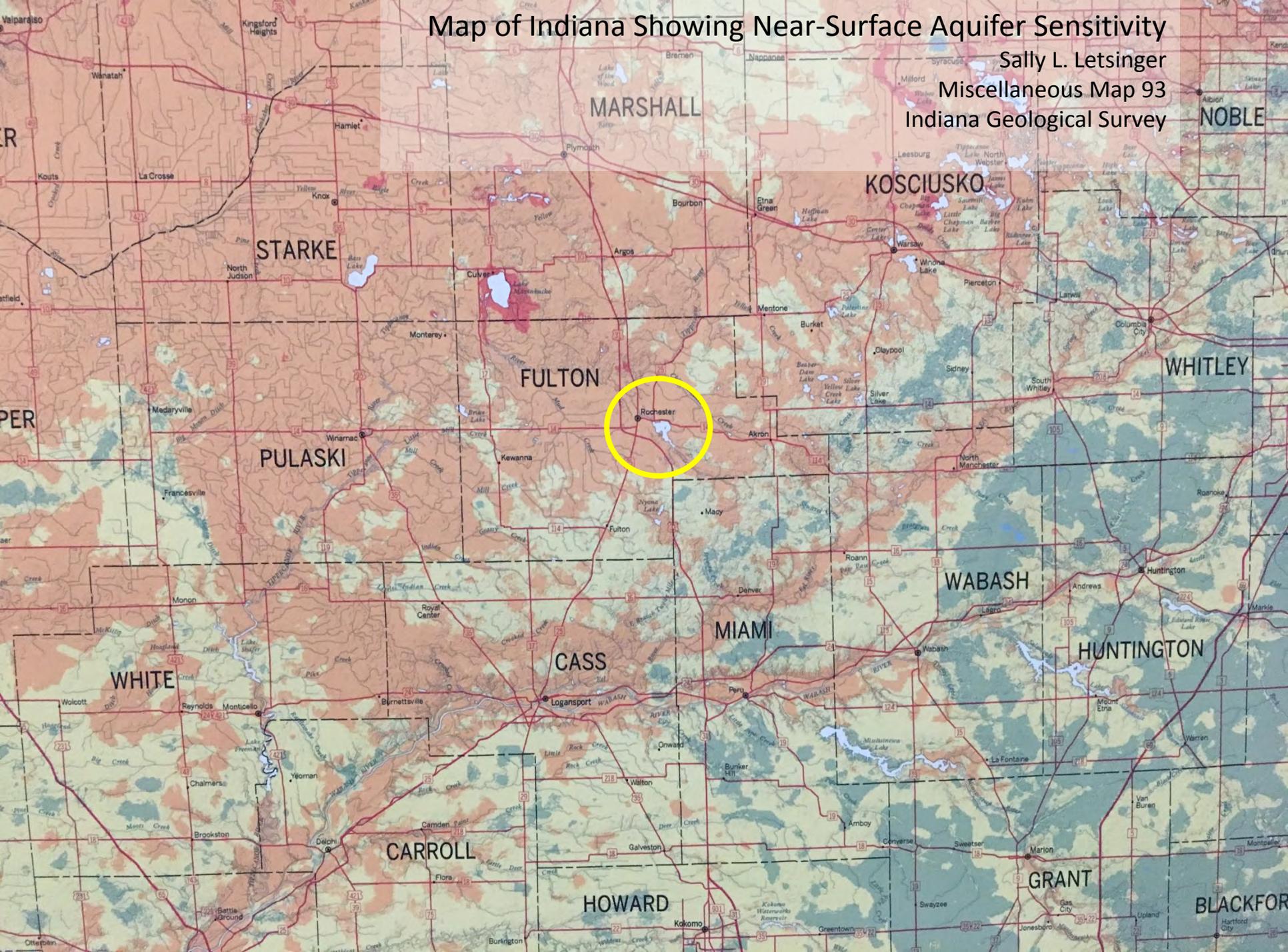


Map of Indiana Showing Near-Surface Aquifer Sensitivity

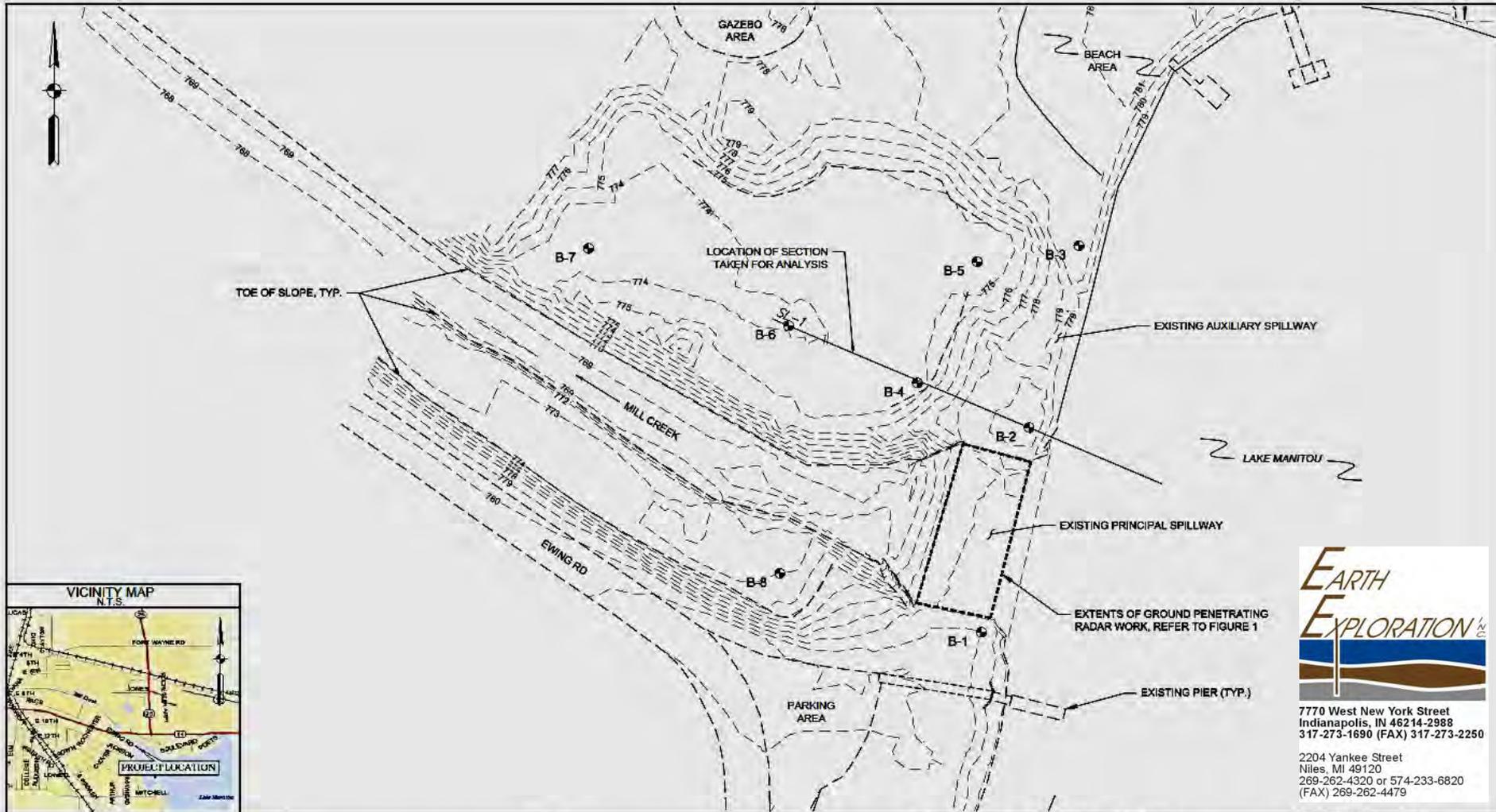
Sally L. Letsinger

Miscellaneous Map 93

Indiana Geological Survey



Geotechnical Evaluation, 2015



7770 West New York Street
 Indianapolis, IN 46214-2988
 317-273-1690 (FAX) 317-273-2250

2204 Yankee Street
 Niles, MI 49120
 269-262-4320 or 574-233-6820
 (FAX) 269-262-4479

LEGEND	NOTES	TEST BORING LOCATION PLAN	PROJECT ENG: SEB
<p>B-1 Test Boring Location and Designation</p>	<ol style="list-style-type: none"> 1. Base map developed from an electronic file provided by Lawson-Fisher Associates P.C. on September 8, 2015. 2. Vicinity map generated using commercially-available software by DeLorme (Street Atlas USA ver. 8.0). 3. Borings were located in the field by Earth Exploration, Inc. on August 13, 2015. 4. Horizontal and vertical location of the test borings were obtained by Lawson-Fisher Associates P.C. 	<p>PROJECT: Lake Manitou Dam and Spillway Improvements LOCATION: Rochester, Indiana CLIENT: Lawson-Fisher Associates P.C. EEJ PROJECT NO.: 1-15-324 SCALE: 1" = 50'</p>	<p>APPROVED BY: MSW DRAWN BY: JBF DATE AND TIME: 9/9/15 DRAWING NO.: 1-15-324.B1</p>





LOG OF TEST BORING

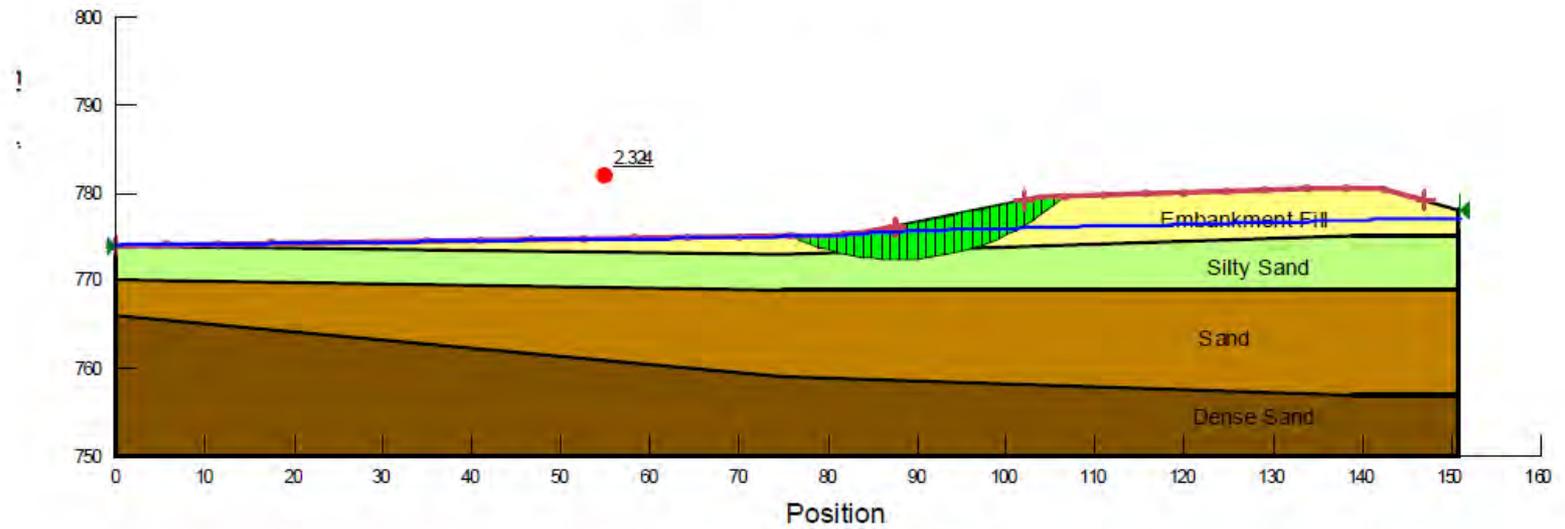
Project **Lake Manitou Dam & Spillway Improvements**
 Location **Rochester, Indiana**
 Client **Lawson-Fisher Associates P.C.**
 7770 West New York Street - Indianapolis, Indiana 46214
 317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-2**
 Elevation **780.5**
 Datum **NAVD 88**
 EEI Proj. No. **1-15-324**
 Sheet **1** of **1**

Project No. **---** Station **---** Weather **Partly Cloudy** Driller **C.H.**
 Struct. No. **---** Offset **---** Temp. **---** Inspector **---**

SAMPLE				DEPTH ft Elev	DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES																			
No.	T V C B	Rec %	Blow Counts			q _p tsf	q _u tsf	LOI %	W %	LL %	PL %	PI %													
SS-1		65	14-17-11-6	780		SP-SM, FINE TO MEDIUM SAND , some gravel, medium dense, moist, brown (fill)																			
SS-2		65	12-9-6-6				SP-SM, FINE TO MEDIUM SAND , trace gravel, medium dense, moist, brown (fill)																		
SS-3		65	2-5-4-5	775				SM, SILTY SAND , trace gravel, loose to very loose, moist, brown, P ₂₀₀ = 18.0 percent (fill)					NP	NP	NP										
SS-4		65	1-1-1-1						SM, ORGANIC SILTY SAND , trace gravel, very loose to loose, wet, dark gray, with organic matter, with peat and marl layers from 7 to 10 ft, SS-5: P ₂₀₀ = 32.5 percent		15.7	28.5													
SS-5		65	1-1-1-1							SM, ORGANIC SILTY SAND , trace gravel, very loose to loose, wet, dark gray, with organic matter, with peat and marl layers from 7 to 10 ft, SS-5: P ₂₀₀ = 32.5 percent		15.2	32.9	NP	NP	NP									
SS-6		65	1-2-5-5	770							SM, ORGANIC SILTY SAND , trace gravel, very loose to loose, wet, dark gray, with organic matter, with peat and marl layers from 7 to 10 ft, SS-5: P ₂₀₀ = 32.5 percent		9.8	109.9											
SS-7		65	5-6-9-9									SM, ORGANIC SILTY SAND , trace gravel, very loose to loose, wet, dark gray, with organic matter, with peat and marl layers from 7 to 10 ft, SS-5: P ₂₀₀ = 32.5 percent		2.9	32.0										
SS-8		65	3-4-7-7	765									SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray												
SS-9		65	2-4-6-6											SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray											
SS-10		65	3-4-5-5												SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray										
SS-11		65	4-6-7-7	760												SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray									
SS-12		65	6-7-9-9														SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray								
SS-13		65	9-12-14-12	755														SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray							
SS-14		65	4-8-10-11																SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray						
SS-15		65	4-9-8-10																	SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray					
				30	SW-SM, FINE TO MEDIUM SAND , some gravel, medium dense, wet, gray																				
End of Boring at 30 ft																									

Lake Manitou Dam



Name: Embankment fill Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Silty Sand Unit Weight: 110 pcf Cohesion: 0 psf Phi: 28 °
Name: Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Dense Sand Unit Weight: 120 pcf Cohesion: 0 psf Phi: 32 °

Figure 3. Slope Stability at Normal Pool

Concrete Spillway Evaluation, 2015

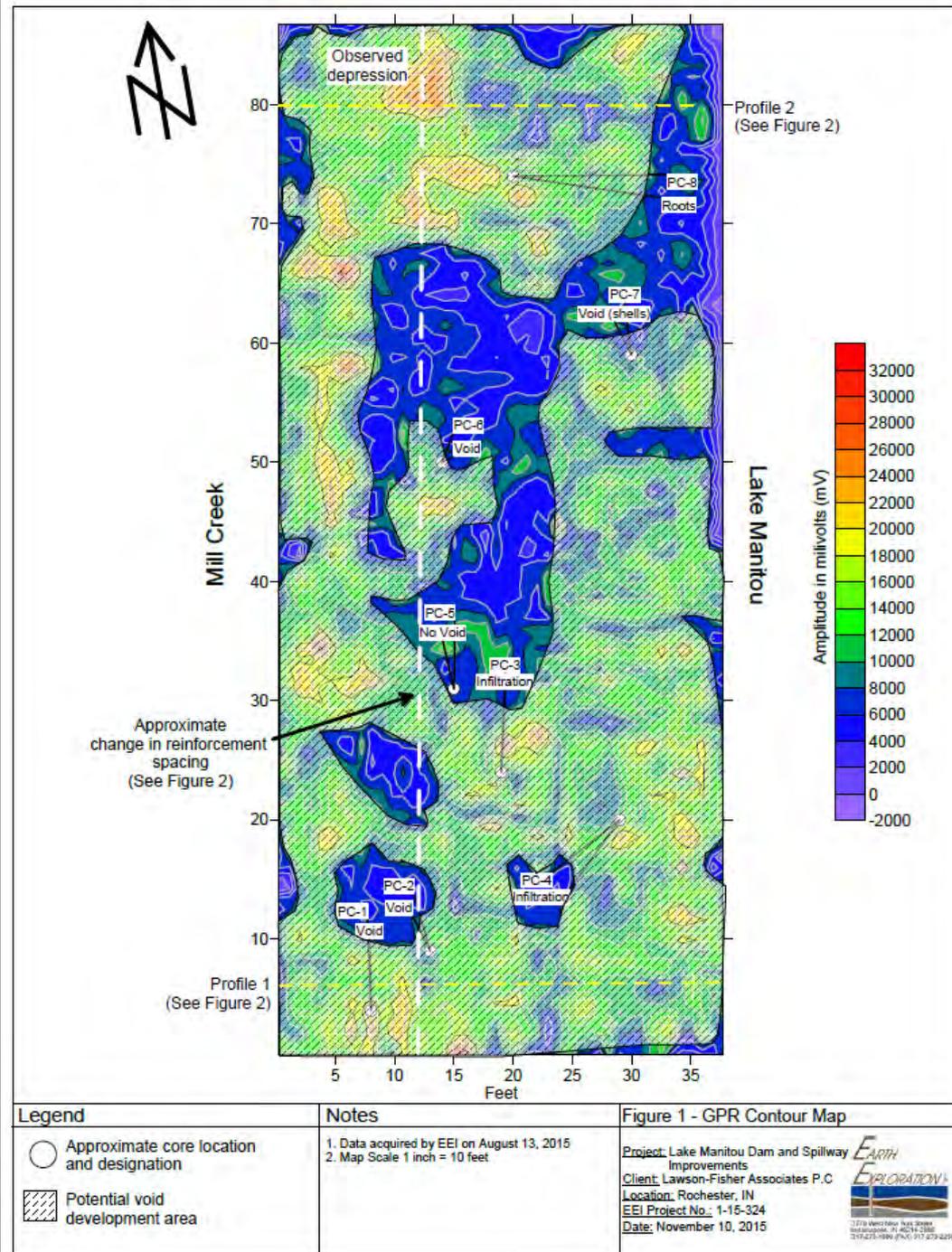


SUMMARY OF CONCRETE CORES

Project: Lake Manitou Dam and Spillway Improvements
Location: Rochester, Indiana
Client: Lawson-Fisher Associates P.C.
EEl Project No.: 1-15-324

Page 3 of 4

Core Designation, Location and Description (in.)	Photograph
PC-5 0-8 1/4" 8 1/4" Portland Cement Concrete Sandy gravel with cobbles near 12 in.	
PC-6 0-9 1/2" 9 1/2" - 11" Portland Cement Concrete with 0.5 in. diameter rebar at 7 in. Void Sandy gravel	



Design Plans, 2016

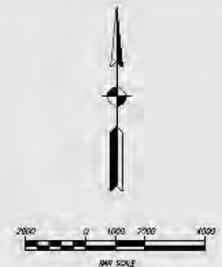
INDIANA DEPARTMENT OF ADMINISTRATION (IDOA)
 INDIANA DEPARTMENT OF NATURAL RESOURCES (IDNR)
 DIVISION OF WATER

PROJECT No. E06-0068
LAKE MANITOU - OUTLET STRUCTURE AND DAM REPAIR
 ROCHESTER TWP, FULTON COUNTY, INDIANA

SE 1/4, SECTION 9, T-30N, R-3E



LOCATION MAP
 SCALE 1" = 2000'



DRAWING INDEX

SHEET	DESCRIPTION
1	TITLE SHEET
2	EXISTING SITE PICTURES
3	EXISTING SITE PLAN AND GENERAL NOTES
4	PROPOSED SITE PLAN
5	OUTLET STRUCTURE PLAN
6-B	DETAILS
9	CROSS SECTIONS
10	TEMPORARY EROSION CONTROL PLAN

LF&A
LAWSON-FISHER ASSOCIATES P.C.
 525 W. WASHINGTON AVENUE
 SOUTH BEND, INDIANA 46601
 PH. (574) 234-3167



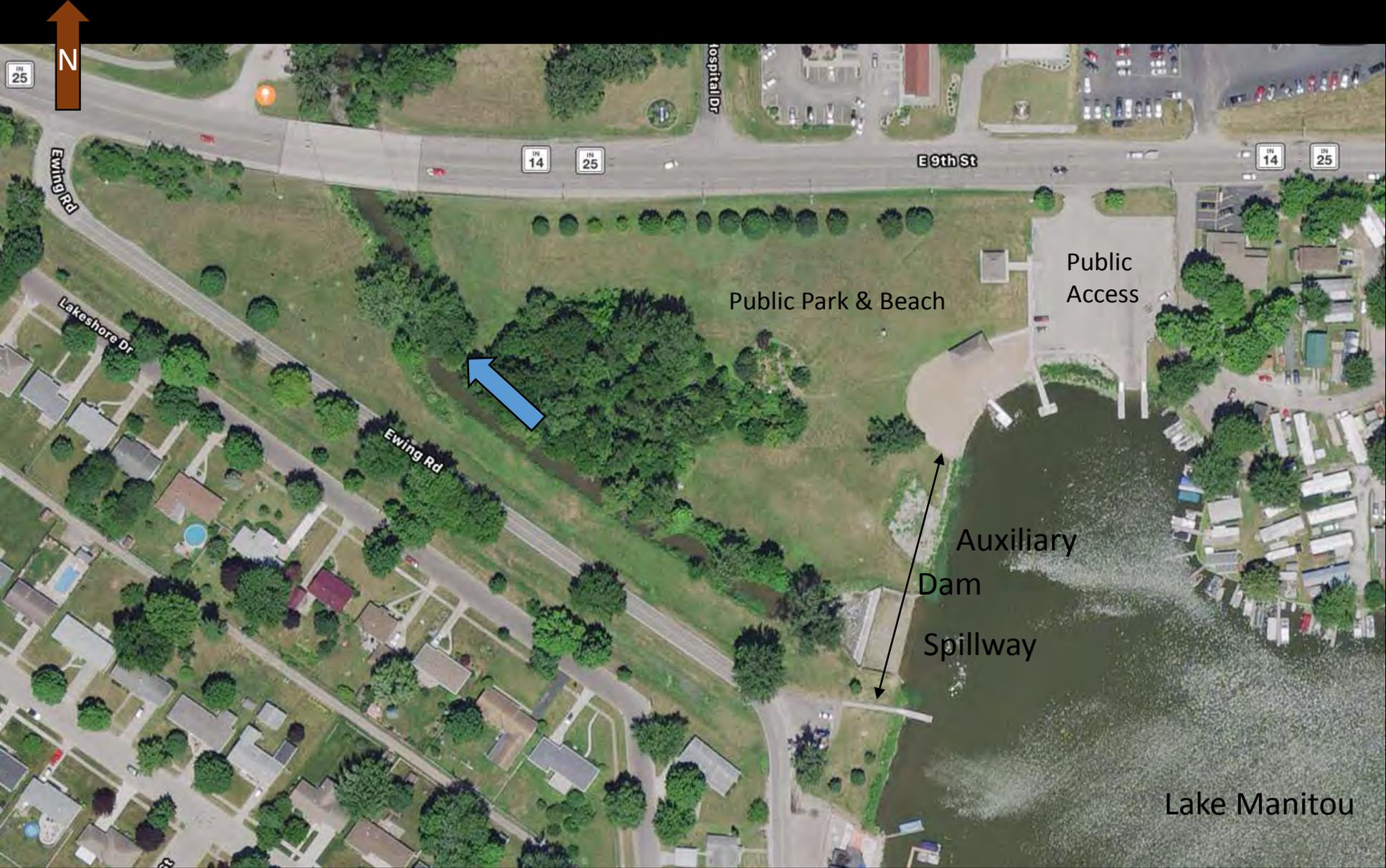
Jay K. Madson 08/22/16
 SIGNATURE DATE

INDIANA DEPARTMENT OF NATURAL RESOURCES
 LAKE MANITOU
 OUTLET STRUCTURE AND DAM

TITLE SHEET

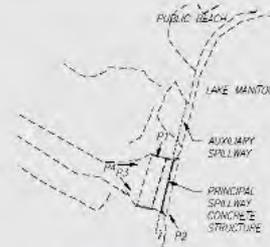
REVISIONS	HORIZONTAL SCALE NOTED	PROJECT NUMBER E06-0068
DRAWN: BJT	VERTICAL SCALE	SHEETS
CHECKED: SKM	SURVEY BOOK	1 OF 10
	DATE AUGUST 2016	

Key Elements Reference Map





PICTURE P1
OUTLET STRUCTURE
LOOKING SOUTH



PHOTOGRAPH ORIENTATION
DIAGRAM



PICTURE P2
OUTLET STRUCTURE
LOOKING NORTH



PICTURE P3
SOUTH DOWNSTREAM
RETAINING WALL



PICTURE P4
NORTH DOWNSTREAM
ABUTMENT AREA

NOTE:
ALL PICTURES TAKEN IN DECEMBER 2015

LFAM
LAWSON-FISHER ASSOCIATES P.C.
525 W. WASHINGTON AVENUE
SOUTH BEND, INDIANA 46601
PH. (574) 234-3167



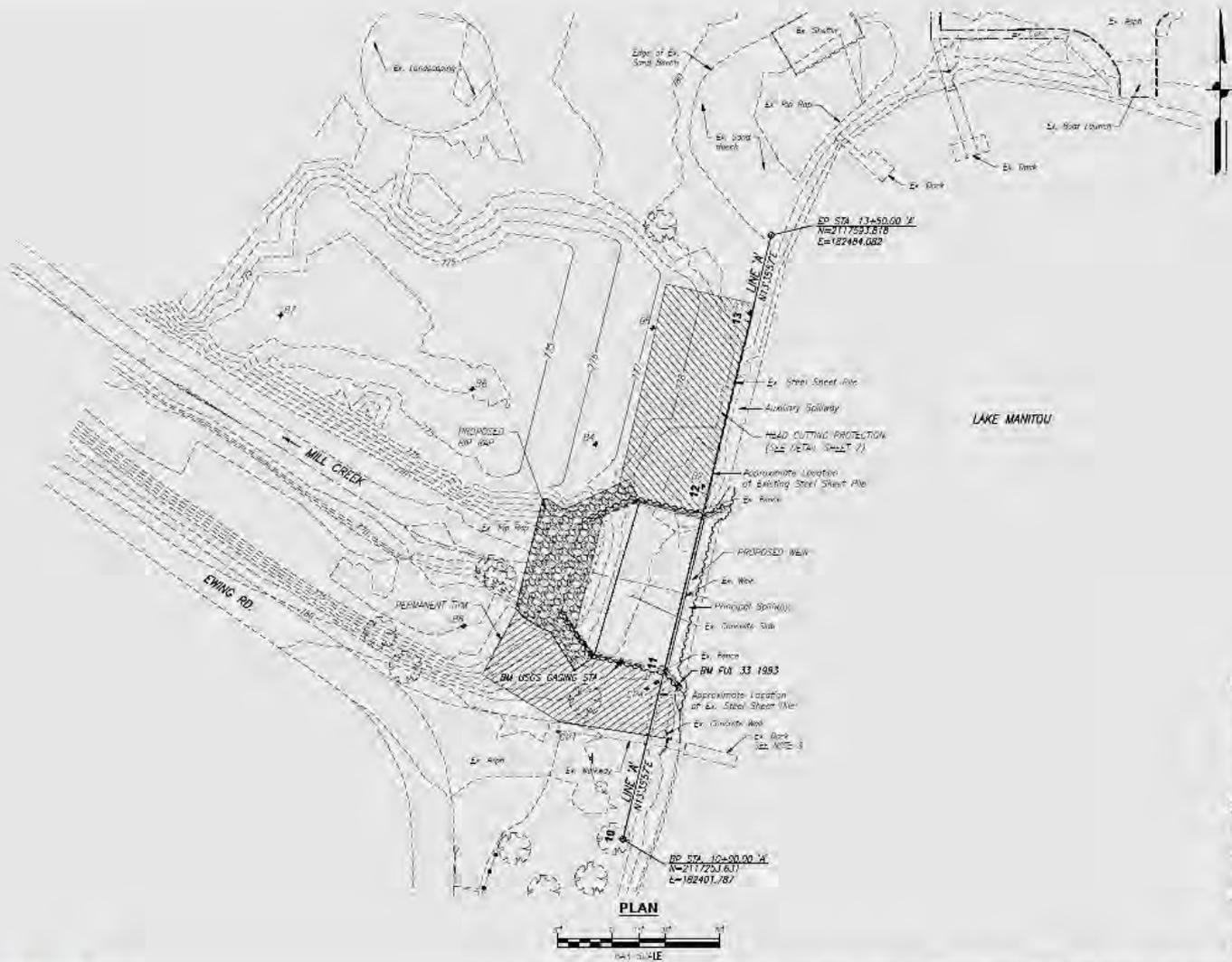
Jay K. Madson 08/22/15
REGISTERED PROFESSIONAL ENGINEER
STATE OF INDIANA
No. 117099

INDIANA DEPARTMENT OF NATURAL RESOURCES
LAKE MANITOU
OUTLET STRUCTURE AND DAM

EXISTING SITE
PICTURES

DATE: 08/22/15	HORIZONTAL SCALE: N/A	PROJECT NUMBER: E06-0068
DRAWN: B.T.	VERTICAL SCALE: N/A	SHEET: 2 OF 10
REVISIONS:	DATE: 08/22/15	

D:\1 - 8/23/2016, 10:41 AM - I:\2015\201525_00_PAVE Dam\Photos\04\1\101_56\CLM\06\1\2200PH_04.dwg



PLAN

LEGEND:

-  HEAD CUTTING PROTECTION
-  RIBBAP
-  PERMANENT TRM

NOTES:

1. SEE SHEET 3 FOR GENERAL NOTES AND SURVEY INFORMATION.
2. SEE SHEETS 5 AND 6 FOR ADDITIONAL DETAILS AND SECTIONS.
3. EXISTING WORK TO BE REMOVED AND REPLACED AS NECESSARY.
4. CONTRACTOR SHALL COORDINATE ALL ACCESS LOGGINGS THROUGH THE DNR WHO WILL COORDINATE WITH THE VARIOUS OWNERS OF THE ACCESS LOGGINGS.
5. EXISTING RIBBAP DOWNSTREAM OF STEEL SHEETING IN AUXILIARY SPILLWAY TO BE REMOVED.

LFAM
LAWSON-FISHER ASSOCIATES P.C.
 525 W. WASHINGTON AVENUE
 SOUTH BEND, INDIANA 46501
 PH. (574) 234-3167

Professional Engineer Seal for **John K. Madson**, No. 111897, State of Indiana, Mechanical Engineering.

John K. Madson 08/22/18
 I - P - E

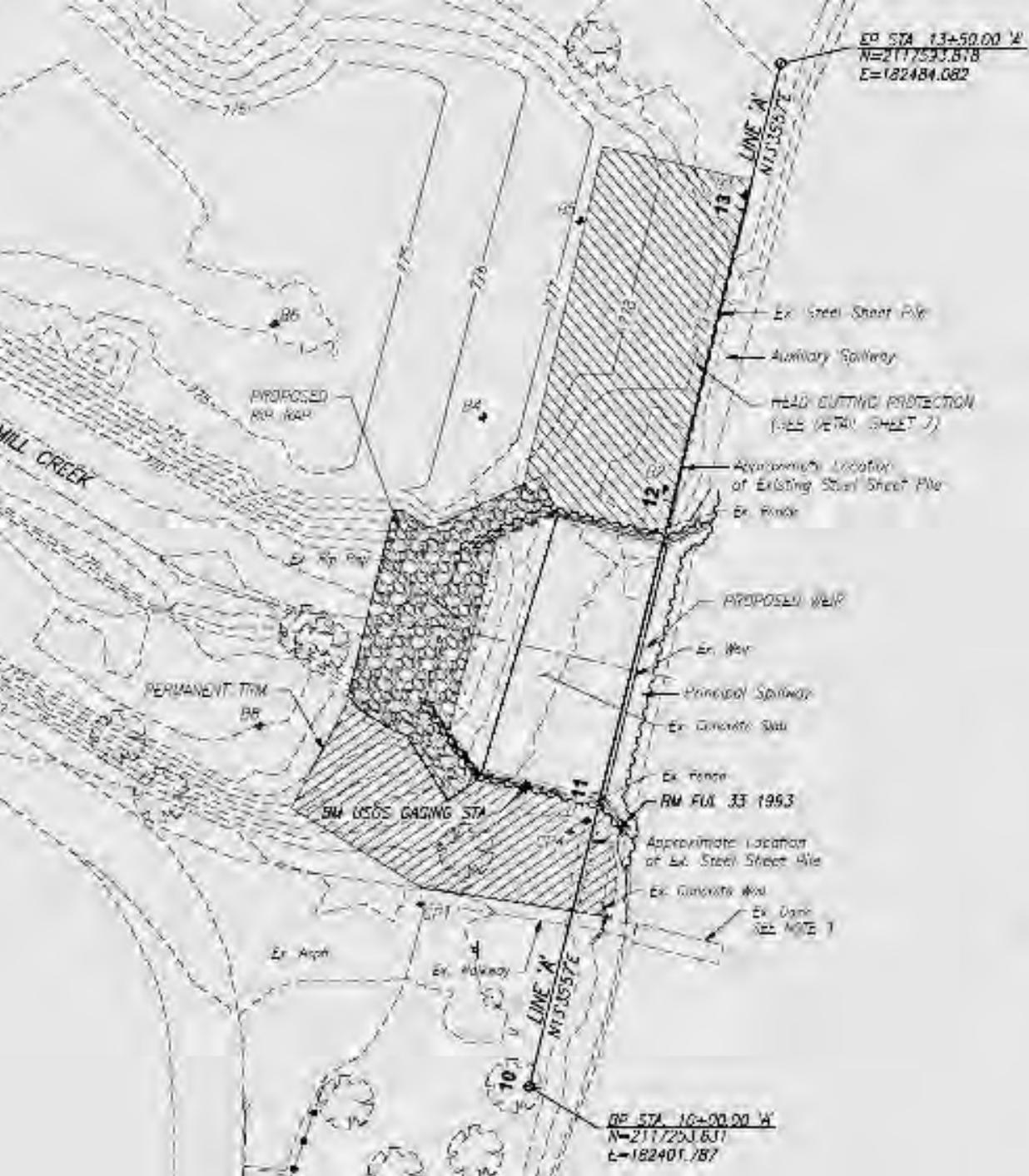
Christopher P. Co 08/22/18
 I - P - E

Professional Engineer Seal for **Christopher P. Co**, No. 111898, State of Indiana, Mechanical Engineering.

INDIANA DEPARTMENT OF NATURAL RESOURCES
**LAKE MANITOU
 OUTLET STRUCTURE AND DAM**

PROPOSED SITE
 PLAN

DATE	SCALE	PROJECT NO.
08/22/18	AS SHOWN	E06-0068
DESIGNED BY	CHECKED BY	SHEET
J. K. Madson	C. P. Co	4 OF 10



EP STA 13+50.00 W
 N=2117533.878
 E=182484.082

LAKE MANITOU

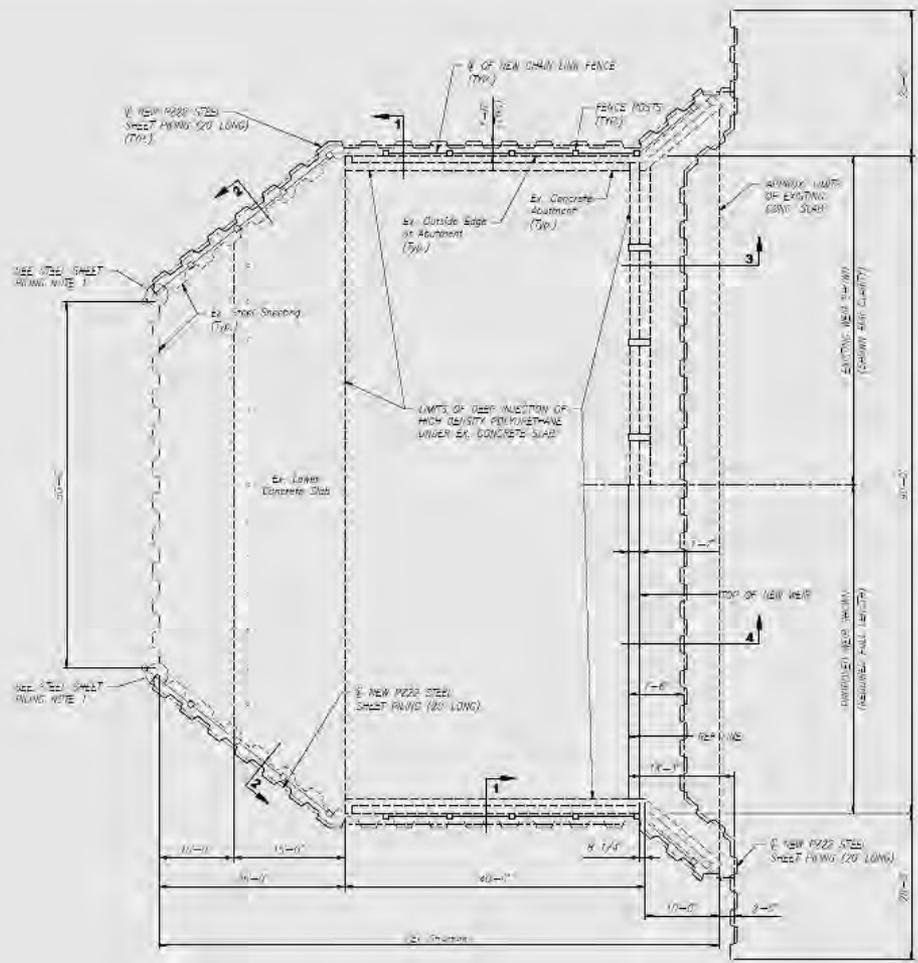
LEGEND:

-  HEAD CUTTING PROTECTION
-  RIRRAP
-  PERMANENT TRM

NOTES:

1. SEE SHEET 3 FOR GENERAL NOTES AND SURVEY INFORMATION.
2. SEE SHEETS 5 AND 6 FOR ADDITIONAL DETAILS AND SECTIONS.
3. EXISTING DAM TO BE REMOVED AND REPLACED AS NECESSARY.
4. CONTRACTOR SHALL COORDINATE ALL ACCESS LOCATIONS THROUGH THE IDNR WHO WILL COORDINATE WITH THE VARIOUS OWNERS OF THE ACCESS LOCATIONS.
5. EXISTING RM R&P DOWNSTREAM OF STEEL SHEETING IN AUXILIARY SPILLWAY TO BE REMOVED.

BP STA 10+00.00 W
 N=2117203.637
 E=182401.787



STEEL SHEET PILING NOTE:

USE A NEW 1/8\"/>

HIGH DENSITY POLYURETHANE (HDP) NOTES:

1. CONSTRUCTION SHALL CONFORM TO SPECIFICATIONS & PROCEDURES OF THE SPECIFICATIONS AND THE STANDARD PROCEDURES FOR DEEP INJECTION OF HDP.
2. THE HDP SHALL BE INSTALLED AS NOTED IN THE SPECIFICATIONS.
3. DEEP INJECTION OF HDP SHALL START NEAR THE WEIR AND CONTINUE DOWNSTREAM.
4. AN ESTIMATE VOLUME OF 25 YD³ OF MATERIAL NEEDED BASED UPON AN ASSUMED 3 IN. VOID UNDER BOTTOM OF THE EXISTING SLAB WITHIN THE LIMITS SHOWN.

CONCRETE NOTES:

1. THE CONCRETE SHALL HAVE A 28 DAY COMPRESSIVE STRENGTH (PSI) OF 4000 PSI AIR CONTENT SHALL BE 0% (2016).
2. ALL REINFORCING STEEL SHALL BE GRADE 60 (fy = 60,000 PSI).
3. ALL EXPOSED CONCRETE EDGES SHALL HAVE A 3/4\"/>

NOTES:

1. SEE SHEET 3 FOR GENERAL NOTES AND SURVEY INFORMATION.
2. ALL DIMENSIONS ARE APPROXIMATE AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR.
3. SEE SHEET 6 FOR DETAILS.
4. SEE SHEETS 4 & 8 FOR RFP GPM LIMITS.

OUTLET STRUCTURE

SCALE 1/8\"/>

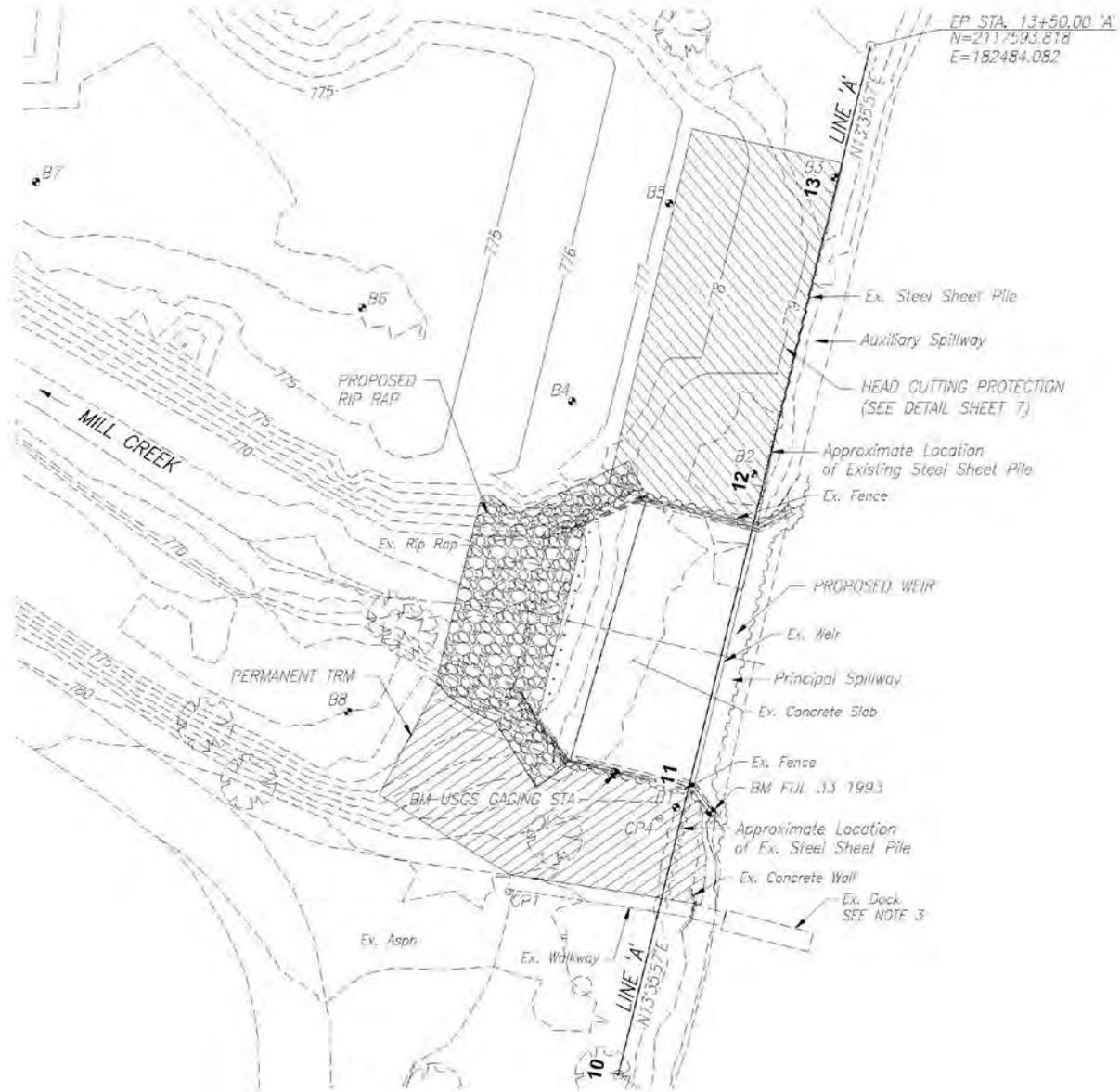


LFA
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 SOUTH BEND, INDIANA 46601
 PH. (574) 234-3157

Thomas J. McPherson 08/22/18
 T.E.
Thomas J. McPherson 08/22/18
 T.E.

INDIANA DEPARTMENT OF NATURAL RESOURCES
 LAKE MANITOU
 OUTLET STRUCTURE AND DAM
 OUTLET STRUCTURE PLAN

DATE	08/22/18	SCALE	AS SHOWN
PROJECT NO.	E06-0068	SHEET	5 OF 10















December 1

December 13



December 13



Ground E3000 Heater
laporte construction co., inc.
Thaw Frozen Ground
Cure Concrete
Heat Air

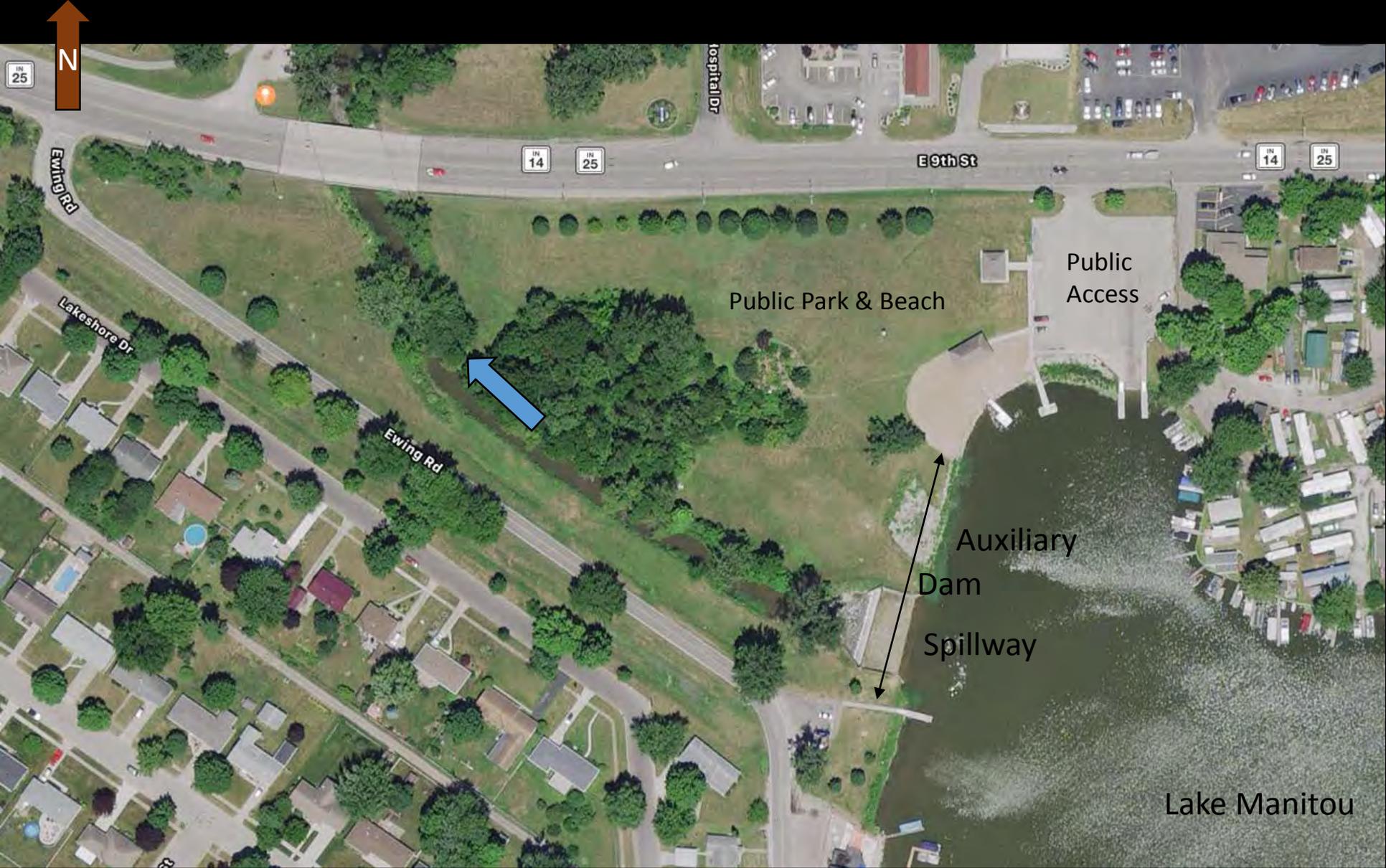
December 28

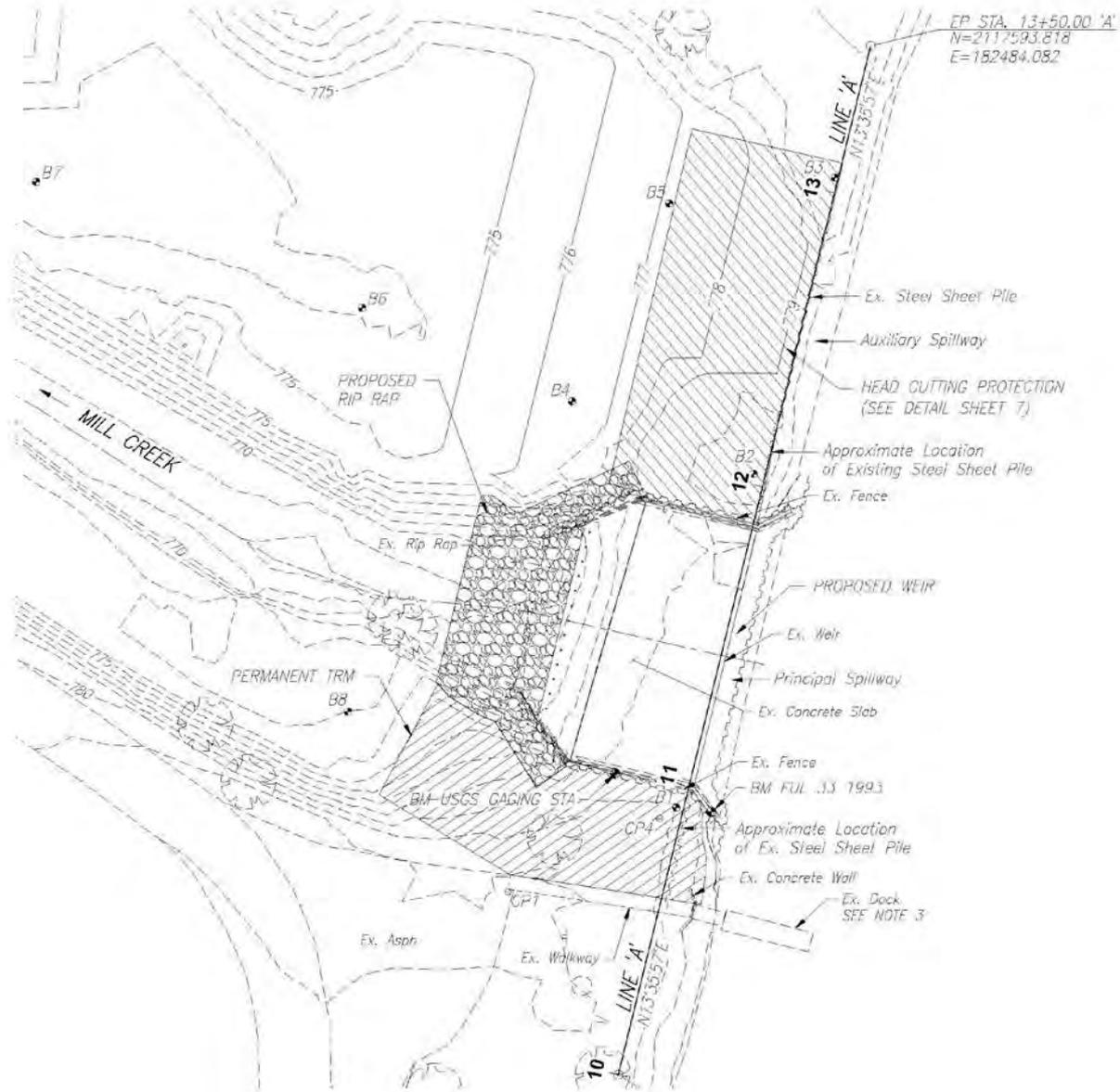
Site is stabilized for the Winter



Winter Break

Key Elements Reference Map





March 16-21, 2017



March 22, 2017



March 22, 2017



Unknown History Can Change Plans

Decide, Document, and Move On

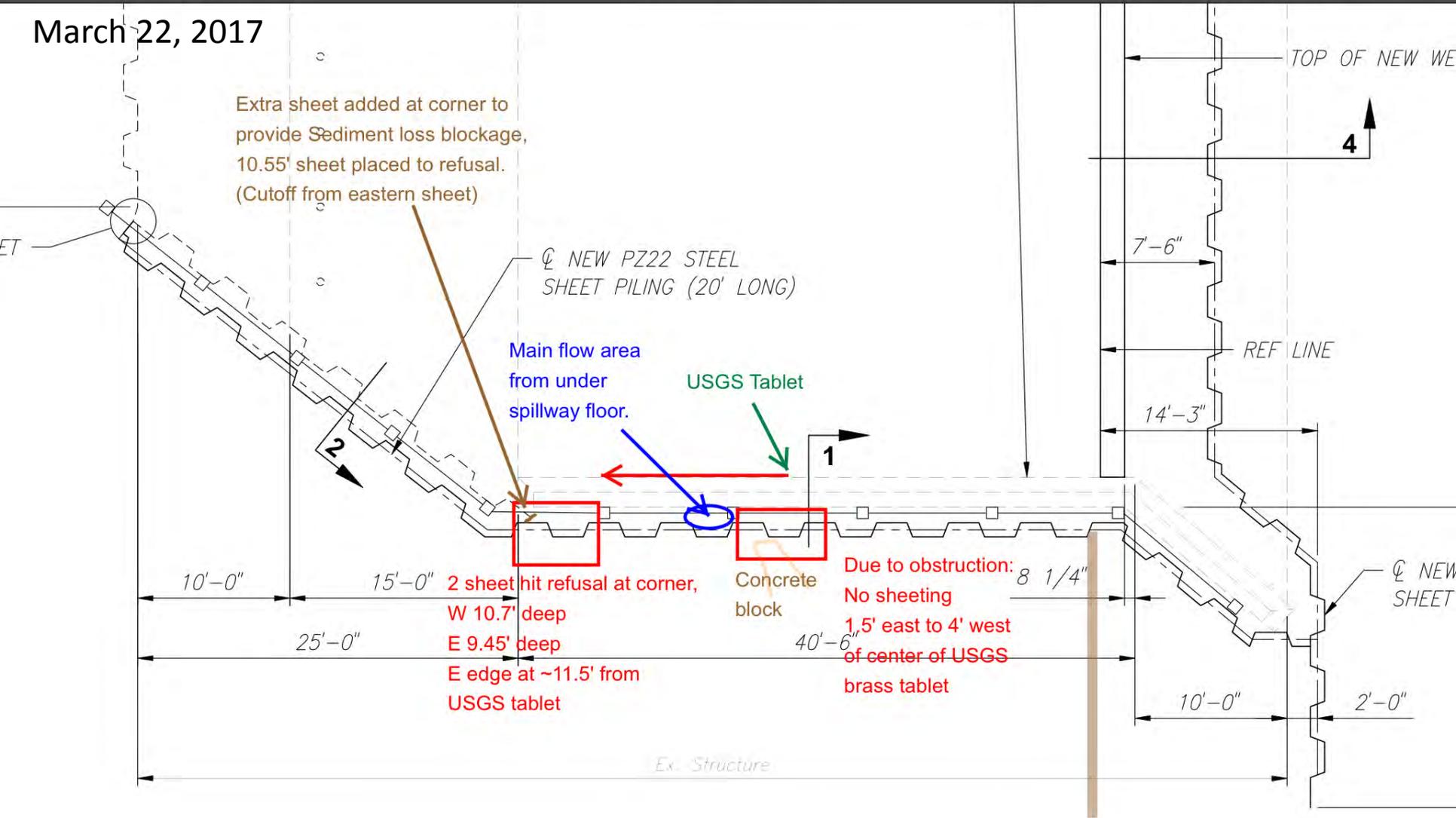
Manitou 2016



160719 - Review Set



March 22, 2017



OUTLET STRUCTURE

SCALE: 1/8" = 1'-0"

March 23, 2017

South Wall Steel
Sheet Piling
Complete



March 31, 2017

South Wall
Complete



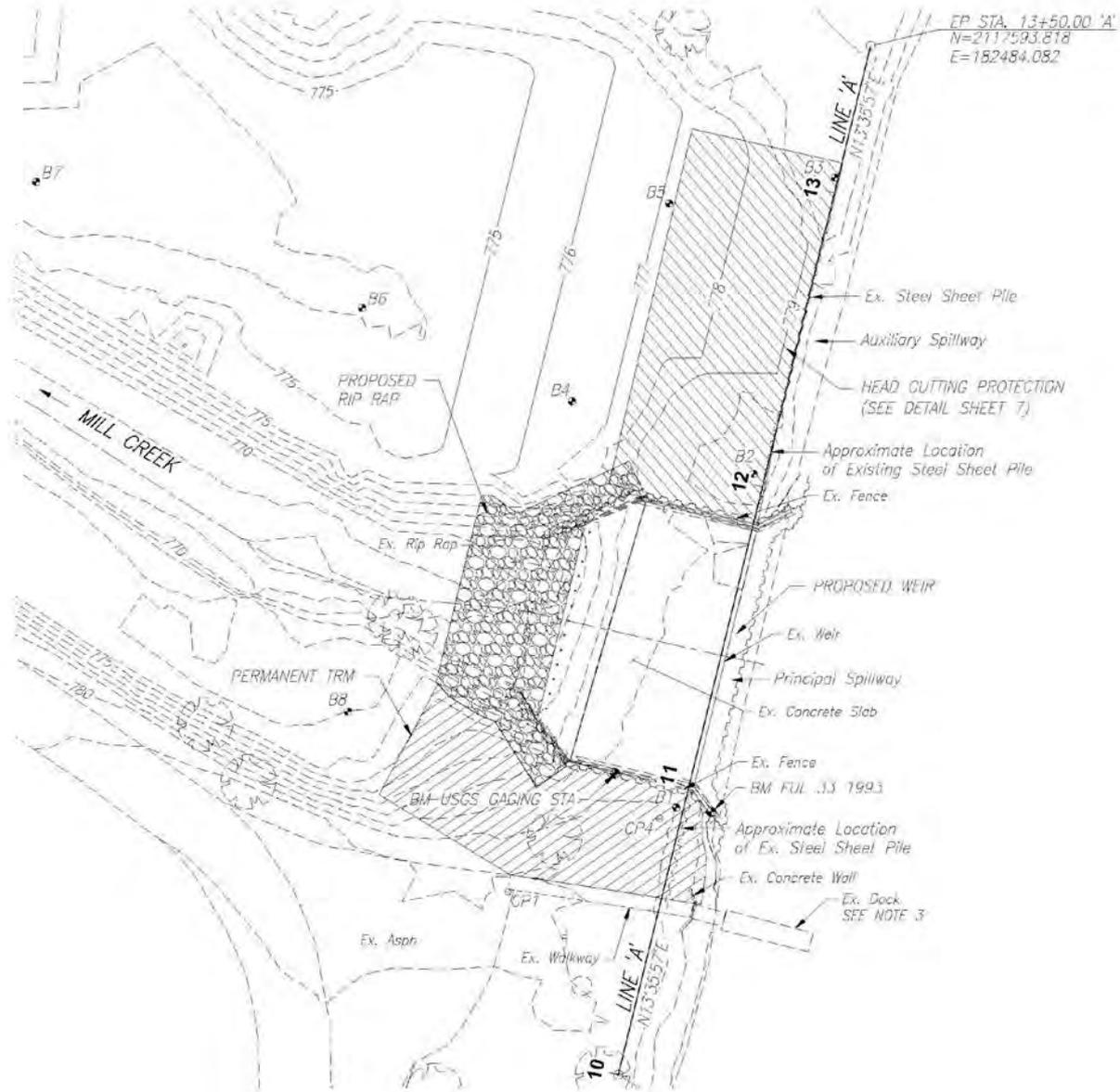
April 6, 2017

North Wall Steel
Sheet Piling
Complete, Ready for
Concrete



April 12, 2017





April 12, 2017

North Embankment
&
Auxiliary Spillway





May 8, 2017



Flexamat Erosion Control Use and Placement



PERMANENT EROSION CONTROL SOLUTIONS
Erosion Prevention and Protection

OUR COMPANY

Motz Enterprises, Inc. is the manufacturer of Flexamat®. The company has been in business for over 30 years and is headquartered in Cincinnati, Ohio.

Flexamat® is sold throughout the United States and Canada with material available locally in most areas.

We take pride in our performance and specifying the right product for the right application.

Flexamat® is an effective, long term solution. We look forward to working with you.



South Platte River, CO



Flexamat®



May 8, 2017

May 8, 2017





May 18, 2017



May 18, 2017

July 15, 2017



Auxiliary Spillway

Spillway

July 15, 2017

Auxiliary Spillway



Spillway Complete
(panoramic)
July 15, 2017



July 15, 2017



HPTRM,



August 23, 2017



August 23, 2017



August 23, 2017



August 23, 2017



August 23, 2017



August 23, 2017

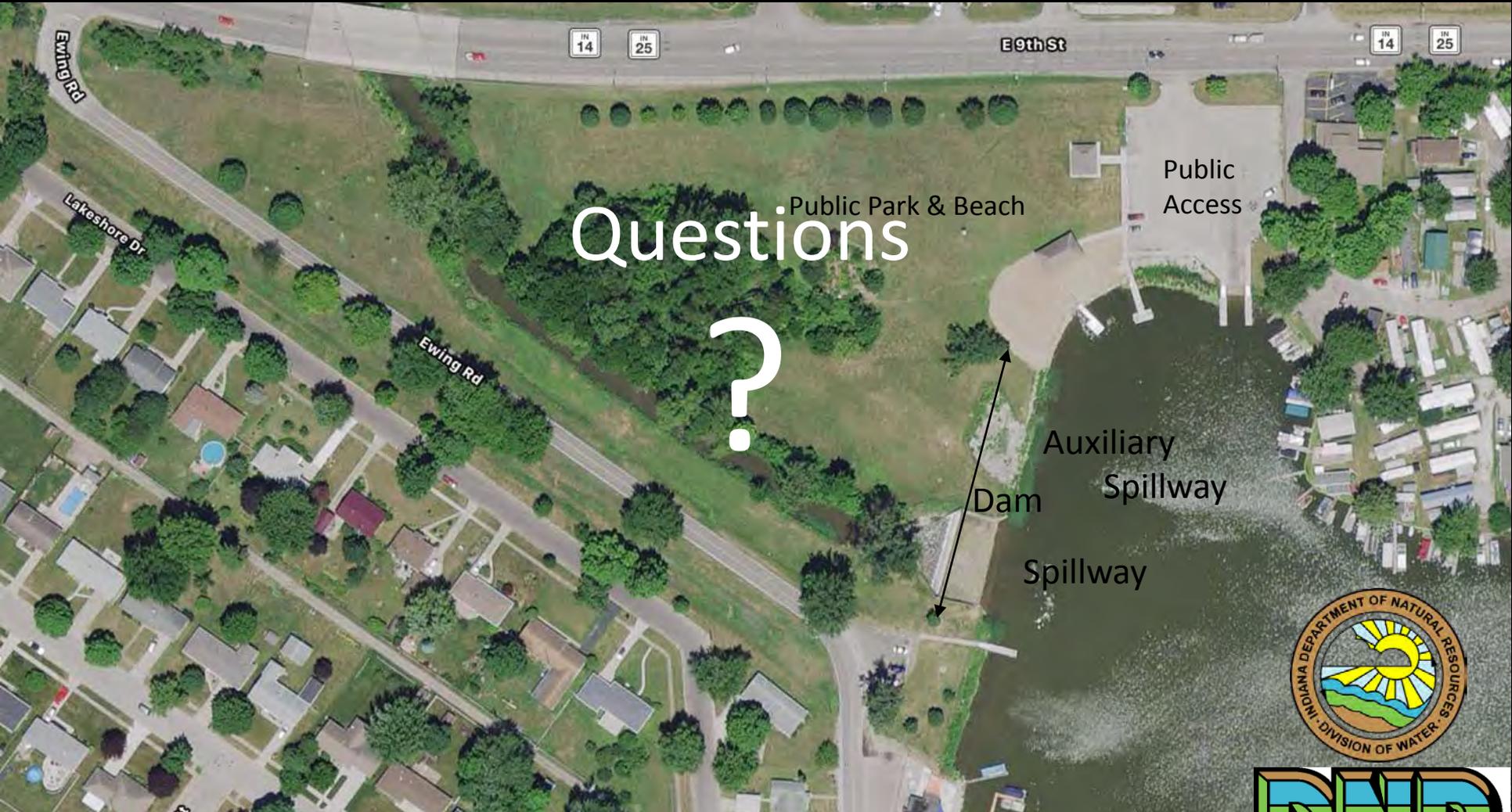




North Embankment and Auxiliary Spillway



Lake Manitou Dam and Spillway Upgrade



Questions

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Public Park & Beach

Public Access

Auxiliary Spillway

Dam

Spillway



INDIANA DEPARTMENT OF NATURAL RESOURCES



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