



Report of:

2014 Lake Lemon Dam Inspection

Unionville, Indiana

Prepared for:

Lake Lemon Conservancy District

7599 North Tunnel Road

Unionville, Indiana 47468

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November 2014

Prepared by:





INNOVATIVE IDEAS
EXCEPTIONAL DESIGN
UNMATCHED CLIENT SERVICE

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Table of Contents

| | | |
|--|-------------------------------------|-------|
| 1.0 | INTRODUCTION..... | 3 |
| 2.0 | PROJECT INFORMATION | 3 |
| 2.1 | General..... | 3 |
| 2.2 | Recent Maintenance Activities | 3 |
| 2.3 | Security | 4 |
| 3.0 | FIELD INSPECTION..... | 4 |
| 3.1 | Embankment..... | 4 |
| 3.2 | Principal Spillway | 5 |
| 3.2.1 | Internal Inspection | 5 |
| 3.2.2 | External Inspection | 5 |
| 3.3 | Auxiliary Spillway | 6 |
| 4.0 | CONCLUSIONS..... | 6 |
| 5.0 | RECOMMENDATIONS | 7 |
| 6.0 | CLOSING REMARKS | 8 |
| APPENDIX I | | 9 |
| DAM EMBANKMENT AND SPILLWAY LOCATION | | 10 |
| APPENDIX II | | 11 |
| INSPECTION PHOTOGRAPHS..... | | 12-23 |
| APPENDIX III | | 24 |
| COMPLETED IDNR DAM INSPECTION FORM | | 25-30 |
| APPENDIX IV..... | | 31 |
| PRECIPITATION RECORDS FOR BLOOMINGTON, INDIANA | | 32-33 |

1.0 INTRODUCTION

The Lake Lemon Conservancy District and the City of Bloomington Utilities requested DLZ Indiana, Inc. (DLZ) perform a field inspection of the Lake Lemon Dam. The Lake Lemon Dam is located near Unionville, Indiana in Monroe County. On October 14, 2014, Senior Project Manager, Martin Brungard, P.E., D.WRE. and Staff Engineer, Raquel Lopez, E.I., both with DLZ, completed an inspection of the dam embankment and spillways. The dam's principal spillway received a detailed inspection as part of the 2012 dam inspection and was found to be in sound condition after minor repair. There was no evidence that another detailed inspection of the principal spillway was needed as part of the 2014 dam inspection.

2.0 PROJECT INFORMATION

2.1 General

The Lake Lemon reservoir was constructed in the 1950's and its primary function at that time was to provide the City of Bloomington its primary source of drinking water. The reservoir is used today for recreation and as a secondary source of drinking water supply for the City of Bloomington. The normal pool area is approximately 1,700 acres and is located within portions of Monroe and Brown counties. The reservoir's watershed covers approximately 71 square miles.

The dam's earthen embankment is roughly 50 feet high with a crest length of approximately 660 feet. The crest width is approximately 13 feet, and the upstream and downstream slopes are inclined at approximately 1:Vertical to 3.5:Horizontal. All references to locations on the dam and spillways assume the reference point is from the reservoir and facing the upstream dam face. The principal spillway consist of a reinforced concrete pipe near the left abutment from its inlet to the gatewell, the pipe is 42 inches in diameter while the portion of the pipe between the gatewell and the stilling basin is 30 inches in diameter. Flow through the pipe is controlled by a slide-gate located within the gatewell. The pipe discharges into a stilling basin near the downstream toe of the dam. The auxiliary spillway is a 329-foot long, concrete ogee-type overflow structure. The auxiliary spillway is located in a valley northeast of the embankment. The dam embankment and spillway location map are presented in **Appendix I**.

Photographs taken during the 2014 inspection and a Photograph Index Map can be found within **Appendix II**. The observations and recommendations resulting from the 2014 inspection have been included within this report. The previous inspection report from 2012 was also reviewed as part of the inspection. The completed IDNR Dam Inspection Report for the 2014 inspection is presented in **Appendix III**.

2.2 Recent Maintenance Activities

In the 2012 Inspection Report, recommendations were made for additional monitoring and maintenance. We understand that Tasks # 1, # 3, # 10 and # 14 were completed as recommended in the 2012 Inspection Report. Details of those tasks are as follows.

- Task # 1: Filled in animal burrows located during the 2012 inspection.
- Task # 3: The pile of brush inspection near the toe of the downstream slope observed during the 2012 inspection was removed.
- Task # 10: A small tree located on the lower end of the right training of the principal spillway observed during the 2012 inspection was removed.
- Task # 14: An Emergency Action Plan (EAP) is being prepared for the Lake Lemon Dam by Christopher B. Burke Engineering, LLC and is expected to be available in the first quarter of 2015.

2.3 Security

The access to the dam embankment is along a private drive with a locked gate. The lake manager has access to this lock, as does the City of Bloomington Utilities. While the embankment, principal spillway, and south end of the auxiliary spillway have no public access, there is public access to the north end of the auxiliary spillway structure at Spillway Road.

3.0 FIELD INSPECTION

Approximately 1.26 inches of rainfall was reported in Bloomington, Indiana, the day before the inspection. Weather conditions during the inspection were rainy, with temperatures ranging from a low of 55°F to a high of 66°F. The rainfall data, measured in Bloomington, Indiana, between October 12, 2014 and October 18, 2014 are included in **Appendix IV**.

3.1 Embankment

There were no serious problem areas in the physical condition of the embankment found by DLZ. The slopes were relatively uniform and there were no significant bulges or depressions noted. Grass and vegetation on the embankment slopes and crest had been mowed just prior to the inspection. The lake supervisor stated the embankment is typically mowed two times a year. The embankment's upstream slope was found to have riprap surfacing to a height of about 5 feet above the normal pool elevation. The riprap surfacing extends below the normal pool elevation and it appears to have protected the embankment from wave-caused erosion.

Vegetation was found extending onto both the left and right abutments at both the upstream and downstream faces. Any vegetation growing on the embankment faces should be fully removed, including brush piles. Clearing all vegetation will enable more thorough inspection of abutment and downstream embankment areas. The abutment areas form 'valleys' that concentrate surface water

drainage from the valley and embankment slopes which increases the potential for erosion. A shallow gully was observed at the downstream left abutment area. It is recommended that the gully be filled and monitored for additional erosion and potential seepage.

Surficial excavations, apparently created by animals, were found on the right upstream slope of the embankment. However, the excavations were shallow and did not appear to be burrows. If burrows are found they should be filled with competent, well compacted material. If burrows cannot be readily filled with compacted soil, Portland cement grout can be poured into burrows to remediate them. The embankment should be regularly monitored for animal burrows because they can create seepage pathways if not filled.

An area of possible “clear” seepage was observed along the downstream toe, near the midpoint of the embankment. This area appeared to be the location of the former stream channel. The clear water source could not be verified due to overgrown vegetation in the area. While the source of the clear water could not be confirmed, that water may have been due to surface runoff from the rainy weather conditions at the time of inspection. Ponded water was also found beyond the downstream toe of slope, just north of the former stream channel location. The ponded water was draining to the former stream channel through a small gully. It was not possible to determine if this gully was the result of seepage or surface runoff. A small water flow was draining from the former stream channel area into the main stream. Water flow from any of these areas below the dam is concerning. If this flow exists during dry weather, corrective actions may be required to manage and control seepage and the potential for internal embankment erosion.

It is recommended that all vegetation near the former stream channel area on the downstream embankment be removed so that this area can be monitored visually on a monthly basis. Seepage or soft ground should be reported immediately to the dam engineer. To enable the quantification of seepage from the former stream channel area, a small temporary earthen embankment should be placed across the former stream channel and a V-notch weir plate be embedded in that embankment to serve as the single drain outlet from the former stream channel area. By monitoring the height of water flowing through the V-notch, a relative assessment of flow can be made. Any changes in seepage appearance or flow should be brought to the attention of a dam engineer immediately.

3.2 Principal Spillway

3.2.1 Internal Inspection

As part of the 2012 inspection, the downstream portion of the principal spillway was dewatered and inspected. No obvious distress or blockages inside the 42-inch diameter pipe were noted during the 2012 inspection report. Repairs to the sluice gate were recommended from the inspection and they were completed. Due to the lack of problems noted in the previous inspection, there was no internal inspection of the principal spillway completed for the 2014 inspection.

3.2.2 External Inspection

The visible portions of the principal spillway appeared satisfactory and the stilling basin conditions appeared to remain unchanged from previous inspections. There is a large crack observed in the left wall near the end of the stilling basin. The channel immediately downstream of the stilling basin appears to be scoured deeply. The footings for the retaining walls downstream of the stilling basin appear to be undermined. The record drawings for the stilling basin show that there are cut-off walls beneath the retaining wall footings that are up to 3-feet below the bottom of footing. The scour depth may be nearly that deep and corrective measures should be implemented to bury the retaining wall footings. It is recommended the scoured area be backfilled with properly-sized riprap or be backfilled with concrete. Because of the high hydraulic forces in the stilling basin and downstream channel when the principal spillway is operating at high flow, riprap size is expected to be very large in order to remain in place in the channel.

3.3 Auxiliary Spillway

The auxiliary spillway did not change significantly since the last inspection. The previous inspection noted minor displacements of $\frac{1}{2}$ to $\frac{3}{4}$ inches at joints located at the spillway. There appeared to be no significant changes to the changes in the joint displacements since the 2012 inspection.

The 2012 inspection report mentioned water begins to spill over the southwest end of the spillway due to settlement. The amount of settlement could not be seen at the time of inspection although settlement was confirmed from a 2014 survey completed by Bledsoe, Riggert, Guerrettaz, Inc. The survey reported a crest elevation of 629.82 (ft, NGVD29) at the southwest end of the spillway and a crest elevation of 630.04 (ft, NGVD29) at the northeast of the spillway. This indicates a difference of almost 3 inches between the northeast and southwest ends of the spillway. While there should not be a problem with that elevation difference for the spillway, crest elevations should be monitored on an infrequent basis to assess if there is more movement.

The brown “sticky” gelatinous substance mentioned in previous inspection reports was not seen at the outlets during the 2014 inspection. Erosion at the spillway could also not be verified at the time of inspection due to the amount of water flowing over the spillway.

Overgrown vegetation was observed at the left auxiliary spillway training wall at its upstream and downstream sides. It is recommended that this vegetation be removed to prevent future wall damage.

4.0 CONCLUSIONS

Based on our observations, it appears the dam facility condition has not changed significantly since the 2012 inspection. The overall surficial condition of the project was determined to be “Satisfactory.”

5.0 RECOMMENDATIONS

1. The area along the downstream toe near the midpoint of the embankment and the surrounding area should be monitored for possible seepage. Due to the high hazard associated with potential seepage, it is recommended this area be monitored on a monthly basis and following significant rainfall events. Report any appearance of erosion, seepage, turbidity, and subsequent changes in seepage quantity in this area to the engineer immediately. (Photographs 7, 8, and 10.)
2. Remove the vegetation within the following locations:
 - i. Vegetation along downstream toe near the midpoint of the embankment should be removed to allow for seepage monitoring. (Photograph 9)
 - ii. Vegetation at the left and right abutments on both the upstream and downstream sides near the valley areas should be removed. (Photograph 5 and 13)
 - iii. Vegetation located at the left ogee spillway training wall at the upstream and downstream sides should be removed. (Photograph 20 and 21)

All undesirable vegetation growth within these areas should be removed by cutting or spraying as part of an annual maintenance program.

3. Monitor the gully located at the downstream left abutment area for additional erosion and potential seepage. (Photograph 13)
 4. Fill any animal borrows on the embankment with competent, well compacted material. Monitor animal activities on the embankment. Monitor animal activities and if deemed necessary, a rodent control program should be implemented. (Photograph 6)
 5. Repair the scoured area in the channel bottom immediately downstream of the stilling basin using riprap or concrete. The design velocities for the outflow will need to be evaluated to properly size the riprap. (Photographs 15 and 17)
-

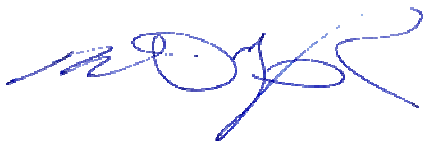
6. Inspect the interior of the outlet pipe at the next inspection.

6.0 CLOSING REMARKS

We appreciate having the opportunity to be of service to you on this inspection. If you have any questions, please do not hesitate to call.

Sincerely,

DLZ INDIANA, LLC



Martin Brungard, P.E., D. WRE
Senior Project Manager

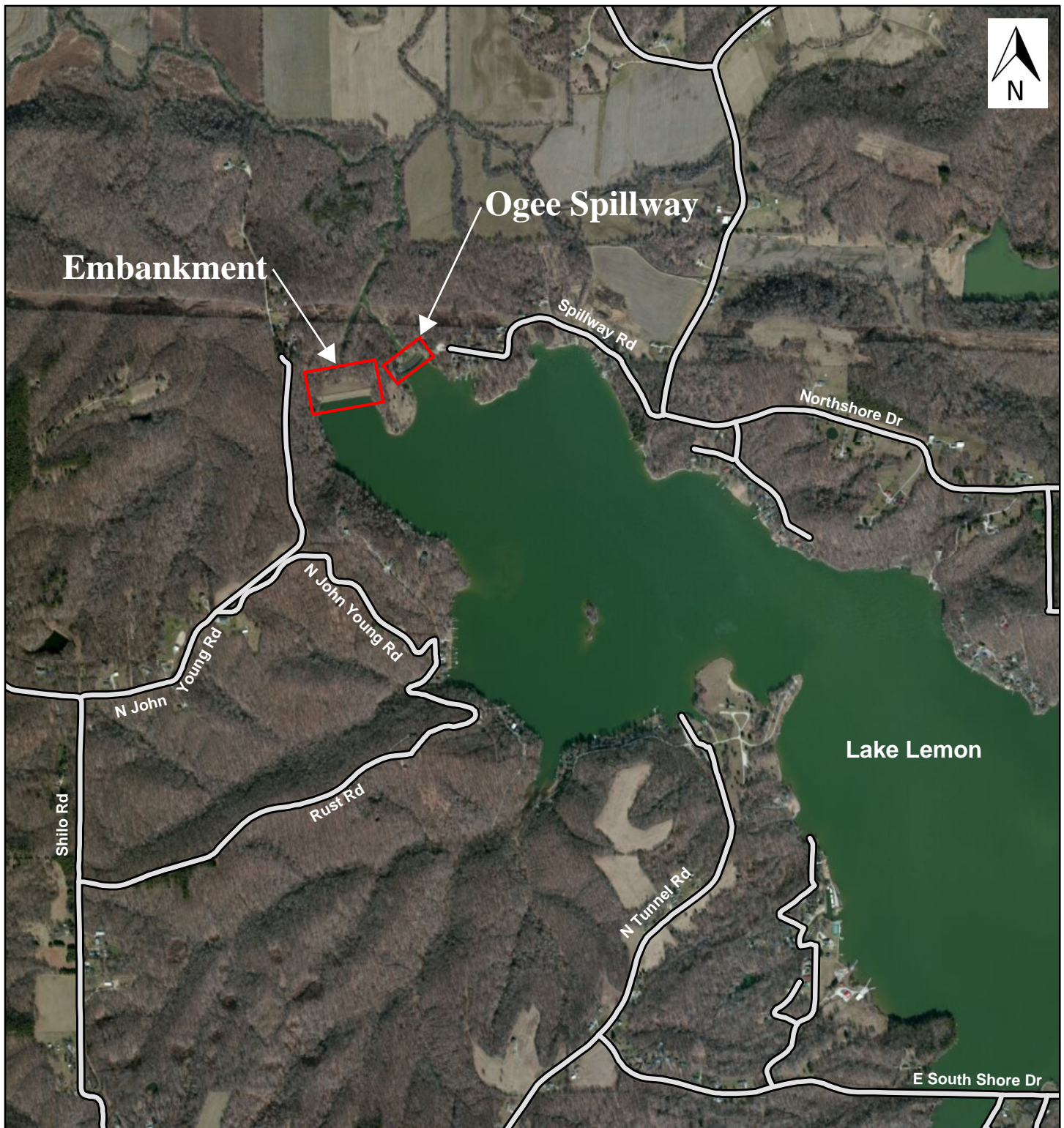


Jonathan E. LaTurner, P.E.
Division Manager

APPENDIX I

DAM EMBANKMENT AND SPILLWAY LOCATION

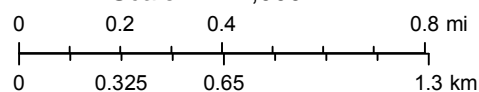
Lake Lemon Dam Embankment and Spillway Location



Date: October 20, 2014

Inspector: Martin Brungard, P.E., D.WRE

Scale: 1: 24,000



LEGEND:

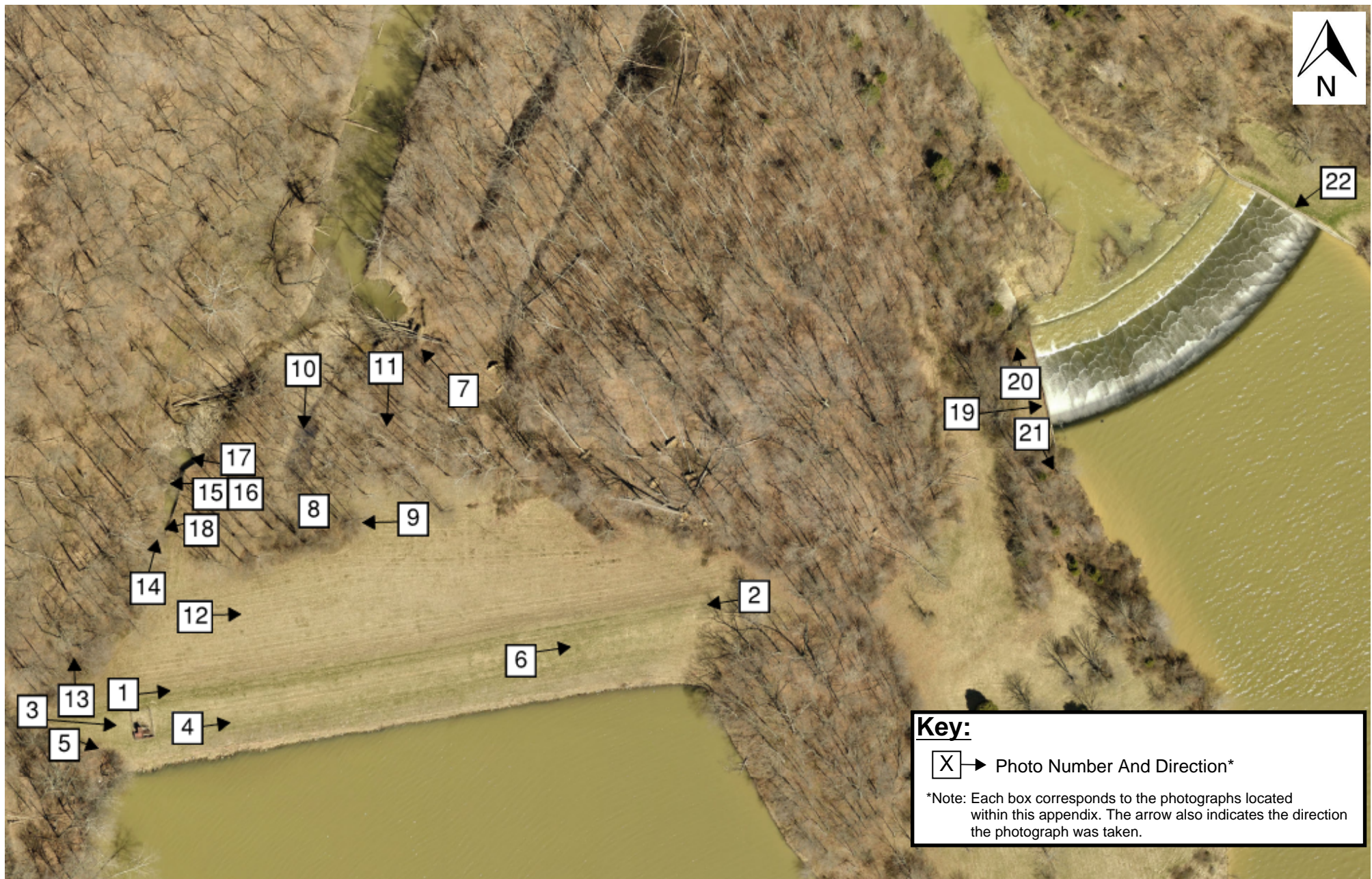
 Minor Road

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

APPENDIX II

INSPECTION PHOTOGRAPHS

Lake Lemon Photo Index Map



Date: October 20, 2014

Inspector: Martin Brungard, P.E., D.WRE

INSPECTION PHOTOGRAPHS



Photograph No. 1

Looking at northeast at the embankment crest towards the right abutment.



Photograph No. 2

Looking at southwest at the embankment crest towards the left abutment.



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Page 1 of 11

INSPECTION PHOTOGRAPHS



Photograph No. 3

Looking southeast the gatewell structure.



Photograph No. 4

Looking at the upstream embankment slope towards the right abutment.



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Inspector: Martin Brungard, P.E., D.WRE
Page 2 of 11

INSPECTION PHOTOGRAPHS



Photograph No. 5

Looking southwest at vegetation encroaching the left abutment.



Photograph No. 6

Mole activity at the upstream embankment.



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Page 3 of 11

INSPECTION PHOTOGRAPHS



Photograph No. 7

Eroded channel located slightly north of the downstream embankment.



Photograph No. 8

Possible clear seepage located at the downstream embankment toe.



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Page 4 of 11