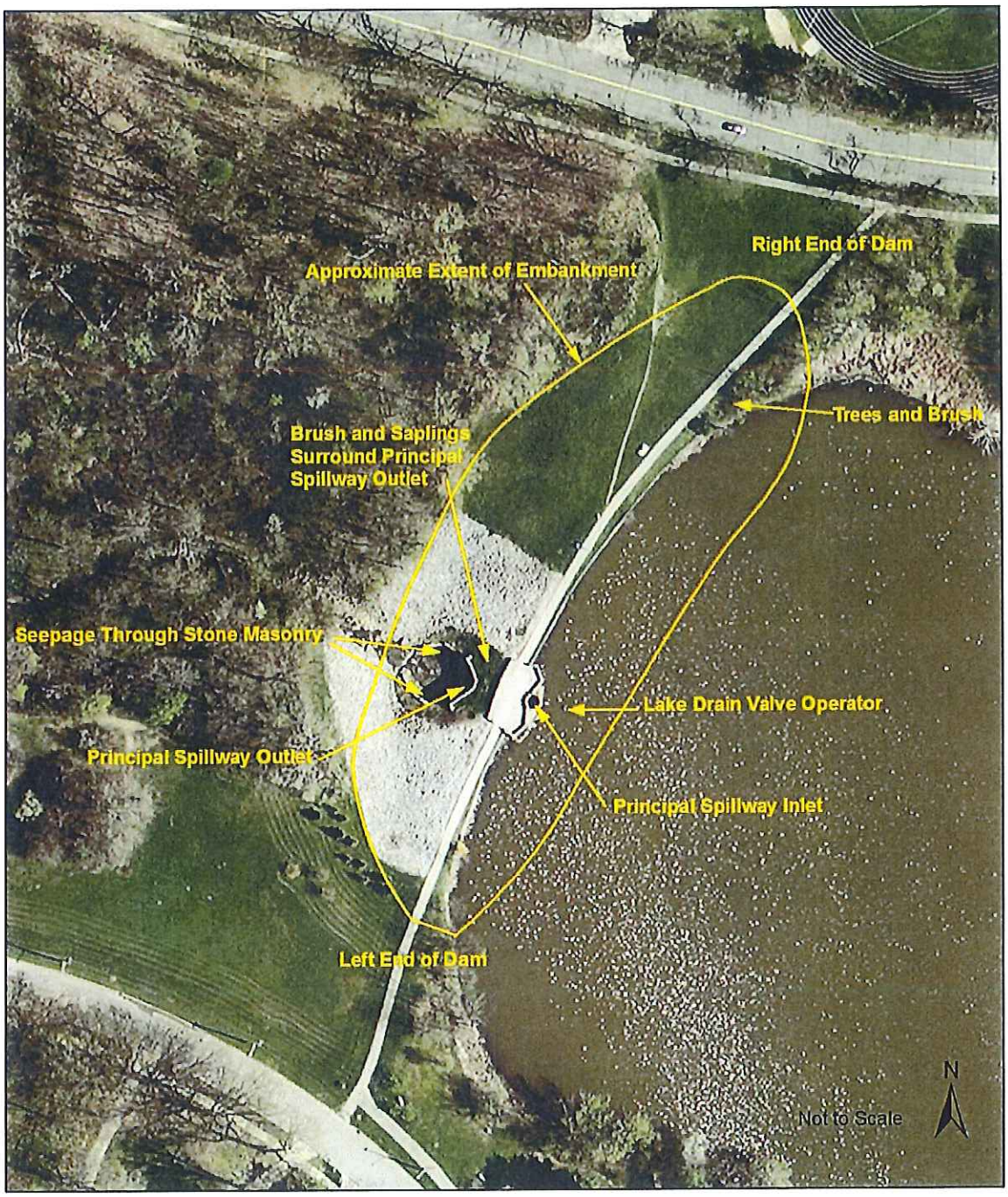
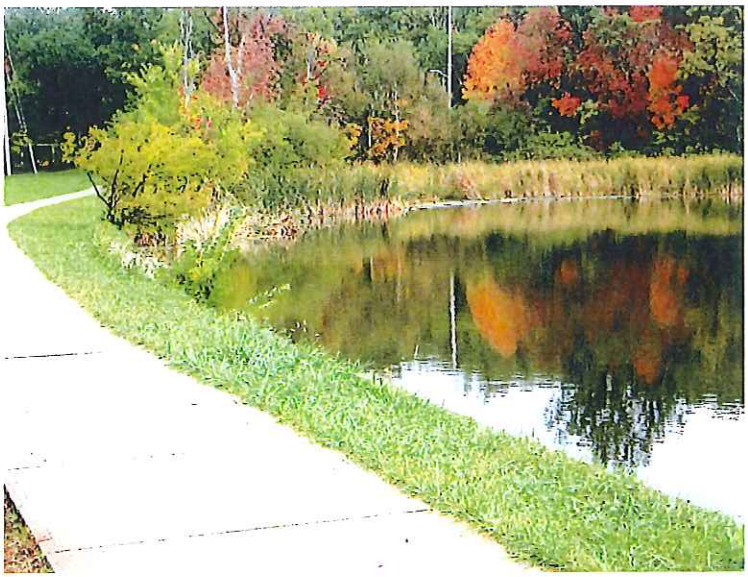
Section 2

Site Map
Upper Shaker Lake Dam
File Number: 1314-002



Photograph No. 1:

Stone wall along the upstream slope on the right side of the dam. Note the trees and vegetation growing through the wall.



Photograph No. 2:

Crest looking towards the right end of the dam.

Photograph No. 3:

Stone wall and crest looking towards the left end of the dam. Note the new (lighter color) riprap on the downstream slope. The new riprap replaced riprap that had been displaced during an overtopping flood earlier in the year.

	Photograph No. 4: Downstream slope.
	Photograph No. 5: Riprap on the downstream slope around the principal spillway outlet.
	Photograph No. 6: Riprap on the downstream slope to the left of the principal spillway outlet.

Photograph No. 7:

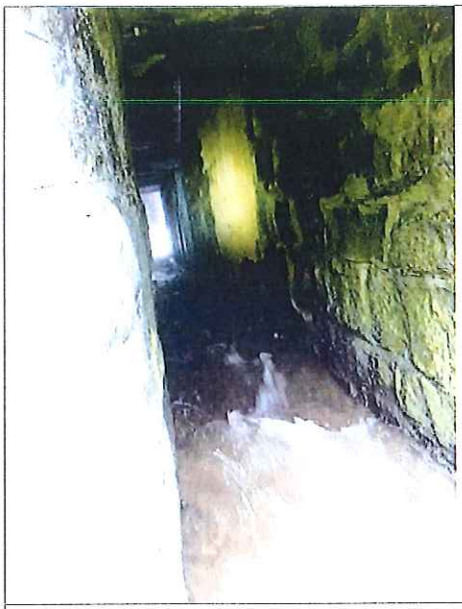
Principal spillway inlet. Note the flat trashrack and small openings.

Photograph No. 8:

Note the cracks in the masonry wall above the principal spillway inlet.

Photograph No. 9:

Interior of the principal spillway conduit.

	Photograph No. 10: Interior of the principal spillway conduit. Note that portions of the conduit have been braced with steel I-beams due to concerns of roof stability.
	Photograph No. 11: Overview of the principal spillway outlet. Note the trees, brush, and ivy growing around the spillway outlet.
	Photograph No. 12: Principal spillway outlet basin.

Photograph No. 13:

Principal spillway outlet basin looking downstream.

Photograph No. 14:

Note the seepage (orange-colored deposits) exiting through the left wall of the principal spillway outlet basin.

Photograph No. 15:

Seepage was observed coming from the floor of the principal spillway outlet basin.

Photograph No. 16:

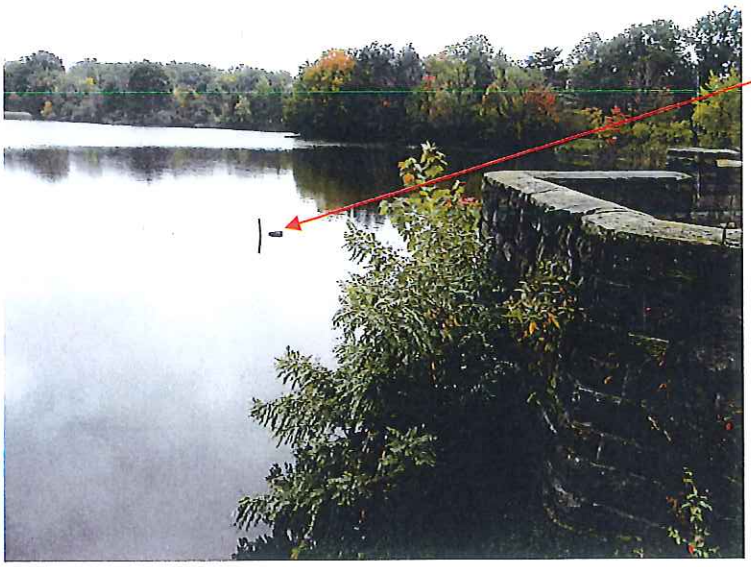
Seepage observed coming from the base of what appears to be a damaged stone block.

Photograph No. 17:

Note the crack in the wall, vegetation growing through the cracks, and missing mortar around the stone block.

Photograph No. 18:

The 4-inch drain pipe was located just downstream of the principal spillway conduit outlet.



Photograph No. 19:

The lake drain is accessed from a riser pipe in the lake.

Dam Classification Checklist

Name of Dam:	Upper Shaker Lake Dam			File Number:	1314-002
County:	Cuyahoga	Date:	September 30, 2014	Engineer:	DCB

The classification of a dam is based on three factors: the dam's height, storage capacity, and potential downstream hazard. The height of the dam is the vertical distance from the crest to the downstream toe. The storage capacity is the volume of water that the dam can impound at the top of dam (crest) elevation. The downstream hazard consists of roads, buildings, homes, and other structures that would be damaged in the event of a dam failure. Potential for loss of life is also evaluated. Various dam failure scenarios must be considered, and they include failures when the dam is at normal pool level and failures during significant flood events. Each of the three factors is evaluated, and the final classification of the dam is based on the highest individual factor. Class I is the highest and Class IV is the lowest. The classification of a dam can change based on future development along the downstream channel.

This checklist is intended to establish or verify the appropriate classification in accordance with the Ohio Administrative Code – it does not necessarily show all potential hazards or the full extent of inundation. In addition, elevations are estimated.

HEIGHT CLASSIFICATION	***STORAGE CLASSIFICATION***	***EXEMPT~NON-REGULATED***
Dam Height = 30.00 feet	Stor. Capacity (top of dam)= 155.00 acre-feet	
____ > 60' - Class I	____ > 5000 acre-feet - Class I	____ Height ≤ 6 feet
____ > 40' - Class II	____ > 500 acre-feet - Class II	____ Storage ≤ 15 acre-feet
X > 25' - Class III	X > 50 acre-feet - Class III	____ 6 ft. < Height < 10 ft. &
____ ≤ 25' - Class IV	____ ≤ 50 acre-feet - Class IV	Stor. ≤ 50 ac-ft

Height Class: III

Storage Class: III

Hazard Class (see next page): I **Estimated Population at Risk:** (16+)

Final Class: I

Class Changed (~~Yes~~, No)

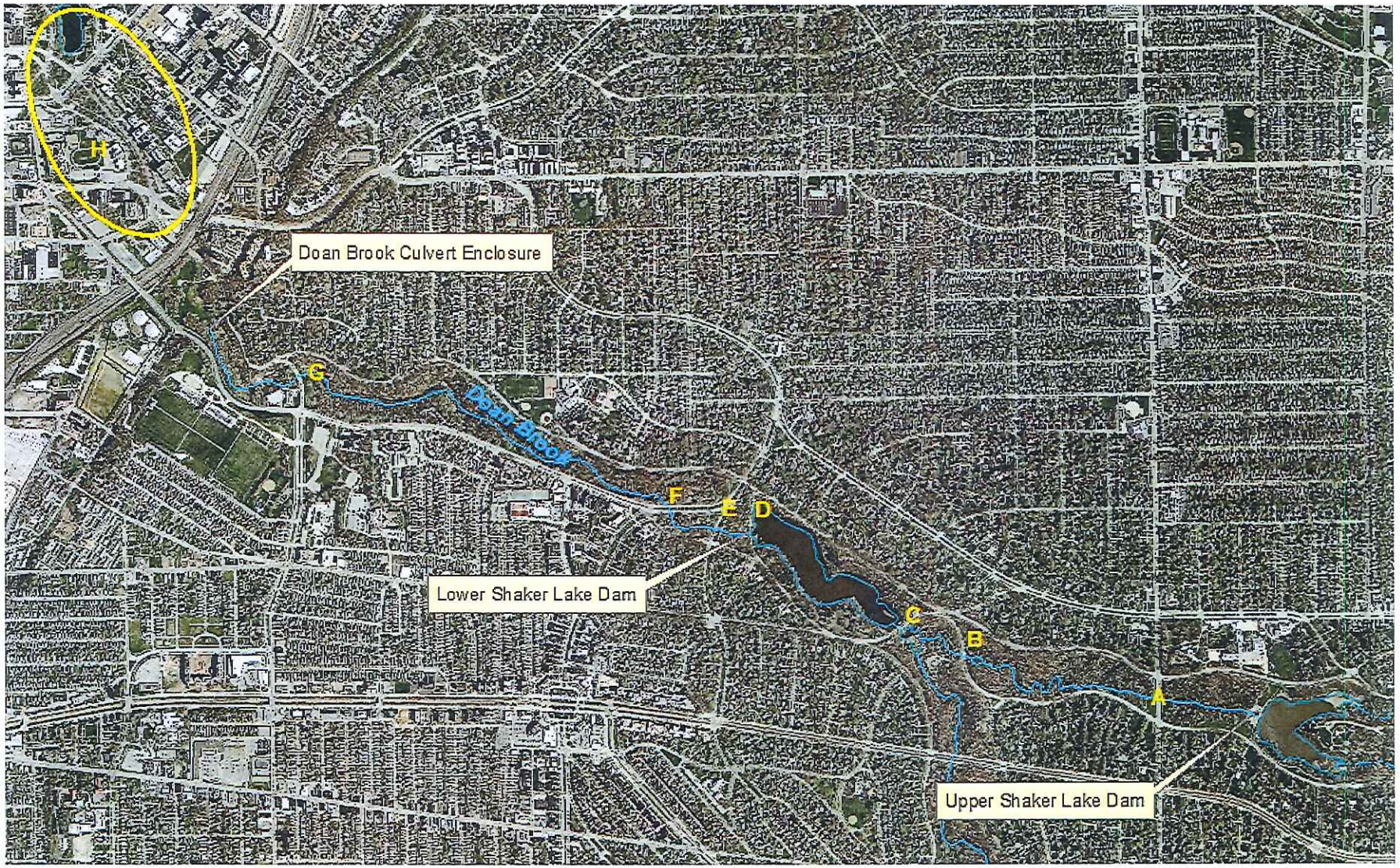
POTENTIAL DOWNSTREAM HAZARD

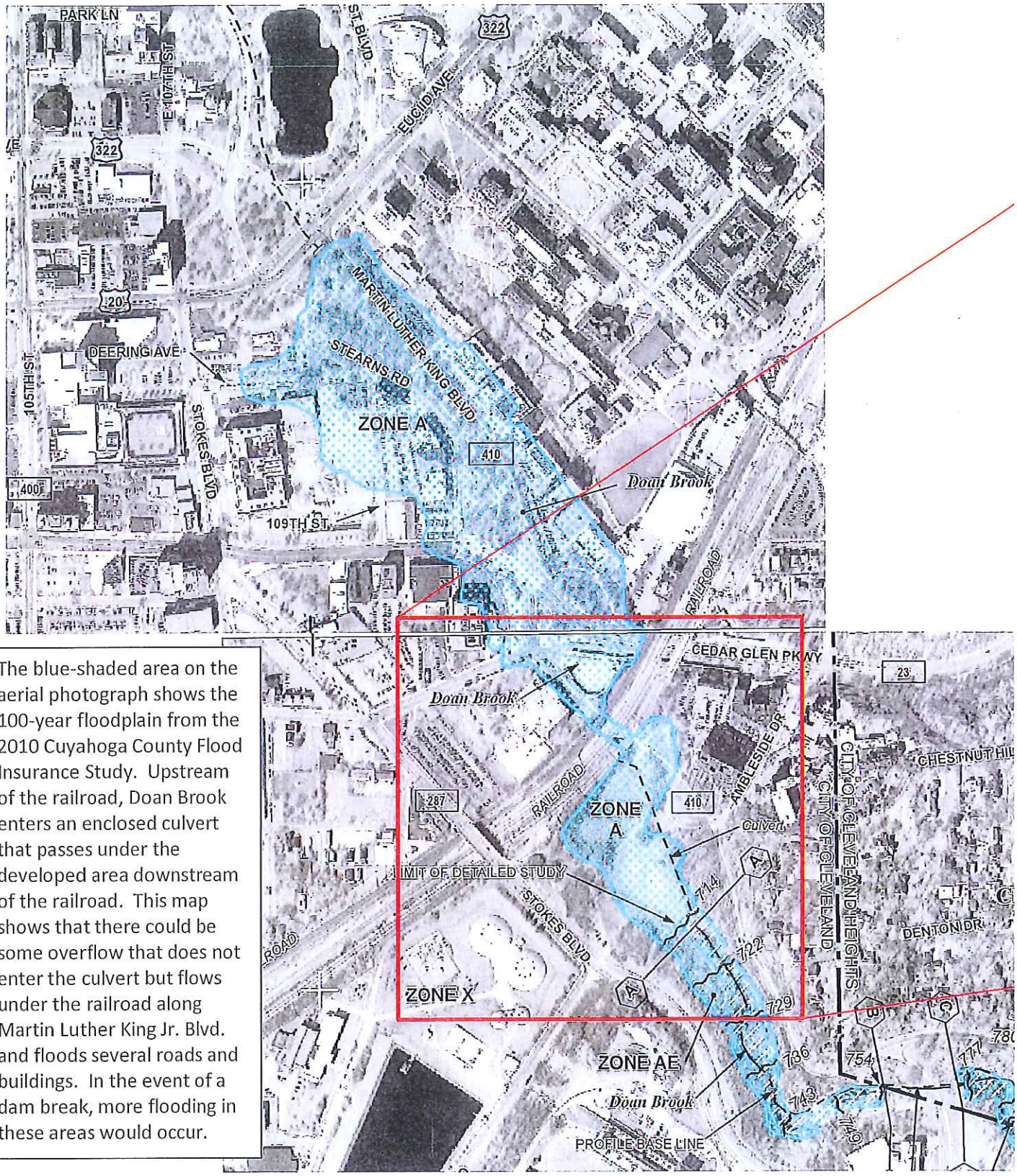
I	II					III		IV	-	-				
Probable loss of human life	Loss of public water supply or wastewater treatment facility, release of health hazardous waste	Flooding of structure or high-value property	Damage to high-value or Class I, II, III dam or levee	Damage to major road (US or state route), disruption of only access to residential or critical facility area	Damage to railroad or public utility	Damage to rural building, not otherwise high-valued property, or Class IV dam or levee	Damage to local road (county and township)	Loss restricted mainly to the dam or agricultural /rural land	No hazard to structure noted	*No hazard assessment; further investigation needed*	Distance downstream of dam to affected structure (feet)	Vertical distance from streambed to base of affected structure (feet)	Horizontal distance from stream to affected structure (feet)	
							A				1300	20	0	Lee Road
							B				3300	<6	0	South Park Boulevard
							C				4000	<6	0	West Woodland Road
			D								6300	17	0	Lower Shaker Lake Dam/Brook Rd
							E				6600	11	0	Coventry Rd
							F				7100	8	0	Fairhill Rd
									G		12100	13-30*	0	East Blvd
H											14,000+	varies	varies	University buildings, roads, and other structures

1. This checklist is intended to establish or verify the appropriate classification in accordance with the OAC – it does not necessarily show all potential hazards or the full extent of inundation.
2. The letters in the above chart correspond to matching letters on the following maps.
3. In the event of dam failure, downstream property owners or other affected parties in additional to those identified in the table above should be made aware of the situation.
4. This downstream hazard investigation is based on field observations and from *2012 aerial imagery obtained from Ohio Statewide Imagery Program (OGRIP).*

** There is a 13 ft tall culvert at East Boulevard. The total embankment height is about 30 feet.*

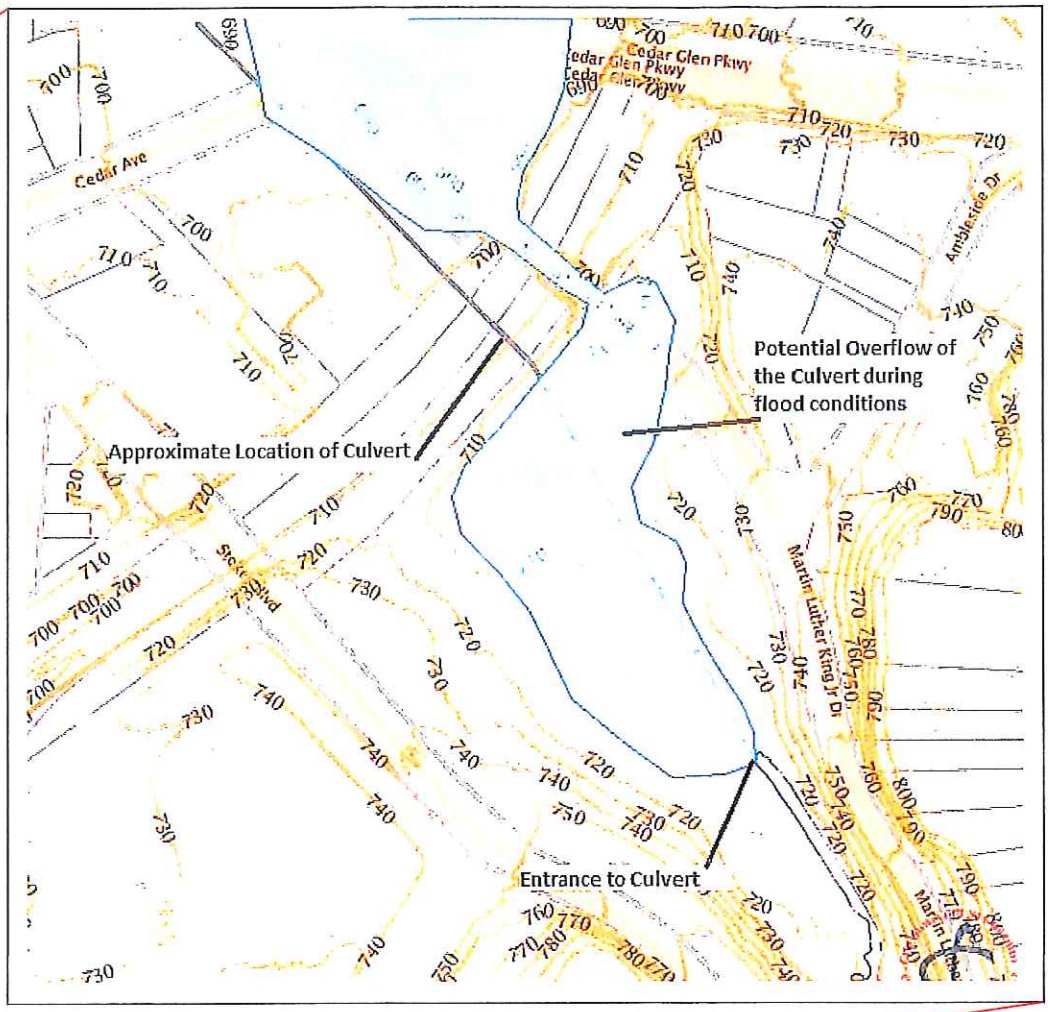
See Next Pages for Location of Developments Downstream of Dam


I
H
Doan Brook Culvert Enclosure
G
Doan Brook
F
E
D
Lower Shaker Lake Dam
C
B
A
Upper Shaker Lake Dam



The blue-shaded area on the aerial photograph shows the 100-year floodplain from the 2010 Cuyahoga County Flood Insurance Study. Upstream of the railroad, Doan Brook enters an enclosed culvert that passes under the developed area downstream of the railroad. This map shows that there could be some overflow that does not enter the culvert but flows under the railroad along Martin Luther King Jr. Blvd. and floods several roads and buildings. In the event of a dam break, more flooding in these areas would occur.

e map below includes 2-ft contours obtained from the Cuyahoga County Auditor Website.
e map shows that overflow from the culvert will flow along Martin Luther King Jr Blvd,
der the railroad to developed areas downstream.



The culvert begins about 1.4 miles downstream of Lower Shaker Lake Dam and about 2.6 miles downstream of Upper Shaker Lake Dam.

Flood Routing Summary

A dam must be able to safely pass severe flood events. A dam uses a combination of reservoir storage capacity and spillway discharge to prevent floodwater from overtopping the embankment crest. As part of this inspection, the Division of Soil and Water Resources did not thoroughly investigate the ability of this dam to safely pass the required design flood. In 2009 the Division of Soil and Water Resources performed hydrologic and hydraulic calculations to estimate the size of the design flood and the total spillway discharge capacity of the dam. These calculations combined with the reservoir storage capacity were used in the flood routings to determine the maximum water surface elevation in the reservoir for various flood events (see Table I).

Upper Shaker Lake Dam is a Class I dam; therefore, in accordance with OAC Rule 1501:21-13-02, the required design flood is 100% of the Probable Maximum Flood (PMF) or the critical flood. This dam and its spillway system must safely pass the design flood without overtopping the embankment crest. Flood routing calculations indicate that the dam can pass 6% of the PMF; Upper Shaker Lake Dam does not appear to be able to safely pass the design flood.

Table I - Flood Routing Summary

Flood Event	Maximum Inflow (cubic feet per second)	Maximum WSEL[1] (feet)	Overtopping Depth[2] (feet)	Overtopping Duration (hours)
PMF	8743	984.9	2.73	5.5
75% PMF	6557	984.4	2.2	4.9
50% PMF	4371	983.8	1.6	4.5
25% PMF	2185	983.0	0.8	3
12% PMF[3]	1049	982.5	0.3	1

1. WSEL – water surface elevation, in feet above the mean sea level
2. A negative number indicates that the dam does not overtop and represents the elevation difference between the Maximum WSEL and the Top of Dam Elevation (freeboard)
3. 12% PMF is similar to the 100-year flood. The 100-year flood event has a 1% chance of occurring in any given year. This is only an approximation.

Top of Dam Elevation: 982.20 feet above msl
Normal Pool Elevation: 978.00 feet above msl

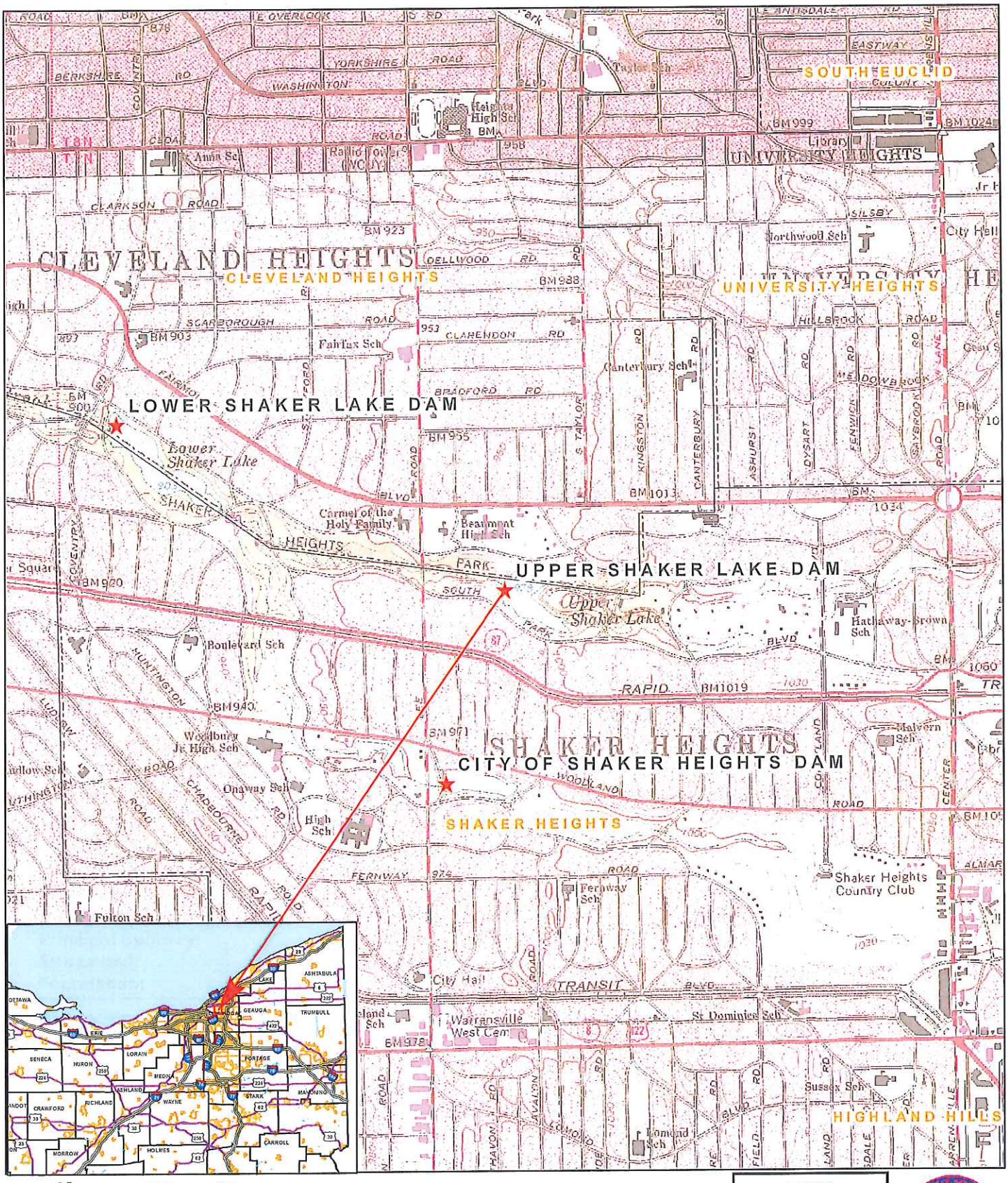
History of Upper Shaker Lake Dam

Date	Event
1852	Dam constructed.
1977	Dam safety inspection by the Division of Soil and Water Resources.
1979	USACOE Phase I Inspection
1985	Dam safety inspection by the Division of Soil and Water Resources.
1998	Removed trees and brush from masonry wall on upstream slope; repaired undermined areas of wall and pressure grouted.
1995	Dam safety inspection by the Division of Soil and Water Resources.
1996	Dam safety inspection by the Division of Soil and Water Resources.
2009	H&H Study submitted and approved.
2009	EPP submitted and approved.
April 29, 2009	Dam safety inspection by the Division of Soil and Water Resources.
May 29, 2012	Plans and specifications approved to install Roller Compacted Concrete on the crest and downstream slope. The plans were not constructed.
2013	Interior of the principal spillway conduit reinforced with steel I-beams for stability issues with the ceiling.
July 25, 2014	The embankment overtopped during a small flood and displaced rock riprap on the downstream slope. The riprap was replaced with new riprap after the flood.
September 30, 2014	Dam safety inspection by the Division of Soil and Water Resources.

Section 3

LOCATION MAP

UPPER SHAKER LAKE DAM - 1314-002



Feb 28, 2007

Dam Safety Inspection Checklist

Name of Dam: Upper Shaker Lake Dam — Cuyahoga County
Date of Inspection: 9-30-2014 — Required Action: None ☐ Mon. ☐ Maint. ☐ Eng. ☑
File Number: 1314-002
Class: I Design Flood: 1.0 Flood Capacity: 0.06
Haz.: I, Height: III, Volume: III

Interview with Owner (at the site):
Owner/Representative present: (Yes) No Name(s): William Boag (City of Shaker Heights), Andre' Spencer (City of Cleveland Heights), Joseph Ciuni (GPD Group)
Owner's Name(s): City of Cleveland (leased to Shaker Heights)
Address: City of Shaker Heights, Dept. of Public Works, 15600 Chagrin Boulevard
City: Shaker Heights State: OH Zip (+4): 44120
Contact Person: Bill Boag, Pub. Works Dir. Telephone: 216-491-1495
Email Address:
Purpose of dam: Recreation, Public

Owner Dam Safety Program
Emergency Action Plan Yes EPP — None ☐ Mon. ☐ Maint. ☐ Eng. ☑
EAP (document): Need full EAP Up-to-date? (yes, no)
Downstream development: Mostly park area, roads, Lower Shaker Lake Dam, University

Operation, Maintenance, and Inspection (No) — None ☐ Mon. ☐ Maint. ☐ Eng. ☑
OMI (document): Needs revision
All drains operable? (yes, no) Unknown Up-to-date? (yes, no)

Normal rate of drawdown: Unknown Accessibility for operation: By boat
Maintenance
Frequency of mowing: Frequently
Other maintenance: Braced interior of principal spillway conduit w/ I-beams

Inspection
Frequency and thoroughness of day-to-day & routine inspections: Inspections are performed sometimes but no formal process.
Problems found during inspections: Added riprap on downstream slope after overtopping flood in July 2014.

Field Information
Pool Elevation (during inspection): 2 inches above normal pool Time: 2:00 (a.m.) (p.m.)
Site Conditions (temp., weather, ground moisture): Damp from earlier rain, 70°F, cloudy
Inspection Party: Dena Barnhouse, Jim Huitger, John Watkins

Confirm the Following: ☑ Dam Height (ft): 30 ☑ NP Area (ac): 11.4

Reference Information

City of Cleveland owns the dam; City of Shaker Heights and City of Cleveland Heights (216-291-3737, Carl Czaga) lease the property and take responsibility for managing the dam; copy City of Cleveland on correspondence: Dept of Water Pollution Control, 12302 Kirby Avenue, Cleveland, OH, 44108-1617, Darnell Brown, Commissioner

Not sure how lake drain is operated, access by boat, about 15 upstream of ps inlet; downstream slope armored with small riprap; two weepholes in d/s wall to left of spillway

Downstream Slope Has Layer Of Rock Riprap.

	Elev.	Area (ac)	Stor. (ac-ft)	(in.)
TOD:	982.2	23	155	0.8
Em. S/w:				
Prin. S/w:	978	11.4	76	
Strmbd:	952.6			

Basin (ac): 1210

Impound. Type: Dam And Spillway
Structure Type: Earthfill
Township: City Of Shaker Heights
Stream: Doan Brook
Designed By: North Union Shaker Colony
Constr. By: North Union Shaker Colony
Year Compl.: 1852 Plans Avail.? Yes At: Repairs Plans At Odnr
Fail./Incid.:

Required Action

Upstream Slope

☑ Gradient: 2H:1V and vertical masonry wall

Typical Problems: shoreline erosion, trees & brush, surface erosion, ruts, rodent burrows, earth slides, cracks

None	Monitor	Repair	Engineer
		✓	
			✓
		✓	

Trees and brush located at the left and right ends. In addition, small trees & other vegetation growing through the masonry wall in places.
The masonry wall had some missing stones, loss of mortar, and cracks. It appeared that the wall was leaning towards the lake on the left side of the dam.
Previous inspections noted erosion on the slope beyond the masonry wall. Due to dense vegetation, these areas could not be inspected. Add erosion control as needed.

Crest

☑ Width (ft): 14 – wider at right end ☑ Length (ft): 615 ☑ Total Freeboard (ft): 4.20

Typical Problems: low areas, trees & brush, surface erosion, ruts, cracks

None	Mon.	Rep.	Eng.
✓			
			✓
	✓		

Concrete sidewalk. Mowed grass. No signs of rodent burrows, cracks, or erosion.
It appeared that the right end and possibly the left end was lower than the center of the dam. The owner showed a video on his phone of the dam overtopping on either side of the principal spillway.
Monitor the crest for depressions or sinkholes.

Downstream Slope

☑ Gradient: 3.5H:1V

Typical Problems: trees & brush, surface erosion, ruts, rodent burrows, earth slides, cracks, seepage

None	Mon.	Rep.	Eng.
		✓	
✓			
		✓	
	✓		✓

Trees and brush were noted on the right downstream toe & groin.
Most of the slope had a good, mowed grass, slope.
The center of the slope was covered with rock riprap about 1 foot in diameter. The riprap had to be replenished after the dam overtopped in July and the old riprap was displaced downstream. Trees, brush, and vines were growing in the riprap.
Seepage was observed on the slope on the left side of the spillway outlet wall. Seepage was also noted coming through the masonry wall and from the floor of the spillway outlet basin. Monitor the seepage and the embankment for sinkholes.

Principal Spillway

☑ 10-ft Stone-masonry Drop Inlet Connected To 2.5-ft X 6.25-ft Conduit

Typical Problems: Inlet obstructed, unsatisfactory trashrack/anti-vortex plate, material deterioration, misalignment, open joints, outlet erosion, outlet overgrown, undermining

None	Mon.	Rep.	Eng.
		✓	
			✓
		✓	✓

Wire fencing has been added to the metal bars on the trashrack. The openings appeared to be < 6 inches which is too small & the trash rack is flat. Routinely gets blocked by debris.
The interior of the inlet and conduit could not be inspected due to flow. A consultant, GPD, designed and installed reinforcing inside the conduit due to stability concerns with the ceiling.
There is a circular masonry wall w/ concrete floor at the outlet. Riprap is at the outlet of this basin. There was loss of mortar in the joints, cracking, and seepage through the walls and floors

☑ Sufficient measurements to perform hydraulics (dimensions, riser depth, outlet elevation)

Required Action

Emergency Spillway

☑ None
☐ Freeboard (to normal pool, feet)

Typical Problems: Flowpath obstructed, material deterioration, erosion, misalignment, overgrown, undermining

None	Monitor	Repair	Engineer
			✓

This dam is required to have an emergency spillway.

☐ Sufficient measurements to perform hydraulics (dimensions, breadth, side slopes)

Lake Drain

☑ Cast Iron Pipe Of Unknown Size

Typical Problems: Poor operating access, inoperable, deteriorated/missing components, outlet erosion

None	Mon.	Rep.	Eng.
			✓

It is unclear whether the drain is operable. It can only be accessed by boat.

Other

None	Mon.	Rep.	Eng.

☑ All Field Data Gathered (inspector's inititals): DCS | JRH

Site Sketch

☑ Investigate Downstream Hazard