



Report of:

2016 Lake Lemon Dam Inspection

Unionville, Indiana

Prepared for:

Lake Lemon Conservancy District

7599 North Tunnel Road
Unionville, Indiana 47468

DLZ Indiana, Inc.

157 East Maryland Street
Indianapolis, IN 46204
Phone: (317) 633-4120
Fax: (317) 633-4177

DLZ Job No. 1463-0991.90

**November 2016/
March 2017**

Prepared by:





INNOVATIVE IDEAS
EXCEPTIONAL DESIGN
UNMATCHED CLIENT SERVICE

REPORT OF: 2016 LAKE LEMON DAM INSPECTION

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November 28, 2016
March 10, 2017

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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 November 28th, 2016, the initial inspection of the dam embankments and spillways were performed and on March 10th, 2017, an additional site visit was made to finalize the inspection. Both inspections were performed by DLZ staff.

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 2016/2017 inspections and a Photograph Index Map can be found within **Appendix II**. This report contains all of the observations and recommendations resulting from the 2016/2017 inspections. The previous inspection report from 2014 was also reviewed as part of the inspection. The completed IDNR Dam Inspection Report for the 2016 inspection is presented in **Appendix III**.

2.2 Recent Maintenance Activities

In the 2014 Inspection Report, recommendations were made for additional monitoring and maintenance. We understand that Tasks # 2, # 4, and # 6 were completed as recommended in the 2014 Inspection Report. Details of those tasks are as follows.

- Task # 2: Vegetation along the embankments and the training wall for the ogee spillway have been cut back and/or removed.
- Task # 4: The animal burrows noted during the 2014 inspection were filled in and are no longer present.
- Task # 6: An inspection of the outlet pipe was performed and is in good working condition.

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

Weather conditions during the inspection were clear and sunny. The high temperature of the day was 43°F. Between March 1st and March 9th there were a total amount of 2.22 inches of rainfall but the most recent rain fall occurred on March 7, 2017 in the amount of 0.64 inches. The ground conditions during the inspection were mostly dry despite the recent rainfall event. The rainfall data, measured in Bloomington, IN between March 1, 2017 and March 9, 2017 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. 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.

Woody 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, as well as any brush piles. Clearing all woody 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.

There were no signs of animal burrows present during the inspection. However, 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.

During the 2014 inspection, an area of possible “clear” seepage was observed along the downstream toe, near the midpoint of the embankment. During the 2016 inspection this area did not show the same signs of any possible “clear” seepage. It is believed that what was observed in the 2014 report was due to the rainy conditions on the day the inspection was performed. There were two small areas where erosion was observed in a perpendicular manner from the dam. Erosion of this type could indicate the potentiality of seepage occurring but beyond these areas on the downstream side of the dam toe there were no signs of seepage. There were a few spots on the lakeside embankment where the ground was very soft but it was believed to have been caused by the recent rainfall and not due to seepage.

On the northwest side of the downstream embankment there were several downed trees lying along the abutment. These trees should be removed immediately as they can cause problems with erosion which can lead to more serious problems. Downed trees can kill the underlying vegetation exposing bare dirt which will more easily erode away during rainfall events. Downed trees can also cause ponding of the rainfall runoff which also can lead to erosion of the soil.

It is recommended that all woody 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.

3.2 Principal Spillway

3.2.1 Internal Inspection

On February 23rd, 2017 an inspection of the outfall pipes was performed by Underwater Construction Corporation (UCC). The conclusion from their report states, “The 42 inch pipe is in good condition and bar racks are also in good condition with no major buildup of material in either. The sluice gate is in good condition, but does have one leak in the seal at the bottom left corner of the gate if facing downstream. The outfall basin overall is in good condition, minus a 76 inch long crack on the west wall and undermining at the base of both wing walls. Finally, the access ladder is not attached to the wall for the bottom 6 feet.” The report that was created by UCC documenting this inspection can be found in **Appendix V**.

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 ½ to ¾ inches at joints located at the spillway. There appeared to be no significant changes in the joint displacements since the 2014 inspection.

Erosion at the spillway could not be verified at the time of inspection due to the amount of water flowing over the spillway.

4.0 CONCLUSIONS

Based on our observations, it appears the dam facility condition has not changed significantly since the 2014 inspection. The overall surficial condition of the project was determined to be "Satisfactory."

5.0 RECOMMENDATIONS

1. On the downstream side of the embankment approximately 20 feet up from the toe and slightly west from the center there are two areas where a slight depression has appeared. These two areas should be monitored on a monthly basis to ensure that they are not increasing in size or if the ground is becoming softer. Report any noticeable changes in these two areas.
 2. The area along the downstream toe near the midpoint of the embankment and the surrounding area should continue to be monitored for possible seepage as indicated in the
-

2014 report for precautionary purposes. 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. (Photograph 9)

3. Remove the woody vegetation within the following locations:
 - i. Downed trees along the western side of the downstream embankment should be removed immediately as they can cause serious problems if left unattended to. (Photographs 8, 10, & 12)

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

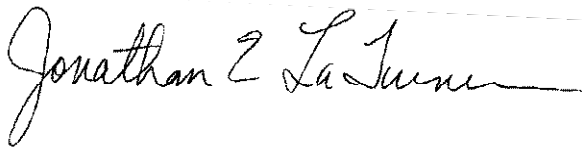
4. Dam should be monitored on a regular basis for the presence of any animal burrows on the embankment. If animal burrows are found at any time they should be filled with competent, well compacted material. If deemed necessary, a rodent control program should be implemented.
5. Repair the scoured area 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 14)

Sincerely,

DLZ INDIANA, LLC



Brian D. Bibb, E.I.
Civil Engineer II

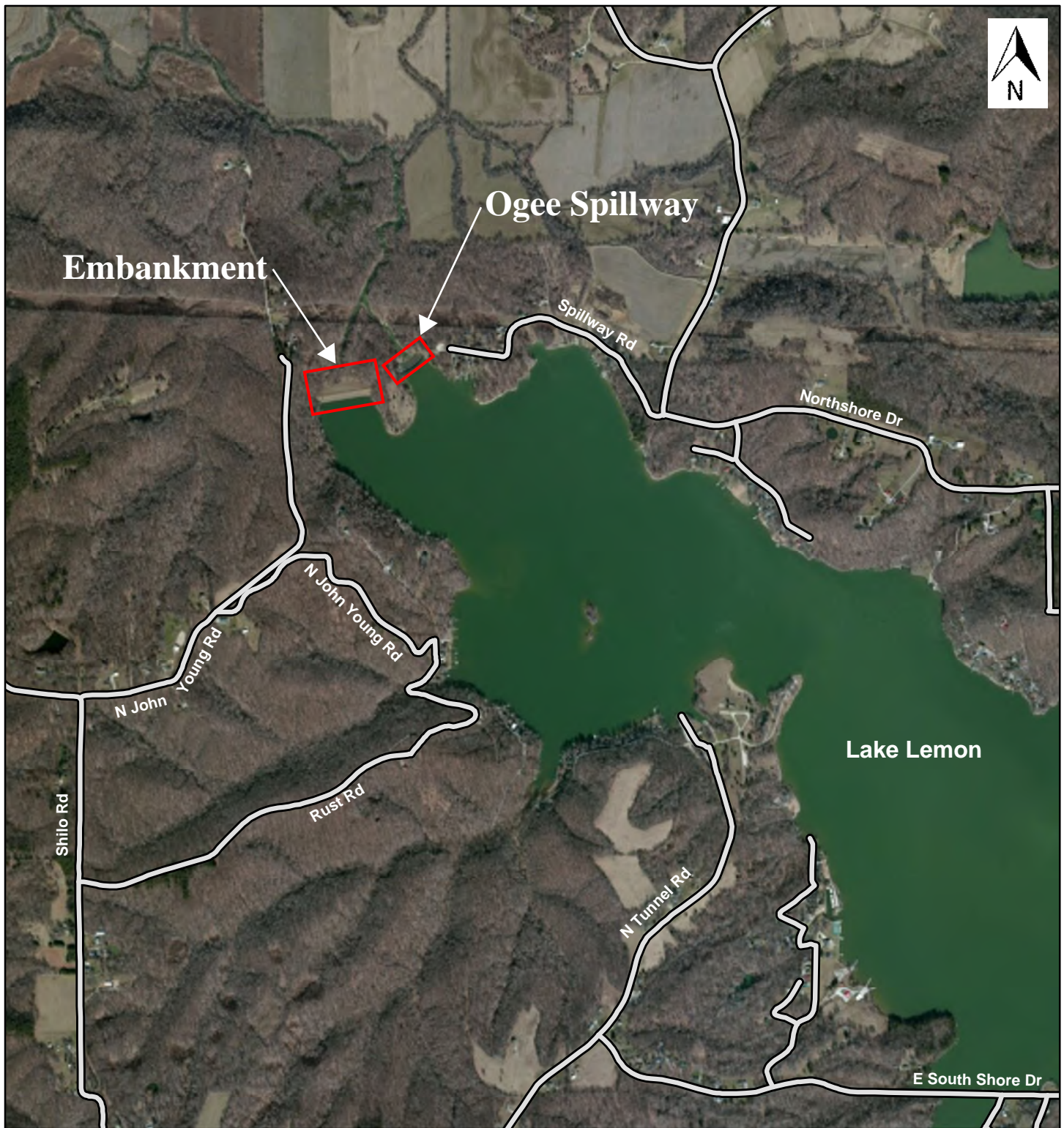


Jonathan E. LaTurner, P.E.
Division Manager

APPENDIX I

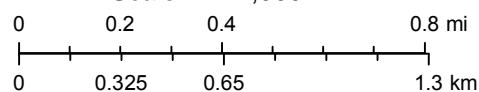
DAM EMBANKMENT AND SPILLWAY LOCATION

Lake Lemon Dam Embankment and Spillway Location



Date: March 10, 2017
Inspector: Jonathan E. LaTurner, P.E.

Scale: 1: 24,000



LEGEND:

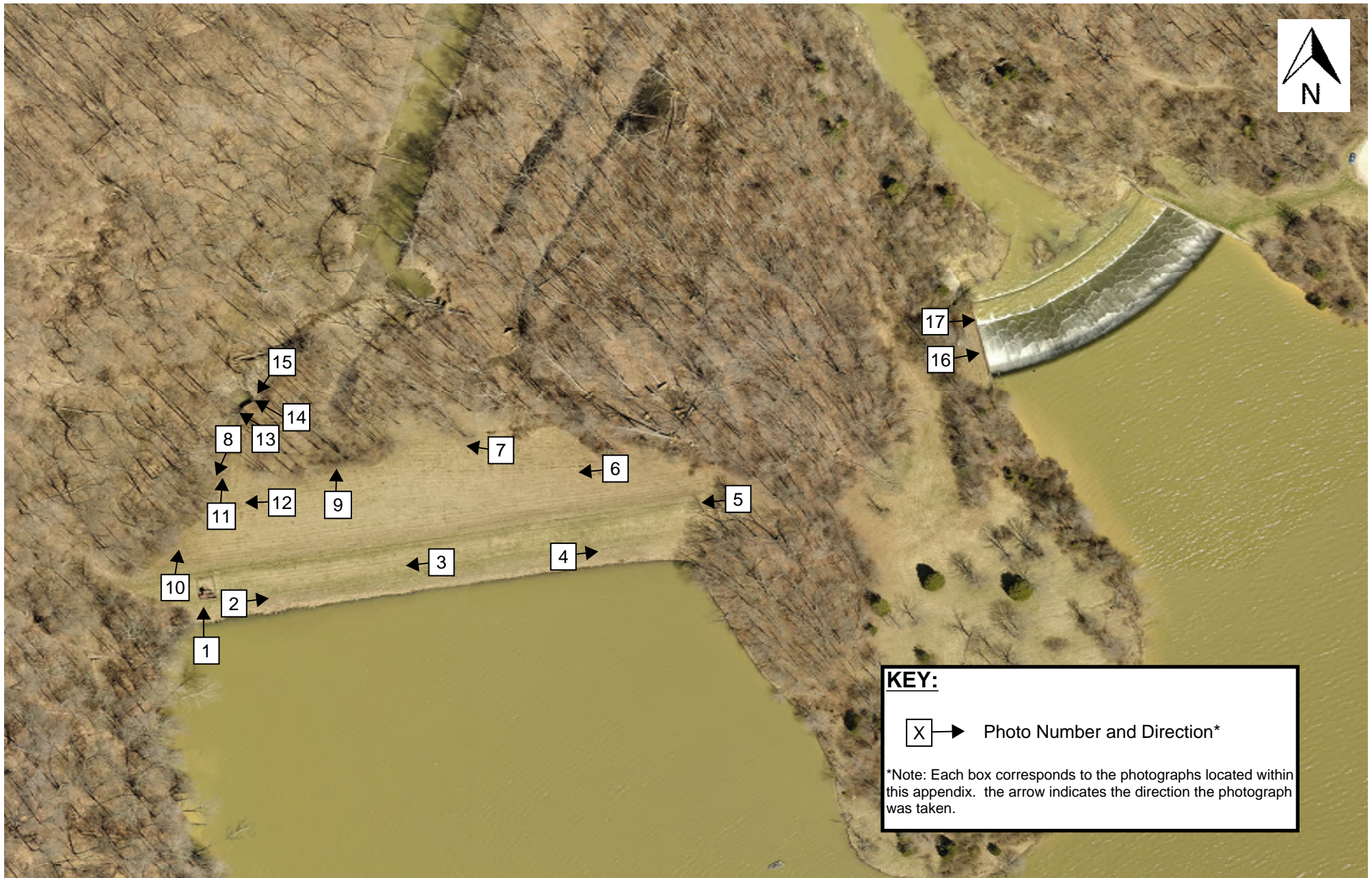
— Minor Road

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 Photograph Location Map



Date: November 28, 2016 & March 10, 2017
Inspector: Jonathan E. LaTurner, P.E.

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

INSPECTION PHOTOGRAPHS



Photograph No. 1

Looking north at the gatewell structure.



Photograph No. 2

Looking east on the upstream side of the embankment.



**LAKE LEMON DAM
UNIONSVILLE, INDIANA**

Date Photographs Taken: 11/29/2016

Inspector:

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INSPECTION PHOTOGRAPHS



Photograph No. 3

Looking west at the midpoint of the upstream embankment.



Photograph No. 4

Looking east at the eastern abutment on the upstream side of the embankment.



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INSPECTION PHOTOGRAPHS



Photograph No. 5

Looking west from on top of the embankment.



Photograph No. 6

Looking west on the downstream embankment.



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INSPECTION PHOTOGRAPHS



Photograph No. 7

Looking west near the midpoint of the downstream embankment.



Photograph No. 8

Looking south along the western downstream abutment.



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INSPECTION PHOTOGRAPHS



Photograph No. 9

Looking north at the area of possible seepage noted in the 2014 report.



Photograph No. 10

Looking north from on top of the embankment at the fallen trees on the downstream side.



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INSPECTION PHOTOGRAPHS



Photograph No. 11

Looking north at the stilling basin.



Photograph No. 12

Looking west at the fallen trees on the western abutment on the downstream embankment.



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INSPECTION PHOTOGRAPHS



Photograph No. 13

Crack found in the left wall of the stilling basin.



Photograph No. 14

Looking at the scoured area downstream of the stilling basin.



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INSPECTION PHOTOGRAPHS



Photograph No. 15

Looking north at the stilling basin.



Photograph No. 16

Looking east towards the ogee spillway.



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INSPECTION PHOTOGRAPHS



Photograph No. 17

Looking east towards the ogee spillway.



**LAKE LEMON DAM
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Date Photographs Taken: 11/29/2016

Inspector:

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APPENDIX III

COMPLETED IDNR DAM INSPECTION FORM

SUGGESTED DAM INSPECTION REPORT (Refer to pages 5 and 6 for instructions.)

Print Form

Name of Professional Conducting Inspection Jonathan E. LaTurner, P.E.		Professional License No. (Indiana) PE910028
Business Address 157 East Maryland St., Indianapolis, IN 46237		Phone: (day) 317 - 633 - 4120 (evening) _____

Company Name
INSPECTION PREPARATION: Reviewed all pertinent technical documentation related to this dam and site in the State's and the Owner's files: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Comment <u>Last inspection report was reviewed prior to inspection. IDNR's file on the project was also reviewed, including the original construction documents. The inspection was split between November of 2016 and March of 2017.</u>
MULTIDISCIPLINARY: I am experienced in the technical disciplines or I am working with other professionals experienced in the technical disciplines to properly inspect this dam and appurtenant works. Technical disciplines, in addition to the general civil engineering, may include geotechnical, geological, hydrologic, structural, and mechanical. Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Comment _____

Dam Name Lake Lemon Dam		Quad. Hindustan	Date of Inspection 11 / 28 / 2016 & 03 / 10 / 2017	
State Dam ID 58-1	Permit (if unapproved see pg. 6) State Approved Construction Completed in 1952	County Monroe	Sec. 28 T. 10 R. N 1 E	Last Inspection 10 / 14 / 2014
Owners Name City of Bloomington Utilities			Owner's Phone ()	
Address/Zip Code P.O. Box 1216, Bloomington, IN 47401				
Contact's Name Adam Casey, Manager		Contact's Phone (day) 812 - 334 - 0233 (evening) 812 - 320 - 2841		Spillway Width Top Bot. ~330 ~16
Hazard High	Drainage Area ~71 MI²	Surface Area ~1700 AC	Height ~50 FT	Crest Length ~660 FT
			Crest Width ~13 FT	Inlet Below Crest ~16 FT
				Slope: Up 3 1/2: 1 Down 3 1/2: 1

FIELD CONDITIONS OBSERVED	DRAWDOWN STRUCTURE
Water Level - Below Dam Crest ~15.8 Ft.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> None
Ground Moisture Condition: Dry <input type="checkbox"/> Wet <input type="checkbox"/> Snowcover <input type="checkbox"/> Other Sunny	Comment A 42-in. diameter R.C. pipe with a gateway and stilling basin.

MONITORING <input type="checkbox"/> Yes <input checked="" type="checkbox"/> None <input type="checkbox"/> Gage Rod <input type="checkbox"/> Piezometers <input type="checkbox"/> Seepage Weirs <input type="checkbox"/> Survey Monuments <input type="checkbox"/> Other
Comments _____

A UPSTREAM SLOPE	GOOD <input checked="" type="checkbox"/>	PROBLEMS NOTED: <input type="checkbox"/> (A-1) None <input type="checkbox"/> (A-2) Riprap - Missing, Sparse, Displaced, Weathered <input type="checkbox"/> (A-3) Wave Erosion-with Scarps <input type="checkbox"/> (A-4) Cracks-with Displacement <input type="checkbox"/> (A-5) Sinkhole <input type="checkbox"/> (A-6) Appears Too Steep <input type="checkbox"/> (A-7) Depressions or Bulges <input type="checkbox"/> (A-8) Slides <input type="checkbox"/> (A-9) Animal Burrows <input checked="" type="checkbox"/> (A-10) Trees, Brush, Briars <input type="checkbox"/> (A-11) Other _____
	ACCEPTABLE <input type="checkbox"/>	
	DEFICIENT <input type="checkbox"/>	
	POOR <input type="checkbox"/>	
Comments: Minor woody scrub brush present along the upstream toe at the waters edge.		

B CREST	GOOD <input checked="" type="checkbox"/>	PROBLEMS NOTED: <input checked="" type="checkbox"/> (B-1) None <input type="checkbox"/> (B-2) Ruts or Puddles <input type="checkbox"/> (B-3) Erosion <input type="checkbox"/> (B-4) Cracks with Displacement <input type="checkbox"/> (B-5) Sinkholes <input type="checkbox"/> (B-6) Not Wide Enough <input type="checkbox"/> (B-7) Low Area <input type="checkbox"/> (B-8) Misalignment <input type="checkbox"/> (B-9) Inadequate Surface Drainage <input type="checkbox"/> (B-10) Trees, Brush, Briars <input type="checkbox"/> (B-11) Other _____
	ACCEPTABLE <input type="checkbox"/>	
	DEFICIENT <input type="checkbox"/>	
	POOR <input type="checkbox"/>	
Comments: None.		

Spillway Width refers to the open channel (typically the emergency or auxiliary spillway) at the control section.

Ft. FBD. refers to the vertical distance from the emergency (auxiliary) spillway control section to the lowest point of the crest of the dam.

Inlet Below Crest refers to the vertical distance from the inlet of the principal spillway to the crest of the dam.

C DOWNSTREAM SLOPE

GOOD	<input type="checkbox"/>
ACCEPTABLE	<input checked="" type="checkbox"/>
DEFICIENT	<input type="checkbox"/>
POOR	<input type="checkbox"/>

PROBLEMS NOTED: ☐ (C-1) None ☐ (C-2) Livestock Damage ☐ (C-3) Erosion or Gullies ☐ (C-4) Cracks with Displacement ☐ (C-5) Sinkholes ☐ (C-6) Appears too Steep ☐ (C-7) Depression or Bulges ☐ (C-8) Slide ☐ (C-9) Soft Areas ☒ (C-10) Trees, Brush, Briars ☐ (C-11) Animal Burrows ☐ (C-12) Other _____

Comments:

Two small depressions were observed approximately 20 feet up from the toe in the middle of the embankment. Appears to be soft soils only with no seepage apparent. Vegetation observed at the west abutment area and at the toe of the downstream slope. There were several downed trees that had fallen onto the west abutment of the downstream embankment.

D SEEPAGE

GOOD (NONE)	<input type="checkbox"/>
ACCEPTABLE	<input checked="" type="checkbox"/>
DEFICIENT	<input type="checkbox"/>
POOR	<input type="checkbox"/>

PROBLEMS NOTED: ☒ (D-1) None ☐ (D-2) Saturated Embankment Area ☐ (D-3) Seepage Exits on Embankment ☐ (D-4) Seepage Exits at Point Source ☐ (D-5) Seepage Area at Toe ☐ (D-6) Flow Adjacent to Outlet ☐ (D-7) Seepage Clear/Muddy

[DRAIN OUTFALLS SEEN ☒ No ☐ Yes ☐ (D-8) Flow Clear/Muddy ☐ (D-9) Dry/Obstructed]

☐ (D-10) Other _____ Describe location of drains and indicate amount and quality of discharge.

Comments:

No apparent seepage observed.

E PRINCIPAL SPILLWAY

GOOD	<input type="checkbox"/>
ACCEPTABLE	<input checked="" type="checkbox"/>
DEFICIENT	<input type="checkbox"/>
POOR	<input type="checkbox"/>

DESCRIPTION:

PROBLEMS NOTED: ☐ (E-1) None ☐ (E-2) Deterioration ☐ (E-3) Separation ☒ (E-4) Cracking ☐ (E-5) Inlet, Outlet Deficiency ☒ (E-6) Stilling Basin Inadequacies ☐ (E-7) Trash Rack ☐ (E-8) Other _____

Comments:

Long vertical crack in the west wing wall of the stilling basin. There is also a problem with scouring downstream of the stilling basin.

F AUXILIARY SPILLWAY

GOOD	<input type="checkbox"/>
ACCEPTABLE	<input checked="" type="checkbox"/>
DEFICIENT	<input type="checkbox"/>
POOR	<input type="checkbox"/>

DESCRIPTION: A 329-foot long concrete ogee-type (curved crest) structure located in a valley northeast of the dam.

PROBLEMS NOTED: ☒ (F-1) None ☐ (F-2) No Auxiliary Spillway Found ☐ (F-3) Erosion-with Backcutting ☐ (F-4) Crack with Displacement ☐ (F-5) Appears to be Structurally Inadequate ☐ (F-6) Appears too Small ☐ (F-7) Inadequate Freeboard ☐ (F-8) Flow Obstructed ☐ (F-9) Concrete Deteriorated/Undermined ☐ (F-10) Other _____

Comments:

The concrete ogee section and training walls appeared unchanged since the 2014 inspection. The spillway appeared to be in satisfactory condition.

G MAINTENANCE AND REPAIRS

GOOD	<input type="checkbox"/>
ACCEPTABLE	<input type="checkbox"/>
DEFICIENT	<input type="checkbox"/>
POOR	<input type="checkbox"/>

PROBLEMS NOTED: ☐ (G-1) None ☐ (G-2) Access Road Needs Maintenance ☐ (G-3) Cattle Damage ☐ (G-4) Spillway Obstruction ☐ (G-5) Brush, Weeds, Tall Grass, on Upstream Slope, Crest, Downstream Slope, Toe ☐ (G-6) Trees on Upstream Slope, Crest, Downstream Slope ☐ (G-7) Rodent Activity on Upstream Slope, Crest, Downstream Slope, Toe ☐ (G-8) Deteriorated Concrete-Facing, Outlet, Spillway ☐ (G-9) Gate and/or Drawdown Need Repair ☐ (G-10) Other _____

Comments:

Refer to page 3 of 6.

H OVERALL CONDITIONS

Based on this inspection and recent file review, the overall surficial condition is determined to be: ☒ (H-1) Satisfactory ☐ (H-2) Fair ☐ (H-3) Conditionally Poor ☐ (H-4) Poor ☐ (H-5) Unsatisfactory

IMPORTANT: IF THIS RATING IS DIFFERENT THAN PREVIOUS IDNR RATING, PLEASE ATTACH EXPLANATION AND REASONS FOR CHANGE ON PAGE 4.

**RECOMMENDATIONS AND ITEMS REQUIRING ACTION BY OWNER
TO IMPROVE THE SAFETY OF THE DAM**

MAINTENANCE-MINOR REPAIR-MONITORING

- ☐ (1) Provide Additional Erosion Protection: _____
- ☐ (2) Mow: _____ ☐ Remove vegetation along downstream toe near midpoint of the embankment and on the west abutment at both
- ☒ (3) Clear Trees and/or Brush From: ☐ the upstream and downstream sides. Remove fallen trees on the downstream west abutment.
- ☐ (4) Initiate Rodent Control Program and Properly Backfill Existing Holes: _____
- ☒ (5) Repair: Repair the riprap that has been scoured from the downstream side of the stilling basin of the principal spillway.
- ☐ (6) Provide Surface Drainage For: _____
- ☒ (7) Monitor: Monitor possible seepage along the downstream toe of embankment including channel erosion and ponding at old channel location.
- ☐ (8) Other: Monitor the gully located at the west abutment area for additional erosion and potential seepage.
- ☐ (9) Other: Monitor animal activities on the embankment, erosion conditions downstream of the stilling basin and any movement of the spillway.

ENGINEERING-EMPLOY AN ENGINEER EXPERIENCED IN DESIGN AND CONSTRUCTION OF DAMS TO:

(Plans & Specifications must be approved by State prior to construction.)

- ☐ (10) Prepare Plans and Specifications for the Rehabilitation of the Dam: _____
- ☐ (11) Prepare As-Built Drawings of: _____
- ☐ (12) Perform a Geotechnical Investigation to Evaluate the Stability of the Dam: _____
- ☐ (13) Perform a Hydrologic Study to Determine Required Spillway Size: _____
- ☐ (14) Prepare Plans and Specifications for an Adequate Spillway: _____
- ☐ (15) Set up a Monitoring Program: _____
- ☐ (16) Refer to Unapproved Status of Dam: _____
- ☐ (17) Develop an Emergency Action Plan: _____
- ☐ (18) Other: _____
- ☐ (19) Other: _____

Recommended schedule for upgrades/comments (Please prioritize and note importance of each item.)

Photographs ☐ Attachments ☐

ENGINEER'S INSTRUCTION Instructed owner on the safety concerns with the structure and how to monitor and inspect the dam and appurtenant works in the interim period between the regulatory two-year inspections. Yes ☒ No ☐

Comment

It is recommended the Lake Manager and Lake Staff continue to visually monitor possible seepage on a regular basis and after significant rainfall events. Contact a qualified engineering firm if any changes are noted.

Professional Engineer's Signature _____ Date _____

Reviewed By _____ Date _____

Owner/Owner's Representative

EXPLANATION FOR CHANGE IN RATINGS (Describe all repairs, upgrades or improvements made if dam conditions and rating have improved since the last inspection. Describe deteriorating conditions if ratings have worsened.)

REASONS FOR RATING CHANGE:

PREVIOUS RECOMMENDATIONS FOR MAINTENANCE, REPAIRS, AND UPGRADES:

HAVE THEY BEEN PERFORMED ☒ YES ☐ NO (If no, please explain:)

* An emergency action plan for the Lake Lemon Dam was prepared by Christopher B. Burke Engineering in 2015.

Supporting Documentation

Photographs ☒ Attachments ☐ Calculations ☐ Drawings ☐ Other ☐

Comments:

INSTRUCTIONS FOR COMPLETING DAM VISUAL INSPECTION REPORT

1. Complete all items that are applicable; if not applicable, write in "N/A". For concrete dams, complete all applicable items and use "comments" section to cover items not included in the check boxes. Also indicate that the dam is concrete in the comments section.
2. Use page 6 to determine ratings of each dam component (items A through G) and for Overall Conditions (Item H).
3. Please write legibly and concisely.
4. Inspector must be knowledgeable with the type of dam, materials, and components being inspected. If not, qualified assistance shall be engaged.
5. The inspector shall review the dam owner's and IDNR project files prior to the inspection. Previous inspection reports shall be closely reviewed for previous problems and deficiencies.
6. If the ratings of the components (items A through G) or the Overall Conditions (item H) of the dam have changed since the last inspection, please complete page 4. If a rating has improved, dam repairs, improvements, analyses, or maintenance must have been performed and documented on page 4.
7. For a dam to have a satisfactory "Overall Conditions" rating, it must have no existing or potential dam safety deficiencies recognized. Safe performance is expected under all anticipated loading conditions, including infrequent hydrologic events (PMP for high hazard dams) and seismic events. The dam owner's project files must contain hydrologic and hydraulic analyses of the dam and its spillways to verify performance. The files must also contain slope stability analyses to verify embankment stability under full reservoir conditions and rapid-draw down conditions. The dam and all of its components must meet current IDNR and design standards. "Normal" deficiencies such as minor erosion, minor seepage, or normal concrete aging may not make a dam unsatisfactory or unacceptable. For a satisfactory "Overall Conditions" rating to be assigned, items A through G generally should all have a "good" rating; however, in some cases an "acceptable" rating may be satisfactory if the "Problems Noted" are minor, or "normal" conditions, such as minor erosion rills, small puddles on crest, or if grass needs mowed, but is in good condition.
8. An inspection report form must be submitted to IDNR along with a formal technical inspection report as described in Chapter 4.0 of Part 3 of the Indiana Dam Safety Inspection Manual.
9. Please sign and date this page in the space below to verify that you have read and understand these instructions.

Inspector's Signature: Jonathan Z. LaTurne

Date: 04/03/2017

GUIDELINES FOR DETERMINING CONDITIONS

CONDITIONS OBSERVED - APPLIES TO UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, PRINCIPAL SPILLWAY, AUXILIARY SPILLWAY

GOOD	ACCEPTABLE	DEFICIENT	POOR
In general, this part of the structure has a good appearance, and conditions observed in this area do not appear to threaten the safety of the dam.	Although general cross-section is maintained, surfaces may be irregular, eroded, rutted, spalled, or otherwise not in new condition. Conditions in this area do not currently appear to threaten the safety of the dam.	Continued deterioration and/or unusual loading may threaten the safety of the dam.	Conditions observed in this area appear to threaten the safety of the dam. Conditions observed in this area are unacceptable.

CONDITIONS OBSERVED - APPLIES TO SEEPAGE

GOOD (NONE)	ACCEPTABLE	DEFICIENT	POOR
No evidence of uncontrolled seepage. No unexplained increase in flows from designed drains. All seepage is clear. Seepage conditions do not appear to threaten the safety of the dam.	Some seepage exists at areas other than the drain outfalls, or other designed drains. No unexplained increase in flows from designed drains. All seepage is clear. Seepage conditions observed do not currently appear to threaten the safety of the dam.	Excessive seepage exists at areas other than drain outfalls and other designed drains. Seepage needs to be evaluated. Increased flow and/or continued deterioration in seepage conditions may threaten the safety of the dam.	Excessive seepage conditions observed appear to threaten the safety of the dam and is unacceptable. Examples: 1) Designed drain or seepage flows have increased without increase in reservoir level. 2) Drain or seepage flows contain sediment. i.e., muddy water or particles in jar samples. 3) Widespread seepage, concentrated seepage or ponding appears to threaten the safety of the dam.

CONDITIONS OBSERVED - APPLIES TO MAINTENANCE AND REPAIR

GOOD	ACCEPTABLE	DEFICIENT	POOR
Dam appears to receive effective on-going maintenance and repair, and only a few minor items may need to be addressed.	Dam appears to receive maintenance, but some maintenance items need to be addressed. No major repairs are required.	Level of maintenance of the dam needs significant improvement. Major repairs may be required. Continued neglect of maintenance may threaten the safety of the dam.	Dam does not receive adequate maintenance. One or more items needing maintenance or repair has begun to threaten the safety of the dam. Level of maintenance is unacceptable.

OVERALL CONDITIONS

SATISFACTORY - No existing or potential dam safety deficiencies recognized. Safe performance is expected under all anticipated loading conditions, including such events as infrequent hydrologic and/or seismic events. Project Files contain necessary hydrologic, and other engineering calculations to verify dam safety and performance.

FAIR - No existing dam safety deficiencies are recognized for normal loading conditions. Infrequent hydrologic and/or

seismic events would probably result in a dam safety deficiency.

CONDITIONALLY POOR - A potential safety deficiency is recognized for unusual loading conditions which may realistically occur during the expected life of the structure. **CONDITIONALLY POOR** may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency; further investigations and studies are necessary.

POOR - A potential dam safety deficiency is clearly recognized for normal loading conditions. Immediate actions to resolve the deficiency are recommended; reservoir restrictions may be necessary until problem resolution.

UNSATISFACTORY - A dam safety deficiency exists for normal conditions. Immediate remedial action is required for problem resolution.

HAZARD CLASSIFICATIONS OF DAMS (STRUCTURE)

LOW HAZARD- A structure the failure of which may damage farm buildings, agricultural land, or local roads

SIGNIFICANT HAZARD- A structure the failure of which may damage isolated homes and highways, or cause the temporary interruption of public utility services.

HIGH HAZARD-A structure the failure of which may cause the loss of life and serious damage to homes, industrial and commercial buildings, public utilities, major highways, or railroads.

UNAPPROVED STATUS OF DAM

A dam that has been given an unapproved status (see entry for permit) means that plans, construction specifications, hydraulic analyses, and/or a geotechnical investigation on your dam, proving the safety of the structure, have not been received and approved by the Indiana Department of Natural Resources (IDNR). IDNR records indicate that no progress has been made to secure this approval. The fact that the dam is inspected under the Regulation of Dams Act (IC 14-27-7.5) in no way alters the illegal status of the structures.

If your dam is indicated to be unapproved, it is requested that your engineer contact the Indiana Department of Natural Resources,

APPENDIX IV

PRECIPITATION RECORDS FOR BLOOMINGTON, INDIANA

Bloomington, IN

Monroe County

© 10:20 AM EDT on March 27, 2017 (GMT -0400)

Weather History for KBMG - March, 2017

From:

March

1

2017

To:

March

9

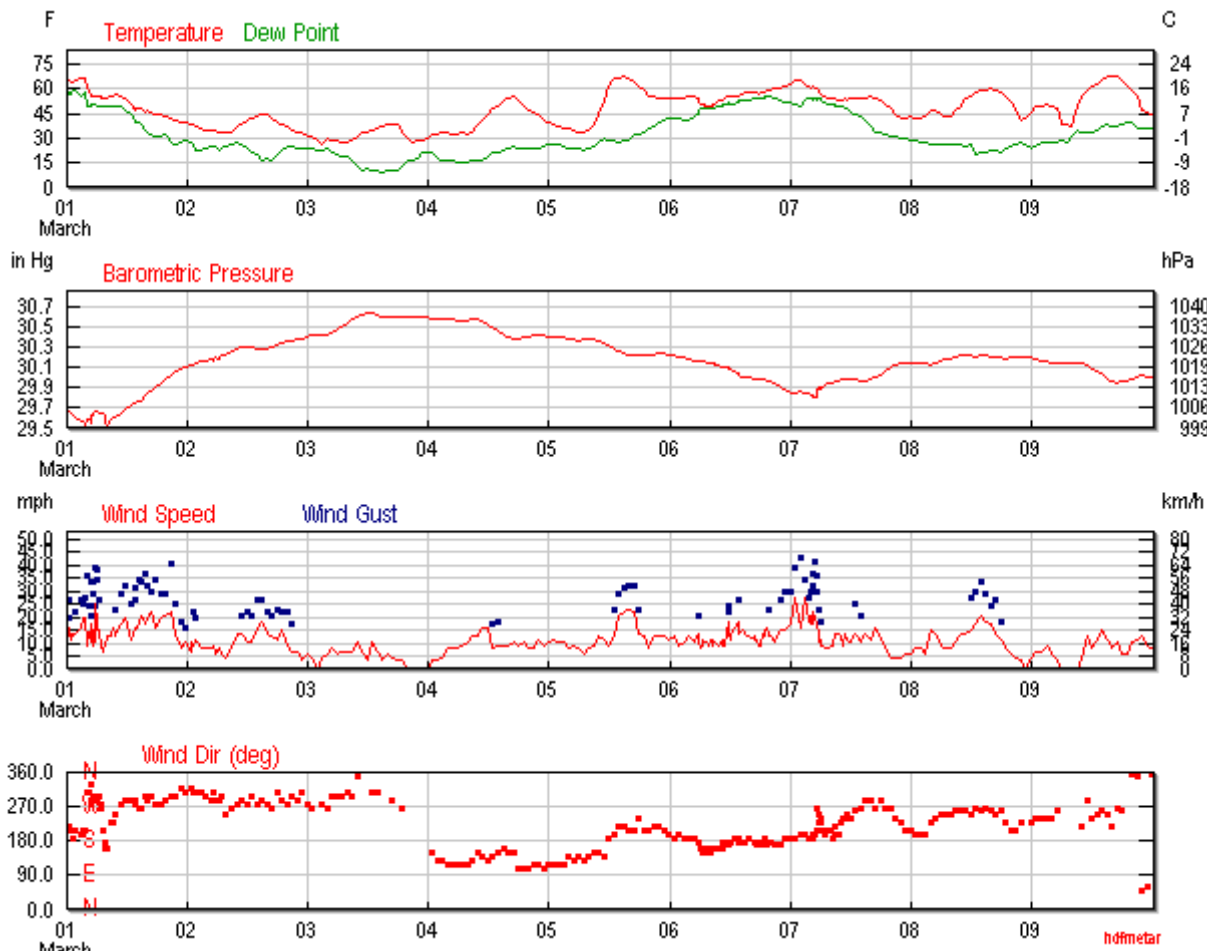
2017

Get History

Daily	Weekly	Monthly	Custom				
				Max	Avg	Min	Sum
Temperature							
Max Temperature				68 °F	58 °F	39 °F	
Mean Temperature				56 °F	47 °F	32 °F	
Min Temperature				49 °F	35 °F	25 °F	
Degree Days							
Heating Degree Days (base 65)				33	18	9	160
Cooling Degree Days (base 65)				0	0	0	0
Growing Degree Days (base 50)				4	1	0	9
Dew Point							
Dew Point				58 °F	31 °F	8 °F	
Precipitation							
Precipitation				0.91 in	0.28 in	0.00 in	2.22 in

	Max	Avg	Min	Sum
Snowdepth	-	-	-	-
Wind				
Wind	28 mph	10 mph	0 mph	
Gust Wind	45 mph	23 mph	16 mph	
Sea Level Pressure				
Sea Level Pressure	30.65 in	30.18 in	29.53 in	

Custom Weather History Graph



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KBMG

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APPENDIX V

LAKE LEMON 42" OUTFALL PIPE INSPECTION REPORT (UNDERWATER CONSTRUCTION CORPORATION)

February 23, 2017

Lake Lemon Conservancy District
7599 North Tunnel Rd.
Unionville, IN 47469

Attention: Adam Casey
Phone (812) 334-0233
Email: Manager@lakelemon.org

Subject: Lake Lemon 42" outfall Inspection
Inspection Date February 23, 2017
UCC Job # 02-17-102.16

Dear Mr. Casey,

Underwater Construction Corporation (UCC) is pleased to provide you with this report for the inspection performed on the outfall pipes on Lake Lemon. Attached, please find the inspection report and pictures illustrating the findings identified during the inspection.

In conclusion: The 42 inch pipe is in good condition and bar racks are also in good condition with no major buildup of material in either. The sluice gate is in good condition, but does have one leak in the seal at the bottom left corner of the gate if facing downstream. The outfall basin overall is in good condition, minus a 76 inch long crack on the west wall and undermining at the base of both wing walls. Finally, the access ladder is not anchored to the wall for the bottom 6 feet.

Thank you, and if you should have any further questions please contact me or Eric Jacobson at 269-921-6645 or through the listings provided below:

Nicholas Bennigan
260-227-1015 cell
Nbennigan@uccdive.com

Eric Jacobson
269-921-6645 cell
Ejacobson@uccdive.com

Sincerely,
Nicholas Bennigan
Nicholas Bennigan
UCC Dive Supervisor

Cc. Job File
Att. DVD

LAKE LEMON CONSERVANCY DISTRICT

Lake Lemon 42" Outfall Pipe Inspection

Dive Supervisor:

Nicholas Bennigan

Inspection Diver:

Steven Pena

Inspected On February 23, 2017



Submitted By:

UNDERWATER CONSTRUCTION CORPORATION

4295 N Roosevelt Rd

Stevensville, MI 49127

Phone: (877) 717-3483

Fax: (414) 988-1191

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1.0 PURPOSE**1.1 Inspection of 42" outfall pipe****1.1.1 Inspection of Plant River Water Intake Pipes:**

- a) Upstream
- b) Downstream
- c) Sluice Gate
- d) Basin

2.0 SITE CONDITIONS

Weather: 70° F / Sunny
River Conditions: Flat with no waves, wind 5mph out of the southwest
Elevation: <1000'
Water Visibility: 3'
Water Depth: 27'
Current: Minimal
Water Temperature: 46° F
Flow Conditions at Pipe: None
Access: Through an opening of the earth dam with ladder access

3.0 CREW AND EQUIPMENT

Crew: Standard Inspection / Four Man Dive Crew
One (1) Diving Supervisor: Nicholas Bennigan
One (1) Inspection Diver: Steven Pena
One (1) In Water Tender: Ryan Zanfirov
One (1) Stand-By Diver: Zack Verchimak
Two (2) Tenders: Andrew Day, Eric Jacobson

Equipment: Two (2) 1 Ton Crew Cab Truck, 24' Pen Trailer with a 370 air compressor, and Video Capability

4.0 FINDINGS

4.1 Upstream of Sluice Gate Findings:

Starting from the upstream side heading out to the lake, the diver found that the ladder is not anchored to the wall properly for the bottom 6 feet and is now loose. Because of this, the mounting is starting to fail and pull away from the wall. Above this section, the ladder is anchored properly and in good condition. In the pipe traveling upstream towards the lake, sediment in the pipe and on the walls was no greater than ¼ inch of light sand on the bottom and very light coverage of algae on the walls. This is consistent for the first 60 feet, at which point the diver located the first construction joint. The joints are in 10-foot increments that stayed consistent for the remaining length of the pipe. The debris built up to ½ inch by the time 70 feet was reached. By the time 100 feet was reached, small shells were present at the bottom of the pipe along with same sand/mud type material. The diver made it to the bar racks at 120 feet into the pipe. The racks were in good condition with slight wear uniformly on all of the bars. The racks are 80 percent covered with small sticks and algae, which was easily brushed away by hand. This section of pipe did not show any signs of cracking or any damage. The water depths for this dive at the entrance was 26 feet and maintained that depth until the diver made it to the bar rack, at which time the depth was 27 feet.

4.2 Downstream of the Sluice Gate Findings:

The diver enter the 42 inch pipe from the basin and traveled up to the sluice gate. Depth of water in the pipe stayed consistent at 5 feet. The sediment in the pipe was a uniform ¾ inch of sand. This pipe also had construction joints every ten feet. By the time the diver reached 150 feet, the debris went away and the diver began to lose visibility. With poor visibility, the diver did not find any major damage to pipe itself. The distance the diver traveled to the sluice gate from the entry point was 180 feet.

4.3 Sluice Gate:

The sluice gate was inspected from both upstream and downstream sides and it was found to be in great condition- all hardware was in place and tight. The diver followed it up to the surface and all cross bracing hardware are solid, as well as the stem. Facing downstream, the bottom left corner is leaking by and this leak by is very minimal. The water depth for this dive was 26 feet on the upstream side and 5 feet on the downstream side.

4.4 Basin:

The basin overall was is in good condition. There is, however one crack in the northwest corner measuring 76 inches in length and averaging ½ inch in width, which one location at the bottom were it is 1 1/8 inch in width. This same crack is visible at the top of the wall as well and appears that the crack extends completely through the wall. Also, we found undermining beneath both wing walls- on the west wall, it is 28 inches at its deepest and 31 inches at its highest. On the east wall, it is 46 inches at its deepest and 31 inches at its highest.

5.0 Recommendations

The entry ladder upstream of the sluice gate is loose and starting to come away from the wall at the bottom. It is recommended to replace or reinforce the ladder back to the wall and anchor properly. Downstream in the basin, it is recommended to back-fill the undermined areas in order to stop the erosion from getting worse.

6.0 Upstream Entry Point



Down Stream Entry Point



Images of Crack



Image of Undermining

