October 4, 2019

Brett Hebert
City of Stoughton
Director of Public Works
bhebert@ci.stoughton.wi.us
608-877-8684

RE: Inspection of Stoughton Dam; Key Seq. No. 247

Mr. Hebert,

On September 20, 2019, FreshWater Engineering performed an inspection of the Stoughton Dam in the City of Stoughton in Dane County. During this visit, FreshWater personnel inspected the earthen embankment, gated spillway, and powerhouse structures according to Wisconsin Department of Natural Resources (WDNR) inspection guidance. We also discussed the dam's history, operation, and management with the dam operator, Mr. Halverson.

The purpose of the inspection was to complete the decadal dam inspection required by WDNR.

This report contains the findings of the inspection and describes the dam, the procedures used to complete the inspection of the dam, and the findings of the inspection.

Please feel free to contact me with any questions you may have.

Sincerely,

Laura Rozumalski, P.E.
President and Principal Engineer
lrozumalski@freshwatereng.com
(608) 616-0128

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Background

The Stoughton Dam is a concrete, former hydroelectric structure impounding the Yahara River immediately west of Fourth Street in Stoughton, Wisconsin. It is located in Dane County. The dam is approximately 50 feet from bank to bank. Operating headwater elevation is between 841.0 and 842.0 ft referenced to the National Geodetic Vertical Datum of 1929 (NGVD29); tailwater elevation is approximately 836.0 ft NGVD29. Normal storage volume is approximately 300 acre-feet and maximum storage is approximately 500 acre-feet per Wisconsin Department of Natural Resources (WDNR) records.

The Yahara River flows around downtown Stoughton. Two hundred feet downstream of the dam, the river flows in two channels 35-40 feet in width, passes under the Fourth Street bridge, then flows past the City of Stoughton wastewater treatment facilities approximately 0.3 miles further downstream. Approximately 1.2 river miles downstream of the dam is an area of medium-density residential development. The nearest downstream impoundment is the Dunkirk Millpond, which is 2.5 miles from the dam.

Inspection Procedures

The WDNR Dam Inspection Checklist was used as a guide during the inspection. The embankment, the gated spillway, the powerhouse structures, upstream shorelines, and downstream area were inspected and documented with photographs and field notes. No additional sampling or testing was conducted. In addition, FreshWater reviewed the last inspection report, historical photos of the dam, aerial photos, dam information, the Emergency Action Plan, and the Inspection, Operation, and Maintenance manual.

The inspection was performed by Laura Rozumalski, PE and Brent Teske of FreshWater Engineering. Weather on the day of the inspection was approximately 80°F with partly cloudy skies and no significant wind.

Findings and Recommendations

The dam's northern embankment is covered with a variety of vegetation. There is a wide, mowed area along the crest that extends the length of the embankment to the Fourth Street bridge. Side slopes had not been mowed recently, though they appear to be maintained periodically and were vegetated primarily by tall grasses and weedy vegetation. Tall vegetation extended only a short distance above water line.

Access to the dam is behind chain link fencing supplemented with barbed wire. Keys are located at the operator's office and the general public is not permitted onto the structure. The locks appear adequate and all fences and railings at the site are in good repair.

The Stoughton Dam received extensive repairs in 2009. As a result, the concrete, steel gates, and fencing are all currently in good condition. The only signs of degradation are small cracks on the operator's walkway and minor discoloration of some of the older concrete.

The operator's walkway has slots allowing visual inspection of the tainter gates and stoplogs from the walkway. The slots are covered by grates and several bolts are missing from these grates. The bolts should be replaced when convenient to prevent a tripping hazard.

Tainter gates, stoplogs, and a sluice gate compose the reservoir water level control structures. All components were replaced during the 2009 renovations. The tainter gates are raised and lowered by motors located on the operator's walkway. Backup operation is possible using a hand crank in case of power outage or other failure. Chains appear new and in good condition. The stoplogs are also in good condition with no signs of damage. The sluice gate is operated by a motor on the right (south) end of the concrete structure. FreshWater was unable to inspect the sluice below the water surface, though the visible components appear in good condition.

Downstream of the dam is a stilling basin. Water flows through the tainter gates and over a concrete tailrace. FreshWater was unable to inspect the concrete tailrace since the area was not dewatered, though all visible concrete components appeared in good condition. The edges of the stilling basin are largely armored by a mixture of gravel, cobbles, boulders, quarried stone, and concrete. The armor appears to adequately stabilize the banks of the basin. Downstream of the stilling basin the river flows into a set of culverts under Fourth Street.

There is also a box culvert along the right (southern) bank of the stilling basin. This culvert connects the basin to a small drainage creek on the opposite side of an earthen embankment. There is no apparent seepage or embankment failures near this location.

The dam's Emergency Action Plan (EAP) is posted at all locations specified in the document, and the operators are aware of the procedures listed therein. A call list is included with the EAP and is planned to be followed if a hazardous situation is found at the structure.

FreshWater recommends very minor fixes to noted issues. The recommended timeline to complete tasks is as follows:

- Embankments:
    - Mow embankment vegetation down to water surface — 8 months
- Operator's Walkway
    - Replace missing bolts on grates — 6 months

Photos

Inspection of Stoughton Dam (Key Seq. No. 00247) 20 September 2019	
File Name	**Description**
00247092019001.jpg	View of dam from downstream
00247092019002.jpg	View of dam from downstream and embankments
00247092019003.jpg	Stilling basin embankment downstream of dam
00247092019004.jpg	View of dam from upstream, right (south) embankment
00247092019005.jpg	Right (south) embankment at reservoir
00247092019006.jpg	Upstream view of dam from left (north) embankment
00247092019007.jpg	Crack visible in operator's walkway; pen for scale
00247092019008.jpg	Grates on operator's walkway with missing bolts
00247092019009.jpg	Right-side control chains of left Tainter gate
00247092019010.jpg	Left-side control chains of left Tainter gate
00247092019011.jpg	Left-side control chains of right Tainter gate
00247092019012.jpg	Right-side control chains of right Tainter gate
00247092019013.jpg	Downstream side of dam as viewed from operator's walkway
00247092019014.jpg	Sluice gate control on upstream face of dam, right side
00247092019015.jpg	View of stoplog bay from downstream of dam
00247092019016.jpg	View of dam from downstream, left bank
00247092019017.jpg	View of operator's walkway from left side of dam
00247092019018.jpg	View of embankment north of dam (along left bank of Yahara River, D/S of dam)
00247092019019.jpg	View of headrace structures leading to former powerhouse
00247092019020.jpg	Dam viewed from downstream, left bank near Fourth Street bridge
00247092019021.jpg	Outlet of stilling basin area downstream of dam, flow under Fourth Street bridge

View of dam from downstream - 00247092019001.jpg

View of dam from downstream and embankments - 00247092019002.jpg

Stilling basin embankment downstream of dam - 00247092019003.jpg

View of dam from upstream, right (south) embankment - 00247092019004.jpg

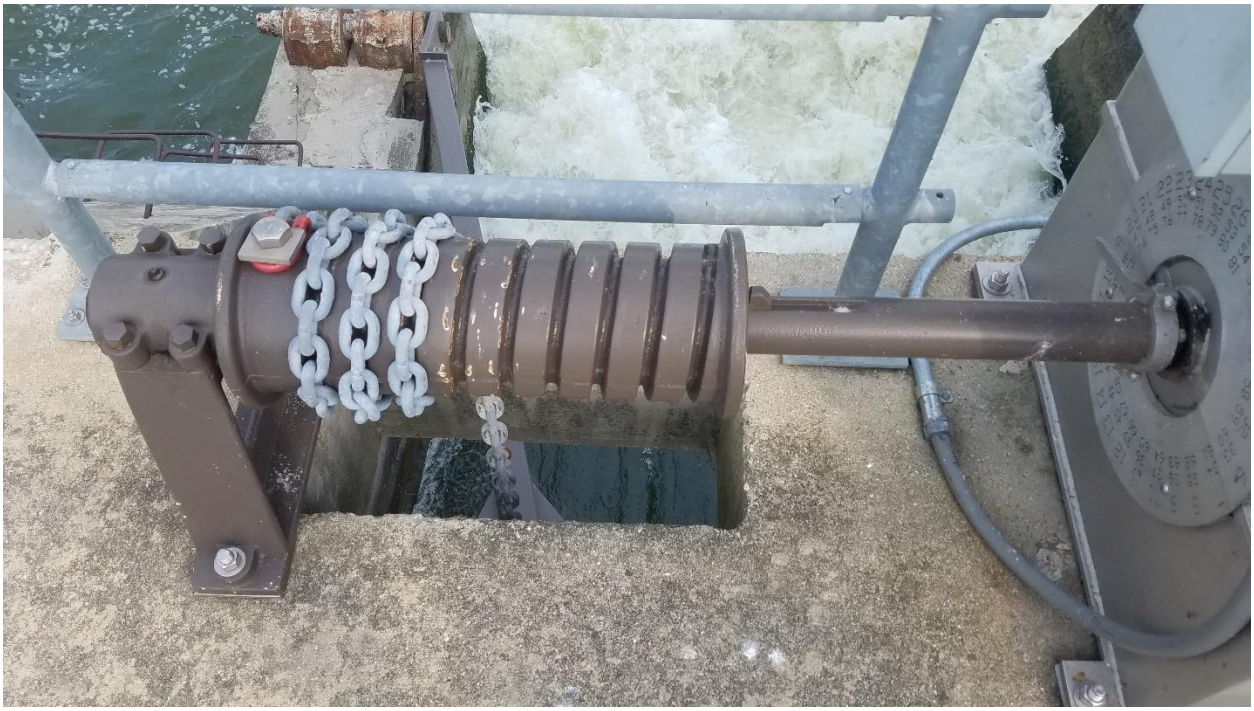
Right (south) embankment at reservoir - 00247092019005.jpg

Upstream view of dam from left (north) embankment - 00247092019006.jpg

Crack visible in operator's walkway; pen for scale - 00247092019007.jpg

Grates on operator's walkway with missing bolts - 00247092019008.jpg

Right-side control chains of left Tainter gate - 00247092019009.jpg



Left-side control chains of left Tainter gate - 00247092019010.jpg

Left-side control chains of right Tainter gate - 00247092019011.jpg

Right-side control chains of right Tainter gate - 00247092019012.jpg

Downstream side of dam as viewed from operator's walkway - 00247092019013.jpg

Sluice gate control on upstream face of dam, right side - 00247092019014.jpg

View of stoplog bay from downstream of dam - 00247092019015.jpg

View of dam from downstream, left bank - 00247092019016.jpg

View of operator's walkway from left side of dam - 00247092019017.jpg

View of embankment north of dam (along left bank of Yahara River, D/S of dam) - 00247092019018.jpg

View of headrace structures leading to former powerhouse - 00247092019019.jpg

Dam viewed from downstream, left bank near Fourth Street bridge - 00247092019020.jpg

Outlet of stilling basin area downstream of dam, flow under Fourth Street bridge - 00247092019021.jpg

WDNR Inspection Forms

Certification for Dam Inspection

Local Dam Name (PRINT): Stoughton Dam

DNR Field File #: 13.10

I certify that I have completed the checklist truthfully and factually:

Certifier's Name (print): Laura Rozumalski, PE

Company Name: FreshWater Engineering LLC

Signature: Laura Rozumalski

Date: 10/4/2019

Multidisciplinary: I am experienced in the technical disciplines or I am working with other professionals experienced in the technical disciplines to properly inspect this dam and appurtenant works. Technical disciplines, in addition to general civil engineering, may include geotechnical, geological, hydrologic, structural, and mechanical:

[Yes] No

Engineer's Wisconsin Registration Number: 6-42230

Expiration Date: 7/31/2020

Engineer's Seal (optional):

Name of Dam: Stoughton Dam	**Date:** 20SEP2019
Inspectors: Laura Rozumalski, Brent Teske	**F.F #:** 13.10
Owner's Name: City of Stoughton; Brett Hebert, Director of Public Works	**Key Seq #:** 247
Street: 1101 Collins Road	
City, State, Zip Code: Stoughton, WI 53589	
County: Dane	**Phone:** (608) 877-8684
Weather and Site conditions: Partly cloudy, 80 degrees	**Email:** bhebert@ci.stoughton.wi.us

GENERAL

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Monuments/Benchmarks**						
	Location:			BM 1 is a railroad spike driven into the east side of a telephone pole immediately north of the dam. Elevation is listed at 847.09 ft NGVD29; FreshWater measured it at 847.23 ft NGVD29			
	Elevation:			Unknown BM located on upstream left wingwall (cross cut into concrete) - elevation measured at 844.51 ft NGVD29. FreshWater was unable to locate other benchmarks shown on plan set.			
	Datum:						
2	**Pool Level**						
	Normal/Operating:			Max: 842 ft NGVD29 (94.84 gage)			
	Maximum:			Min: 841 ft NGVD29 (93.84 gage)			
	Minimum:			Minimum outflow: 15 cfs			
	Staff Gage						
3	**Access Road**	X	X				
4	**Signage/ Security**						
	Portage/route:						
	Dam Warning:	X	X				
	Downstream Hazard:						
	Fencing/Railings/Catwalks:	X	X				

Additional Comments:

Flow at time of inspection was reported to be approximately 580 cfs

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

GENERAL (Cont.)

5 Hazard Section

A. D/S Development

Density: Wastewater treatment plant is ~0.3 miles D/S

Distance: Medium-density residential development ~1.2 river miles D/S

Type (Residential, Commercial, Industrial):

B. Channel Crossing

Type: Bridge, Ford, Culvert, Trestle, Other (Explain) (Circle One)

Dimensions: The Yahara River passes under 4th St bridge in two channels D/S of the dam

D/S distance:

Traffic Level (Local, CTH, Rail Road, STH, Interstate, etc):

- N crossing (by powerhouse) stream width ~35 ft
- S crossing (main spillway) stream width ~40 ft

C. Distance to nearest D/S community/impoundment:

Name: Dam located in City of Stoughton, approx. 2.5 river miles to Dunkirk Millpond

D. Anticipated Hazard (based on landuse and zoning): Low

E. Dam Failure Analysis

Date Completed/Approved: 01MAR2011 (DNR Engr initials - WDS)

Is map available? Yes

Are map & profile adopted? Yes

List adoption date: 01AUG2011 (DNR Engr initials - RRD)

Verify validity of failure mode:

Verify validity of DFA conclusions:

F. Emergency Action Plan	Y	N	Comments, Explanation, and Description	M	I	R
1. Current plan posted?	X		Current plan is posted at all required locations and operator understands it. Warning system is in place per EAP; call list included in EAP Appendix			
2. Understood by Operator?	X					
3. Warning systems?	X					
4. Certification of last test?						
5. Remote operation?						
6. Revision Date?						
7. Habitable structures?						
8. Recreation areas?						
9. Changed hazard potential?		X				
10. New development?						
11. Other comments?						

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EMBANKMENTS

Description: Earthen embankment, mowed and well maintained

	Item	N	P	Location on Embankment and Deficiency	Action M	Action I	Action R
1	**Vegetation:**	X		No problem			
	A. Trees Quantity (<5,sparse,dense): Diameter: Location:			None			
	B. Brush Quantity (sparse,dense): Location:	X	X	Sparse sumac near embankment. Not currently an issue, but should be cut down when mowing next.			3
	C. Ground cover Type (grass, crown vetch,other): Quantity (bare, sparse,adequate, dense): Appearance (too tall, too short, good):	X	X	Grass well-maintained at embankment crest. Appears to be less-frequently mowed on slopes.			3
2	**Erosion**	X		No problem ☐ Not applicable ☐ Could not inspect			
	A. Wave erosion (Beaching): Scarp: Length/ Width: Location:			None - cobble/riprap armor upstream and downstream of dam appear to provide adequate protection.	X		
	B. Runoff Erosion (Gullies) Quantity: Length/ Width/ Depth: Location:			None			
3	**Instabilities**	X		No problem ☐ Not applicable ☐ Could not inspect			
	A. Slides Transverse: Longitudinal: Scarp: Length/ Width: Crack Length/ Width:			None			
	B. Cracks: Transverse: Longitudinal: Length/ Width/ Depth: Location: Other:			None			
	C. Bulges/ Depressions Size: Height/ Depth:			None			
	D. Slope (Too Steep) U/S, D/S						

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

Additional Comments:

EMBANKMENTS (Cont.)

Item	N	P	Notes/ Observations	Action M	Action I	Action R
4 Slope Protection	X	No problem	Not applicable / Could not inspect			
A. Type (none, riprap, wave berm, concrete slabs, loose formed concrete/asphalt):			Cobbles, wingwalls upstream and downstream in good condition			
B. Condition:						
5 Other	X	No problem	Not applicable / Could not inspect			
A. Rodent burrows (few, many) Location:			None			
B. Ruts Length/ Width/ Depth: Location:			None			
C. Other						
6 Alignment	X	No problem	Not applicable / Could not inspect			
A. Vertical Low area: Elevation Difference: Location:			Lowest point is near 4th St. bridge (843.9 ft NAVD88) High point is near the dam (846.0 ft NAVD88) Difference in height is 2.1 ft	X		
B. Horizontal						
C. Width Too narrow: Location:			The embankment along the northern edge of the stilling basin is approximately 50 ft wide; no concerns noted	X		
7 Toe	X	No problem	Not applicable / Could not inspect			
Cracks/Slumps: Embankment drains: Type/Flow: Location: Seepage/ Wetness: Hummocky:						
8 Seepage	X	No problem	Not applicable / Could not inspect			
Wet area:						
Boil:						
Sinkhole:						
Aquatic vegetation:						
Rust colored deposits:						
Other:						
Sediment in Flow:						
Flowrate: Location:						

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

Additional Comments:

SPILLWAY-PRINCIPAL - GATES				Action		
Item	N	P	Notes/ Observations	M	I	R
1 Gates	X		No problem ☐ Not applicable ☐ Could not inspect			
A. Types (lift/slide, tainter(radial), stoplogs, leaf, roller, flashboards, needles, other): Number and Size:	X	X	2x tainter, steel, 14 ft crest length 2x stoplogs, steel, 14 ft crest length	X		
B. Stoplogs Dimensions: Condition:	X	X	14 ft length, steel in good condition	X		
C. Abutments Condition: * Seepage/wetness:	X	X	Concrete is in good condition, no signs of seepage or wetness	X		
D. Piers (number, shape) Condition: *	X	X	2 concrete piers in good condition	X		
E. Operability Type of Operator: Condition(chain, cables,hoists): Security(locked?): Backup Operator:	X	X	Electric motors to operate tainter gates locked behind dam access gates Chains in excellent condition Hand crank attachments in case of motor inoperability	X		
F. Access	X	X	Gated, chain link fence and barbed wire	X		
G. Condition Rust: Seals (leakage):	X	X	Good, no rust noted	X		
H. Ice protection Type (Heaters, Bubblers, Barriers, Other)			N/A			
I. Debris Prevention (Rack, boom, etc.)			N/A			
J. Condition of Flowway	X	X	Appears good	X		
K. Drains Type (Weep holes/ Relief drains/ Other): Flow rate: Location:						
L. Other						

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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:

Minor cracking noted on walkway, some bolts holding walkway grates are missing - Photos included
Recommend replacing bolts when convenient

* **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)			Planset shows apron approx. 35 feet long; FreshWater unable to inspect Wingwalls and bank armoring appear in good condition			
	B. Scour			Could not inspect			
	C. Material	X	X		X		
	a. Riprap: Avg Diameter:			Highly variable - Cobbles, small boulders, quarried stone, brick, concrete at various locations			
	Condition (adequate, sparse, displaced, weathered):			Appears to be in good condition			
	Bedding fabric- (Yes/ No):			Unable to inspect any bedding fabric			
	b. Concrete * Dimensions/Location:			Wingwalls extend approx. 35 feet along banks			
	D. Sidewall/Headwall Misalignment: Location: Description:			No issues noted			
	E. Separated Joint / Loss of Joint Material: Location: Description:			N/A			
	F. Natural						
2	**Undermining**	X		No problem / Not applicable / Could not inspect			
	Location: Description:			None observed			

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Action Suggestion
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2. Plan to do soon
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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

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): Size:	X	X	Sluice gate located on right (south) side of dam, upstream face	X		
B. Operated (Yes/ No)			No			
2 Lake drain components						
A.Concrete structure Location: Description:* Condition:*						
B. Valve control (operating device): No operating device; No stem Bent/Broken Stem; Access Other: Operability:			Located on operator's walk	X		
C. Valve/Sluice gate Quantity: a. Metal deterioration (surface rust, minor, moderate, extensive, other): Location: Flow rate: b. Misalignment c. Leakage - Flow rate			Sluice located on right side of dam, minor surface rust on gearbox exterior	X		
D. Outlet conduit Size: Material: Condition:						
E. Energy dissipater Type (endwall, plunge pool impact basin, stilling basin, rock-lined channel, none): Condition:*			Flow goes into stilling basin downstream of tainter gates and stoplogs	X		

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Action Suggestion
1. Requires immediate action
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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

Powerhouse/ Mill Building

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Est. Capacity (Kw):**				X		
	Date last used:			~1999			
	Current Use:			No longer in use			
2	**Item:**				X		
	A. Headrace general Gates/ Trashracks: Vegetation/ Erosion: Sloughs/Slides/Cracks: Seepage Wetness: Rodent Burrows: Concrete:			Weirs at downstream end of headrace; concrete recently repaired or replaced Remnants of older concrete structures also present; left wingwall deteriorating Railing near headrace shows significant surface rust			
	B. Tailrace Scour: Vegetation/Erosion: Sloughs/Slides/Cracks: Seepage wetness: Rodent burrows: Concrete:						
	C. Foundation: general Concrete: Seepage: Integrity:						
	D. Superstructure Condition:			Appears abandoned but no signs of imminent structural failure			

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Additional Comments: