December 2, 2014

Cliff Evanitski
General Manager
Long Point Region Conservation Authority
4 Elm Street
Tillsonburg, Ontario
N4G 0C4

Dear Mr. Evanitski,

Re: Dam Inspection Report
Norwich, Teeterville, Lehman, Deer Creek, Backus Mill, and Hay Creek Dams

Introduction

The report that follows presents our summary of the findings of the 2014 inspections of the above noted structures. I refer you to a proposal submitted by Riggs Engineering Ltd. to Long Point Region Conservation Authority dated July 3, 2014 that outlines the scope of work and details the tasks to be completed as part of the 2014 dam inspections.

Inspections at the six sites were carried out by staff from Riggs Engineering and accompanied by staff of Long Point Region Conservation Authority. Site visits to Norwich, Teeterville and Lehman Dams were completed on September 11, 2014. Deer Creek, Backus Mill and Hay Creek Dams were inspected on September 15, 2014.

Nomenclature

This report adopts the naming convention that assumes the observer stands in the middle of the river and looks downstream. For example, references are made to left and right embankments, wingwalls, banks, or other structures or dam components, which relate to what a person sees by standing in the middle of the river and looking downstream.

Background

Long Point Region Conservation Authority staff has provided the following documentation for our review:

- Crysler, Davis & Jorgensen Limited, drawings of **Norwich Dam**, dated June 1965. Provided set includes drawings labeled 6427-1 to 6427-7 and represents original drawings of the dam.

- Crysler, Davis & Jorgensen Limited, drawings of **Teeterville Dam**, dated June 1962 (drawing labeled 6152-1 of the Teerville Dam) and dated April 1962 (drawing labeled 6208-1 of the stop log hoist). Two drawings provided represent only a partial set.

- Vance, Needles, Bergendoff & Smith Limited, drawings of **Lehman Dam**, dated August 1963. Provided set includes drawings 1 to 21, which represents original drawings of the dam.

- Woodstock Engineering Consultants Limited, drawings of **Deer Creek Dam**, dated July 1969. Provided set includes as constructed drawings 1 to 43, and a drawing by Armco Drainage & Metal Products of Canada Ltd. for the dam outlet gate (drawing 2-1707-A).

- Geotechnical Evaluation, **Backus Dam**. Prepared by Peto MacCallum Ltd. on behalf of the Long Point Region Conservation Authority, Hamilton, Ontario. September 1992.

- Jewitt, Dodd & Vallee Surveying & Engineering, drawings of **Hay Creek Dam**, dated April 1966. Provided set includes drawings 6604-1 to 6604-8, which represents original drawings of the dam. A drawing by the same designer was issued in June of 1972 related to remedial work implemented on the downstream wingwalls (drawing 7131-1).

Record of past inspections provided to Riggs Engineering includes the following:

- Inspection of Norwich Dam, B.M. Ross and Associated Limited, Report prepared on behalf of then Ministry of Natural Resources, November 17, 1987.

- Inspection of Hay Creek Dam, B.M. Ross and Associated Limited, Report prepared on behalf of then Ministry of Natural Resources, November 12, 1987.

- Inspection of Deer Creek Dam, B.M. Ross and Associated Limited, Report prepared on behalf of then Ministry of Natural Resources, November 10, 1987.

In 2014 Ministry of Natural Resources was changed to Ministry of Natural Resources and Forestry. The 1987 inspection reports for Teeterville, Backus Mill and Lehman dams were not available for our review. It is believed that these sites were inspected in 1987. Additionally, the following inspections were provided:

- Dam inspections, MIE Consulting Engineers Limited, Report prepared on behalf of the Long Point Region Conservation Authority, November 13, 2009.

The 2009 inspections only focused on the conditions of the stop logs at Teeterville and Vittoria Dams, debris accumulation at Lehman Dam, and the stop log hoist mechanism of Hay Creek Dam.

To our best knowledge, routine inspections of the above six dam sites are carried out internally by LPRCA staff on the regular bases. Documentation of comprehensive and detailed inspections by professional engineers licensed in Ontario focusing on civil works at each site has not been carried out since 1987.

Existing conditions

Observations from site inspections carried out in September of 2014 are documented in detailed photographic log for each site. Appendices A-F present photographic logs that document conditions observed for each site at time of inspections. The photographic logs provided are intended to be used as a baseline reference for future inspection and monitoring efforts.

A brief description of each site is provided below, together with most significant observations.

Norwich Dam

Norwich Dam is located in the town of Norwich on the Big Otter Creek. The dam was originally constructed between 1966 and 1968 to provide recreation and low flow augmentation. The dam consists of left and right earth embankments and a concrete gravity dam structure. The concrete gravity dam structure also functions as the main spillway. A sluice gate located inside the wetwell structure on the right upstream wingwall allows the reservoir to be lowered for maintenance and/or emergency repairs. The Norwich Dam is owned entirely by Long Point Region Conservation Authority.

Embankments at Norwich Dam were found to be in a generally good condition. Evidence of missing riprap was noted at the left upstream bank, at the location of maximum reservoir fetch. The right embankment was noted to be in good condition, with crest and side slopes vegetated with grass that is regularly mowed. Previous dredging operations of the reservoir included placing dredged sediment on top of the crest of the left embankment, as well as adjacent downstream areas. Irregularities evident in the embankment are thus believed to have resulted placement of dredged sediment and not due to settlement. The slope of the right upstream embankment was noted slightly irregular at the waterline, with the possibility of the localized soil erosion.

The original drawings of the Norwich Dam shows the upstream and downstream embankment slopes to be lined with riprap (one man size stones, roughly equivalent to 12 to 18 inch riprap). Riprap on the slopes was not visible, as it is possible that it was covered up by dredged sediment in the past.

A number of mature trees were identified on the slope of the left upstream embankment. Some localized loss of fill (due to surface water drainage) was noted adjacent to right wingwall.

Detailed inspection of the main spillway concrete was not possible, as the headpond level was such that water was flowing continually over the spillway. None of the spillway concrete was exposed during the inspections.

Concrete in the left and right wingwalls is noted to be in generally good condition, with only minor locations of damage associated with alkali-silicate reaction at the right downstream wingwall. A crack between the wetwell and the right downstream wingwall was noted. Future monitoring of the crack is required.

Mature trees were noted to be growing in the channel/bank immediately downstream of the stilling basin, adjacent to the right downstream wingwall. Tree roots in this location have the potential to exacerbate concrete deterioration of the nearby structures.

Hand railing specified in the original dam drawings was found at the site on the left and right wingwalls. The railing is 3 ft tall, and does not meet current MNR requirements (which require that vertical fall hazards have railing installed according to Ontario Building Code standards).

There are signs at the dam, although they do not meet current MNR requirements.

Teeterville Dam

The Teeterville Dam is located in the community of Teetervile, on the Big Creek. The original construction date of the dam is unknown, but is believed that the original structure is in the order of 100 years old. The steel truss spanning the Big Creek (located

at the existing dam) carried vehicular traffic of County Road 25. Sometime in the 1970's a new embankment and roadway were constructed upstream of the existing dam. The existing roadway embankment and the bridge crossing are under the ownership of Norfolk County, while the dam is believed to be owned by the Long Point Region Conservation Authority. It is presently unknown who owns the existing steel truss bridge that spans the creek at the dam site.

The Teeterville dam consists of a concrete gravity structure that is the main dam. Subsequent to the construction of the original concrete structure, concrete piers were added on the downstream face, probably for the purpose of adding stop logs and increasing the headpond elevation. Currently, the piers form a set of four bays, each with capacity to hold three stop logs. Original overhead stop log hoist was installed sometime after 1962, and entirely replaced in 1997.

There is no ability to lower the headpond at Teeterville Dam, other than removing the existing stop logs.

The upstream embankment of Teeterville dam is not longer functioning, as the upstream slope of the County Road 25 embankment now abuts the reservoir. The downstream embankment of the dam is in generally good conditions, and is free of cracks and settlement. In some sections, voids were observed adjacent to the grouted concrete at the right downstream wingwall, but these are believed to be local. Portions of the left downstream embankment are vegetated with brush, and are also free of seepage, cracking or settlement.

The left downstream embankment, adjacent to the left downstream wingwall, is lined with stacked blocks that have been grouted. Voids in the stacked blocks are visible. Wetness was noted adjacent to the bank-wingwall interface, at the left downstream wingwall. It is unknown if the wetness is seepage from the upstream reservoir.

The concrete wingwalls are in poor to fair condition. Seepage is evident on both left and right downstream wingwalls, at the interface with the concrete piers. The upstream wingwalls were covered with stacked blocks or buried from the construction of the County Road 25. There is a large visible crack located on the left upstream wingwall that is greater than 10 mm in width.

Mature trees were noted growing adjacent to left and right upstream wingwall.

The original steel truss bridge that spans the dam is heavily deteriorated, with many stringer beams with sections that are completely corroded. The existing bridge deck is supported by the underlying stringer beams. In some sections the deck rests on stringer beams that have completely lost their ability to carry load. The existing hand rail at the bridge is loose, and partially consists of wire fence.

The existing bridge deck is used by LPRCA staff to access the stop log lifting gantry cranes, as well as grounds maintenance staff to move equipment (riding mowers) from one side of the creek to the other.

Ladders of the stop log gantry cranes are connected to the downstream steel truss. The gantry cranes themselves are anchored to the concrete of the piers.

The condition of the original concrete spillway was not able to be assessed, due to high reservoir levels at times of inspections. Concrete of the piers that support the stop logs

are in various state of disrepair. Spalled sections are evident, as are missing sections. Visible reinforcing bars are seen at a number of bays.

There are signs at the dam, although they do not meet current MNR requirements.

Lehman Dam

Lehman Dam is located in the town of Delhi on North Creek, a tributary of Big Creek. The dam was constructed in 1964 to provide a drinking water reservoir for the town of Delhi. Main components of the dam include an earth embankment, intake chamber, a concrete spillway, a fish ladder, and associated outlet works. The sluice gate at the intake chamber has previously been identified as not operable. It is our understanding that repairs to the gate shall be carried out in the near future.

The main embankment at Lehman Dam appears in good shape, and is free of cracks, seepage or other noticeable deteriorations. Toe drains that empty into the downstream outlet structure were both observed to be functioning. Riprap was noticed on the above water portions of the right upstream embankment, which was placed in about 2005 or 2006. At that time, riprap was not placed on the embankment below the waterline. Minor brush vegetation was noted to be regularly cleared, even though some were still visible at time of inspections.

Concrete of the downstream outlet structure appears to be in generally good condition, with only minor deterioration detected. The outlet at the fish ladder appears to be in good condition, as do the concrete blocks at the outlet and the sheet piling.

The right wingwall, which also forms part of the fish ladder channel, appears in good condition, and is generally free of cracks and signs of deterioration. A joint movement was noted at the interface between the right downstream wingwall and the upstream face of the fish ladder. A small corresponding crack in the wingwall was noted, and should be monitored in the future.

Concrete of the left wingwall also appears in good condition, and is free of cracks and major deteriorations. The drain holes at the bottom of the left wingwall were observed to be functional. Heavy brush and trees behind the left wingwall were noted.

Joint filler material was noticed as deteriorated at a number of locations in the concrete at the wingwalls at Lehman Dam.

The fish ladder intake gate located in the right upstream wingwall was noted as functional. Long Point Region Conservation Authority staff notes that trash accumulation at the fish ladder intake gate presents a persistent problem. Near the outlet of the fish ladder an opening in the grate was noticed. It is believed the opening is required for upstream fish migration, but represents a fall hazard.

Visual examination of the fish ladder outlet channel noted the possible erosion of the downstream channel. Right bank downstream of the fish ladder outlet channel appears steep, and was heavily vegetated with brush.

An above water inspection of the concrete of the intake tower did not notice any major signs of deterioration. The access walkway between the downstream slope of the embankment and the intake tower appear to be in generally good condition. The beams driven into the embankment slope (at the pile bent) were noticed to have webs completely deteriorated at the water line.

The concrete at the main spillway appears in good condition, with some brush vegetation growing through the cracks. Some deterioration in the joints was noticed in the spillway. The stilling basin downstream of the spillway (and confined between the wingwalls) was filled with water, so its condition could not be evaluated. The riprap downstream of the stilling basin was noticed to be much lower than the elevation of the concrete. Note that the original drawings show the downstream riprap to be flush with the stilling basin.

There are signs at the dam, although they do not meet current MNR requirements.

Deer Creek Dam

Deer Creek Dam is a composite gravity dam located outside of the community of Langton, west of the intersection of Highway 59 and County Road 45. The dam is located on Deer Creek, a tributary of Big Creek. The original intent of the dam was for water storage and recreation activities. The dam was constructed in 1969. Main components of the dam consist of an earth embankment, a concrete spillway, and an upstream low level intake that allows lowering of the headpond if necessary. The main spillway has two bays of stop logs, which could partially control headpond water levels.

The left upstream embankment was noted to be in generally good condition. Brush vegetation was noticed along the upstream slope, underlain by existing riprap. The existing riprap was noted as deteriorated in some sections, likely due to freeze-thaw action. A change in slope was noticed approximately half way between the lift control chamber and the bridge. It is possible that localized slumping or erosion took place along the noted section.

The downstream embankment slope was covered with heavy brush vegetation, despite preventative measures. Seepage, cracking or otherwise loss of fill on the downstream slopes was not noticed. Toe drains emptying into the stilling basin on the downstream side were observed as functioning. The toe drains consist of 12 inch corrugated steel pipes. At the right downstream wingwall, the toe drain was noted as partially clogged, but still functional.

The reinforced concrete of the lift control chamber, located on the upstream slope of the embankment, was noted to be deteriorated. It is believed that application of salt during winter months exacerbate the observed spalling. The gate operated from the lift control chamber was noted as functional, with regular servicing by Conservation Authority staff.

Portions of the upstream left wingwall was noted as missing above the waterline, as exposed reinforcement was visible during inspections. Remaining upstream wingwall concrete was in generally good conditions, with only minor cracking observed. Zones of damage from alkali-silica reaction were noted at a number of locations. Concrete spalling of the left upstream wingwall, adjacent to the spillway was noticed as well.

Some spalling of the concrete was noticed just upstream of the spillway of the right upstream wingwall. Some zones of damage from alkali-silicate reactions were observed, and noted in the photographic log.

The downstream wingwall (left and right) were observed to be in good condition. No noticeable cracking or otherwise deteriorated section were observed during inspections. Joint filler material was observed to be missing in the panels of the wingwalls. Brush vegetation was noted as growing above both wingwalls.

Hand rails were installed only on the left downstream wingwall, and were noted to not meet current standards.

The main spillway concrete was observed to be in generally good condition, with no noticeable cracking, spalling or deterioration. One of the stop logs in the right bay was noted to have previously shifted, which resulted in more water spilling from the reservoir. Some amount of debris was seen on the spillway. Small amount of moss-type vegetation was evident on the spillway. The downstream stilling basin is completely silted up, with cattails growing adjacent to the existing baffle blocks. The downstream silt is presently not impeding the functioning of the spillway.

Concrete at the downstream low flow outlet structure was observed to be deteriorated, particularly the left wingwall. Localized spalling and heavy damage from alkali-silicate reaction were observed. As with the rest of downstream embankment slopes, heavy brush vegetation was present adjacent to the low flow outlet structure.

There are signs at the dam, although they do not meet current MNR requirements.

Backus Mill Dam

Backus Mill Dam is a concrete gravity dam located on Dedrich Creek, and is presently part of Backus Heritage Conservation Area. Exact time of construction of the Backus Mill Dam is unknown, and is believed to have occurred sometime in the 1800's. The dam is believed to consist of a concrete gravity spillway (with above stoplogs), an earthen embankment, and a millrace intake and associated millrace channel. The millrace intake supplies water to a grist mill used for demonstrating operations at the historic mill site. Detailed inspection of the timber millrace structure was not carried out.

The slopes of the embankment on the upstream side are relative mild. Distress in the upstream slopes was not evident during inspections. The right downstream slope, adjacent to an access road on the right side of the spillway is observed as fairly steep, approximately 1.5H:1V. The slope at this location is vegetation with heavy brush, and there are mature trees growing though it.

The slopes of the left downstream embankment (including left of the millrace channel) are observed to be steep, having an inclination of 1.5H:1V or steeper. The slope of the left downstream embankment is vegetated with heavy brush, and mature trees. Over steepened sections of the slope were observed, with ongoing localized loss of material. Erosion is particularly evident at the toe of slope left of the access stairs. A void in the left downstream embankment was observed, adjacent to the left downstream wingwall.

Upstream wingwalls consist of newer sheet piling, and are in good condition. A cap plate supports a hand rail above the existing sheet piling.

Millrace intake at Backus Mill Dam consists of a corrugated steel pipe, with a wooden plank that acts as a lift gate. A pedestrian access bridge is located just south of the millrace intake.

The main spillway of the dam is in generally good condition, given its age. Evidence of the repair carried out in 1992 was visible. The right downstream wingwall was fairly short, and consists of mass concrete and grouted concrete blocks placed on the slope above. Brush vegetation is seen growing through the grouted concrete blocks. At the toe

of slope (at the right downstream wingwall) sheet piling was observed that extend perpendicular to the channel and act to stabilize the toe of slope.

Similar observations are noted at the left downstream wingwall. The wingwall consists of mass concrete, with the slope above as grouted concrete blocks. Sheet piling at the toe of slope acts to stabilize the toe of slope at the wingwall, and extends a nominal distance to the left.

Concrete access stairs (with hand rails) are located adjacent to the left downstream wingwall. Localized loss of fill at the downstream embankment slope adjacent to the stairs is evident.

Channel and toe of slope immediately downstream of the spillway is lined with 100 mm riprap. Erosion protection works were also noted at the banks just downstream of the dam, implemented sometime after the repairs of the 1992.

There are signs at the dam, although they do not meet current MNR requirements.

Hay Creek Dam

The Hay Creek Dam is located on the Hay Creek, approximately 4.5 km from its outlet to Lake Erie. The dam consists of a concrete gravity dam spillway structure and an earth embankment. Construction of the Hay Creek dam took place in 1967. The top of the embankment carries Port Ryerse Road, and its associated road crossing. Steel stop log lifting frame is located on the deck of the main control structure. Submerged gate exists through the right upstream wingwall and runs under the embankment. The gate allows for drawing down the headpond. The stop log gains were originally equipped with a shear pin mechanism that allows the logs to release if water levels rises too rapidly and too much load is applied on the structure. Shear pin mechanism were disabled in 1997, and was simply bolted to the outside gain.

The main embankment at Hay Creek Dam was noted to be in a general state of good condition. Cracks, voids, or loss of fill was not evident during inspections. The left upstream embankment slope was noted to be lined with riprap. Some riprap deterioration was noted, as some of the larger stones cracked over time. Geometry of the slope was generally consistent throughout. A gabion mattress was noted immediately adjacent of the both upstream wingwalls. Generally, the left upstream embankment slope was overgrown with brush vegetation.

The downstream embankment was noted as vegetated with brush. Some small diameter trees were observed on the downstream slope. Seepage or wetness was not identified during the inspections.

Concrete at the main control structure above the deck (at the stop log lifting frame) appears in generally good conditions, with only minor deterioration.

Left upstream wingwall, adjacent to the bridge abutment was noted as heavily deteriorated. Past movement of the right upstream wingwall was evident, which is responsible for deterioration of the concrete in the right abutment of the bridge. Evidence of damage of alkali-silicate in the main control structure above the right upstream wingwall was noted.

Concrete in the downstream wingwall was in generally good condition. A steel brace installed between the left and right downstream wingwall was observed, and noted to be

in good condition. Evidence of past movement of the left and right downstream wingwall was observed, especially when viewed from the top of the downstream deck. For both downstream wingwalls, the movement was greatest at the top.

Seepage and wetness trough the joint between the left downstream wingwall and the left abutment were observed. Similar seepage was also noted between the two panels at the left downstream wingwall. Localized concrete spalling was observed at the lower portions of the wingwall, at the joints. Wetness and seepage indicates water buildup behind the left wingwall. Backfill material behind the walls is not longer free draining, as originally specified.

Similar conditions are noted at the left downstream wingwall, although the amount of deterioration at the joints was less. It is anticipated that the amount of water buildup behind the left downstream wingwall is less than on the right.

The slope surface of the downstream embankment slope adjacent to the wingwalls (on both sides) was observed to be surfaced with asphalt.

Damage to fence was noted at the control structure. Multiple openings in the fence were noted, especially on the upstream side of the main control structure.

Original handrail was observed at the both downstream wingwalls.

There are signs at the dam, although they do not meet current MNR requirements.

Recommended follow up work
The recommended follow up work are given based on priority codes, which are defined according to their relative urgency.

Cost estimates of the repairs were not part of the scope of work of this assessment, and are thus not presented. The three levels of priorities are identified as:

- Priority S (safety related, requires immediate attention),
- Priority 1 (will require action within 1 to 2 years),
- Priority 2 (will require action in 2 to 5 years),
- Priority 3 (will require action in 5 to 10 years).

General (applicable to all dam sites)
Replacement of existing handrails is recommended to take place as a Priority 2 (2 to 5 years) only in instances where public has access (parks, day use areas, etc).

In cases where potential exists for recreational boaters (canoe, kayak or equivalent) to use the reservoir areas, in river signs should be installed to warn of an approaching dam.

Signs posted at each dam site should conform to MNR Public Safety Around Dams, Best Management Practices, August 2011.

Norwich Dam
Priority S (safety related, require immediate attention)

- None

Priority 1 (1 to 2 years)

- Remove trees (with stumps) at left upstream embankment and at right downstream wingwall, and replace with appropriate backfill.
- Remove brush vegetation from upstream slope of embankments, and in vicinity of wingwalls.
- Install safety signs in the park area (on both sides) and at locations of vertical fall hazards at the dam's wingwalls.
- Install a missing padlock on grate.

Priority 2 (2 to 5 years)

- Where public has access remove existing railing from wingwalls, and replace with railing consistent with Ontario Building Code.
- Obtain services from a Professional Engineer licensed in Ontario to:
    - Conduct above and below water survey on upstream slope of right embankment at a number of cross sections, to identify zones of possible slope erosion.
    - Conduct a topographic survey (or otherwise) probe the channel downstream of stilling basin for indications of channel bed erosion.
    - Issue drawings and specifications relating to replacement of riprap (as per original drawings) on upstream slope of the left and right embankments and on left upstream bank adjacent to left embankment. The same professional services agreement should include replacing the washed out fill adjacent to the left wingwall.

Priority 3 (5 to 10 years)

- Complete a dam safety review along with comprehensive dam inspections, comparing with 2014 conditions.

Teeterville Dam

Priority S (safety related, require immediate attention)

- Cease using existing steel truss bridge entirely. This means ceasing crossing of grounds equipment (riding lawn mowers, etc), and ceasing stop log operations by LPRCA staff due to unsafe access conditions.
- Hire a Professional Engineer licensed in Ontario to evaluate the capacity of the truss and existing bridge deck, and obtain recommendation for remedial repairs or replacement.
- Lower water level at winter operating level, and cease operation until Priority 1 assessments of the dam are complete (see below).

Priority 1 (1 to 2 years)

- Seek services from a Professional Engineer licensed in Ontario to:
    - Complete detailed inspections of all components of the structure during period free of leaves and vegetation (late winter, early spring).
    - Carry out intrusive investigations (boreholes through the embankment, coreholes through the concrete) required to evaluate existing conditions at Teetervilee Dam.
    - Carry out necessary analyses required to determine most appropriate repairs.
    - Evaluate current stop log operations.
    - Obtain recommendations for repairs to the main structure and its components, along with detailed cost estimates.

- Complete a dam safety review of the Teeterville Dam, specifically focusing on hydraulic capacity, stability, stop log operations, and other related issues.
- Remove trees (with stumps) at left and right upstream embankment, and replace with appropriate backfill. Professional Engineer specializing in geotechnical engineering should be consulted prior to removal of trees takes place, as removal of trees may exacerbate slope erosion in the short term.
- Remove brush vegetation from downstream slopes.
- Install safety signs in the park area (on both sides) and at locations of vertical fall hazards at the dam's wingwalls.

Priority 2 (2 to 5 years)

- Conduct a topographic survey (or otherwise) probe the channel downstream of stilling basin for indications of channel bed erosion. Note that an opinion from a Professional Engineer should be sought related to potential erosion and its remedial actions.

Priority 3 (5 to 10 years)

- none

Comment:
Implementing the above recommendations assumes that continued operation of the Teeterville Dam is required. Should consideration of dam removal be contemplated, a different priority schedule would likely result. If the dam is to be slated for removal, the focus of follow up work would require assessment of upstream and downstream impacts, particularly those related to how the County Road 25 bridge and its embankment might be affected from dam removal, and not so much on assessment of the performance of existing dam structures. Further, existing Ministry of Natural Resources and Forestry regulations related to dam removal require impact assessments be completed related to hydrology, hydraulics, sediment characteristics (volumes, chemistry, and disposal), etc. Necessary investigations would be required to estimate the volume of accumulated sediment in the upstream reservoir, as well as its chemistry.

Lehman Dam
Priority S (safety related, required immediate attention)

- None

Priority 1 (1 to 2 years)

- Remove vegetation growing above the left wingwall. All vegetation (trees, brush, grasses) should be removed within a distance of 5 m of the wingwall.
- Remove vegetation from the spillway.
- Deterioration in the pile bent structure should be repaired.
- Safety signs in the park area (on both sides) and at locations of vertical fall hazards at the dam's wingwalls should be installed.

Priority 2 (2 to 5 years)

- Where public has access, remove existing railing from wingwalls and gangway to intake chamber, and replace with railing consistent with existing MNR regulations and Ontario Building Code.
- Seek services from a Professional Engineer licensed in Ontario to:
    - Carry out topographic survey above and below water on the upstream slope of the right embankment to identify potential zones slope erosion. At

the same time, probing investigations should be carried out to assess the presence and conditions of the riprap below water on the upstream slope.
    - If riprap was washed out or is otherwise missing, it should be replaced as per the original drawings. Riprap downstream of the stilling basin should be restored to the correct elevation, as per original drawings. Services from a Professional Engineer licensed in Ontario will be required for plans and specifications related to riprap replacement.
    - Probe the channel downstream of the fish ladder, and the channel downstream of the outlet structure should be carried out to investigate possible erosion and bed lowering. This is required as channel erosion, if left unchecked, could lead to increased deterioration of the fish ladder structure.
    - Channel banks downstream of the fish ladder outlet should be inspected during leaf off times (later winter, early spring), and stabilized if erosion is identified.
    - Provide drawings for joint sealing repairs.

Priority 3 (5 to 10 years)
- Complete a dam safety review along with comprehensive dam inspections, comparing with 2014 conditions.

Deer Creek Dam

Priority S (safety related, required immediate action)
- None

Priority 1 (1 to 2 years)
- Seek services from a Professional Engineer licensed in Ontario to:
    - Carry out a topographic survey (or slope measurements) above and below water on the upstream slope of the left embankment to identify potential zones of sloughing or slope erosion. This is particularly important for the area where the change in slope was observed, needed to identify the cause of identified sloughing.
    - Prepare drawings and specifications related to re-grading the upstream embankment slopes.
- Remove vegetation from the embankment slopes, and above downstream wingwalls (for a minimum distance of 5 m).
- Install safety signs in the park area (on both sides) and at locations of vertical fall hazards at the dam's wingwalls.

Priority 2 (2 to 5 years)
- Where public has access, remove existing railing from wingwalls, and replace with railing consistent with Ontario Building Code.
- Inspect existing corrugated steel toe drains. If block by debris, clear or replace to ensure its continued long-term performance.
- Repair deteriorated concrete at the lift control chamber.
- Repair spalled concrete in the upstream wingwalls.
- Repair deteriorated concrete at the downstream low flow outlet structure.

Priority 3 (5 to 10 years)
- Complete a dam safety review along with comprehensive dam inspections, comparing with 2014 conditions.

Backus Mill Dam

Priority S (safety related, required immediate attention)

- Retain a Professional Engineer licensed in Ontario to inspect and evaluate capacity of the road and pedestrian crossings at the millrace intake and the main spillway, and seek recommendations for remedial works (if required).

Priority 1 (1 to 2 years)

- Install safety signs in the park area (on both sides) and at locations of main spillway and millrace intake.
- Seek services from a Professional Engineer licensed in Ontario to investigate causes and propose solutions related to downstream embankment slope erosion. The solutions will likely include, but not be limited to the following:
    - Removal of brush vegetation from the downstream slope of the embankment, along with mature trees from slope.
    - Bringing new material and re-grading downstream slope to a 2H:1V inclination
    - Installing French drains at the new toe of slope.
    - Extend downstream wingwalls at the spillway to accommodate re-graded 2H:1V inclination of the slope.
    - Extend the stilling basin to accommodate the re-graded 2H:1V slope.
- The above anticipated remedial repairs will require preparation of drawings and specifications by a Professional Engineer licensed in Ontario, and regulatory approvals from the Ministry of Natural Resources and Forestry.

Priority 2 (2 to 5 years)

- Where public has access, remove existing railing from upstream wingwalls and replace with railing consistent with Ontario Building Code.

Priority 3 (5 to 10 years)

- Complete a dam safety review along with comprehensive dam inspections, comparing with 2014 conditions.

Hay Creek Dam

Priority S (safety related, required immediate repairs)

- Retain a Professional Engineer licensed in Ontario to investigate hydraulic capacity of the dam and associated flooding characteristics with the configuration of shear pins disabled. These analyses are required as the Hay Creek Dam structure currently is operated differently than was originally approved by the Ministry of Natural Resources and Forestry.

Priority 1 (1 to 2 years)

- Seek services from a Professional Engineer licensed in Ontario to
    - Investigate causes and propose solutions related to deterioration in downstream wingwall. The solutions will include a design or designs that best relieves the buildup of water behind the wingwalls. Drawings and specifications will be required, as would approvals from the Ministry of Natural Resources and Forestry.
    - Complete drawings and specifications related to needed joint repairs.
    - Investigate cause and identify solution to the concrete deterioration on the upstream wingwalls.
- Remove brush vegetation from upstream and downstream embankment slopes.

- Remove mature trees (with stumps) from slopes in the downstream embankment.
- Remove and replace existing fence along downstream embankment, on both sides of the control structure.
- Install safety signs at dam site.

Priority 2 (2 to 5 years)

- Since public has no access to site, replacement of existing railings is not required.

Priority 3 (5 to 10 years)

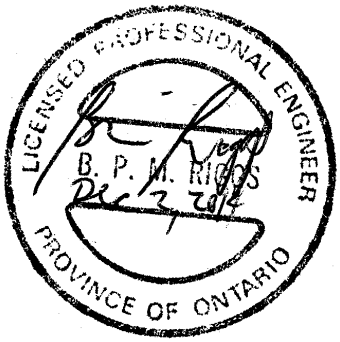
- Complete a dam safety review along with comprehensive dam inspections, comparing with 2014 conditions.

Should you have additional questions, please do not hesitate to call.

Yours truly,

Riggs Engineering Ltd.

Pat Prodanovic, Ph.D., P.Eng.
Water Resources and Marine Engineer



Brian Riggs, P.Eng.
Principal, Riggs Engineering Ltd

Appendix A

Norwich Dam Photographic Log

Photo #1 – Norwich Dam aerial photo 2006, downloaded from MNR Land Information Ontario database.

Photo #2 – Norwich Dam left upstream bank adjacent to left embankment. At location of maximum reservoir fetch, bank is presently grassed; bank used to be covered with riprap.

Photo #3 – Norwich Dam, right upstream bank. Right bank adjacent to the reservoir is a park area.

Photo #4 – Right downstream embankment, standing on right upstream wingwall, looking westward. Embankment appears in good condition.

Photo #5 – Right embankment, looking towards the main structure. No evidence of cracking, seepage or loss of fill on the downstream side.

Photo #6 – Right downstream embankment. LPRCA staff notes that past dredge material was placed on top of embankment and adjacent downstream areas.

Photo #7 – Right upstream embankment, vegetated with tall grasses

Photo #8 – Right upstream embankment, standing near the waterline and looking towards the main structures. Some erosion and steepened slopes noted near the waterline.

Photo #9 – Close up of the right slope on the right upstream embankment near the waterline.

Photo #10 – A general view of the left embankment.

Photo #11 – Left downstream embankment, looking towards the main structure. Slope is grassed and free from evidence of seepage or erosion.

Photo #12 – A close up view of the left upstream embankment, noting the mature trees on the upstream slope.

Photo #13 – Close up view left upstream embankment.

Photo #14 – Norwich Dam main spillway and stilling basin. Note minor damage to some of the baffle blocks.

Photo #15 – Norwich Dam main spillway, looking towards the right wingwall. Note trees in close proximity to the right downstream wingwall.

Photo #16 – Norwich Dam stilling basin. Note the outlet pipe located on the bottom of the right downstream wingwall.

Photo #17 – Norwich Dam wetwell, located adjacent to the right wingwall on upstream face. Padlock on the steel grate noted as missing.

Photo #18 –Wetwell at right wingwall. Gate not tested during inspections. LPRCA staff notes gate is functional.

Photo #19 – Handrail and at right upstream wingwall. Top of embankment adjacent to right wingwall is surfaced with asphalt.

Photo #20 – Handrail at right downstream wingwall. Top surface of embankment downstream of wetwell is surfaced with asphalt.

Photo #21 – Sheet pile embedded into concrete on the right wingwall.

Photo #22 – Right downstream wingwall. Concrete appears in generally good condition. Some cracking noted at the wetwell-wingwall interface, on the downstream face.

Photo #23 – Top view of the crack at the wetwell-wingwall interface, on the downstream face.

Photo #24 – Same crack on the wetwell-wingwall interface, isometric view.

	
Photo #25 – Right downstream slope adjacent to right wingwall is vegitated with tall grasses. Note the handrail on top of wingwall.	Photo #26 – Right upstream slope adjacent to right wingwall. Portion of the slope is surfaced with asphalt.
	
Photo #27 – Right upstream wingwall. Concrete appears in generally good condition.	Photo #28 – Right downstream wingwall. Note signs of concrete deterioration.
	
Photo #29 – Right downstream wingwall. Note the trees growing adjacent to stilling basin.	Photo #30 –General view of the right wingwall. Note the handrail and tall grass vegetation growing on the downstream site of stilling basin and wingwall.

Photo #31 –Right upstream wingwall is in generally good condition.

Photo #32 – Right downstream wingwall, in good condition.

Photo #33 – Close up view of the right downstream wingwall.

Photo #34 – Close up of right downstream wingwall, the downstream face.

Photo #35 – Left upstream wingwall, looking towards the headpond.

Photo #36 – Left upstream wingwall. Note localized fill erosion adjacent to wingwall.

Photo #37 – Left downstream wingwall note localized fill erosion.

Photo #38 – Downstream slope of the left embankment, at the left downstream wingwall. Slope is vegetated with grass.

Photo #39 – Downstream channel, standing on left wingwall and looking downstream.

Photo #40 – Downstream channel, standing on right downstream bank and looking downstream

Appendix B

Teeterville Dam Photographic Log

Photo #1 – Teeterville Dam aerial photo 2006, downloaded from MNR Land Information Ontario database.

Photo #2 – Remnant of right upstream embankment (county roadway constructed after the dam is located immediately upstream).

Photo #3 – Right embankment, looking towards the main structure. Surface of an abandoned road is visible on top of the existing embankment.

Photo #4 – Slope of the right downstream embankment appears in generally good condition, free of seepage.

Photo #5 – Close up of the slope of the right downstream embankment.

Photo #6 – Left upstream embankment. The dam's left embankment is located downstream of the county road embankment.

Photo #7 – Left embankment, standing at the dam looking eastward.

Photo #8 – Left downstream embankment, as seen from top of road, standing adjacent to the left wingwall.

Photo #9 – Lower portions of the left downstream embankment. Parts of the embankment are covered with dense brush vegetation.

Photo #10 – Upper portions of the left downstream embankment. Seepage, cracks or loss fill through left embankment were not observed.

Photo #11 – Right downstream wingwall. Note the seepage at the interface between the wingwall and right most downstream pier.

Photo #12 – Close up of the seepage through concrete at the interface between the wingwall and right most downstream pier. Note concrete deterioration in wingwalls and pier.

Photo #13 – Gabion mattress located on top of the right embankment at the right downstream wingwall. Downstream slope appears grouted; holes in the grout are observed.

Photo #14 – Close up of the grouted portion of the right downstream slope, adjacent to the right wingwall.

Photo #15 – Right upstream wingwall. Note tree growing adjacent to the wingwall.

Photo #16 – Close up view of the right upstream wingwall. Concrete spalling observed at the waterline, and extends along length of wingwall.

Photo #17 – General overview of the left downstream wingwall, seen from the right bank. Seepage through the wingwall at the left bank was observed.

Photo #18 –Left downstream wingwall. The seepage noted was between the left most pier and the wingwall concrete.

Photo #19 – Lower portion of the left downstream wingwall.

Photo #20 – Lower portion of the left downstream wingwall, at the interface at the bank.

Photo #21 – Wetness was noted adjacent to the bank-wingwall interface, at the left downstream wingwall.

Photo #22 – Left downstream wingwall. Upper portions consist of stacked blocks, grouted together.

Photo #23 – Upper portions of the left downstream wingwall. Note the stacked blocks on top of the concrete wingwall.

Photo #24 – Close up view of the upper portions of the left downstream wingwall, at the interface with the bridge deck.

Photo #25 – Left upstream wingwall consists of stacked blocks, likely on top of poured concrete wingwall underneath.

Photo #26 – A mature tree is growing at the left upstream wingwall, adjacent to the old steel truss.

Photo #27 – A crack at the left upstream wingwall, below the old roadway surface.

Photo #28 – Close up of the crack at the left upstream wingwall. Width of the crack is in excess of 10 mm.

Photo #29 – Teeterville Dam as seen from the left downstream bank. The old roadway bridge is located on top of the dam, and carries maintenance traffic.

Photo #30 – Teeterville Dam as seen from the right downstream bank.

Photo #31 – Deck of the existing steel truss bridge. Decking is fairly new, and is supported by original steel stringers, girders, and trusses.

Photo #32 – Railing at the bridge is loose, and consists partially of fence wire.

Photo #33 – Majority of the stringers spanning the girders are out of alignment.

Photo #34 – Some of the stringers that support the existing bridge deck are heavily deteriorated, and do not carry load.

Photo #35 – Close up view of the stringers below the bridge deck. Web of the beam is entirely corroded.

Photo #36 – General view of the stringers adjacent to the deck.

Photo #37 – Stop log lifting gantry cranes on the right most bay. Gantry cranes are anchored to the existing piers at each bay.

Photo #38 –Gantry crane as seen from the top of deck. Access to the gantry cranes is via ladder connected to the existing steel truss deck.

Photo #39 –Gantry crane as seen from the left bank. Note that stop logs are resting on the hand rail of the gantry crane.

Photo #40 – Teeterville Dam piers. Note the heavy concrete deterioration at the base of the piers.

Photo #41 – Right most bay; concrete at the piers heavily deteriorated.

Photo #42 – Concrete is also heavily deteriorated at the inner bays of the dam. Note the elevation difference between the sill of the dam and the bottom of channel.

	
Photo #43 – Downstream channel, as seen from the right bank.	Photo #44 – Downstream channel, as seen from the left bank.

Appendix C

Lehman Dam Photographic Log

Photo #1 – Lehman Dam aerial photo 2006, downloaded from MNR Land Information Ontario database.

Photo #2 – Right downstream embankment, looking towards the right bank of the headpond.

Photo #3 – Middle portion of the right downstream embankment.

Photo #4 – Right downstream embankment, looking towards the spillway.

Photo #5 – Lehman Dam outlet structure, looking towards the spillway.

Photo #6 – Lehman Dam outlet structure, standing at toe of slope and looking downstream.

Photo #7 – Lehman Dam toe drain (inside the outlet structure) was observed to be functioning, draining left portion of the embankment.

Photo #8 – Lehman Dam toe drain (inside the outlet structure) was observed to be functioning, draining right portion of the embankment.

Photo #9 – Downstream outlet channel and fish ladder outlet. A perforated pipe observed for collecting upland storm water.

Photo #10 – Right wingwall of the outlet structure. Minor spalling of concrete on the downstream side. Concrete in generally good condition.

Photo #11 – Left wingwall of the outlet structure, (at the interface with the fish ladder outlet). Concrete observed to be in good condition.

Photo #12 – Outlet of the fish ladder channel, Concrete blocks and sheet pile wall in good condition.

	
Photo #13 – Lehman Dam downstream channel. Banks heavily vegetated.	Photo #14 – Upper portion of the Lehman Dam fish ladder.
	
Photo #15 – Middle portions of the Lehman Dam fish ladder, as seen from the toe of slope.	Photo #16 – Lower portion of the Lehman Dam fish ladder. The adjacent right downstream wingwall concrete is in good condition.
	
Photo #17 – Outlet of the fish ladder. Right bank is grouted with concrete. Opening in grate required for upstream fish migration. Opening poses safety hazard for staff.	Photo #18 – Outlet of fish ladder, looking downstream. The channel immediately downstream of the outlet appears lower than bottom of outlet.

Photo #19 – Fish ladder outlet channel, looking downstream.

Photo #20 – Right bank of the fish ladder outlet channel is heavily vegetated and steep.

Photo #21 – Top of the embankment, standing near spillway and looking towards the right bank.

Photo #22 – Right upstream embankment. Some brush vegetation on upstream slope, which is lined with recently placed riprap above the waterline.

Photo #23 – Right upstream embankment, looking towards the right bank.

Photo #24 – Right upstream embankment, standing on intake structure and looking towards the left bank.

Photo #25 – Right upstream embankment, standing on intake structure and looking towards the right bank.

Photo #26 – Intake tower and access walkway, as seen from toe of embankment slope.

Photo #27 – Lehman Dam intake tower. Concrete is in generally good condition. Overflow gates are located on three sides of the structure.

Photo #28 – Typical view at the intake grate. Small amount of trash observed adjacent to grate.

Photo #29 – Pile bent supporting the access walkway to the intake structure. Steel appears in good condition.

Photo #30 – Bottom of the pile bent, at the waterline.

Photo #31 – Right bent. Corrosion through the web observed at waterline.

Photo #32 – Left bent. Corrosion through the web observed at waterline.

Photo #33 – Lehman Dam main spillway, standing on top of wingwall and looking downstream.

Photo #34 – Main spillway, standing in stilling basin and looking upstream. Minor vegetation growing through the concrete spillway observed.

Photo #35 – Fish ladder intake gate in the right upstream wingwall. LPRCA staff informs gate is functional.

Photo #36 – Trash accumulation adjacent to the fish ladder intake gate.

Photo #37 – Stilling basin and downstream channel. Note the missing riprap stone downstream.

Photo #38 – Channel downstream of the spillway is heavily vegetated with brush. Loose riprap evident.

Photo #39 – Right downstream wingwall, at the stilling basin. Concrete appears in good condition.

Photo #40 – Right downstream wingwall, as seen from the stilling basin. The wingwall also functions as the fish ladder channel.

Photo #41 – Right downstream wingwall, at the connection to the fish ladder channel.

Photo #42 – Crack and joint movement at the right downstream wingwall and fish ladder channel structure.

Photo #43 – Top view of the joint movement at the right downstream wingwall and fish ladder.

Photo #44 – Left upstream wingwall. Bank above wingwall covered with heavy brush vegetation.

Photo #45 – Middle portion of the left downstream wingwall. Note vegetation above.

Photo #46 – Lower portions of the left downstream wingwall.

Photo #47 – Drain holes at the left downstream wingwall observed as functioning.

Appendix D

Deer Creek Dam Photographic Log

Photo #1 – Deer Creek Dam aerial photo 2006, downloaded from MNR Land Information Ontario database.

Photo #2 – Deer Creek headpond, standing on the left downstream embankment, looking towards the main structure.

Photo #3 – Deer Creek headpond, standing on the left downstream embankment, looking towards the park area on the left bank.

Photo #4 – Top of the embankment is the County Road 45.

Photo #5 – Left upstream embankment, looking towards the main structure. Slope is covered with riprap; brush vegetation present along slope.

Photo #6 – Close up view of the deterioration of the riprap along the slope of right upstream embankment. Riprap varies from 10 to 1000 mm.

Photo #7 – Left upstream embankment, looking towards the left bank. Slope below waterline appears mild.

Photo #8 – Change in slope observed above the waterline approximately half way between the lift control chamber and the bridge.

Photo #9 – Lift control chamber, located on top of left upstream embankment.

Photo #10 – Lift mechanism inside lift chamber used to open and close the low flow gate located. LPRCA staff reports lift mechanism is functioning properly.

Photo #11 – Access to the lift chamber from above. Minor concrete deterioration at the top.

Photo #12 – Concrete spalling on the outside of the lift chamber. Damage likely exacerbated from application of salt during winter on adjacent road.

Photo #13 – Close up view of the concrete spalling outside of the lift chamber.

Photo #14 – Lift chamber, as seen from the left downstream slope.

Photo #15 – Left upstream wingwall. Note missing concrete and exposed reinforcing bars.

Photo #16 – Left upstream wingwall, along the upstream slope. Concrete is in generally good condition.

Photo #17 – Left upstream wingwall, at top of slope.

Photo #18 – Some amount of alkali-silicate reaction on top of the left upstream wingwall.

Photo #19 – Upper portions of the left upstream wingwall, just downstream of the Road 45 bridge.

Photo #20 – Left upstream wingwall, as seen from the right upstream bank. Note concrete spalling at the waterline.

Photo #21 – Close up of the concrete spalling at the waterline.

Photo #22 – Left upstream wingwall adjacent to the spillway.

Photo #23 – Left upstream wingwall, closer to the roadway bridge.

Photo #24 – Left upstream wingwall, at and underneath the roadway bridge. Concrete appears in good condition.

	
Photo #25 – Right upstream wingwall. Concrete is in generally good condition, although spalling is visible at waterline where wall changes alignment.	Photo #26 – Right upstream wingwall, upper portions. Top of spillway is at the old water level gauge.
	
Photo #27 – Right upstream wingwall. Note the drain pipe that is the outlet of the ditch running parallel to the road.	Photo #28 – Right upstream wingwall, underneath the existing bridge.
	
Photo #29 – Left downstream wingwall, panel 1 Panels are numbered from 1 (at bridge) to 8 (at stilling basin). No joint filler material between panels.	Photo #30 – Left downstream wingwall, pannels 2 and 3.

Photo #31 – Spillway and remaining left downstream wingwall panels.

Photo #32 – Left downstream wingwall, panel 7.

Photo #33 – Left downstream wingwall, panel 8. Corrugated steel toe drain noted as functional.

Photo #34 – Right downstream wingwall, panel 1 Panels are numbered from 1 (at bridge) to 8 (at spillway). No joint filler material between panels.

Photo #35 – Right downstream wingwall, middle portions. Note railing and brush vegetation at top of wingwall.

Photo #36 – Right downstream wingwall, panel 8. Corrugated steel toe drain is partially clogged, but still functional.

Photo #37 – Deer Creek Dam main spillway, standing on top of bridge and looking upstream.

Photo #38 – Close up view of right stop logs.

Photo #39 – Close up view of left stop logs.

Photo #40 – Main spillway, as seen from the right bank. Top right stop log has shifted and is allowing more water to spill.

Photo #41 – Main spillway, underneath the road bridge. Note debris on the spillway.

Photo #42 – Main spillway below the bridge.

Photo #43 – Main spillway, looking downstream.

Photo #44 – Downstream most portion of the spillway. Note cattails growing through the stilling basin. Baffle blocks almost completely silted.

Photo #45 – Downstream low flow outlet structure. Area is generally vegetated with heavy brush.

Photo #46 – Low flow outlet structure, looking downstream. Water depth measured as 1.5 m.

Photo #47 – Low flow outlet structure, left downstream wingwall. Note concrete deterioration.

Photo #48 – Low flow outlet structure, left downstream wingwall. Note alkali-silica reaction.

Appendix E

Backus Mill Dam Photographic Log

Photo #1 – Backus Mill Dam aerial photo 2006, downloaded from MNR Land Information Ontario database.

Photo #2 – Backus Mill headpond, standing at the road and looking towards the berm that divides the reservoir into two.

Photo #3 – Backus Mill headpond, looking at the main spillway structure and left upstream bank. Note pedestrian access at spillway.

Photo #4 – Roadway crossing the dam, looking towards left bank. Existing roadway is surfaced with asphalt.

Photo #5 – Left and right upstream wingwalls at the main spillway structure.

Photo #6 – Close up of the left upstream wingwall that consists of sheet piling. Piling is in good condition.

Photo #7 – Upstream embankment and millrace intake. Slopes of upstream embankment are fairly mild. Note pedestrian access over millrace intake.

Photo #8 – Gate at the millrace intake structure. Opening consists of a corrugated steel pipe, with a wooden plank that acts as a lift gate.

Photo #9 – Backus millrace is an elevated channel, supported by a timber pile bent structure.

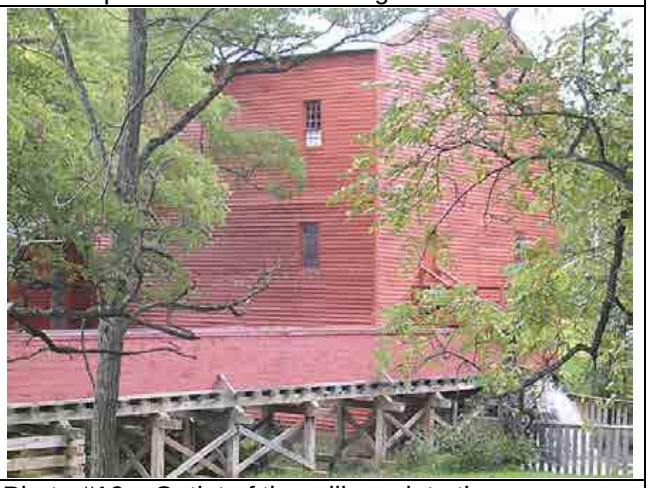


Photo #10 – Outlet of the millrace into the downstream channel.

Photo #11 – Backus Mill Dam, right downstream embankment. Slope is approximately 1.5H:1V and is covered with heavy brush and mature trees. Seepage at toe of slope was not observed.

Photo #12 – Channel and right downstream bank.

Photo #13 – Left downstream embankment, standing at spillway structure and looking towards the millrace. Slope is steep and covered with brush and mature trees.

Photo #14 – Close up view of the left downstream embankment, showing riprap at toe of slope and brush vegetation.

Photo #15 – Left downstream slope, looking towards the millrace. Localized loss of fill evident in some section, with over steepened slope.

Photo #16 – Left downstream embankment, looking towards the main spillway. Note tree and brush vegetation on and adjacent to the slope.

Photo #17 – Backus Mill Dam spillway, looking upstream.

Photo #18 – Left downstream wingwall. Cold joint in concrete evident.

	
Photo #19 – Toe of the right downstream wingwall consists of sheet piling. Upper portions of the slope above wingwall consist of grouted concrete blocks.	Photo #20 – Close up view of the slope above right downstream wingwall. Vegetation is growing through the grouted concrete blocks.
	
Photo #21 – Left downstream wingwall, underneath the bridge. Evidence of past concrete repairs is evident.	Photo #22 – Left downstream wingwall. Slope above consists of grouted concrete blocks, with brush vegetation growing between the blocks.
	
Photo #23 – Toe of left downstream wingwall consists of sheet piling, driven into creek bed. Downstream channel is covered with 100 mm riprap	Photo #24 – Left downstream embankment left of the access stairs consists of slope that is over steepened. Localised loss of embankment fill was observed.

	
Photo #25 – Void in the left downstream embankment noted, adjacent to the left downstream wingwall.	Photo #26 – Channel downstream of main spillway, some bank protection present.
	
Photo #27 – Close up view of the bank protection downstream of main spillway.	

Appendix F

Hay Creek Dam Photographic Log

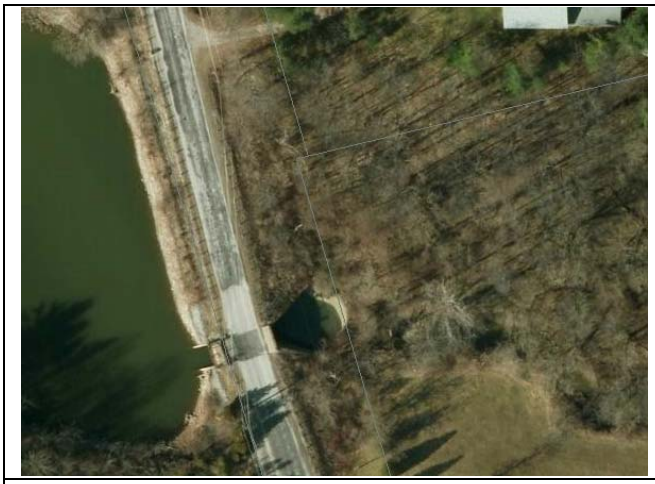


Photo #1 – Hay Creek Dam aerial photo 2006, downloaded from MNR Land Information Ontario database.

Photo #2 – Port Ryerse Road, looking from Woolley Road towards the Hay Creek Dam. Top of embankment is the asphalt road surface.

Photo #3 – Hay Creek Dam control structure, with stop log lifting frame.

Photo #4 – Left upstream embankment. Upstream face lined with riprap, and overgrown with brush vegetation.

Photo #5 – Close up of the riprap at the left upstream embankment.

Photo #6 – Left upstream embankment, standing at left wingwall looking towards left. Gabion mattress adjacent to left upstream wingwall. Damaged fence.

Photo #7 – Right upstream embankment, standing on right wingwall looking right. Note gabion mattress.

Photo #8 – Right upstream embankment past the gabion mattress. Heavy brush vegetation present.

Photo #9 – Left downstream embankment. Brush and trees growing along lower slopes. Seepage through embankment not observed.

Photo #10 – Right downstream embankment, looking towards road. Portion of the embankment adjacent to right downstream wingwall is surfaced with asphalt.

Photo #11 – Left downstream embankment, looking towards toe of slope. Portion of the embankment adjacent to left downstream wingwall is surfaced with asphalt.

Photo #12 – Concrete deterioration at the left upstream wingwall.

Photo #13 – Close up of the deterioration at the left upstream wingwall.

Photo #14 – Shear pin mechanism (disabled) at the left gain, looking from right wingwall.

Photo #15 – Right gain, standing at top of control structure, looking down from the deck.

Photo #16 – Left gain, standing at top of control structure, looking down from the deck.

Photo #17 – Exposed reinforcing bar above left gain, looking down from deck.

Photo #18 – Right upstream wingwall. Note the low flow gate opening mechanism. LPRCA staff confirms mechanism is operational.

Photo #19 – Movement evident in the right upstream wingwall.

Photo #20 – Right upstream wingwall, looking downstream. Wingwall movement responsible for deterioration of right abutment concrete.

Photo #21 – Alkali silicate reaction above the right upstream wingwall. Sheet pile evident, in line with stop logs. Opening in fence. Alkali silicate reaction.

Photo #22 – Minor deterioration (spalling) of concrete adjacent to the railing on the upstream side of the bridge.

Photo #23 – Railing at the downstream side of the bridge.

Photo #24 – Close up view of minor concrete spalling on the downstream pad.

Photo #25 – Right upstream wingwall at Hay Creek Dam.

Photo #26 – Right downstream wingwall. Note the steel brace installed to limit lateral movement between downstream wingwalls.

Photo #27 – Joint at right downstream wingwall. Wetness and moisture at the joint indicates backfill material is no longer free draining and water is building up behind the wall.

Photo #28 – Top view of the joint at the interface of the bridge abutment and right downstream wingwall. Most of the lateral movement is at the top.

Photo #29 – Close up of the top view of the right downstream wingwall and bridge abutment.

Photo #30 – Joint movement at right downstream wingwall.

Photo #31 – Left downstream wingwall. Note horizontal brace and seepage through joint between wingwall and bridge abutment.

Photo #32 – Left downstream wingwall, downstream most section. Note seepage through joint.

Photo #33 – Upper portions of the joint between bridge abutment and left downstream wingwall. Note exposed joint filler material and seepage below.

Photo #34 – Close up of the concrete spalling through joint in the left downstream wingwall. Moisture indicates water build up behind wall.

Photo #35 – Close up of the joint between bridge abutment and left downstream wingwall. Moisture along wall indicates water build up behind wingwall.

Photo #36 – Top view of the joint between bridge abutment and left downstream wingwall. Note joint movement.