

# **Report**

## **Structural Condition Assessment of the Lake Shady Dam**

**Oronoco, MN**

**Prepared for: Olmsted County, MN**

**February 2011**

**Project No. 000362-11003-0**

February 28, 2011



Mr. Terry Lee  
Olmsted County Environmental Services  
2117 Campus Drive SE, Suite 200  
Rochester, MN 55904

Re: Structural Condition Assessment Report  
Lake Shady Dam, Oronoco, MN  
Bonestroo File No. 000362-11003-0

Dear Mr. Lee:

We have completed our Structural Condition Assessment (SCA) of the Lake Shady Dam structure and immediate area. The focus of this SCA was to evaluate the condition of the existing dam structure and assess flood damage that this structure may have sustained from the flood event on September 23 and 24, 2010. Some of the repair work on and around the dam has been completed on an emergency basis, while other work must wait until spring.

Due to winter weather conditions and the considerable amount of ice and snow limiting the ability to visually inspect parts of the dam, and particularly the surrounding site, the focus of this assessment is primarily on the stability and integrity of the concrete portion of the dam itself. Observations of the surrounding area are noted, and photographs taken to document current conditions are included for future reference.

If it is desired to retain and/or upgrade this dam for the foreseeable future, a follow-up, in-depth condition assessment should be conducted in order to verify that all portions of the existing structure will satisfactorily fit into those future plans.

In the meantime, please contact me at 651-604-4766 or [phil.caswell@bonestroo.com](mailto:phil.caswell@bonestroo.com) with any questions or concerns you may have regarding the findings of this report.  
Respectfully,

BONESTROO

A handwritten signature in black ink that reads "Philip J. Caswell".

Philip J. Caswell, PE  
Senior Structural Engineer/Project Manager

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

A handwritten signature in black ink that reads "Philip J. Caswell", identical to the one above.

Philip J. Caswell, P.E.

Date: February 28, 2011

Registration No.: 19204

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## 1.0 Introduction

Olmsted County retained Bonestroo to inspect the Lake Shady Dam to evaluate structural damage sustained by the September 2010 flood event that overtopped the dam and eventually washed out the embankment around the north abutment, draining Lake Shady. Some repair work has been completed since that event, including restoration of the north embankment and roadway approach to the Highway 18 bridge, immediately downstream of the dam. Other repair work was being conducted at the time of the inspection, while much more work remains to be done.

The scope of the inspection consisted of visual inspection of readily-accessible portions of the dam and immediate surroundings for signs of distress, structural damage, and/or movement. Those features of the dam that were inspected include:

- Overall Site and Embankments
- Principal Fixed-Crest Spillway
- Principal Gated Spillway
- Tainter Gates

Due to obstructions by ice and snow, some of these features, or portions of the features, were not able to be observed. These are noted as such. No evaluation was made of the area hydrology or hydraulic capacity of the dam, nor was an analysis of the dam stability performed. This work was completed recently by others, and is included in separate documents available through Olmsted County.

If it is desired to upgrade and maintain the dam at this location for the foreseeable future, a follow-up, in-depth condition assessment must be performed to verify that all portions of the existing structure will satisfactorily fit into those future plans.

## 2.0 Description of Lake Shady Dam

The Lake Shady Dam, in its current configuration, was constructed in 1937, and consists of a 50-ft. wide concrete fixed ogee-crest spillway on the right side (looking downstream), and five 20-ft. wide gated ogee-crest spillway sections with operable tainter gates on the left side. Total length between abutments measures 165 ft. Hydraulic height at normal pools is approximately 15 ft. See the plan drawing of the dam in Figure 1.

The main spillway section typically has a 2-ft. high break-away flashboard installed on top of the crest, raising the impounded lake level accordingly. A portable gas-powered, motorized drive is used to engage the geared operators and gate lifter chains to operate the tainter gates. According to dam operator, Steve Wittlief, it takes approximately 1 hour to fully open each gate. Minnowa Construction workers had fully opened, by handwheel, Gates 1 thru 4. The operator for Gate No. 5, in the center of the channel, was frozen closed, but reportedly was able to be opened once the weather warmed. All gates are currently open.

The dam is situated between a steep limestone/sandstone bedrock bluff on the south side, and sloped embankment fill on the north side. A concrete tied-arch bridge, carrying Minnesota Avenue (County Highway 18) across the outlet channel, runs parallel and approximately 100 feet downstream (east) of the dam. River Street descends from Minnesota Avenue at the top of the embankment, terminating at a small parking area just above lake level west of the dam.

## 3.0 Description of 2010 Flood Event

Heavy rains in September, 2010, caused Lake Shady to swell quickly, and flood waters overtopped the dam on September 23 and early on the 24th. The main spillway flashboard broke away and was deposited downstream. Flood waters flowed over and around the north abutment and washed out the embankment and north roadway approach to the Highway 18 bridge. The buried reinforced concrete core wall at the north abutment was undermined, fractured, and collapsed. Embankment soil was washed away, leaving only pitted limestone bedrock exposed. See Photo Nos. 1 through 4. The bedrock left exposed around the arch bridge north footing was found to be eroded and unstable. A reinforced concrete supplemental footing was constructed to anchor the bridge to sound bedrock.

With the embankment soils washed away, the north pile-supported approach span and abutment were left exposed, suspended several feet in the air. The exposed abutment piles were reinforced with supplemental structural steel and a new footing was constructed. Embankment fill was imported and placed around the bridge and dam north abutments and the access road reconstructed. See Photo No. 22.

## 4.0 Scope of Condition Assessment

A field inspection of the Lake Shady Dam was performed on January 26, 2011, to assess the condition of dam and immediate surroundings following the damage sustained by the flood, and following the restoration of the north embankment and roadway/approach to the Highway 18 bridge. In addition, Minnowa Construction workers were on site opening the radial gates as well as placing large stone backfill behind the south abutment walls.

Woody debris that had accumulated along the top of the dam during the flood had been removed, so the elevated walkway was fully accessible.

In addition to visually inspecting the viewable portions of the dam, it was also evaluated for movement, vertically and horizontally. Vertical elevations were taken along the suspended concrete walkway to detect variations due to uplift or settlement, and the upstream edge of the walkway was sighted for horizontal misalignment.

## 5.0 Assessment Findings and Observations

A description of the inspection findings and observations is provided below. In general, aside from the loss of north embankment soils from around the north abutment, the dam structure itself is in fair condition and did not experience significant structural damage from the flooding. Emergency repairs have been completed to stabilize and reinforce the bridge north approach span and roadway immediately downstream of the dam. Work on the south abutment was being completed at the time of this inspection.

Accompanying inspection photographs are included in Appendix A, while the detailed checklists used for the inspection are included in Appendix B.

### 5.1 EMBANKMENTS

While mostly snow-covered, the following observations could be made of the north and south embankments:

North embankment restoration was essentially complete. Embankment was to grade with large (est. 12" to 24") rip rap armoring. See background of Photo No. 23. The maintenance/access road at north end has been restored and is functional, but has not been paved.

A tree (approx. 12" diam.) is growing adjacent to the east wing wall of the north abutment. See Photo No. 16.

South abutment backfill was lost during the flooding. Minnowa Construction was in the process of placing large (approx. 12" diam.) limestone rip rap backfill at the time of the inspection. No compaction of this material was performed or was even practically possible. See Photo No. 9.

Downstream channel wall, on the right side, also appeared to have lost backfill material, and the exposed surface of bedrock appeared very weathered. Closer inspection could not be performed due to accessibility and snow coverage. See Photo No. 20.

It could not be determined whether the left abutment core wall, which failed and was washed-out during the flood, was reconstructed prior to the emergency placement of the embankment fill. It is assumed that it was not. Therefore, there currently is less resistance to embankment seepage available than there was prior to the flood.

### 5.2 PRINCIPAL SPILLWAY – FIXED CREST

Although the upstream water level was a few feet below the concrete ogee-crest spillway, only a portion of the downstream face was visible, with the top and toe obstructed by ice and snow. Of the visible concrete portion, no structural distress, cracking or movement was observed. The 2-foot high flash board had been removed by the flood, but it appeared that the spillway structure had not sustained any damage. See Photo No. 8.

Surface web-cracking with efflorescence (white chalky substance) was observed in the faces of the right abutment wall, indicating that water was penetrating the concrete and that spalling is likely to begin soon. See Photo No. 19.

Due the presence of surface ice in the pool immediately downstream of the crest, no soundings were taken to determine whether excessive scouring has occurred. Soundings should be performed both upstream and downstream following ice-out in the spring.

### 5.3 PRINCIPAL SPILLWAY – GATED

As mentioned previously, four of the five radial gates were opened fully, with the fifth (No. 5, center of channel) left closed, frozen in place. Notable items observed in the gated spillway area include:

1. Water was flowing over the spillways, which appeared level, with uniform flow. Ice covered much of the faces of the spillways, particularly No. 1 and No. 5, so these were not observable. Nos. 2 through 4 appeared to function without problems and showed no signs of distress. See Photo Nos. 5, 7 and 29.
2. Some concrete deterioration was observed, including spalling at Pier Nos. 2 and 3 (See Photo No. 11); surface cracking with efflorescence at the left abutment walls (Photo Nos. 15 and 16); and a diagonal stress crack in right wall of Spillway No. 5. This deterioration does not yet adversely affect the functioning of the dam, but left unaddressed will create problems long term.
3. The steel guardrail on top of the concrete access walkway and wing walls at both abutments was severely damaged by woody debris that collected against it during the flood. In addition, the walkway concrete spalled and was damaged at some of the rail post anchorages. It appeared that these areas had been patched previously, but were damaged during the flood. See Photo Nos. 11 and 12.
4. Elevations were taken at approximately 23-foot intervals (above each pier) along the walkway, to determine whether the dam had experienced any vertical movement. All elevations were within 0.04' so, in our opinion, no movement has occurred.
5. The upstream face of the walkway was sighted (visually) to determine whether any differential horizontal movement had occurred. No misalignment was observed. See Photo No. 17.
6. Radial gates, lifters and chains, with some notable exceptions, appeared to be in good condition and to operate properly. Gate No. 1 could not be opened due to a damaged lifting mechanism. No distress, distortion, or other damage was observed on any of the gates. See Photo Nos. 23 through 27. The geared operator for Gate No. 2 has been damaged and the housing leaks. See Photo No. 28.
7. No distress or damage was observed at the gate trunnions and anchorages. See Photo Nos. 30 and 31.
8. Besides the complete wash-out of the embankment soils around the north end, the backfill soils were eroded from behind the south abutment walls and deposited downstream. The backfill replacement work was underway at the time of this inspection, and is expected to be complete at the time this report is issued. The backfill material consisted of large (12" or larger) limestone rip rap. See Photo No. 9.

## 6.0 Conclusions and Recommendations

From the findings of the inspection, the dam structure has remained in relatively good structural condition following the September flood. Again, while no evaluation of the hydraulic capacity of the dam was performed as part of this inspection, the fact that flood waters overtopped the dam suggests that it has inadequate spillway capacity. The recommendations provided below should be considered in conjunction with any other plans for upgrading the dam for any long-term continued operation:

Specific recommendations for addressing the deficiencies observed include:

1. Steel guardrail, along the dam's elevated concrete walkway and above the walls of each abutment, was either severely damaged or torn from its anchorage at the walkway all together by the force of the current against the woody debris trapped against it. This railing is necessary for safe access to operate the gates, and must be replaced.
2. Gas-powered gate lifter was on the access walkway during the flood event, and sustained damage to the extent that it must be replaced. The lifter was customized for connection to the geared operators.
3. Gate #4 geared operator was damaged during preparations for the flood, and the lubricant has leaked out. To ensure the continued operability of the gate in the future, this must be repaired and the housing replaced. See Photo No. 28.
4. Spillway flash boards, lost downstream during the flood, have not been recovered and must be replaced.
5. Buried concrete core wall, extending into the embankment from the north abutment, was undermined as the embankment soils were eroded and collapsed. The embankment soils were replaced under emergency conditions, without reconstructing the core wall. This wall is necessary to prevent seepage through the embankment, around the north abutment, and must be reconstructed. Embankment material must be re-excavated, then replaced following the installation of the core wall.
6. Parking lot along the north embankment, upstream of the dam, was damaged by erosion from the flood waters. The extent could not be determined with the snow cover present. The quantity shown is an estimate.

In addition to the damage observed that is attributable to the flooding, other necessary repairs were identified, some of which have been identified previously.

7. Patching the existing concrete is necessary in several locations where cracking and/or spalling was observed. This includes the access walkway and upstream sides of some of the gated spillway piers. See Photo Nos. 11 and 12. Overall, the concrete is exhibiting extensive web-cracking, and efflorescence (white chalky substance), an indication of water penetration. This water penetration will continue to deteriorate the concrete through freeze-thaw cycles, eventually requiring extensive patching. See Photo Nos. 15 and 16.
8. Construct a containment berm along the north embankment, upstream of the dam, as directed by the DNR. This berm is necessary to prevent the possibility of future floods again overtopping the north embankment and bypassing the dam.

Recommendations for repairing the observed damage or deficiencies necessary to permit the continued future use of the dam, with associated costs, include, but are not limited to:

Recommended Repairs of Damage Due to Flood			
Item No.	Description	Scope	Est. Cost
1	Remove/replace guardrail	240 LF @ \$100 Remove exist./new anchorages	\$24,000
2	Replace gas-powered gate lifter	Customized for application	\$5,000
3	Replace Gate #4 lifting mechanism	Remove exist./fabricate new/ with installation	\$8,000
4	Replace spillway flash boards, cables and rigging	50' (x 2' high) @ \$40/LF	\$3,000
5	Excavate north embankment soils, reconstruct core wall	150 CY excavation/backfill 10 CY reinf. concrete	\$10,000
6	Repair parking area – 12" aggregate, 4" bituminous	11,650 SF (per aerial photo) @ \$3.35/SF	\$39,000
		Total estimated cost:	\$81,000

Estimated costs for repairs not associated with damage from the flooding or, in the case of the north embankment berm required by the DNR, is new work, and includes the following:

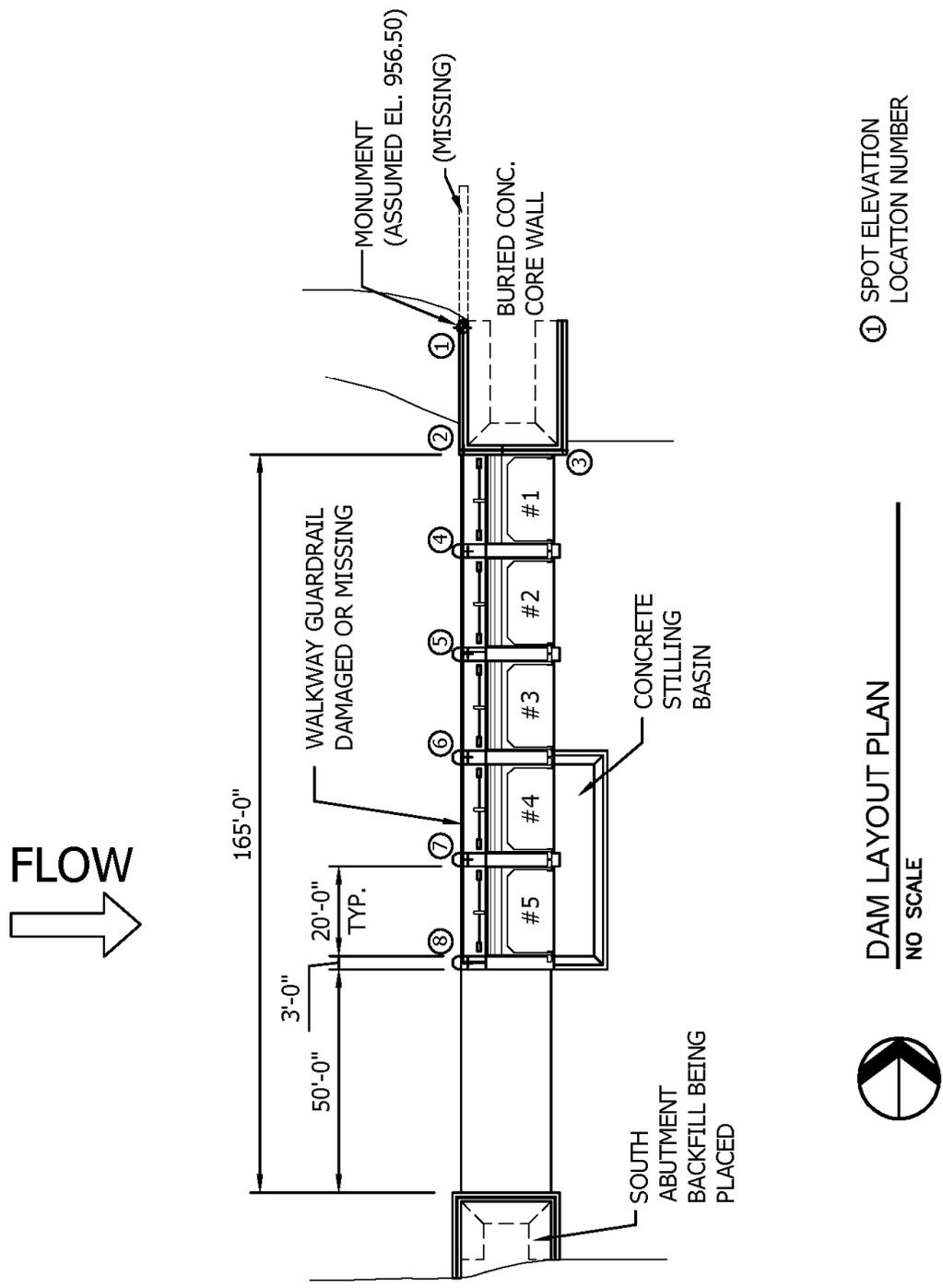
Other Recommended Repairs			
Item No.	Description	Scope	Est. Cost
7	Patch/repair concrete	Temp. scaffolding, labor and materials	\$10,000
8	Construct upstream containment berm	300 LF x 6 avg. ht. w/ 3:1 slopes @ \$10/CY	\$18,700
		Total estimated cost:	\$28,700

It must be reiterated that this structural condition assessment did not include an evaluation of the hydraulic capacity of the dam. Any and all upgrades, expansions and/or improvements of the dam due to hydraulic considerations are beyond the scope of this assessment and are expressly not included.

It is also recommended that bottom soundings be taken immediately upstream and downstream of the dam to determine whether any scouring has occurred that may pose potential problems, similar to that observed at the north bridge pier.

## 7.0 Disclaimers and Qualifications

The opinions stated in this report are based on limited visual observations and physical investigation only. No warranty is made, expressed or implied, that deficiencies that may affect life safety or property, though not addressed in this report, may not exist. In addition, note that any recommendations and/or descriptions of repair or remediation work necessary are for general information or budgeting purposes only, and do not constitute design and bidding and/or construction documents.



① SPOT ELEVATION  
LOCATION NUMBER

DAM LAYOUT PLAN  
NO SCALE



PLAN

ORONOCO, MINNESOTA  
LAKE SHADY DAM

FIGURE: 1



I:\362\362110030\REPORTS\TECHNICALREPORTS\362110030FIG1.DWG

DATE: 02/25/2011

COMM: 362-11003-0

# Appendix A - Photographs



**Photo No. 1 – Dam Overtopping and Bridge Washout at North Abutment (Sept. 2010)**



**Photo No. 2 – North Bridge Approach Span, Post-Flood (Sept. 2010)**



**Photo No. 3 – Upstream View of Dam, Post-Flood (Sept. 2010)**



**Photo No. 4 – Washed-out North Embankment (Sept. 2010)**



**Photo No. 5 – Gated Spillways (Left Side)**



**Photo No. 6 – Backfilling Operations at Right Abutment**



**Photo No. 7 – Gated Spillways (No. 4 in center)**



**Photo No. 8 – Fixed-Crest Spillway**



**Photo No. 9 – Right (South) Abutment with New Rip Rap Backfill**



**Photo No. 10 – Parking Lot (Left Bank)**



**Photo No. 11 – Upstream View of Gated Spillways**



**Photo No. 12 – Deteriorated Concrete Walkway**



**Photo No. 13 – View Looking South**



**Photo No. 14 – Survey Monument, North Abutment Wing Wall**



**Photo No. 15 – Previously-Patched Deteriorating Concrete, Northeast Wing Wall**



**Photo No. 16 – Deteriorating Concrete, Northeast Wing Wall**



**Photo No. 17 – No Misalignment Visible Along Maintenance Walkway**



**Photo No. 18 – Cracked Left Wall of Main Spillway**



**Photo No. 19 – Backfilling Operations at South (Right) Abutment**



**Photo No. 20 – Downstream Channel Wall and Deteriorated Bedrock**



**Photo No. 21 – Dam Signage**



**Photo No. 22 – View of Access Road at North End**



**Photo No. 23 – Gates No. 1 thru 4 in Fully Open Position**



**Photo No. 24 – Gate No. 2**



**Photo No. 25 – Sides of Gates No. 2 and 3**



**Photo No. 26 – Gate Lifting Chain**



**Photo No. 27 – Foote Brothers Gate Operator**



**Photo No. 28 – Damaged Gate No. 2 Operator**



**Photo No. 29 – View of Dam from Downstream**



**Photo No. 30 – Tainter Gate Trunnions**



**Photo No. 31 – Trunnions for Gate No. 4 (left) and No. 5 (right).**

# Appendix B – Inspection Checklists

Name of Dam:	Lake Shady	Date:	1/26/11
Inspectors:	P. Caswell - Bonestroo	F.F.#:	
Owner's Name:	Olmsted County, MN	Key Seq #:	
Street:	Minnesota Av.		
City, State, Zip Code:	Oronoco, MN		
County:	Olmsted	Phone:	
Weather and Site conditions:	Overcast, 25°F ±	Email:	

GENERAL				Action		
Item	N	P	Notes/ Observations	M	I	R
1 Monuments/Benchmarks		<input checked="" type="checkbox"/>	Location: Top of wing wall, north abutment. Elevation: Datum: N/A. Assumed EL. = 956.50 from drawings.			
2 Pool Level			Normal/Operating: Low flow/level - all gates (except #5) open. Maximum: Minimum: Staff Gage			
3 Access Road	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Good with add'l agg. base from construction operations.	<input checked="" type="checkbox"/>		
4 Signage/ Security			Portage/route: None. Dam Warning: <input checked="" type="checkbox"/> wooden, on dam. See photo. Downstream Hazard: None. Fencing/Railings/Catwalks: <input checked="" type="checkbox"/> No security fencing present.			

**Additional Comments:**

1. Minnowa Construction on site, importing rock fill for crossing U/S of dam. Workers also opened gates. Gate #5 (farthest south) became impassable due to freeze-up. Workers will try again when thawed.

N= Noted; P= Photo; M= Monitor  
 I= Investigate; R= Repair  
 F.F.= Field File; RT = Right; LT = Left  
 U/S = Upstream; D/S = Downstream

**Action Suggestion**

1. Requires immediate action
2. Plan to do soon
3. Do when convenient

<b>Dam Inspection Checklist</b>			
Dam Name:	Lake Shady	F.F. #:	
Date:	1/26/11	Page	1 of 7



EMBANKMENTS (Cont.)								
Item	N	P	Notes/ Observations			Action		
						M	I	R
<b>4 Slope Protection</b>	<input type="checkbox"/>	<input type="checkbox"/>	No problem	<input type="checkbox"/>	Not applicable	<input checked="" type="checkbox"/>	Could not inspect	
A. Type (none, riprap, wave berm, concrete slabs, loose formed concrete/asphalt):	<input type="checkbox"/>	<input type="checkbox"/>	Large rip rap placed around north abutment, inc. access road. Remainder was snow-covered.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Condition:	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>5 Other</b>	<input type="checkbox"/>	<input type="checkbox"/>	No problem	<input type="checkbox"/>	Not applicable	<input checked="" type="checkbox"/>	Could not inspect	
A. Rodent burrows (few, many) Location:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
B. Ruts Length/ Width/ Depth: Location:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
C. Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>6 Alignment</b>	<input type="checkbox"/>	<input type="checkbox"/>	No problem	<input type="checkbox"/>	Not applicable	<input checked="" type="checkbox"/>	Could not inspect	
A. Vertical Low area: Elevation Difference: Location:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
B. Horizontal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
C. Width Too narrow: Location:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>7 Toe</b>	<input type="checkbox"/>	<input type="checkbox"/>	No problem	<input type="checkbox"/>	Not applicable	<input checked="" type="checkbox"/>	Could not inspect	
Cracks/Slumps: Embankment drains: Type/Flow: Location: Seepage/ Wetness: Hummocky:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>8 Seepage</b>	<input type="checkbox"/>	<input type="checkbox"/>	No problem	<input type="checkbox"/>	Not applicable	<input checked="" type="checkbox"/>	Could not inspect	
Wet area: Boil: Sinkhole: Aquatic vegetation: Rust colored deposits: Other: Sediment in Flow: Flowrate: Location:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
N= Noted; P= Photo; M= Monitor I= Investigate; R= Repair F.F.= Field File; RT = Right; LT = Left U/S = Upstream; D/S = Downstream			<b>Action Suggestion</b>			1. Requires immediate action 2. Plan to do soon 3. Do when convenient		
<b>Additional Comments:</b>								
<b>Dam Inspection Checklist</b>								
Dam Name:			F.F. #:		Date:		Page <u>3</u> of <u>7</u>	

SPILLWAY--PRINCIPAL - FIXED CREST				Action		
Item	N	P	Notes/ Observations	M	I	R
<b>1 Fixed Crest</b>	<input checked="" type="checkbox"/>		No problem			
<b>A. Dimensions</b>						
Top Width:			50'-0" clear			
<b>B. Materials</b>			Cast-in-place concrete (original, 1937).	<input checked="" type="checkbox"/>		
<b>C. Shape</b> (sharp-crested, broad-crested, ogee, chute, gated, overflow, morning glory, dropbox, labyrinth)		<input checked="" type="checkbox"/>	Ogee crest. Plan elevation = 947.0			
<b>D. Debris</b>		<input checked="" type="checkbox"/>				
Prevention (racks, booms, etc.):			None. Lake level drawn down, not over flow.			
<b>E. Concrete Condition *</b>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		
			Could not inspect. Not accessible or viewable.			
<b>F. Flashboards</b> (none, number):	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Type (Metal, wood):						
Dimensions:			2'-0" High x crest width.			
Operability:			N/A. Missing since Sept. 2010 flood.			
<b>G. Abutments</b>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		
Condition: *			Cracking and efflorescence visible.			
Seepage/wetness:			Could not inspect seepage due to frozen conditions.			
<b>H. Drains</b>						
Type: Weep holes, Relief drains, Other:						
Flow Rate:			Unknown.			
<b>I. Other</b>						
N= Noted; P= Photo; M= Monitor I= Investigate; R= Repair F.F.= Field File; RT = Right; LT = Left U/S = Upstream; D/S = Downstream				<b>Action Suggestion</b> 1. Requires immediate action 2. Plan to do soon 3. Do when convenient <b>Controlled = Gated</b> <b>Uncontrolled = Overflow</b>		
<b>Additional Comments:</b>						
* Type of Concrete Problems: Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other						
<b>Dam Inspection Checklist</b>						
Dam Name:		F.F.#:		Date:		4 of 7

SPILLWAY--PRINCIPAL - OUTLET EROSION CONTROL & UNDERMINING									
	Item	N		P		Notes/ Observations	Action		
		M	I	R					
1	<b>Outlet Erosion Control</b>	No problem		Not applicable		Could not inspect			
	A. Type (none, endwall, plunge pool, energy dissipation structure, rock lined channel, apron)					Grated Spillways #1 #2 - Conc. lined. Spillways			
	B. Scour								
	C. Material								
	a. Riprap: Avg Diameter: Condition (adequate, sparse, displaced, weathered): Bedding fabric- (Yes/ No):								
	b. Concrete * Dimensions/Location:								
	D. Sidewall/Headwall								
	Misalignment: Location: Description:								
	E. Separated Joint / Loss of Joint Material:								
	Location: Description:								
	F. Natural								
2	<b>Undermining</b>	No problem		Not applicable		Could not inspect			
	Location: Description:								
N= Noted; P= Photo; M= Monitor I= Investigate; R= Repair F.F.= Field File; RT = Right; LT = Left U/S = Upstream; D/S = Downstream		<b>Action Suggestion</b> Controlled = Gated		1. Requires immediate action 2. Plan to do soon 3. Do when convenient Uncontrolled = Overflow					
<b>Additional Comments:</b>          									
* Type of Concrete Problems: Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other									
<b>Dam Inspection Checklist</b>									
Dam Name:		F.F.#:		Date:		Page 5 of 7			

SPILLWAY-PRINCIPAL - GATES				Action		
Item	N	P	Notes/ Observations	M	I	R
<b>1 Gates</b>			No problem			
			Not applicable			
			Could not inspect			
<b>A. Types</b> (lift/slide, tainter(radial), stoplogs, leaf, roller, flashboards, needles, other): Number and Size:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Principal spillway controlled by tainter gates, Crest plan elev. = 940.0 5 gates x 20'-0" total.			
<b>B. Stoplogs</b> Dimensions: Condition:	<input type="checkbox"/>	<input type="checkbox"/>	N/A.			
<b>C. Abutments</b> Condition: * Seepage/wetness:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Generally good. Diagonal crack observed in Gate #1 right abutment wall.	<input checked="" type="checkbox"/>		
<b>D. Piers</b> (number, shape) Condition: *	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5 conc. piers at 1'-6" R. Piers #2 & #3 (L-R) spalled.			<input checked="" type="checkbox"/>
<b>E. Operability</b> Type of Operator: Condition(chain, cables,hoists): Security(locked?): Backup Operator:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Foote Bros. geared operators w/ 2 lifting chains each. Chains in good condition. Gate #1 operator was inoperable. 5'-0" dia. hand wheel - too slow for emergency op.			<input checked="" type="checkbox"/>
<b>F. Access</b>	<input type="checkbox"/>	<input type="checkbox"/>	Easily accessed via elevated walkway. Steel guardrail heavily damaged, creates obstruction.			<input checked="" type="checkbox"/>
<b>G. Condition</b> Rust: Seals (leakage):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Gates show no signs of distress, distortion, deflection or damage. Seals appear adequate.	<input checked="" type="checkbox"/>		
<b>H. Ice protection</b> Type (Heaters, Bubblers, Barriers, Other)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	None.			
<b>I. Debris</b> Prevention (Rack, boom, etc.)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Some woody debris retained on D/S side of gates. Does not obstruct operation.			<input checked="" type="checkbox"/>
<b>J. Condition of Flowway</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No obstructions			<input checked="" type="checkbox"/>
<b>K. Drains</b> Type (Weep holes/ Relief drains/ Other): Flow rate: Location:	<input type="checkbox"/>	<input type="checkbox"/>	None observed.			
<b>L. Other</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Steel guardrail anchorages have spalled conc.			
N= Noted; P= Photo; M= Monitor I= Investigate; R= Repair F.F.= Field File; RT = Right; LT = Left U/S = Upstream; D/S = Downstream Action Suggestion 1. Requires immediate action 2. Plan to do soon 3. Do when convenient Controlled = Gated      Uncontrolled = Overflow						
<b>Additional Comments and/or Sketch:</b> 1. Concrete exhibits deterioration due to age and exposure. No damage or distress from 2. Steel guardrail and anchorages to concrete walkway heavily damaged or missing. Requires replacement and concrete repair.						
* Type of Concrete Problems: Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other						
<b>Dam Inspection Checklist</b>						
Dam Name:		R.F.#:		Date:		Page 6 of 7

FIELD BOOK						
Profile Leveling For: T/ DAM SPOT ELEVS.			Instrument Person: P. CASWELL			
Original Notes in Field Book #			Rod Person: J. BARTON			
Instrument Used:			Note Taker: P. CASWELL			
Weather Conditions: OVERCAST, 25°F ±						
STATION	B.S. +	H.I.	F.S. -	ELEV.	DIST.	REMARKS
1	3.94	960.44		956.50*		MONUMENT - N. END, N. ABUTMENT
2			3.98	956.46	(-0.04)	T/CONC. - SW CORNER, N. ABUT.
3			3.99	956.45	(-0.05)	T/CONC. - SE CORNER, N. ABUT.
4			3.97	956.47	(-0.03)	T/CONC. - WALKWAY @ PIER #1
5			3.93	956.51	(+0.01)	" " " #2
6			3.98	956.46	(-0.04)	" " " #3
7			3.99	956.45	(-0.05)	" " " #4
8			3.99	956.45	(-0.05)	" " " #5
Bench Mark Information (Location, Elevation, Datum): * MONUMENT DISK IN CONCRETE. ASSUMED ELEV. 956.50.						
Comments: MAX VERT. DIFFERENCE, MAX - MIN = 0.06' (APPROX. 3/4"). - WITHIN TOLERANCE OF CONSTRUCTION. NO MOVEMENT FOUND.						
Suggested Survey points:						
	HW TW D/S Channel (at toe) Aux. Crest LT	Sill Crest Abutments Aux. Crest RT		Low Embankment Lt. Groin Rt. Groin Outlet Pipe Invert		
Dam Inspection Checklist						
Dam Name:	F.F.#:	Date:			Page 7 of 7	