March 28, 2014

Gordon Stinson, DFD Project Manager
Wisconsin Department of Administration
Division of Facilities Development
PO Box 7866
101 E. Wilson St, 7th Floor
Madison, WI 53707-7866

Re: Dam Safety Inspection Report, Little Falls Dam, Field File No. 55.01

Dear Mr. Stinson:

Ayres Associates reviewed the existing documentation and completed an inspection of the Little Falls Dam on August 8, 2013, in accordance with Wisconsin Department of Natural Resources (DNR) guidelines. This letter summarizes the main observations made during the inspection.

Existing Spillway Capacity

The existing available information for the Little Falls Dam was reviewed. The 1979 Army Corps of Engineers Inspection Report estimated the discharge for the dam. This information was then extrapolated to show the 1000 year flow (Q_{1000}) in a 1987 Warzyn report. These flows are significantly lower than current Flood Insurance Study (FIS) dated March 16, 2009.

	1979 and 1987 Reports (cfs)	Current FIS (cfs)
Q_{100}	9,300	13,099
Q_{1000}	15,000	16,700

The Little Falls Dam is classified as a high hazard dam and must pass the Q_{100} through its principal spillway and Q_{1000} through its emergency spillway per NR333. The 1979 USACE inspection noted that the spillway could pass 9600 cfs through the gated and overflow spillways. This with the new FIS flows is below the Q_{100}. The 1987 Warzyn report was developed to determine how to pass the Q_{1000}. That report concluded that the most economical way to increase the spillway capacity would be to pass flows overtop the entire concrete structure.

We do not concur with this recommendation and believe other alternatives should be considered. The dam does not have adequate capacity, and overtopping the walkway is an inadequate way to pass high flows. Additional studies are required to determine options to increase spillway capacity.

Dam Inspection

Underwater and gate inspections were completed on September 20, 2013. The report from the underwater inspection can be found in Appendix A and the gate inspection report can be found in Appendix B.

The following table summarizes recommended maintenance based on what was observed during the inspections. The schedule is based on DNR recommendations. Please note that "right" and "left" refer to directions while standing on the dam looking downstream, and gates are numbered from left to right.

Maintenance Item	Schedule
1. Evaluate alternatives to increase spillway capacity and dam stability under higher FIS flows.	April 2015
2. Repair gates 2 and 4	November 2016
3. Repair voids on downstream side	November 2016
4. Have backup power onsite	April 2014
5. Install benchmarks	November 2014
6. Install signs for portage route	May 2014

The following paragraphs provide a more detailed description of each maintenance item and its importance for dam safety.

1. The Little Falls Dam does not meet the spillway capacity regulations set by NR333. The dam must be able to pass the Q_{100} through its principal spillway and the Q_{1000} through its overflow spillway because it is classified as a high hazard dam. The Q_{100} is 13,099 cfs (FIS) and the Q_{1000} is 16,700 cfs (FIS extended); the spillway capacities must be increased to meet these criteria. Further evaluation of alternatives to increase spillway capacity is needed.

2. Tainter gates 2 and 4 were inoperable during the inspection, gate 3 was functioning correctly. The trained operator, Aaron Mason, DNR Willow River State Park Manager, noted that gate 2 binds against the abutment wall, and gate 4 has not been operable for approximately one year. Photo 5 on Appendix D shows scrape marks from the gate rubbing against the abutment wall; this causes too much friction for the winch to overcome. Further investigation into the cause of the inoperable gates was performed by the DNR. It was found that the winches may not be lifting the gates plumb which could cause the gates to become wedged between the abutments. Further investigation into the actual cause of the inoperable gates is necessary.

   The gates must be repaired; the loss of these gates greatly reduces the dam's ability to pass high flows. The gates should be fixed pending the results of the spillway capacity evaluation.

   In addition to repairing the operability of the gates, the gates need the following repairs found during the tainter gate inspection:

   - Gates 2, 3, and 4 need to be cleaned, sand blasted, and painted.
   - The edges of all rough cuts should be ground smooth.
   - Replace nuts and bolts with section loss and fill empty bolt holes.
   - On gate 2, the full penetration weld of the splice of the left arm's bottom angle of the lower double should be welded to full thickness of the leg of the angle.
   - On gate 2, a leak was observed at the bottom left corner of the bay which appears to be coming underneath the concrete of the left wall, see photo 19 of the Tainter Gate Inspection Report in Appendix B. This should be stopped by filling the void with grout or other appropriate material.

Additional information about these recommendations can be found in Appendix B. The estimated cost for the gate repairs is about $15,000 to $20,000 per gate for gates 2, 3, and 4. These costs may increase significantly if the existing paint is found to be lead based. These repairs should be pursued after the gates are operable pending the results of the spillway capacity evaluation.

3. Three voids were found underwater on the downstream side of the dam. A void was found beneath the downstream side of gate 1 at the streambed concrete interface. It is a maximum of 6 inches high; it extends a maximum of 2 feet under the concrete, and can be found along the entire width of gate 1. Another void was found in the concrete at the downstream side of gate 4 approximately 1.5 feet below the water surface. This void is 1.5 feet high, it extends 4 inches into the concrete, and is 4 feet long; there is exposed steel that shows signs of minor corrosion. A third void was found at the streambed concrete interface downstream of the overflow spillway on the right side of the spillway. It is 4 inches high, extends 1.5 feet under the concrete, and is 3 feet long. The voids are to be filled, this repair is estimated to cost between $5,000 and $10,000. More details about the voids found during the tainter gate inspection can be found in Appendix A.

4. There is no backup power located onsite to run the gates during a power outage. It was noted in an incident report from March 1989 that opening the gates manually was difficult and a slow process. There was also a correspondence from October 19, 1992 that indicates a generator will be brought up from Hudson in the event that gates need to be opened during a power outage. It is recommended that a generator be stored onsite and tested regularly. The availability of the Hudson generator should be confirmed and a clear process of obtaining the generator be defined in the IOMP.

5. Benchmarks on the dam should be installed and referenced to a datum such as NAVD88. This will allow monitoring of the dam components for movement. Installing benchmarks on the dam is estimated to cost between $1500 and $2500.

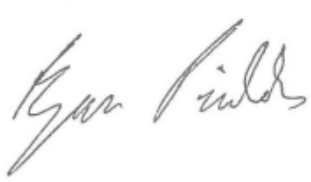
6. A signed portage route must also be established. Michael Rogney at the DNR can provide assistance or additional information if needed. Installing portage signs is estimated to cost between $500 and $1000.

The inspection checklist, consultant checklist, and photos from the inspection are enclosed, along with a CD containing electronic files. We have sent the same items to Michael Rogney, the DNR dam safety contact for your county. Please let us know if we can be of further assistance to you.

Sincerely,

Ayres Associates Inc.

Chris Goodwin, PE
Water Resources Engineer
Direct: 715.831.7682
GoodwinC@ayresassociates.com



Ryan Pichler
Water Resources Engineering Staff
Direct: 715.831.7541
PichlerR@ayresassociates.com

Enclosures

cc: Michael Rogney, DNR

Appendix A
Underwater Inspection Report

Underwater Inspection

Little Falls Dam
Willow River State Park
St. Croix County, Wisconsin

Prepared for:

Wisconsin Department of Administration
Division of Facilities Development
Madison, Wisconsin

September 2013

Underwater Inspection

Little Falls Dam
Willow River State Park
St Croix County, Wisconsin

AYRES ASSOCIATES
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Ayres Associates Project No. 26-0770.00
File: r130920a.bks.docx

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Executive Summary

This report is in response to the direction of the State of Wisconsin Department of Natural Resources for a detailed underwater inspection of the Little Falls Dam.

The Little Falls Dam is located in the Willow River State Park. It is owned by the State of Wisconsin and operated by the Wisconsin Department of Administration Division of Facilities Development. The dam is approximately 370 feet long and consists of a non-overflow section, tainter gates, and a fixed crest spillway.

The underwater inspection was complete by Brian Schroeder, PE, Jason Cook, PE and Chris Marcum on September 20, 2013. Mr. Schroeder led the team and completed the underwater inspection. Mr. Cook tended the diver while using SCUBA and operated the surface supplied air diving equipment. Mr. Marcum tended the diver while using the surface supplied air diving equipment.

The underwater inspections were completed with SCUBA and surface supplied air equipment. The downstream side of the dam was inspected using line tended SCUBA. The tender was positioned along the length of the spillway and north tainter gates on top of the concrete energy dissipater. The tender was also positioned adjacent to the south tainter in a shallow area. The upstream side of the dam was completed using surface supplied air that was stationed in a boat on the water upstream of the dam.

The gates were locked and tagged out so that they could not be opened during the underwater inspection. The required minimal flow was provided over the fixed crest spillway and over the top of the south tainter gate.

The gallery under Tainter Gate 1 (20 foot main tainter gate at south end of dam) was also inspected. The gallery is a confined space but not a permit required confined space. There is a small opening to the gallery at the south side. The inspector entered the gallery from this opening. There are two bays in the gallery. Bay 1 is the south bay. Bay 2 is the north bay.

Photos were obtained during the inspection and are in Appendix A.

The diver swam several passes along the length of both the upstream and downstream sides of the dam. The diver started at the streambed and worked toward the water surface.

The visibility underwater at the time of the inspection ranged from 4 feet to 10 feet.

In summary, below water the dam is in good condition.

Inspection Findings

The concrete below water is in good condition. The concrete was struck with a hammer and sounded solid. The concrete surfaces were covered with marine growth. Random areas of the concrete surfaces were cleaned so as to remove the marine growth and more clearly see the concrete.

At the downstream side of the dam, several voids were identified underwater. The voids are summarized in Table 1.

Location	Description
Downstream of South tainter gate at streambed	Void at streambed maximum 6 inches high (vertical) by maximum 2 feet deep (into concrete face headed upstream) by full width of the tainter gate
Downstream of North tainter gate 1.5 feet below water surface	Void in downstream face 1.5 feet high (vertical) by 4 inches deep (into concrete face headed upstream) by 4 feet long with exposed reinforcing steel that has minor corrosion
Downstream of spillway at North end at streambed	Void in downstream face maximum 4 inches high (vertical) by maximum 1.5 feet deep (into concrete face headed upstream) by 3 feet long

Table 1 Voids in Downstream Face

At the upstream side of the dam there were no deficiencies observed.

The upstream face of the skin plates of the tainter gates appeared in good condition

The cables and attachments to the tainter gates appeared in good condition.

The underside of the concrete deck (walkway) located just above the water surface at the upstream side appeared in good condition.

The streambed typically is silt, sand, gravel, rocks, and some debris. At both sides of the dam there was no indication of scour as the stream bed was generally level and tight with the dam face. At the upstream side, the streambed gently slopes up to the water surface at both ends of the dam.

The concrete walls of the gallery are in good condition. The north wall of the north cell has a crack with efflorescence.

Recommendations

The voids identified below water in the downstream face of the dam should be filled.

Underwater inspections should continue at a 5 year frequency.

Appendix A
Underwater Inspection Photos

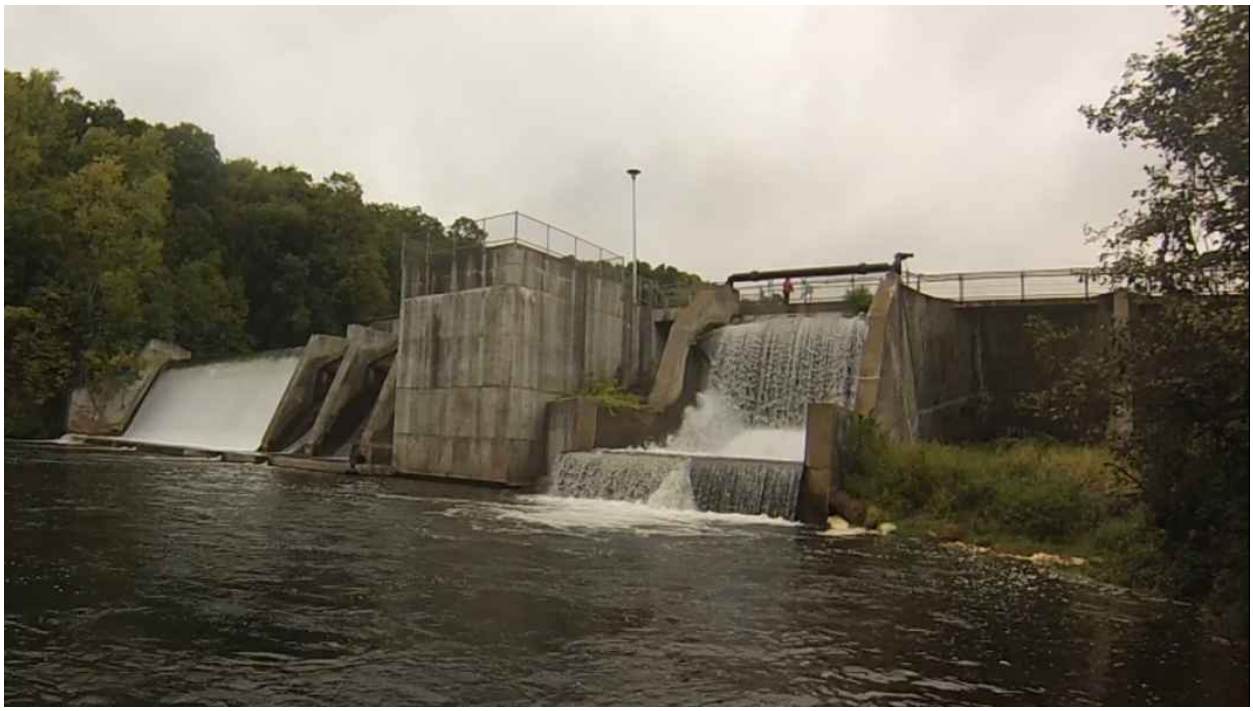

Photo 1: downstream profile

Photo 2: upstream profile

Photo 3: typical concrete condition underwater, algae at top of spillway at upstream side

Photo 4: typical marine growth underwater and log in corner at south end of spillway, upstream side

Photo 5: underwater inspection of non-overflow section

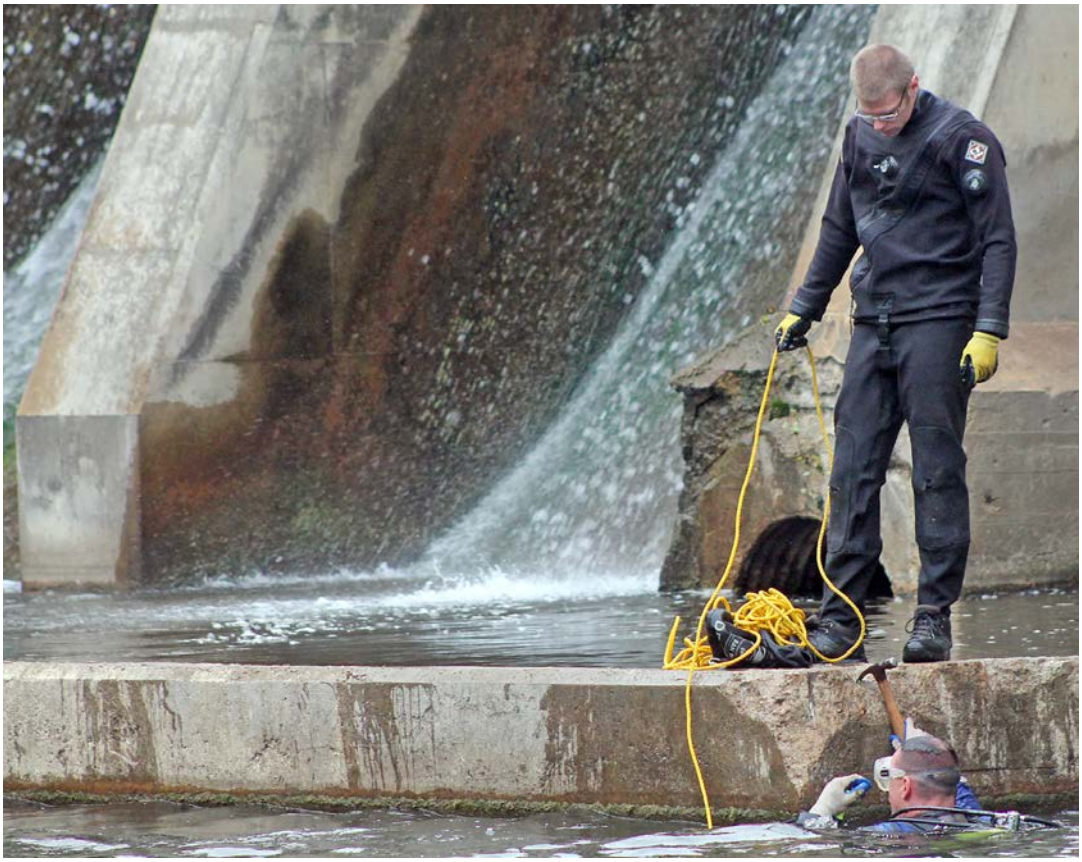

Photo 6: underwater inspection of downstream side

Photo 7: Bay 1 – south wall – opening to gallery

Photo 8: Bay 1 – west wall

Photo 9: Bay 1 – north wall

Photo 10: Bay 1 – east wall

Photo 11: Bay 2 – south wall

Photo 14: Bay 2 – west wall

Photo 13: Bay 2 – north wall – crack with efflorescence

Photo 12: Bay 2 – east wall

Appendix B
Tainter Gate Inspection

Tainter Gate Inspection

Little Falls Dam
Willow River State Park
St. Croix County, Wisconsin

Prepared for:

Wisconsin Department of Administration
Division of Facilities Development
Madison, Wisconsin

September 2013

Tainter Gate Inspection

Little Falls Dam
Willow River State Park
St Croix County, Wisconsin

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Ayres Associates Project No. 26-0770.00
File: r130920b.bks.docx

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Executive Summary

This report is in response to the direction of the State of Wisconsin Department of Natural Resources for a detailed inspection of the tainter gates at the Little Falls Dam.

The Little Falls Dam is located in the Willow River State Park. It is owned by the State of Wisconsin and operated by the Wisconsin Department of Administration Division of Facilities Development. The dam is approximately 370 feet long and consists of a non-overflow section, tainter gates, and a fixed crest spillway.

The tainter inspection was complete by Brian Schroeder, PE, Jason Cook, PE and Chris Marcum, EIT on September 20, 2013. Mr. Schroeder led the team and climbed on the tainter gates to complete the inspection. Mr. Cook also climbed the tainter gates to complete the inspection. Mr. Marcum assisted with the inspection from the deck on top of the dam.

Access to the gates was gained by use of personal fall arrest systems and rappelling on rope from the deck on top of the dam. Mr. Schroeder and Mr. Cook rappelled down on rope onto the downstream side of the gates. While inspecting, Mr. Schroeder and Mr. Cook remained attached to the ropes as belays to complete the personal fall arrest system. Upon completion of the inspection, Mr. Schroeder and Mr. Cook climbed up the rope back to the deck on top of the dam. The inspectors assessed the condition of the gates, gathered notes, and obtained photographs.

The gates were locked and tagged out so that they could not be opened during the inspection. The required minimal flow was provided past the south tainter gate and over the fixed crest spillway. The south tainter gate was raised so that water flowed below the gate rather than above the gate. This allowed access to the gate from the deck on top of the dam.

The gates are numbered form left to right as looking downstream stream. Gate 1 is at the south end of the dam and gate 4 is at the north end of the dam.

Photos obtained during the inspection are in Appendix A.

In summary, Gate 1 is in good condition and Gates 2 to 4 are in poor condition due to heavy corrosion and section loss.

Inspection Findings

There is heavy marine growth on the members of each gate.

Gate 1

Gate 1 is in good condition as no deficiencies were observed.

Gates 2 to 4

Gates 2 to 4 are in poor condition due to heavy corrosion and section loss.

There is severe corrosion of the connection hardware causing section loss of the bolt heads and nuts.

There is laminating corrosion at the skin plate and vertical beams. After removal of the laminations, it appears the thickness of the skin plate is reduced by 1/16 inch.

The bottom seals leak.

Gate 2

The bottom angle of the left arms lower double angle member is spliced with a full penetration weld. The weld is not as thick as the leg of the angle.

The bottom double angles of the right arm have corrosion with pitting.

The left wall has several vertical and diagonal cracks.

There is a leak at the bottom left corner that appears to be coming past the left wall.

Gate 3

Some members of the arms have no clearance to the sidewalls. Other members have been cut to provide clearance. The remaining steel at the cuts has rough edges.

The bracing between the arms at the downstream side of the gate is bent.

Vertical members 4^{th} and 5^{th} from the left are missing bolts at the top.

The outstanding legs of the angles of the bottom horizontal truss are bent.

Recommendations

The gates should be cleaned, sand blasted and painted. Sand blasting may reveal additional section loss which should be analyzed.

The edges of all rough cuts should be ground smooth.

The arm members with no clearance to the side walls should be analyzed to determine how much section can be removed to provide clearance and if any replacement section is needed.

Bolt heads and nuts with section loss should be replaced and any empty bolt holes should be filled. Any new hardware shall be high strength structural bolts and nuts of matching size.

At gate 2, the full penetration weld of the splice of the left arm's bottom angle of the lower double should be welded to full thickness of the leg of the angle.

At gate 2, the leak past the left wall should be stopped by filling the void with grout or other appropriate material.

Tainter gate inspections should continue at a 5 year frequency.

Appendix A

Tainter Gate Inspection Photos

Photo 1: Gate 1 – downstream side with water flowing over gate in normal operation

Photo 2: Gate 1 – downstream side with water flowing below gate for inspection

Photo 3: Gate 1 – left arm

Photo 4: Gate 1 – right arm

Photo 5: Gate 1 – typical marine growth

Photo 6: Gate 2 – downstream side

Photo 7: Gate 2 – left arm

Photo 8: Gate 2 – bottom angle of left arm's lower double angle welded splice

Photo 9: Gate 2 – bottom angle of left arm's lower double angle welded splice

Photo 10: Gate 2 – bottom angle of left arm's lower double angle welded splice

Photo 11: Gate 2 – right arm

Photo 12: Gate 2 – corrosion and pitting of lower double angles of right arm near trunnion

Photo 13: Gate 2 – laminating corrosion at skin plate and vertical beam

Photo 14: Gate 2 – laminating corrosion at skin plate and vertical beam

Photo 15: Gate 2 – severe corrosion of nuts at top left arm near skin plate

Photo 16: Gate 2 – cracks in left wall

Photo 17: Gate 2 – vertical crack in left wall

Photo 18: Gate 2 – vertical crack in left wall

Photo 19: Gate 2 – leak at bottom near left arm appears to be coming past left wall

Photo 20: Gate 2 – leak at bottom seal near right arm

Photo 21: Gate 3 – downstream side

Photo 22: Gate 3 – left arm

Photo 23: Gate 3 – vertical member at left arm with no clearance to wall

Photo 24: Gate 3 – vertical member at left arm cut for clearance to wall

Photo 25: Gate 3 – right arm

Photo 26: Gate 3 – right arm member cut for clearance to wall

Photo 27: Gate 3 – right arm member cut for clearance to wall

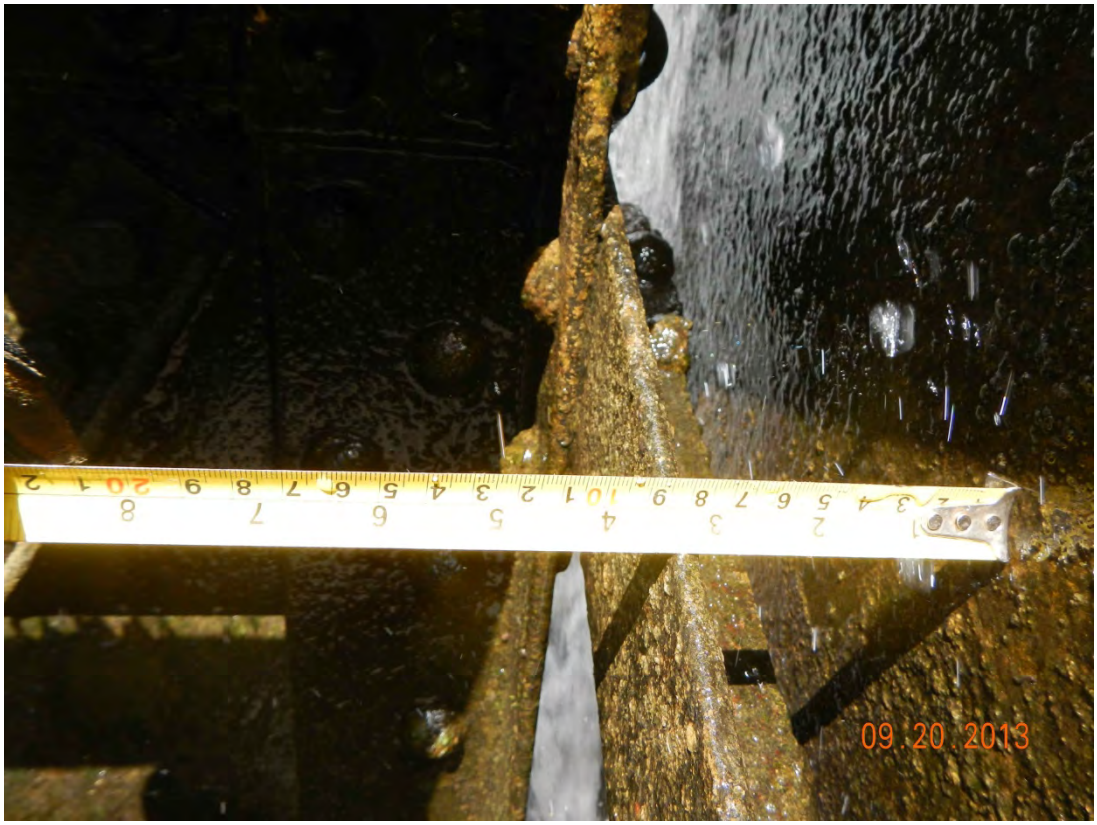

Photo 28: Gate 3 – right arm member cut for clearance to wall

Photo 29: Gate 3 – right arm member cut for clearance to wall

Photo 30: Gate 3 – bent bracing

Photo 31: Gate 3 – bent brace

Photo 32: Gate 3 – bent bracing

Photo 33: Gate 3 – bent bracing

Photo 34: Gate 3 – vertical member 3rd from left with corrosion and section loss on flange

Photo 35: Gate 3 – vertical member 3rd from left with corrosion and section loss on flange

Photo 36: Gate 3 – vertical member 3rd from left with corrosion and section loss on flange

Photo 37: Gate 3 – vertical member 4th from left has missing bolt at top

Photo 38: Gate 3 – vertical member 5th from left has missing bolt at top

Photo 39: Gate 3 – bottom horizontal truss diagonal, vertical leg of angle bent

Photo 40: Gate 3 – bottom horizontal truss, vertical leg of angles bent

Photo 41: Gate 3 – bottom horizontal truss, vertical leg of angle bent

Photo 42: Gate 3 – leak at bottom right corner

Photo 43: Gate 3 – leak at bottom seal near middle of gate

Photo 44: Gate 3 – leak at bottom left corner

Photo 45: Gate 4 – downstream side of gate

Photo 46: Gate 4 – typical framing of Gates 2 to 4

Photo 47: Gate 4 – left arm

Photo 48: Gate 4 – right arm

Photo 49: Gate 4 – laminating corrosion at skin plate and vertical beam

Photo 50: Gate 4 – laminating corrosion at skin plate and vertical beam

Photo 51: Gate 4 – laminating corrosion removed at skin plate and vertical beam

Photo 52: Gate 4 – laminating corrosion removed at skin plate and vertical beam

Photo 53: Gate 4 – severe corrosion of nuts at top left arm near skin plate

Photo 54: Gate 4 – severe corrosion of nuts at top left arm near skin plate

Appendix C
DNR Inspection Checklist

Name of Dam:	Little Falls Dam	**Date:**	8/8/2013
Inspectors:	Chris Goodwin and Ryan Pichler	**F.F #:**	55.01
Owner's Name:	Wisconsin DNR	**Key Seq #:**	54
Street:	1034 County Rd A		
City, State, Zip Code:	Hudson, WI 54016		
County:	St Croix	Owner's Phone:	
Weather and Site conditions:	Sunny, 80 deg	Email: Gordon.Stinson@Wisconsin.gov	

GENERAL

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Monuments/Benchmarks**	X					
	Location:	Beneath spruce tree left of dam.					
	Elevation:	747.02					
	Datum:	NAVD88					
2	**Pool Level**	X					
	Normal/Operating:	Unknown					
	Maximum:	Unknown					
	Minimum:	Unknown					
	Staff Gage	X					
3	**Access Road**	X		Good roadway through Willow River State Park.			
4	**Signage/ Security**						
	Portage/route:	X		No sign is present, but there is a trail.			
	Dam Warning:	X		Buoys and signs are upstream of dam, no warning horn and lights when opening gates			
	Downstream Hazard:		X	High hazard, but DFA is still in draft form.			
	Fencing/Railings/Catwalks:	X		Good condition.			

Additional Comments:

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

GENERAL (Cont.)

5	Hazard Section							
	A. D/S Development	X						
	Density:	Low density along river, but high density around Lake Mallalieu						
	Distance:	2.75 miles DS or dam to Lake Mallalieu						
	Type (Residential, Commercial, Industrial):	Residential						
	B. Channel Crossing	X						
	Type:	State Park Trail Bridge (SPTB), Trout Brook Rd (TBR), and HWY 35						
	Dimensions:	SPTB = 140' L x 10' W TBR = 50'L x 30' W and 150'L x 30' W HWY 35 = 380' L x 60'W						
	D/S distance:	SPTB = 0.7 miles, TBR = 1.8 miles, and HWY 35 = 4.7 miles						
	Traffic Level (Local, CTH, Rail Road, STH, Interstate, etc):	Trial Bridge = light pedestrian traffic and maintenance vehicle, Trout Brook Rd = local HWY 35 = STH						
	C. Distance to nearest D/S community/impoundment:	X						
	Name:	Hudson, WI						
	D. Anticipated Hazard (based on land use and zoning**):**	X	Anticipated high hazard.					
	E. Dam Failure Analysis		X					
	Date Completed/Approved		X					
	Is map available?		X					
	Are map & profile adopted?		X					
	List adoption date:		X					
	Verify validity of failure mode:		X					
	Verify validity of DFA conclusions:		X					
	F. Emergency Action Plan	**Y**	**N**	**Comments, Explanation, and Description**		**M**	**I**	**R**
	1. Current plan posted?	X		Simplified, new one being drafted.				
	2. Understood by Operator?	X						
	3. Warning systems?		X					
	4. Certification of last test?		X					
	5. Remote operation?		X					
	6. Revision Date?	X		Sep-13				
	7. Habitable structures?	X						
	8. Recreation areas?	X						
	9. Changed hazard potential?	X						
	10. New development?							
	11. Other comments?							

Additional Comments:
Draft DFA was submitted to the DNR August 2013.

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

EMBANKMENTS

Description:

	Item	N	P	Location on Embankment and Deficiency	Action M	Action I	Action R
1	**Vegetation:**			No problem			
	A. Trees	X					
	Quantity (<5,sparse,dense):			Sparse just downstream of dam and dense further downstream of dam.			
	Diameter:						
	Location:			Downstream of concrete dam structure.			
	B. Brush	X					
	Quantity (sparse,dense):			Dense			
	Location:			Just downstream of dam structure.			
	C. Ground cover		X				
	Type (grass, crown vetch,other):			Riprap			
	Quantity (bare, sparse,adequate, dense):						
	Appearance (too tall, too short, good):						
2	**Erosion**			No problem / Not applicable / Could not inspect			
	A. Wave erosion (Beaching):		X				
	Scarp: Length/ Width:						
	Location:						
	B. Runoff Erosion (Gullies)		X				
	Quantity:						
	Length/ Width/ Depth:						
	Location:						
3	**Instabilities**			No problem / Not applicable / Could not inspect			
	A. Slides		X				
	Transverse:						
	Longitudinal:						
	Scarp: Length/ Width:						
	Crack Length/ Width:						
	B. Cracks:	X					
	Transverse:						
	Longitudinal:						
	Length/ Width/ Depth:						
	Location:						
	Other:			No significant concrete cracking			
	C. Bulges/ Depressions		X				
	Size:						
	Height/ Depth:						
	D. Slope (Too Steep) U/S, D/S		X				

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

Additional Comments:
No earthen embankment. Walked downstream side of concrete embankment no excessive cracking and no seepage.

EMBANKMENTS (Cont.)

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
4	**Slope Protection**		No problem	Not applicable		Could not inspect	
	A. Type (none, riprap, wave berm, concrete slabs, loose formed concrete/asphalt):	X		Riprap on the downstream side of dam. Riprap is covered in vegetation.			
	B. Condition:						
5	**Other**		No problem	X Not applicable		Could not inspect	
	A. Rodent burrows (few, many) Location:						
	B. Ruts Length/ Width/ Depth: Location:						
	C. Other						
6	**Alignment**		No problem	X Not applicable		Could not inspect	
	A. Vertical Low area: Elevation Difference: Location:						
	B. Horizontal						
	C. Width Too narrow: Location:						
7	**Toe**		No problem	X Not applicable		Could not inspect	
	Cracks/Slumps: Embankment drains: Type/Flow: Location: Seepage/ Wetness: Hummocky:						
8	**Seepage**		No problem	Not applicable		Could not inspect	
	Wet area:	X					
	Boil:		X				
	Sinkhole:		X				
	Aquatic vegetation:		X				
	Rust colored deposits:		X				
	Other:						
	Sediment in Flow:		X				
	Flowrate:	Small trickle of flow less than 2 GPM.					
	Location:	Downstream of dam on left side.					

N= Noted; **P**= Photo; **M**= Monitor
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Action Suggestion
1. Requires immediate action
2. Plan to do soon
3. Do when convenient

Additional Comments:

SPILLWAY--PRINCIPAL - FIXED CREST					Action		
	Item	N	P	Notes/ Observations	M	I	R
1	**Fixed Crest**		No problem	Not applicable / Could not inspect			
	A. Dimensions Top Width: Crest Elevation:	X		10' Gates 1-3 elevation = 731.6; Gate 4 = 728.6			
	B. Materials	X		Concrete			
	C. Shape (sharp-crested, broad-crested, ogee, chute, gated, overflow, morning glory, dropbox, labyrinth)	X		There is an overflow spillway and gated spillways.			
	D. Debris Prevention (racks, booms, etc.):		X				
	E. Concrete Condition *	X		Concrete was in good condition no major cracking or deterioration was observed.			
	F. Flashboards (none, number): Type (Metal, wood): Dimensions: Operability:		**X**				
	G. Abutments Condition: * Seepage/wetness:	X		Abutments were in good constion no major cracking or deterioration was observed. No seepage or wetness was observed through abutments			
	H. Drains		No problem	Not applicable / Could not inspect			
	Type: Weep holes, Relief drains, Other:_____ Flow Rate:		X				
	I. Other						

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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

Additional Comments:

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY-PRINCIPAL - GATES					Action		
	Item	N	P	Notes/ Observations	M	I	R
1	**Gates**			No problem ☐ Not applicable ☐ Could not inspect			
	A. Types (lift/slide, tainter(radial), stoplogs, leaf, roller, flashboards, needles, other):	X		From right to left gate 4 binds on the right abutment, gate 3 operates, gate 2 is not operable, and gate 1 operates.			
	Number and Size:			Gates 2-4 are 9'x12' gates and gate 1 is 12'x22'.			
	B. Stoplogs		X				
	Dimensions:						
	Condition:			There are slots for stoplogs but non in place.			
	C. Abutments	X					
	Condition: *			Minimal cracking an deterioration was observed.			
	Seepage/wetness:			None was observed			
	D. Piers (number, shape)	X					
	Condition: *			Minimal cracking an deterioration was observed.			
	E. Operability	X					
	Type of Operator:			Gates and hoists to be operated at each gate.			
	Condition(chain, cables,hoists):			Gate 2 was inoperable and gate 4 bound on the abutment. The other equipment was ok.			
	Security(locked?):			Gate operating boxes are locked, but dam is walkway is open to the public.			
	Backup Operator:						
	F. Access	X		Access to the gates is from only the left side through the state park.			
	G. Condition	X					
	Rust:			Yes, see Tainter Gate Inspection report			
	Seals (leakage):			Yes, see Tainter Gate Inspection report			
	H. Ice protection		X				
	Type (Heaters, Bubblers, Barriers, Other)			No ice protection was observed.			
	I. Debris		X				
	Prevention (Rack, boom, etc.)			No debris prevention was observed.			
	J. Condition of Flowway	X					
				Minimal cracking and deterioration was observed.			
	K. Drains		X				
	Type (Weep holes/ Relief drains/ Other):			No weep holes of relief drains were observed.			
	Flow rate:						
	Location:						
	L. Other	X		Leakage was observed through gates 2-4.			

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

Controlled = Gated **Uncontrolled** = Overflow

Additional Comments and/or Sketch:

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY--PRINCIPAL - WHISTLE TUBES										Action		
	Item	N	P	Notes/ Observations						M	I	R
1	**Whistle Tubes**		Full circle/Whistle tube		Half circle riser		Glory hole (Drop Inlet)					
	A. Inlet Riser Diameter		X									
	B. Outlet pipe * Dia: Type:		X									
	C. Low level draw /Inlet Pipe What kind & Size:		X									
	D. Debris/Trash Rack		X									
	E. Antivortex		X									
	F. Material		X									
	G. Alignment		X									

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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

Additional Comments and/or Sketch:

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY--PRINCIPAL - OUTLET EROSION CONTROL & UNDERMINING

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Outlet Erosion Control**		X	No problem ☐ Not applicable ☐ Could not inspect			
	A. Type (none, endwall, plunge pool, energy dissipation structure rock lined channel, apron)						
	B. Scour		X	Unknown no scour investigation was performed.			
	C. Material **a. Riprap**: Avg Diameter: Condition (adequate, sparse, displaced, weathered): Bedding fabric- (Yes/ No): **b. Concrete *** Dimensions/Location:		X				
	D. Sidewall/Headwall Misalignment: Location: Description:		X				
	E. Separated Joint / Loss of Joint Material: Location: Description:		X				
	F. Natural		X				
2	**Undermining**			No problem ☐ Not applicable ☐ Could not inspect			
	Location: Description:		X				

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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

Additional Comments:

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY--AUXILIARY

Description:					Action		
	Item	N	P	Notes/ Observations	M	I	R
1	**Dimensions**	X					
	Length/ Width:	72' long x 10' wide, entire dam acts as an emergency spillway to pass 1000 year flow.					
	Outfall Slope:	Vertical onto apron.					
2	**Type** (turf, reinforced turf,		X				
	riprap, block, concrete):						
3	**Signs of usage**		X				
	(debris, bent grass, etc.):						
4	**Vegetation:**		X	No problem			
	A. Trees		X				
	Quantity (<5, sparse, dense):						
	Diameter:						
	Location:						
	B. Brush		X				
	Quantity (sparse, dense):						
	Diameter:						
	Location:						
	C. Ground cover:		X				
	Type (grass, crown vetch, other)						
	Quantity (bare, sparse, adequate dense):						
	Appearance (tall, short,good):						
5	**Slope protection**						
	A. Type (none, riprap, wave		X				
	berm, concrete slabs, other):						
	Condition:	Concrete slab, minimal cracking and deterioration was observed.					
6	**Erosion**		No problem	X Not applicable		Could not inspect	
	A. Wave erosion (beaching):		X				
	Scarp: Length/ Width:						
	Location:						
	B. Runoff erosion (Gullies)		X				
	Quantity:						
	Length/ Width/ Depth:						
	Location:						
7	**Instabilities**		No problem	Not applicable		Could not inspect	
	A. Slides		X				
	Transverse Length:						
	Longitudinal Length:						
	Scarp: Length/ Width:						
	Location:						
	Crack Length/ Width:						
	Location:						

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

Additional Comments:

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY--AUXILIARY (Cont.)				Action		
Item	N	P	Notes/ Observations	M	I	R
B. Bulges: (Depressions, Hummocky):		X				
Size:						
Height/ Depth:						
8 Other		No problem	Not applicable		Could not inspect	
A. Rodent burrows (few, many)		X				
Location:						
B. Ruts		X				
Location:						
Length/ Width/ Depth:						
C. Other (debris):		X				
9 Outlet erosion control		No problem	Not applicable		Could not inspect thoroughly	
A. Type (none, endwall, plunge pool, energy, dissipation structure rock-lined channel, apron):	X		Apron, minimal cracking and deterioration was observed.			
Condition (Scour?):			Scour analysis was not performed.			
B. Material						
Riprap: Avg. diameter:						
Condition (adequate, sparse, displaced, weathered):						
Bedding fabric (Yes/No):						
C. Concrete *		Not applicable				
a. Condition *	X					
b. Cracking *	X					
Dimensions/Location:			Minimal cracking was observed			
c. Sidewall/ Headwall*	X					
Misalignment:			None was observed			
Location:			Right wingwall			
Description:			Minimal cracking and deterioaration was observed.			
d. Joints	X					
Separated:			None was observed			
Loss of material:			None was observed			
Location:						
Description:						
D. Natural		X				
10 Undermining		No problem	Could not inspect thoroughly			
Location:		X				
Description:			Scour analysis was not performed. Void areas were found during the underwater inspection.			

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

Additional Comments:
Investigate elevations of fuse plugs. Potential flooding on left side as water would flow near bridge abutment
Large riprap from bridge on may prevent right fuse plug operation.

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

LAKE DRAINS

(Low level outlet, not a principle or aux. spillway)

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**General**		None found	Does not have one			
	A. Type of lake drain (isolated control/intake tower, valve vault with outlet conduit valve in riser/drop inlet siphon):	X		Sluice gate.			
	Size:			Unknown			
	B. Operated (Yes/ No)		X	Was not operated and do not know history of operation.			
2	**Lake drain components**						
	A.Concrete structure	X					
	Location:			Between gates 2 and 3.			
	Description:*			Drain through existing concrete structure.			
	Condition:*			Concrete is in good condition.			
	B. Valve control (operating device):		X				
	No operating device; No stem Bent/Broken Stem; Access			Unknown			
	Other:						
	Operability:			Was not operated and do not know history of operation.			
	C. Valve/Sluice gate	X					
	Quantity:			1			
	a. Metal deterioration (surface rust, minor, moderate, extensive, other):			Unknown			
	Location:			Between gates 2 and 3.			
	Flow rate:			Unknown			
	b. Misalignment			None obeserved.			
	c. Leakage - Flow rate			None obeserved.			
	D. Outlet conduit		X				
	Size:						
	Material:						
	Condition:						
	E. Energy dissipater		X				
	Type (endwall, plunge pool impact basin, stilling basin, rock-lined channel, none):						
	Condition:*						

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

Additional Comments:
Remove vegetation at conduit outlet.

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

Powerhouse/ Mill Building

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Est. Capacity (Kw):**		X				
	Date last used:						
	Current Use:						
2	**Item:**		X				
	A. Headrace general						
	Gates/ Trashracks:						
	Vegetation/ Erosion:						
	Sloughs/Slides/Cracks:						
	Seepage Wetness:						
	Rodent Burrows:						
	Concrete:						
	B. Tailrace		X				
	Scour:						
	Vegetation/Erosion:						
	Sloughs/Slides/Cracks:						
	Seepage wetness:						
	Rodent burrows:						
	Concrete:						
	C. Foundation: general		X				
	Concrete:						
	Seepage:						
	Integrity:						
	D. Superstructure		X				
	Condition:						

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

Additional Comments:

FIELD BOOK

Profile Leveling For: **Little Falls Dam** **Instrument Person:** Chris Goodwin

Original Notes in Field Book # **Rod Person:** Ryan Pichler

Instrument Used: Level and rod **Note Taker:** Chris Goodwin

Weather Conditions: Sunny, 80 degrees

STATION	B.S. +	H.I.	F.S. -	ELEV.	DIST.	REMARKS
BM	4.35			747.02		Elevation of BM from previous survey 7/1/2013 NAVD88. Previous plans use NAVD29 = 746.75
Pool Elevation			9.77	741.60		Upstream left bank.
Staff Gauge Pier			7.46	743.91		

Bench Mark Information (Location, Elevation, Datum):

Elevation of BM from previous survey 7/1/2013 NAVD88. Previous plans use NAVD29 = 746.75

Comments:

Suggested Survey points:

HW	**Sill**	**Low Embankment**
TW	**Crest**	**Lt. Groin**
D/S Channel (at toe)	**Abutments**	**Rt. Groin**
Aux. Crest LT	**Aux. Crest RT**	**Outlet Pipe Invert**

STATION	B.S. +	H.I.	F.S. -	ELEV.	DIST.	REMARKS

Note: Survey data is a valuable dataset to document the constant or changing condition of your dam. It is often the best method to document changes, deficiencies and past construction or survey errors. In most instances, the decision to conduct a field survey will be based on the professional opinion of the consultant engineer and the responsibility of the dam owner. Based on the inspection report results, the Department may determine that a survey is required.

Examples of scenarios where survey is recommended by the Department:

1. To establish a baseline if the dam has no previous survey, an insufficient survey, or no current as-built plans on file
2. If evidence of an instability is documented during the inspection. Instabilities could include embankment settling, cracking, or slumping, cracking concrete, or noticeable miss-alignment.
3. For dams where the last survey on record is greater than 10 years old.
4. When new benchmarks or a new staff gage are installed.

Survey Standards:

- The Dam Datum must be the same as the Flood Insurance Study Datum for the County
- Survey may require both horizontal and vertical data collection and control
- Any Benchmarks or Staff Gages must be tied to the Dam Datum
- Survey Points noted on this page of the Dam Inspection Checklist are the minimum points suggested for a dam survey
- Use the appropriate level of accuracy consistent with Land Surveying standards to document the data being collected

Suggested Survey points:

HW	**Sill**	**Low Embankment**
TW	**Crest**	**Lt. Groin**
D/S Channel (at toe)	**Abutments**	**Rt. Groin**
Aux. Crest LT	**Aux. Crest RT**	**Outlet Pipe Invert**

SKETCH

Appendix D
Inspection Photos

Photograph 1: Right Abutment Wall and Overflow Spillway

Photograph 2: Overflow Spillway

Photograph 3: Gates 2-4

Photograph 4: Gates 2-4 – Cracking on Abutment 4

Photograph 5: Gates 2-4 – Evidence of Gate 4 Binding on Abutment

Photograph 6: Gates 2-4 – Sluice Gate Outlet

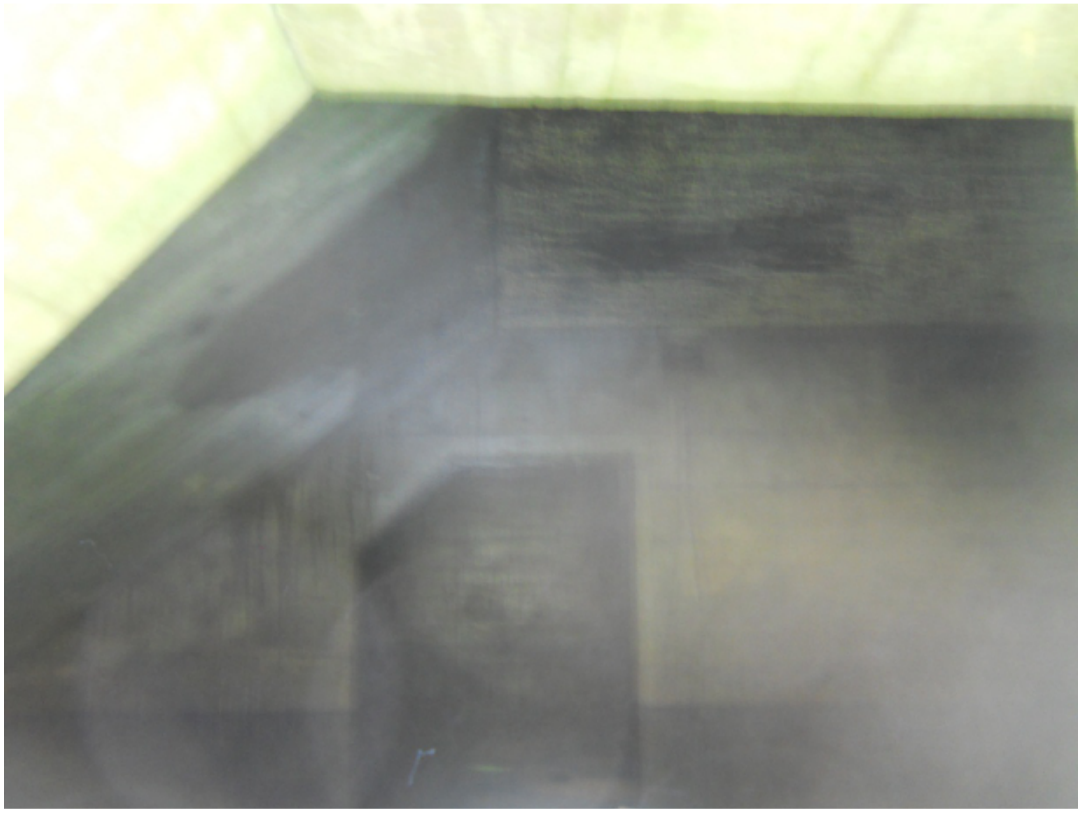
Photograph 7: Walkway Cracking

Photograph 8: Gate 1

Photograph 9: Gate 1 – Right Trunnion

Photograph 10; Gate 1 – Left Trunnion

Photograph 11: Gate 1 – Downstream Side



Photograph 12: Interior of Dam

Photograph 13: Non-Overflow Section – Upstream Side

Photograph 14: Non-Overflow Section – Upstream Side

Photograph 15: Non-Overflow Section – Downstream Side

Photograph 16: Non-Overflow Section – Downstream Side

Photograph 17: Non-Overflow Section – Downstream Side

Photograph 18: Non-Overflow Section – Downstream Side

Photograph 19: Non-Overflow Section – Downstream Side

Photograph 20: Non-Overflow Section – Downstream Side

Photograph 21: Non-Overflow Section – Downstream Side

Photograph 22: Non-Overflow Section – Downstream Side

Photograph 23: Non-Overflow Section – Downstream Side