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June 4, 2018

Mr. Butch Asselin
Town Manager
85 Pleasant Street
PO Box 153
Oxford, ME04270

Subject: Inspection of Thompson Lake Dam

Dear Mr. Asselin,

As requested, MBP Consulting (MBP) has performed the inspection of the Thompson Lake Dam and prepared this letter report on the findings. The report contains a review of the project data, results of the visual observations, condition assessment, preliminary hydrologic and hydraulic evaluation, conclusions and recommendations. The recommendations include the short-term and long-term remedial measures to improve the reliability, longevity, safety and functionality of the Thompson Lake Dam.

General

The Thompson Lake Dam (Maine ID 00133, NatDam ID ME00016) is located at the outlet of Thompson Lake, on Outlet Stream, a tributary of the Little Androscoggin River, in the Town of Oxford (Town), Cumberland County, Maine (Figure 1). The dam was originally installed around 1800, rebuilt in 1863 and modified in 1974. The 1863 dam reportedly raised the natural lake level by 10 feet. Since 1863 the dam was owned by the Robinson Manufacturing Co. The Robinson woolen textile mill was closed in 2004 and the dam ownership was transferred to the Town of Oxford in 2009. The dam has low hazard classification.

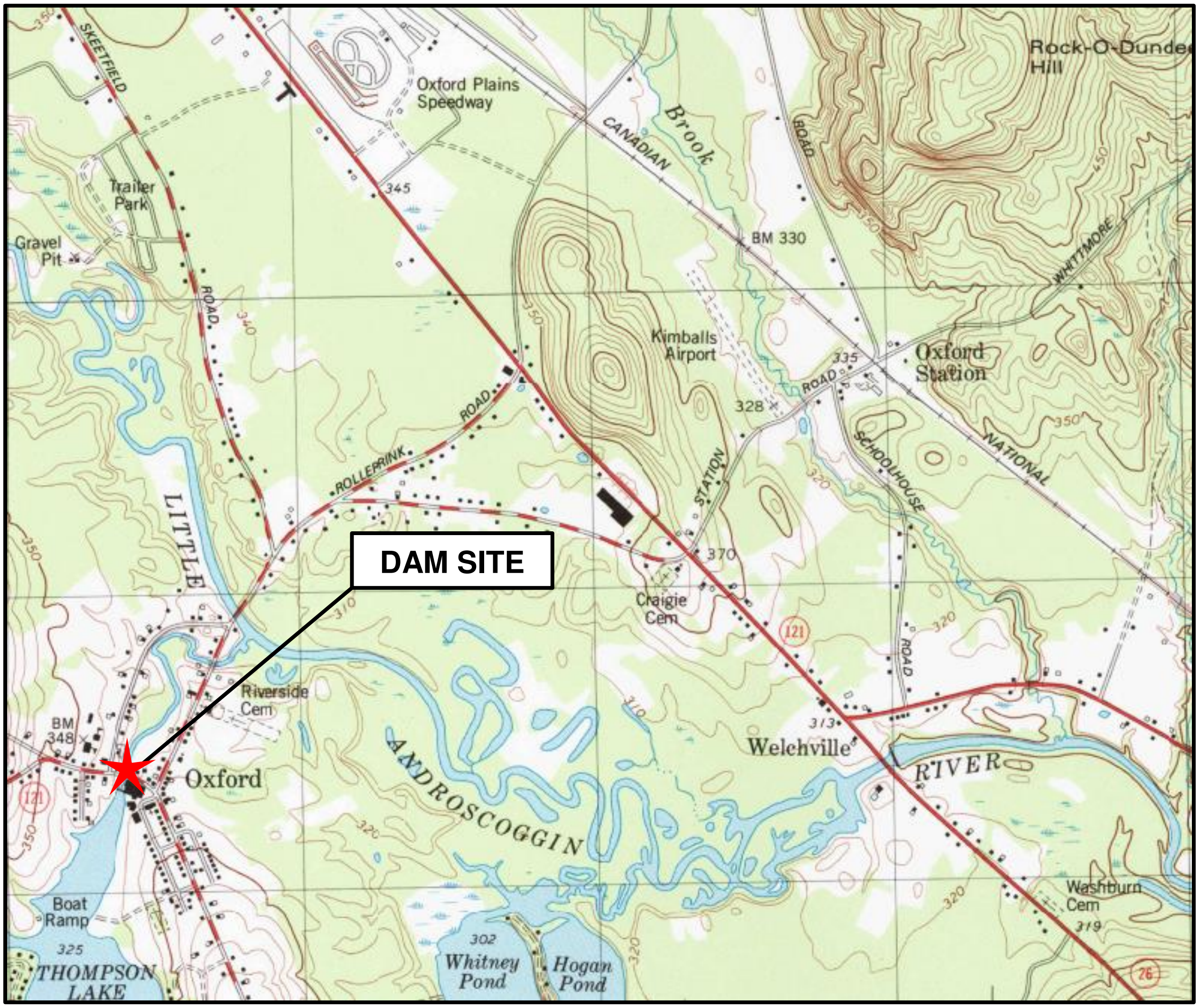

FIGURE 1. THOMPSON LAKE DAM LOCATION MAP
(USGS Quadrangle Oxford, Maine, Scale 1: 24,000)

Dam Impoundment[1]

The 9-mile long dam impoundment, Thompson Lake, has surface area 4,225 acres, maximum storage 29,980 acre-feet, mean and maximum depth 35 feet and 121 feet, respectively, and 35-square mile watershed (Figure 2). The 32.2-mile lake shoreline subdivided between towns of Oxford (29% +/-), Otisfield (29% +/-), Poland (24% +/-) and Casco (18% +/-). The impoundment accommodates 1,200 seasonal and year-round residencies, three summer youth camps, and two public launches. The lake provides wildlife benefits, recreational activities, fire control, and limited water supply. The lake is stocked by the MDIFW with landlocked salmon annually.

The lake water quality, shoreline erosion and recreational activities are monitored by the Thompson Lake Environmental Association (TLEA) established circa 1970. The lake levels are measured by the Town from the top of the dam daily. Based on the TLEA's evaluation of the multi-year record of the level readings and assessment of the influence of water level changes on shoreline erosion and water quality, the lake summer and winter levels were established, in consultation with the MDIFW, at 14 inches and 32 inches, respectively, in 2012.

Dam Description[2]

The 76-foot long dam consists of masonry and concrete sections. The masonry structure made of mortared cut granite blocks is tied to the dam abutment on the left[3] and concrete section on the right. The masonry section is about 40 feet long, 15 to 17 feet high (estimate), 11 feet wide on the top and widening at the base. The stone structure contains three sluices (spillways) to pass the excess flow (Figure 3). A west (left) sluice, 7 feet-2 inches wide and 3.6 feet deep, is an overflow spillway and accommodates three, 9-inch high removable wooden stoplogs (boards). A central sluice is a low-level outlet controlled by an electrically operated 6-foot high by 5-foot wide

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[1] References: DEP, Nonpoint Source Management Program 2016 Annual Report, June 2017; TLEA, http://thompsonlake.org/history.html; Maine Department of Inland Fisheries & Wildlife (MDIFW).

[2] This dam description is based on information contained in the report "Inspection of Thompson Lake Dam", MEMA, 1998 and observations and measurements taken during these field inspections. All dimensions indicated herein are approximate.

[3] The terms "left" and "right" refers to an orientation of dam structures or their parts looking in the downstream direction (toward the flow).

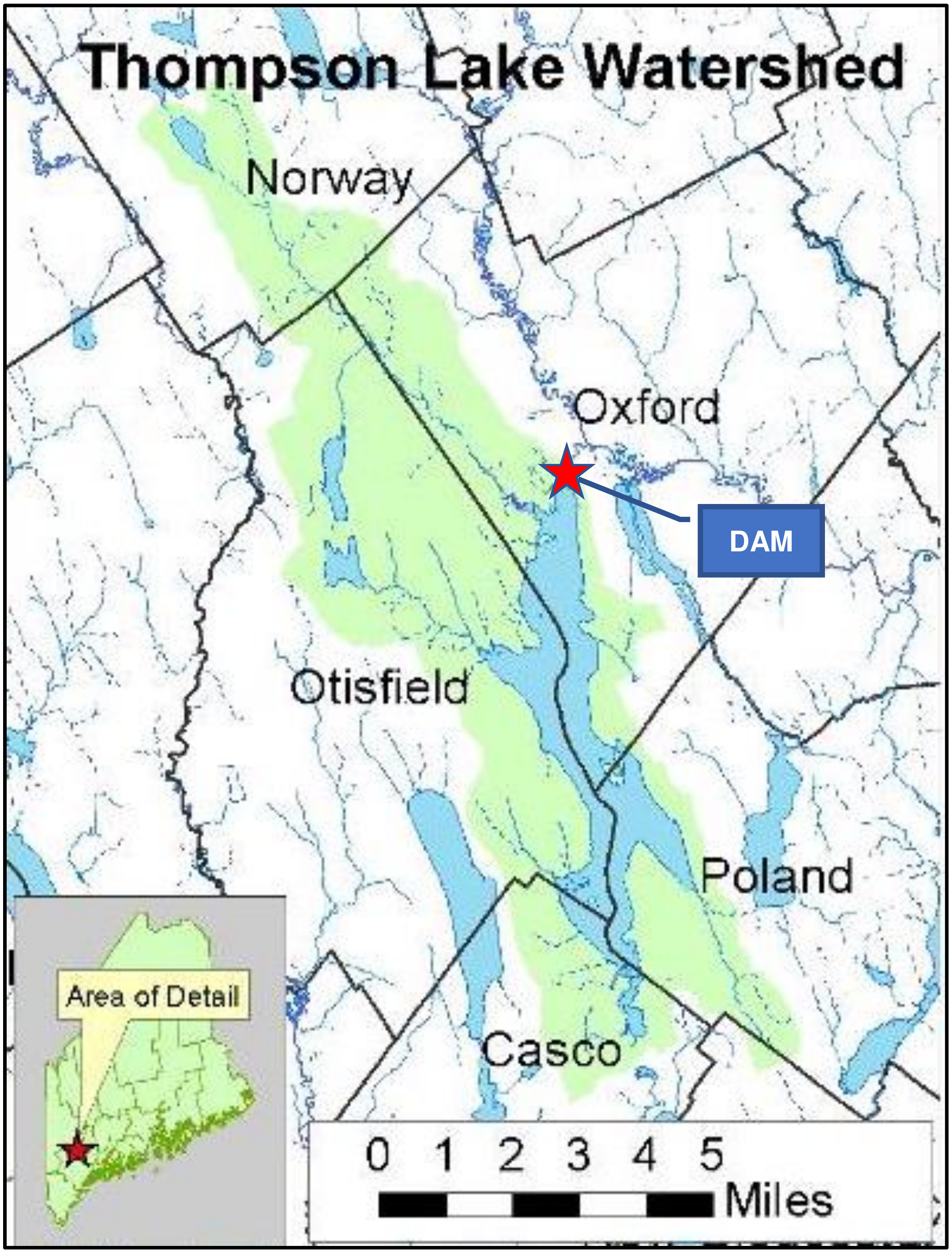

FIGURE 2. DRAINAGE AREA OF THOMPSON LAKE DAM
(DEP Annual Report, June 2017)

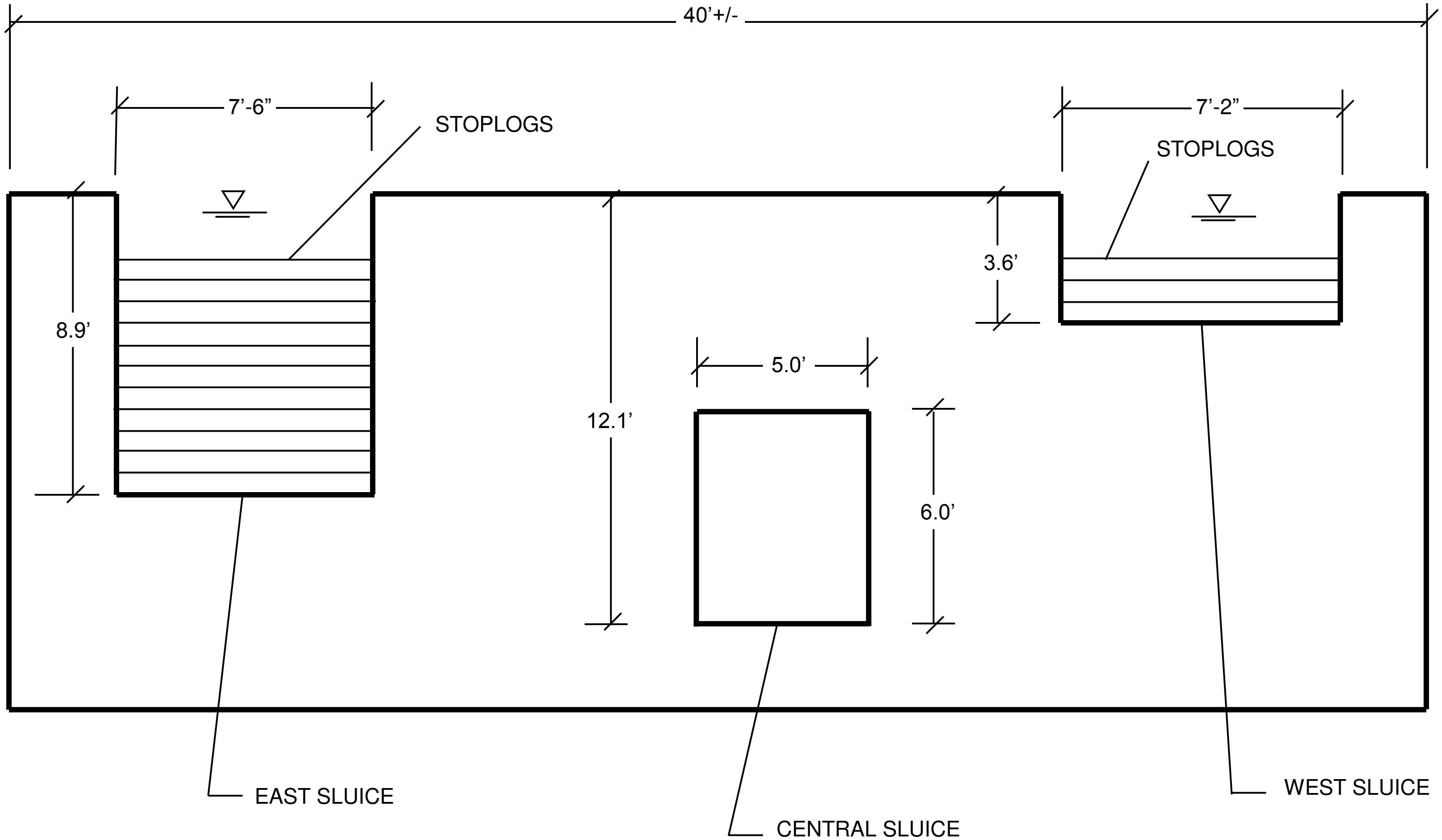

FIGURE 3. DOWNSTREAM ELEVATION OF MASONRY DAM SECTION: GENERAL ARRANGEMENT.
NTS

<u>NOTE</u>:
ALL DIMENSIONS SHOWN IN THIS SKETCH ARE APPROXIMATE.

aluminum slide gate. The gate sill is at 12.1 feet below the top of the dam. The east (right) overflow sluice, 7 feet-6 inches wide and 8.9 feet deep, includes a number of 8 to 9-inch high wooden boards. The upstream masonry face between east and west sluices is covered with a 14-inch thick concrete wall. The downstream toe of the structure contains a stone apron, approximately 5 to 6 feet thick, composed of large cut granite blocks to protect the streambed from scouring and the dam base from undermining.

The 36-foot long concrete dam section is located between the Robinson mill building on the east dam abutment and the stone masonry structure. The section includes a 16-foot long concrete wall (parapet) on the top which runs between the mill building and the pond shore wall. The parapet is 8 inches thick and 3 feet high above the top of the dam and was likely part of the mill flood protection system. The concrete section includes two intakes, each equipped with a gate and a rack-and-pinion hoist to supply process water to the mill in the past. The right intake and gate were abandoned years ago. The left intake is reportedly leaking and is scheduled to be permanently sealed.

The approach channel to the dam contains three concrete piers (pylons) which were previously used to support steel trashracks and a catwalk used for trashracks cleaning. A new log boom located about 100 feet upstream of the dam was installed for debris control. The downstream discharge channel is confined by the mill building on the right and a 10-12-foot high stone wall on the left.

Dam Repairs

The following dam repair, modifications and improvements have been performed in the last 25 years:

1993: Installation of an electrically operated aluminum slide gate at the central sluice. The gate was manufactured by Whipps Inc., Athol, MA. Construction items included a sandbag cofferdam, dewatering, decommissioning the original gate, a 14-inch thick reinforced concrete overlay anchored to the masonry, steel channel gate sill, and stoplog angle guides in the west sluice. The work was performed by the Bancroft Manufacturing Contracting Corp., South Paris, ME.

2011: A new log boom installed in the approach channel upstream of the dam.

2012: Removal of the original upstream steel trashracks and catwalk from the dam approach channel.

2013: Repair of the east sluice stoplog guide (channel) and grouting a void at the sluice sill. The work was performed by the Diver Down Underwater Services Inc. (DDUS), Portland, ME.

2014: Installation of a steel trashrack to protect the gate and central sluice opening from floating debris. The trashrack was designed, fabricated and installed by the DDUS.

2018: The left gated mill process water intake is leaking and is scheduled to be permanently sealed.

Inspection

The inspection of the Thompson Lake Dam was performed on May 2 and 4, 2018 by Myron Petrovsky of MBP Consulting accompanied by Messrs. Butch Asselin and Craig Delano, both of Town of Oxford. Mr. Delano, a caretaker of the dam for over 40 years, assisted with operation of the sluices and shared his observations on historical dam performance and repairs.

During both inspections, the weather was clear with the ambient temperature about 75° F. The lake was full, at the depth 16 inches measured from the benchmark established on the top of the dam near the east abutment. The central sluice gate was inoperable, reportedly due to malfunctioning of the electrical hoist, and was in closed position. During the first inspection, the dam was operating near its maximum available capacity with the west sluice cleared of all stoplogs and four stoplogs removed from the east sluice. During the second inspection, the sluice stoplogs were reinstalled to reduce the flow and allow observation of the downstream area of the dam. The inspection included approximate dimensional survey to determine length and height of the dam, geometry of the sluices and sluice sill elevations from the top of the dam. These measurements provided the input for assessment of the hydraulic capacity of the dam. Representative photographs taken during both inspections are included in Attachment to this report. Photos 1, 2 show upstream and downstream elevations of the dam. The condition of the following dam structures was observed:

West Sluice. The 7.2-foot wide, 3.6-foot deep west sluice built as a broad-crested overflow weir appeared in operational condition. The left wall of the sluice exhibited wide open joints and mortar missing (Photos 3, 4). One stone block appeared overstressed, cracked but stable, with no signs of movement observed (Photo 3). The right sluice wall contained large voids, cracked stone slab and was leaking moderately, about 1 gallon per minute (gpm) (Photo 5). The sluice opening width was shorten by the 1993 concrete overlay on the left side (Photo 4). This was likely done to accommodate a stoplog guide. With the stoplogs in place (second inspection), the boards were leaking extensively at estimated rate 1-2 cubic feet per second (cfs) or about 500-1,000 gpm (Photos 4, 5). The steel platform spanning the sluice and handrail were quite rusty but solid and safe for foot traffic and stoplog operation (Photo 6).

Central Sluice. The central sluice is a low-level outlet containing a slide gate attached to the 1993 concrete overlay. The exposed gate frame and stem appeared in reasonable condition (Photo 7). The gate stem and hoist showed some rust and should be lubricated periodically. The gate was closed and inoperable for some period of time, reportedly, due to the problem with an electrical motor. The gate could be operated manually but at the very slow-moving rate. The gate malfunctioning reduced significantly operating dam capacity to pass excessive flows and created conditions for silt accumulation at the dam.

The submerged top of the 2014 gate trashrack observed through 1 to 2 feet of water appeared clean and debris free (Photo 8). However, the amount of debris collected at the deeper areas of the trashrack was unknown.

The left and right sluice walls downstream of the gate were leaking near the sluice floor. The estimated combined leakage coming from voids and open joints was about 50-80 gpm (Photos 9, 10). The gate observed at some distance from the downstream appeared relatively watertight (Photo 11).

East Sluice. The east sluice is similar in construction to the west sluice (Photo 12). The structure is also a broad-crested weir, about the same width but over 5 feet deeper. The sluice is entirely stoplogged but only four top boards are routinely used for flow control. The steel platform installed for operation of the stoplogs appeared sound but showed signs of rust (Photo 13). The stoplogs observed during the second inspection were extensively leaking with an estimated rate of 2-3 cfs (Photo 14). The sluice walls downstream of the stoplogs contained a number of voids and open masonry joints with mortar missing. The joints were leaking significantly with a total estimated flow of 25-35 gpm (Photos 15, 16). Saplings and brush were observed growing on the top of the left sluice wall with roots established in open masonry joints (Photo 14).

Concrete Section. The 30-foot wide, 36-foot long concrete section of the dam extending between the east sluice and mill building was in adequate condition (Photos 19, 20). The structure contained a gated old process water intake controlled by a rack-and-pinion hoist (Photo 17). The intake gate was reportedly leaking and is currently scheduled for decommissioning. The top of the structure included a 3-foot high, 16-foot long concrete parapet wall extending between the mill building and the flood wall running along the pond shoreline (Photo 18). This flood protection system provides a safe access to the dam from the mill side during significant storms.

Approach Channel. The approach channel extending between the log boom and the dam includes a concrete flood wall on the right and a short retaining wall on the left installed to protect the low laying abutment (Photo 21). The log boom installed in 2011 appeared in good condition. The right bank of the channel was covered with dense brush obstructing the inspection (Photo 21). A significant number of large trees growing along the left bank near the waterline were apparently undercut by soil erosion (Photo 22). The trees could fall into the pond, block the sluices during high water and reduce the water conveying capacity of the dam. The left retaining wall built of stone masonry and concrete was extending about 25 feet upstream from the dam (Photo 23). The wall contained a large, near horizontal crack at the waterline. Over a half of the wall concrete cover was eroded away exposing deteriorated masonry.

Three concrete piers in the approach channel, each 2 feet wide, 12 feet long (per the 1998 MEMA inspection report), were situated close to the dam. The piers in the past supported a trashrack and a catwalk used for debris removal. The central pier was observed sagging and tilting toward the lake (Photo 24). This pier movement was not noticed during the 1998 inspection of the dam. The piers can obstruct the flow, catch debris and reduce hydraulic efficiency of the channel.

Discharge Channel. The discharge channel at the dam includes a mill building on the right, a stone apron on the streambed and a stone retaining wall on the left (Photo 25). The mill building of concrete substructure and brick superstructure appeared in adequate condition.

The channel apron protecting the toe of the dam from undermining and streambed from erosion consisted of up to 4 to 6 layers of cut stone slabs. Timber cribbing observed at the downstream end of the apron was likely used for the base leveling and support prior to stone placement (Photo 28). The observed apron was in poor condition with estimated 80 percent of stone slabs moved, displaced and washed out. The most deteriorated apron area was in the middle, aligned with the central gate sluice. This area contained a deep scour hole (a plunge pool) extending from the toe of the dam to about 30 feet downstream (Photos 26, 27). The estimated depth of water in the scour hole with stone blocks laying on the bottom was about 5 to 6 feet. A proximity of the plunge pool to the dam could undermine the structure and cause instability.

The left, 10 to 12-foot high dry-laid stone retaining wall extending between the dam and access mill bridge was in poor condition (Photos 29, 30). The wall contained a significant number of large voids and widely open joints with chinking stone missing, and many cap slabs displaced or absent. The wall was heavily overgrown with tree and bush. Tree roots were penetrating into the structure dislodging and moving large stone slabs. The structure showed signs of instability: the wall area located 10-15 feet from the dam was out of plumb and bulged toward the discharge channel (Photo 29). Failure of the wall may cause stability concerns of the west dam abutment and channel bank.

Hydrology and Hydraulics

A preliminary hydrologic and hydraulic study was performed to estimate the spillway design flood (SDF), determine the hydraulic capacity of the dam and check the existing dam hydraulic capacity against the SDF.

Site Hydrology. Based on the size of the structure (intermediate) and downstream hazard (low), the SDF for the Thompson Lake Dam is the 100-year flood (minimum required). The peak flows from the dam watershed were assessed for the flood frequencies (recurrence intervals) ranging from 2 to 500 years using the 1999 USGS report for estimating peak flows for streams in Maine. The USGS methodology uses the statistical regression analysis. The regression equation entries include a drainage area of the site and percentage of wetlands in the basin. The watershed area of the dam shown in Figure 2 is 35 square miles. The estimated percentage of wetlands is 21%. The calculated peak flows for the recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years are included in Table 1.

Table 1
Peak Flows at the Thompson Lake Dam for Different Recurrence Intervals

	Recurrence Intervals (Years)						
	2	5	10	25	50	100	500
Peak Flow (cfs)	479	689	837	1,027	1,171	1,327	1,690

As shown in Table 1, the Spillway Design Flood for the dam is 1,327 cfs. By the State of Maine regulations, the dam should have the capacity to safely pass the SDF flood without overtopping.

Dam Hydraulics. During the field inspection, the size of the dam water conveyance facilities (the central gate sluice and east and west stoplog sluices) and their sill elevations (depth) from the top of the dam were measured. The results of the sluice dimension measurements are included in Figure 3. The maximum discharge capacity of each sluice was calculated with the pond level at the top of the dam (zero freeboard) using standard weir and orifice equations. The total dam capacity was determined for three plausible operating cases:

Case 1. All west sluice stoplogs and four upper east sluice stoplogs removed, gate inoperable and closed (current condition).

Case 2. West and east sluices in Case 1, gate operable and open.

Case 3. Both west and east sluices cleared of all stoplogs, gate operable and open.

The results of the hydraulic capacity calculations for different dam operating conditions are included in Table 2.

Table 2
Hydraulic Dam Capacity

Facility	Dam Operating Conditions		
	Case 1	Case 2	Case 3
	Discharge (cfs)		
West Sluice	148	148	148
Central Sluice (gate)	0	436	436
East Sluice	215	215	617
Dam Capacity Total	362	798	1201

As can be seen in Table 2, the current hydraulic capacity (Case 1), with the gate out of service, is very small (less than 2-year flood), the dam cannot pass moderate storms, and the risk of overtopping is highest. With the gate in service (Case 2), the dam capacity significantly increases approaching the 10-year flood. Hypothetically, if the east sluice was completely cleared of the stoplogs (Case 3), the dam can pass about the 75-year storm which is still significantly less than the 100-year project flood requirement.

Discussions and Conclusions

Based on review of the project information, field observation findings and hydrologic/hydraulic assessment, the dam appeared stable and operable at the time of the inspection. The overall condition of the dam is judged to be fair[4] to poor[5]. The poor rating is the result of very limited hydraulic dam capacity, numerous leaks and voids in the masonry, extensively leaking stoplogs, inoperable gate, disintegration of the apron, formation of the scour pool at the dam toe and potential instability of the left retaining wall of the discharge channel. The lack of design or construction records impedes the assessment of the dam. These dam deficiencies may require at some point in the future to perform significant repairs to improve operation and reduce the risk of incidents or failure of the dam. The following discussions and conclusions regarding the condition of the dam are offered:

1. The dam at present time, with the sluice gate out of service, has a very limited hydraulic capacity and is not able to pass safely a small storm event. With the gate operation restored, the hydraulic capacity of the dam is approaching the 10-year flood which is significantly less than the 100-year spillway design flood required. This hydraulic deficiency highlights the urgency of restoration of the central sluice gate operability. The dam was reportedly overtopped twice in the last 40 years, in the 1970s and about 6-7 years ago. During those floods, all sluices were cleared of removable stoplogs and the gate was fully open.

2. The dam is not designed for overtopping. With the climate changing, the frequency and severity of the storms may intensify, thus increasing the risk of dam overtopping exasperated by the insufficient hydraulic capacity. The overtopping could cause deterioration of the structure and abutments, erosion, scour, base undermining, instability and failure of the dam. As reported by the dam industry, the overtopping events constitutes about 80 percent of dam failures.

3. The east sluice is about 9 feet deep and has the largest theoretical capacity of all three sluices. However, the lower stoplogs are not removable by available means, continuously under full hydrostatic and silt pressure, and their condition is unknown. The 1998 MEMA report indicated the lowest stoplog in the sluice was bulged 1-2 inches downstream and

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[4] Fair is defined as a component that requires maintenance.
[5] Poor is defined as a component that has deteriorated beyond a maintenance issue and requires repair; the component no longer functions as it was originally intended.

leaking with an estimated rate 10-20 gpm. There is a recorded history of failures of stationary, deep-seated, not removable stoplogs. Estimates show that sudden failure of the east sluice stoplogs could drop the lake by one foot in 6 to 7 days.

4. The removable stoplogs in the east and west sluices, when installed, were leaking extensively with a total estimated discharge 3 to 5 cfs (1,500 to 2,500 gpm). This amount of leakage obstructs observation and condition assessment of the sluices and may influence the lake level during the periods of low rainfall and droughts.

5. The dam masonry has a number of physical deficiencies including voids, open joints, missing mortar, cracked stone blocks and leaking joints. The open joints and voids are attraction for vegetation growth, including trees and brush, which was observed in all sluices. Vegetation roots can dislodge masonry and initiate or increase seepage along root pathways. A total masonry leakage was estimated at about 80 to 120 gpm and was mostly observed on the sidewalls of the central and east sluices. It does not appear that this leakage had impacted the structural integrity of the structure at this time. However, with the repeated exposure to freeze-thaw cycles and vegetative impacts it is reasonable to believe that the progression of the deterioration will accelerate to the point where it may endanger the structure. This assessment is supported by the dam caretaker's observations who reported the increase in size of the leaking voids and the amount of the masonry leakage in the last 10-20 years. The east sluice leakage recorded in the 1998 MEMA Inspection Report was significantly less than the leakage observed during this inspection.

6. The gate trashrack installed in 2014 is submerged and does not have a platform for debris cleaning operations. With the gate sill located at the depth over 12 feet from the top of the dam, the manual debris removal could present maintenance challenges. Accumulation of debris at the trashrack may significantly reduce the hydraulic capacity of the gate.

7. The approach channel includes three concrete piers (pylons) previously used for supporting a trashrack and a catwalk. The piers are obstructing the flow to the dam and can collect debris impending the flow movement further. The central pier is sagging and tilted

upstream. This phenomenon, not observed during the 1998 MEMA inspection, could be the result of the pier base erosion by the channel currents or dam foundation seepage. Trees and brush growing on both banks of the waterway may contribute to the amount of debris entering the channel. The retaining wall installed along the west bank of the approach channel has experienced cracking, concrete cover failure and significant deterioration of the stone masonry. This retaining wall protects the low-lying abutment against erosion and controls seepage around the dam.

8. Floating debris is the perennial issue at the dam. Accumulation of debris during high flows can reduce the dam hydraulic capacity, raise the lake level and flood the lake shores. Due to the very narrow east and west sluices, each less than 8 feet, and estimated clearance 4 to 5 feet, the dam ability to pass large debris is very limited. The interceptor log boom installed in the approach channel in 2011 could improve debris control at the dam.

9. The downstream discharge channel at the dam is protected with a cut stone apron. The dam is judged to be built on soil foundation and the apron performs a critical role in protecting the toe of the dam against erosion and undermining. The apron appeared to be heavily built with up to 4 to 6 layers of stacked granite slabs placed over timber cribbing. The cribbing likely used as the base support and leveling measure could facilitate movement of the stone blanket.

10. The inspection observed almost complete disintegration of the apron area aligned along the central gate sluice with stone blocks moved and washed out. The apron areas downstream of the east and west sluices were also significantly damaged with stone slabs distorted, displaced and partially missing. Severe deterioration of the apron could be caused by operation of the dam, design and construction deficiencies, and the lack of maintenance. It is also possible that the past dam overtopping events have contributed to deterioration of the apron.

11. The lack of the streambed protection has resulted in formation of a deep scour hole (plunge pool) at the toe of the dam. The hole was positioned at the toe of the central sluice and extended about 30 feet downstream. A similar condition of the apron was observed 20

years ago during the 1998 MEMA inspection. The depth of the plunge pool is unknown; however, based on the field estimates and measurements, it is reasonable to assume that the base of the dam at the hole could be undermined to some extent. The base undermining could influence stability of the structure, shorten seepage pathways and increase the risk of internal erosion of the foundation soil.

12. The left stone retaining wall of the discharge channel contained large voids and wide-open joints. The cap slabs were missing and displaced at several locations. The abundance of large voids in the masonry has resulted in dense wall overgrowth consisting of large trees, saplings, and brush with roots penetrating into the masonry and dislodging stone. The wall was out of plumb and bulging toward the stream at the location about 10-15 feet downstream from the dam. This wall displacement is not recent occurrence and was observed during the 1998 MEMA inspection. The bulge could be indication of potential instability of the wall. Failure of the wall may weaken the west abutment, affect dam and channel slope stability and initiate seepage around the dam.

13. The dam presents a potential danger to the general public (boaters, swimmers, fishermen, and passersby) during its operation when high velocity flows are continuously discharging downstream. No warning signs were observed to be installed in the areas upstream and downstream of the dam.

Recommendations

The recommendations include short-term and long-term operation, maintenance and remedial measures intended to improve safety, integrity, longevity and functionality of the dam.

A. <u>Short-Term Remedial Measures</u>

The short-term remedial measures are usually small-scale repairs and operation, maintenance and monitoring items which do not require obtaining the Maine DEP permits. The following short-term remedial measures are suggested:

1. Perform topographic and bathymetric surveys of the dam, abutments, and the approach and downstream channels. The survey drawing will assist in the assessment of the dam and development of remedial measures.

2. Trees and brush growing on the dam, west abutment, slopes of the approach channel, and the left stone wall of the discharge channel should be cut and removed to provide unobstructed observation of the dam facilities and vicinity and protect the structures and abutments from damage by root penetration and uprooting.

3. To mitigate and reduce the amount of debris at the dam, the towns neighboring the lake may consider pre-emptive measures to reduce the amount of debris entering the lake. These measures may include cutting and removal of the shoreline trees with overhanging branches, eroded and exposed root system and dead trees.

4. The concrete piers located immediately upstream of the dam and obstructing the flow in the approach channel should be removed. Prior to the removal, the central tilted and unstable pier should be observed by divers for base undermining which could be caused by the channel currents and/or dam foundation leakage. The diver's findings should be documented and evaluated.

5. The slide gate in the central sluice provides over 50 percent of the available dam hydraulic capacity and is currently inoperable. Restoration of operation of the gate should be a priority in reducing the risk of overtopping, enhancing operational flexibility and improving safety of the dam. The gate hoist and stem (observed rusted) should be cleaned and lubricated every 6 to 12 months.

6. The gate trashrack is submerged and does not have a platform for cleaning and debris removal. The trashrack should be checked by divers and cleaned from debris annually for 3-5 years. The diver's findings should be recorded and evaluated.

7. The old mill water process intake located in the concrete section of the dam is reportedly leaking. The intake should be sealed and the gate equipment removed from the dam. The intake decommissioning method and accompanying documentation (sketches, photos) should be included into the dam records.

8. The removable stoplogs in the east and west sluices are leaking extensively when in place. The leakage could be reduced by replacing the worn stoplogs with new boards and the use of a plastic cover on the waterside. The new boards should fit tightly when stacked.

9. During the 1998 MEMA inspection, the east sluice bottom stoplog was observed bulging downstream and leaking. Due to the excessive leakage, the east sluice stoplogs were not accessible for observation during this inspection. The unremovable stoplogs should be inspected, condition evaluated and damaged boards (bended, cracked, decayed), if found, replaced. The stationary, not removable east sluice stoplogs should be inspected bi-annually and the findings documented and assessed.

10. The steel platforms spanning the east and west sluices and handrail on the top of the dam exhibited significant rust and should be repainted. This repair activity should be included in a regular maintenance program.

11. The plunge pool scoured in the stone apron of the discharge channel at the toe of the dam should be inspected by divers. The depth and extent of the pool and the location of the dam base, if exposed, should be determined. During the underwater inspection, the scour hole should be observed for signs of erosion, undermining, instability and seepage. The diving inspection findings should be reported, documented, evaluated and remedial measures developed, as necessary.

12. The sluice sidewalls contain a number of large voids and open, leaking and vegetated joints. To protect the masonry from degradation these voids and joints should be cleaned, grouted and sealed. The upstream face leakage entries should be identified and sealed prior to the downstream repair work. This masonry repointing, sealing and repair work should be described and materials and repair methods used documented.

13. The left stone retaining wall of the discharge channel exhibited bulging area located about 10-15 feet downstream of the dam. The wall bulging usually indicates a potential instability and safety concerns. However, this bulging is not a recent occurrence and was observed during the 1998 MEMA inspection. To assess the need and urgency of the wall remediation, it is recommended to establish survey monitoring of this area. The survey should be performed annually for 3 to 5 years and the collected data evaluated for movement and settlement. The survey set-up should be documented. Based on the survey findings, the need and timing for the wall repair should be assessed.

14. Warning signs on both dam abutments and along the approach and discharge channels should be installed to improve public safety, mitigate vandalism, and reduce the Town's potential liability in the event of accidents.

B. Long-Term Remedial Measures

The proposed long-term remedial measures are intended to bring the dam in compliance with the dam safety regulations and current engineering standards and practices. The proposed general approach to the dam remediation includes development of remedial options, alternative analysis, a conceptual design of selected remedial options and an estimate of construction cost.

To assist in development of remedial measures it is suggested:

- Perform a limited subsurface investigation (test borings) to determine the dam base elevation and general properties of the dam foundation material.

- Perform hydrologic and hydraulic analyses using computer modeling of the dam watershed with existing and modified dam and determine the peak flows, design flood, water profiles and flow velocities.

The long-term remedial measures include the existing dam and the dam requiring significant modification of the existing structures.

B.1 Existing Dam Remedial Measures

These remedial measures improve the condition of the dam and increase its hydraulic capacity but do not involve significant alteration of the dam structures. The following dam remediation measures are proposed:

- Install a concrete overlay on the upstream face of the east sluice and concrete dam section tied to the 1993 concrete overlay.
- Rehabilitate the left retaining wall of the approach channel.
- Fill the scour hole at the toe of the dam and restore the stone apron.
- Replace the bulging section of the left stone wall of the discharge channel, if necessary.
- Develop overtopping protection measures for the dam, west abutment and downstream area for the safe passage of the 100-year spillway design flood which exceeds the current dam capacity.

B.2 Dam Modification Remedial Measures

These remedial measures are intended to improve the condition of the dam and increase its hydraulic capacity to safely pass the spillway design flood without dam overtopping. The following remedial measures are proposed:

- Replace the ineffective stoplog system in the east sluice with a new slide gate.
- Lower the crest of the west sluice and install a new slide gate.
- Raise the top of the dam to increase the head and hydraulic capacity.
- Enlarge the east and west sluices.
- Replace the existing sluices with a single, automatically operated large gate.
- Install upstream and downstream cutoff walls at the dam base to reduce the risk of internal soil erosion and protect the dam from undermining.
- Replace the existing stone apron with a concrete stilling basin or concrete apron.

The above dam repair and modification measures could be implemented separately or in combination with other options. Following completion of the conceptual design, alternative analysis and construction cost estimate, the Town and other stakeholders[6] should choose, based on their priorities, preferences and funding resources, the most appropriate approach to the dam remediation, repair options, construction phases, and timing.

If you have any questions or need clarification regarding this report, please contact me at 207-773-5425 or myronp@maine.rr.com.

Sincerely,

MBP CONSULTING

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Principal

Attachment: Inspection Photographs

[6] The Towns of Otisfield, Poland and Casco; the Thompson Lake Environmental Association.

ATTACHMENT

INSPECTION PHOTOGRAPHS

Photo 1. Upstream View of Dam.

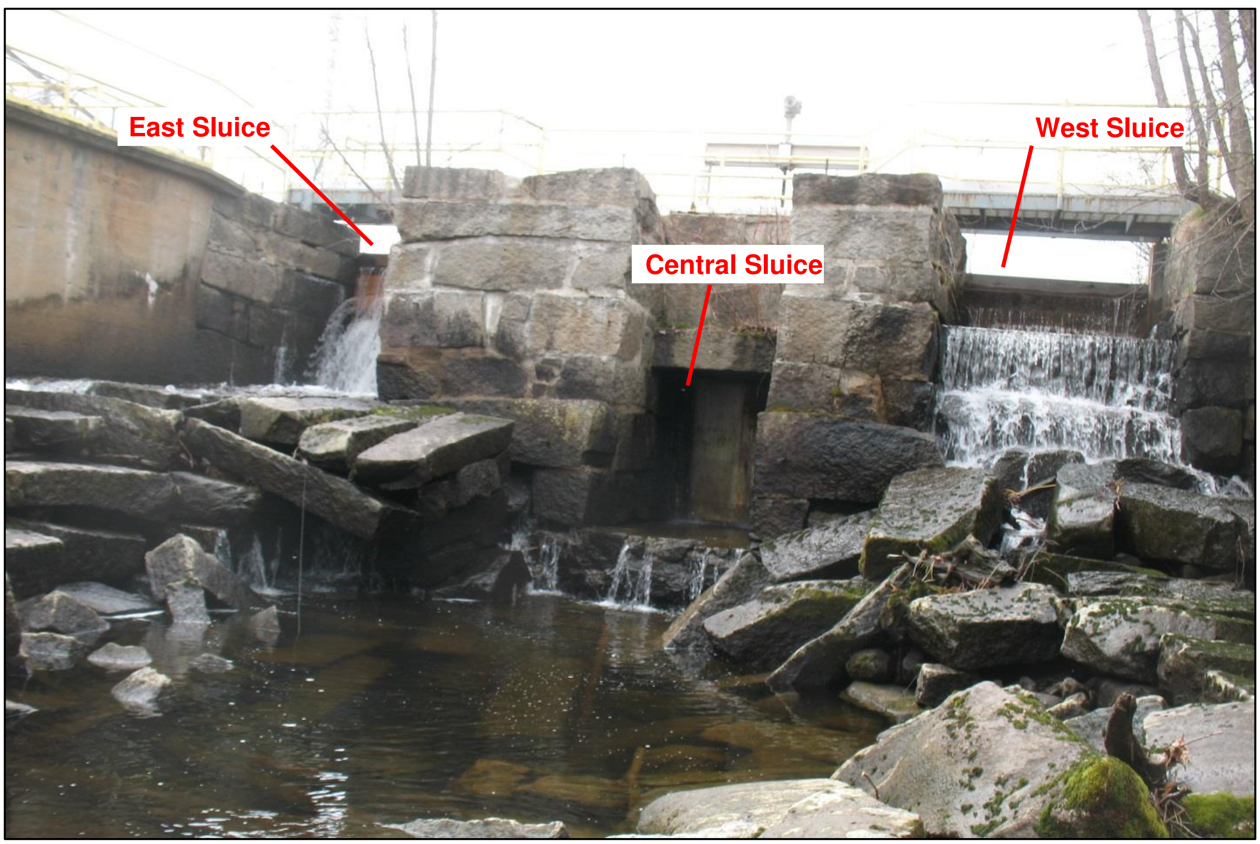

Photo 2. Downstream View of Dam.

Photo 3. Left Wall of West Sluice. Note Open Joints, Crack in Masonry, Vegetation.

Photo 4. Downstream View of West Sluice: Voids in Masonry, Leaking Stoplogs, 1993 Concrete Overlay (arrow) in Sluice Opening.

Photo 5. Right Wall of West Sluice. Note Missing Mortar, Large Voids and Crack in Masonry.

Photo 6. West Sluice Operating Platform.

Photo 7. Upstream View of Central Sluice: Concrete Overlay (arrow), Gate Frame, Operator and Stem Installed in 1993.

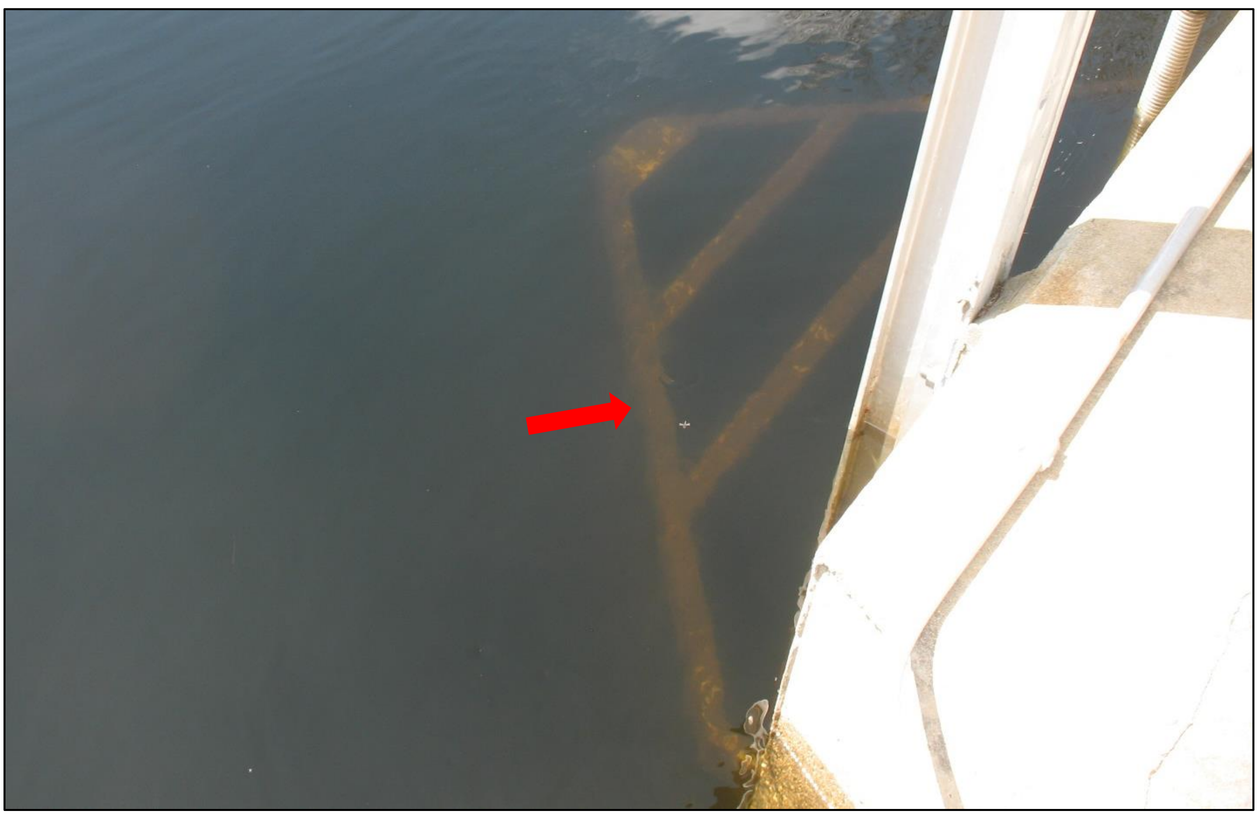

Photo 8. Central Sluice: Submerged Gate Trashrack Installed in 2014.

Photo 9. Downstream View of Central Sluice. Note Leakage in Left Wall.

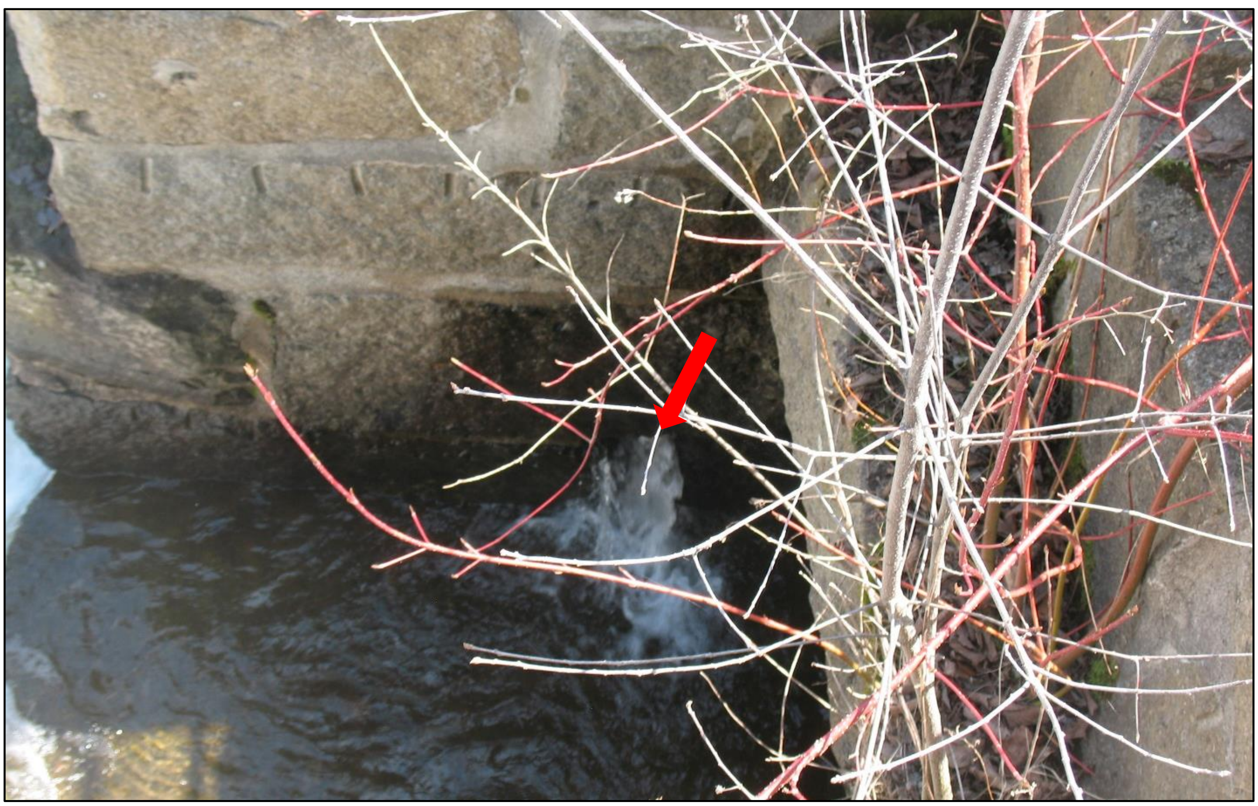

Photo 10. Central Sluice: Significant Right Wall Leakage near Sluice Bottom, Vegetation.

Photo 11. Downstream View of Closed Central Sluice Gate. Note Large Void in Masonry.

Photo 12. Upstream View of East Sluice.

Photo 13. East Sluice Stoplog Operating Platform and Handrail. Note Steel Rust.

Photo 14. Downstream View of East Sluice. Note Leaking Stoplogs and Trees in Masonry.

Photo 15. East Sluice Left Wall: Open Voids and Leakage in Masonry.

Photo 16. East Sluice Right Wall. Note Voids and Leakage in Masonry.

Photo 17. Upstream Face of Concrete Dam Section and Old Water Process Intake Gate Hoist.

Photo 18. Concrete Dam Section at Mill Building and 3-foot High Concrete Parapet Wall (arrow) on Top of Dam.

Photo 19. Concrete Dam Section Looking Upstream. Note Stored Lifting Rods Used for Stoplog Operation.

Photo 20. Downstream View of Concrete Dam Section.

Photo 21. Log Boom in Approach Channel. Note Left Bank Trees and Right Bank Overgrowth.

Photo 22. Left Approach Channel Bank Between Log Boom and Dam. Note Large Trees at Waterline.

Photo 23. Left Approach Channel Retaining Wall. Note Wall Erosion and Large Crack at Waterline.

Photo 24. Right Approach Channel Retaining Wall and Old Piers Supporting Original Trashracks and Catwalk. Note Sagging Central Pier and Tree at Waterline.

Photo 25. Discharge Channel. Left Channel Side Obscured by Dense Vegetation.

Photo 26. Disintegrated Stone Apron. Note Scour Hole at Dam Toe and in Channel Floor.

Photo 27. Movement and Separation of Stone Apron Block from Dam.

Photo 28. Exposed Base Timber Cribbing Used for Apron Construction.

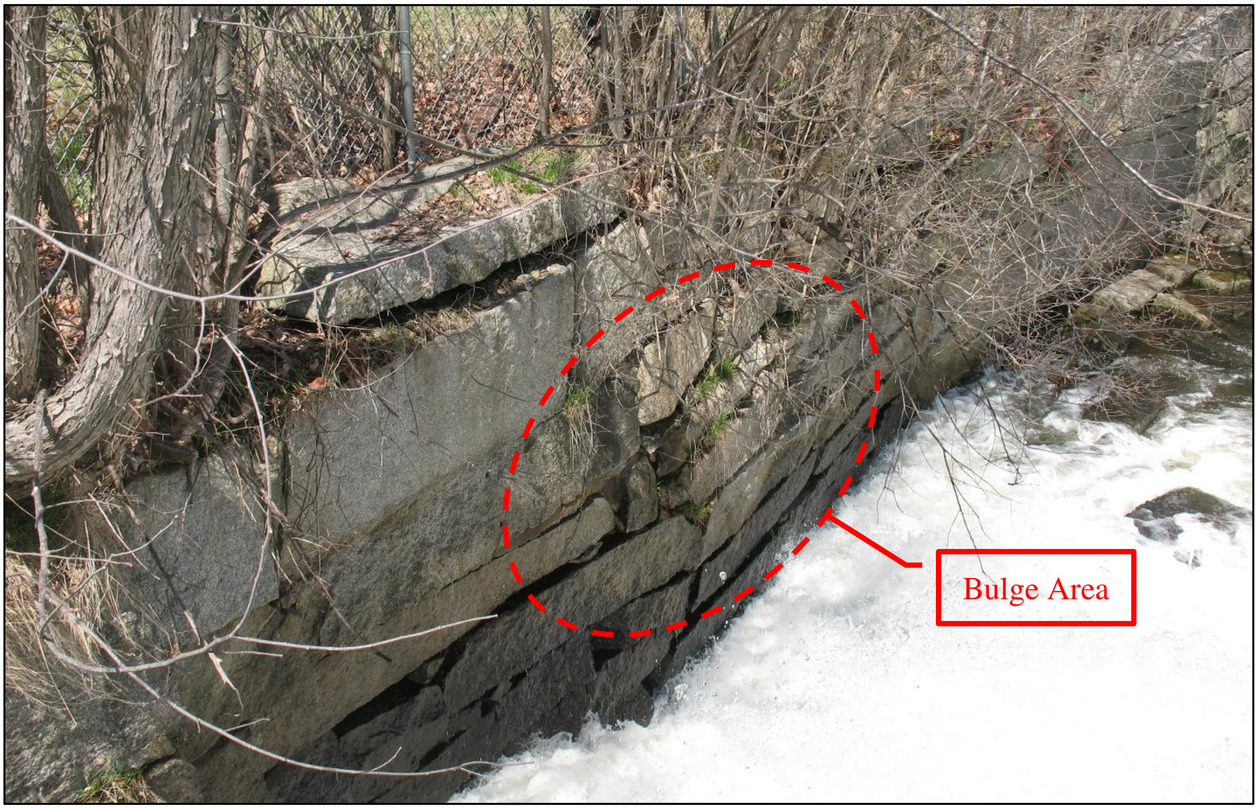

Photo 29. View of Left Discharge Channel Retaining Wall from Dam. Note Bulging, Displaced and Missing Stone, Voids, Large Trees and Brush.

Photo 30. View of Left Discharge Channel Retaining Wall from Channel Floor.