GEORGINA

Final Report

Pefferlaw Dam
Public Safety Risk Assessment

Town of Georgina, Pefferlaw, Ontario

D.M. Wills Project Number 19-5381

D.M. Wills Associates Limited
Partners in Engineering, Planning and
Environmental Services
Peterborough

September 2022

Prepared for:
Town of Georgina

WILLS

Executive Summary

D.M. Wills Associates Limited (Wills) was retained by the Town of Georgina (Town) to complete a Public Safety Risk Assessment (PSRA) for the Pefferlaw Dam in the Town of Georgina, Pefferlaw, Ontario. The PSRA was carried out in accordance with the Best Management Practices for Public Safety Around Dams (MNR, 2011) and the Canadian Dam Association (CDA) Guidelines for Public Safety Around Dams (CDA, 2011). Wills' staff attended the site on April 4, 2022.

The objective of the PSRA is to identify the potential hazards associated with the dam and its operation, assess the level of risk associated with the potential hazards and recommend risk reduction measures to mitigate the potential hazards.

Based on the Risk Assessment Worksheet and the recommended risk tolerance, 1 High risk, 6 Medium risks and 24 Low risks exist at the Pefferlaw Dam. There are a number of existing public safety measures in place including signage, railings, fencing and operational controls.

Wills has identified a number of opportunities where the modification/replacement of existing public safety measures or the addition of new public safety measures has the potential to reduce the Risk Level (RL) for some activities and component areas. There are also some recommendations that will not reduce the RL; however, they are still expected to provide an overall improvement to public safety. If the recommended risk reduction measures are implemented, there would be 0 High risks, 4 Medium risks and 27 Low risks. We recommend that the risk reduction measures be implemented following a staged approach. The staged approach has a focus on keeping the public safe while improving the Town's public safety due diligence. Future reviews and monitoring by Town staff will determine whether additional control measures such as additional barriers/fencing, signs, booms, patrols, etc. are required.

Given that there are potential public safety hazards at the site, the preparation of a Public Safety Plan would be prudent. The Town could consider completing this plan once the planned dam rehabilitation works are completed and the recommended additional public safety measures are implemented.

Summary of Revisions

Rev. No.	Revision Title	Date	Summary of Revisions
1	Draft Report	June 3, 2022	Issued for Client Review
2	Final Report	September 7, 2022	Issued as Final

This report/proposal has been formatted considering the requirements of the Accessibility for Ontarians with Disabilities Act.

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1.0 Introduction

D.M. Wills Associates Limited (Wills) was retained by the Town of Georgina (Town) to complete a Public Safety Risk Assessment (PSRA) for the Pefferlaw Dam. The PSRA was carried out in accordance with the Best Management Practices for Public Safety Around Dams (MNR, 2011) and the Canadian Dam Association (CDA) Guidelines for Public Safety Around Dams (CDA, 2011). Wills' staff attended the site on April 4, 2022.

The objective of the PSRA is to identify the potential hazards associated with the dam, assess the level of risk associated with the potential hazards and recommend risk reduction measures to mitigate the potential hazards. In order to achieve the noted objective, this PSRA Report will:

- Present the Managed System Approach to Public Safety Around Dams.
- Provide a general description of the site and identify the nature of the public uses at the Pefferlaw Dam.
- Discuss the operations activities and procedures carried out at the site.
- Present the Risk Assessment based on the findings of the site visit.
- Recommend risk reduction measures for consideration by the Town.

The 2011 CDA Risk Assessment Spreadsheet Tools were used to perform the risk analysis and for the risk treatment evaluation process. The completed Risk Assessment spreadsheets are provided in **Appendix B**.

Of primary concern to the Town at this time is gaining a general understanding of the public safety risks at the dam so they can be considered as part of the ownership transfer from the Lake Simcoe Region Conservation Authority (LSRCA) to the Town. It is noted that public access to the truss bridge was restricted at the time of our site visit; however, this PSRA assumes that public access will be reopened if the dam rehabilitation works (truss bridge replacement and concrete repairs) are completed. Recommendations that should be considered prior to allowing public access to the truss bridge are provided herein.

Within this report, left and right are referenced looking in the downstream direction.

2.0 Public Safety Management System

2.1 Background

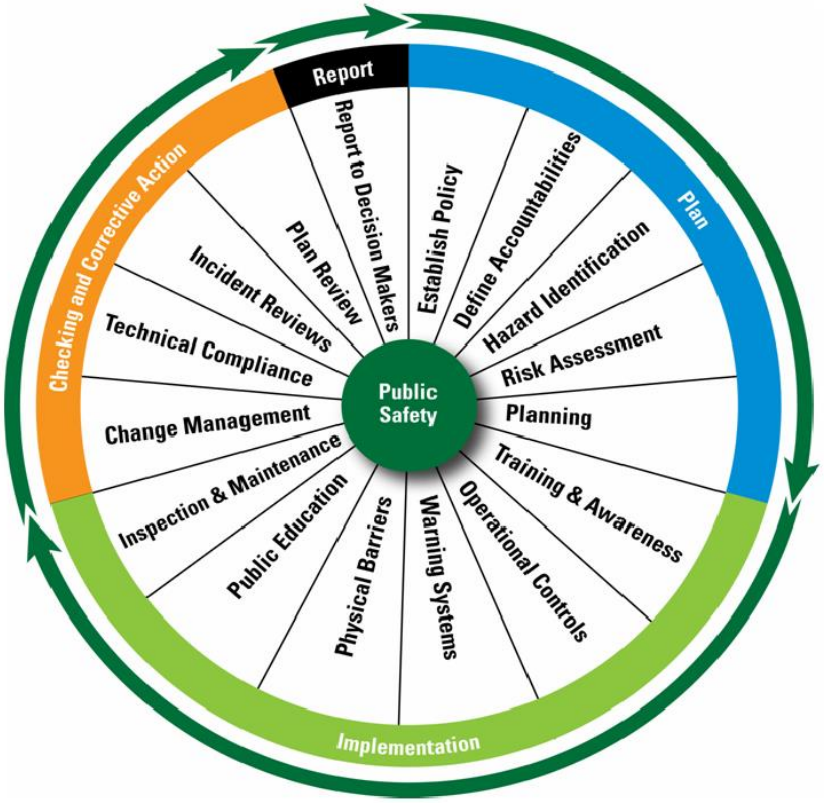
Dams, and their associated structures and operational practices, present a number of potential hazards to the public. Protecting the public from these potential hazards is an important element of a dam owner's due diligence. Public safety should be considered throughout all stages of a dam's life cycle, from design to decommissioning; however, this is most important during the operational phase of the project.

Potential hazards may arise in areas where the dangers posed by structures on the waterway are not well known to the public. This is especially true in the immediate upstream and downstream vicinity of hydroelectric dams and water control structures. The risk to the public may increase when rapidly changing flow conditions around dams and hydraulic structures are combined with a general lack of public knowledge about the dangers posed. Even relatively low head structures could possibly create submerged hydraulic eddies where overflow water continuously re-circulates, trapping individuals in what are referred to as "drowning machines". It is possible that some of the drowning fatalities that have occurred in Canada around dams could have been prevented through rigorous public safety measures, public education and physical warnings directed toward the structures and areas of specific hazards.

The Best Management Practices for Public Safety Around Dams (MNR, 2011) were prepared to provide dam owners with guidance on the identification of public safety hazards associated with a dam and the measures that can be taken to either eliminate or mitigate these hazards. They recommend that a Managed System Approach be applied to public safety. The Best Management Practices describe the Managed System Approach as a "Public Safety Wheel" that puts equal emphasis on the importance of planning, implementation, checking, revising and reporting to ensure public safety around dams. The "Public Safety Wheel" is shown in **Figure 1**.

The Managed System Approach is meant to be implemented as a cyclical process to ensure continual improvements to public safety. As described above, this report will focus on the PSRA to identify the potential hazards associated with the dam; assess the level of risk associated with the potential hazards and recommend risk reduction measures to mitigate the potential hazards.

Figure 1 – Public Safety Wheel (MNR, 2011)



2.2 Hazard Identification and Risk Assessment Process

A PSRA is an important part of the Managed System Approach to Public Safety Around Dams and is a necessary component of a Public Safety Plan. In general, a PSRA involves the determination of:

- The seasonal nature and extent of the public activities occurring at the site.
- Exposure to hazards (number of people exposed to hazardous events).
- Likelihood of adverse consequences if a person is exposed to the hazards.
- Consequences (outcome of the adverse event).

The Best Management Practices for Public Safety Around Dams (MNR, 2011) provides some information on Public Safety Risk Assessments; however, they lack a detailed methodology. The Guidelines for Public Safety Around Dams (CDA, 2011) provides the detailed methodology required to complete the Risk Assessment. The CDA methodology provides a traceable framework for qualitative but explicit consideration of incident likelihoods and their consequences. The CDA Public Safety Risk Assessment process includes 11 steps:

Step 1: Gather Information

Step 2: Establish Boundaries of Site Components

Step 3: Identify Public Activities within Each Component

Step 4: Identify the Hazards within Each Component

Step 5: Identify Existing Risk Treatments and their Effectiveness

Step 6: Assign Incident Likelihood Rating

Step 7: Assign Incident Consequence Rating

Step 8: Determine Risk Rating

Step 9: Evaluate Risk and Assign Risk Level

Step 10: Repeat Steps 5 to 9 for all Activities for the Component

Step 11: Repeat Steps 3 to 10 for all Components of the Site

Each step of the process is documented within the Risk Assessment Worksheet (Microsoft Excel spreadsheet) that was developed by CDA, specifically for dams and hydropower facilities.

This PSRA for the Pefferlaw Dam site took into account the identified potential hazards, the degree to which the public is exposed to them and the consequences if the potential hazard is realized. The potential hazards and the degree of public exposure were assessed through the site inspection, review of operating procedures and information provided by the Town and LSRCA staff. The PSRA process involves a systematic review of each potential hazard, its potential impact on the public and the assignment of a Risk Rating (RR) to the potential hazard. The RR is a measure that depends on the assessed probability of a hazard occurring and the consequences if it were to occur.

2.3 Criteria for Risk Evaluation

For the purposes of the PSRA, the following definitions apply:

- A **Hazard** exists if there is reasonable potential for anyone to suffer serious injury or death because of the site features and/or conditions.
- An **Incident** is the potential or actual interaction between a member of the public and a hazard associated with a dam or its operations.
- **Consequence** is the most likely outcome when people are exposed to the hazard.
- An **Occurrence** is defined as the presence of members of the public in the hazardous area of the component under consideration, regardless of whether an incident occurs. Occurrences are estimated from known incidents, anecdotal evidence and additional knowledge about public presence in the area.

To carry out the PSRA, the following Risk Evaluation Criteria have been established:

- Incident Likelihood Rating (ILR): **Table 1** identifies the criteria for this rating. The criteria are based on the Guidelines for Public Safety Around Dams (CDA, 2011).

- Incident Consequence Rating (ICR): **Table 2** identifies the criteria for this rating. The description of the consequences and anticipated incident consequence identifications are based on the Guidelines for Public Safety Around Dams (CDA, 2011).
- RR and Risk Level (RL): **Table 3** identifies the RL as Low, Medium and High based on the RR. The RR is based on the likelihood (occurrence of people in the hazard area) multiplied by the consequence (most likely outcome when people are exposed to the hazard).

Table 1 – Incident Likelihood Rating Table (CDA, 2011)

Descriptor	Definition of Likelihood	Incident Likelihood Rating (ILR)
Very Frequent	More than 10 occurrences in any one of the last 3 years or 25 or more occurrences in total in the last 3 years	5
Frequent	More than 2 occurrences in any one of the last 3 years	4
Occasional	An occurrence in the last 6 years	3
Possible	An occurrence in the last 10 years	2
Remote	No known occurrences in the last 10 years	1

Table 2 – Incident Consequence Rating Table (CDA, 2011)

Anticipated Incident Consequences	Definition of Consequences	Incident Consequence Rating (ICR)
Fatality	Fatality	5
Critical	Permanent Partial or Total Disability	4
Major	Medical Treatment or Stranding	3
Minor	First Aid	2
Insignificant	No Attention Required	1

Information regarding public visitation to the site, including the types of activities and frequency, was provided by the Town and LSRCA staff through email correspondence.

The CDA method of risk assessment produces results that can vary between 1 and 25. These values are referred to as the RR. Risk Levels are assigned to the RR based on an organizations risk tolerance. **Table 3** outlines the RL for each RR. This is an example of a moderate risk tolerance with "High" RL in the 10 – 25 range; "Medium" in the 5 – 9 range; and "Low" in the 1 – 4 range. This risk tolerance is the same as the risk tolerance used by conservation authorities and is similar to the risk tolerance used by the Ministry of Northern Development, Mines, Natural Resources and Forestry. This risk tolerance will be carried forward within this report.

Table 3 – Risk Rating and Risk Level

Risk Rating and Risk Level			Incident Consequences				
			Insignificant 1	Minor 2	Major 3	Critical 4	Fatality 5
Incident Likelihood	Very Frequent	5	Medium(5)	High(10)	High(15)	High(20)	High(25)
	Frequent	4	Low(4)	Medium(8)	High(12)	High(16)	High(20)
	Occasional	3	Low(3)	Medium(6)	Medium(9)	High(12)	High(15)
	Possible	2	Low(2)	Low(4)	Medium(6)	Medium(8)	High(10)
	Remote	1	Low(1)	Low(2)	Low(3)	Low(4)	Medium(5)

Risk Level	
High	10 to 25
Medium	5 to 9
Low	1 to 4

2.4 Key Assumptions of the Risk Assessment Process

The CDA Public Safety Risk Assessment process is inherently conservative in that it makes a number of conservative assumptions in the development of the Incident Likelihood and Consequence Ratings. The key assumptions used in the risk assessment process include:

- Members of the public that enter a hazardous area are assumed to come into contact with the identified hazard(s). For example, if a member of the public is climbing a ladder that is not meant for public access then it is assumed that they would fall from the maximum height and the ICR would be based on the most likely outcome of that incident (i.e. medical treatment).
- Physical barriers are intended to act as deterrents and are not designed to prevent access from those seeking to unlawfully gain access to an owner's property or controlled areas.
- Installation of signs or physical barriers is not intended to address naturally occurring hazards; both water based (e.g. rapids, submerged boulders, etc.) and landforms (e.g. cliffs) that occur on lakes and rivers and at dam sites.
- Recreational use of waterways (e.g. boating, swimming, etc.) is assumed to occur during periods of the year when the reservoir is ice-free (i.e. does not occur when there is floating ice in the waterway) or has been otherwise designated for use by the authorities. Winter recreational activities such as ice fishing, snowmobiling and skiing can also occur upstream of dams.
- The public's safe exit from an area will be based on normal healthy individuals.

3.0 Site Description and Public Use

3.1 Site Location

The Pefferlaw Dam is located approximately 200 m south (upstream) of Pefferlaw Road in the Village of Pefferlaw, Regional Municipality of York, Town of Georgina, Ontario. The location of the dam is shown in **Figure 2**. The Pefferlaw Dam outlets to the Main Branch of the Pefferlaw River which discharges into Lake Simcoe approximately 5.2 km downstream of the dam.

3.2 General Site Description

The Pefferlaw Dam was originally constructed in the early 1880's in conjunction with another dam on the Wilfrid Branch of the Pefferlaw River. The original purpose of the dam was to provide water storage to power three mills located on the watercourse. Mill races were constructed on both the east and west sides of the Main Branch of the Pefferlaw River to channel water to the mills. The mills ceased operations some time ago, and the remaining headpond now provides recreational uses and contributes to the general aesthetic of the area, as the former mill sites downstream of the dam have been redeveloped as a municipal park and a number of residences have been constructed adjacent to the headpond. Several residences have docks constructed on the headpond. The general site plan for the dam site is provided in **Figure 3**.

The Pefferlaw Dam site is comprised of the following key elements:

- An access driveway and gate (**Photo 1** and **Photo 2**) on the west side of the river and an access gate (**Photo 3**) on the east side of the river. The access gates are locked, blocking public vehicular access to dam site and parking area (**Photo 4**).
- A 31 m long concrete gravity structure (**Photo 5** and **Photo 6**) with a 20 m long earth embankment on the west side (**Photo 7**) and a 30 m long earth embankment on the east side (**Photo 8**).

  The concrete gravity structure includes a 13 m long concrete weir (**Photo 9**) topped with timber flash boards on the left (west) side of the structure, a 4.8 m wide sluiceway (**Photo 10**) with timber stoplogs in the middle of the structure and a 7.2 m long overflow weir (**Photo 11**) on the right (east) side of the structure. There are concrete aprons below the weirs and the centre sluiceway.
- A steel truss bridge with a pedestrian crossing (**Photo 12**) and an operating deck above the stoplog sluiceway (**Photo 13**).
- A masonry wall from the former mill structure (**Photo 14**).
- A municipal park area (**Photo 15**).
- A private dock located on the east side of the dam (**Photo 16**).
- The Pefferlaw River upstream of the dam (**Photo 17**).
- The Main Street Dam (**Photo 18**) located on the adjacent branch of the Pefferlaw River.

Photo 1 – Main Access Driveway, West Side of Dam

Photo 2 – Access Gate, West Side of Dam

Photo 3 – Access gate, East Side of Dam

Photo 4 – Parking Area, West Side of Dam

Photo 5 – Control Structure, Upstream

Photo 6 – Control Structure, Downstream

Photo 7 – West Earth Embankment

Photo 8 – East Earth Embankment

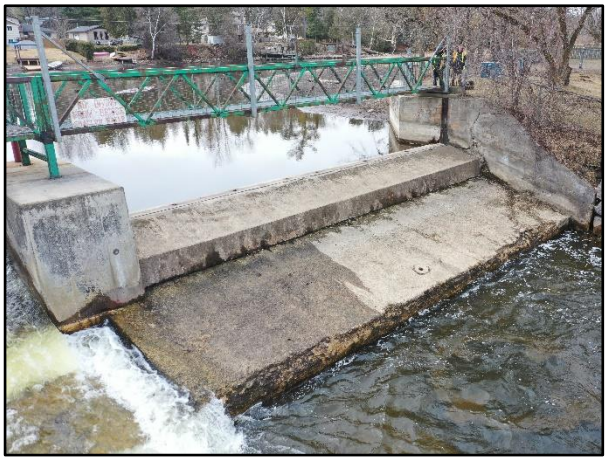


Photo 9 – West Concrete Weir

Photo 10 – Sluiceway

Photo 11 – East Concrete Weir

Photo 12 – Pedestrian Crossing

Photo 13 – Operating Deck

Photo 14 – Former Mill Structure

Photo 15 – Municipal Park Area

Photo 16 – Private Dock

Photo 17 – Pefferlaw River, Upstream

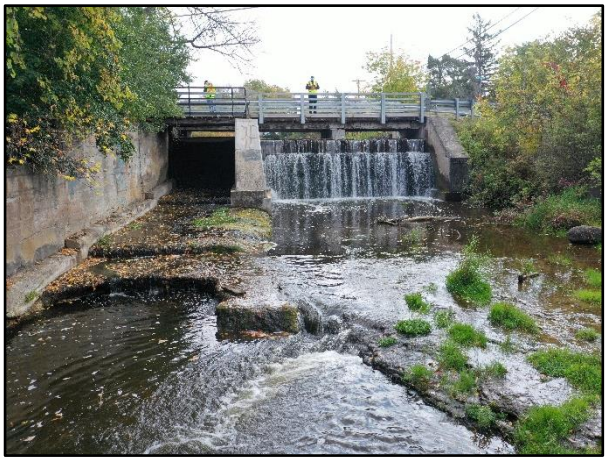
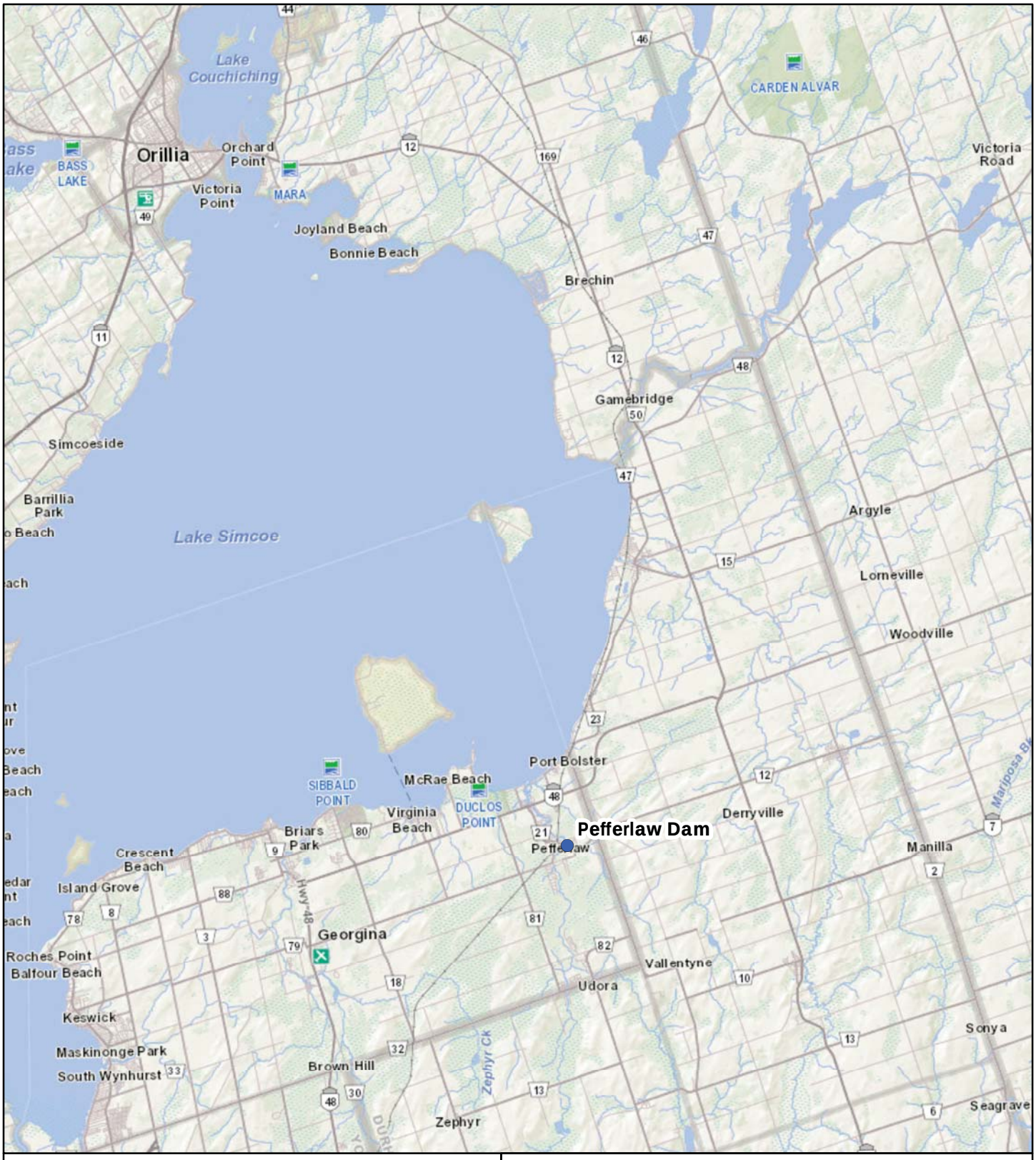


Photo 18 – Main Street Dam



Legend

- Pefferlaw Dam

N

NAD 1983 UTM Zone 17N
1:250,000

Created in ArcMap 10.7
Queens Printer for Ontario, 2022

0 2.25 4.5 9 km

Figure 2 - Location Plan

Drawn By:	DG
Checked By:	DG
Map Date:	2022-04-21
Project Number:	5381
Map File:	220421-5381

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Legend

Ontario Roads

- Highway
- Ramp
- Arrterial
- Local
- Resource

N

NAD 1983 UTM Zone 17N
1:1,500

Created in ArcMap 10.7
Queens Printer for Ontario, 2022
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0 15 30 60 m

Figure 3 - Site Plan

Drawn By:	DG
Checked By:	DG
Map Date:	2022-04-21
Project Number:	5381
Map File:	220421-5381

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3.3 Component Area Identification

For the purposes of this PSRA, the Pefferlaw Dam site was divided into three main components, namely:

1. **Headpond**: The Headpond component area boundary extends from the upstream side of the dam and has a radius of 25 m measured from a point at the approximate centre of the upstream side of the concrete control structure.
2. **Structure**: The Structure component area boundary includes the earth embankments on the east and west sides of the river as well as the concrete control structure and steel truss bridge.
3. **Tailrace**: The Tailrace component area boundary extends from the downstream side of the dam to the upstream side of the Pefferlaw Road bridge, a distance of approximately 110 m, and encompasses the river banks to a distance of 2 m back from the water's edge.

The component areas are shown in **Figure 4**.

3.4 Activities and Hazards

In general, when conducting a PSRA, public activity in the area is determined through the gathering of anecdotal evidence left after public activity in the area has taken place, discussions with the public who may be found on-site and interviews with the owner's employees who have worked in the area. In this case, knowledge of known public activity and interaction with safety hazards was gained through information provided by the Town and LSRCA staff as well as on-site observation of anecdotal evidence. Additional information collected through a petition on the Change.org website and associated links are included in **Appendix A**.

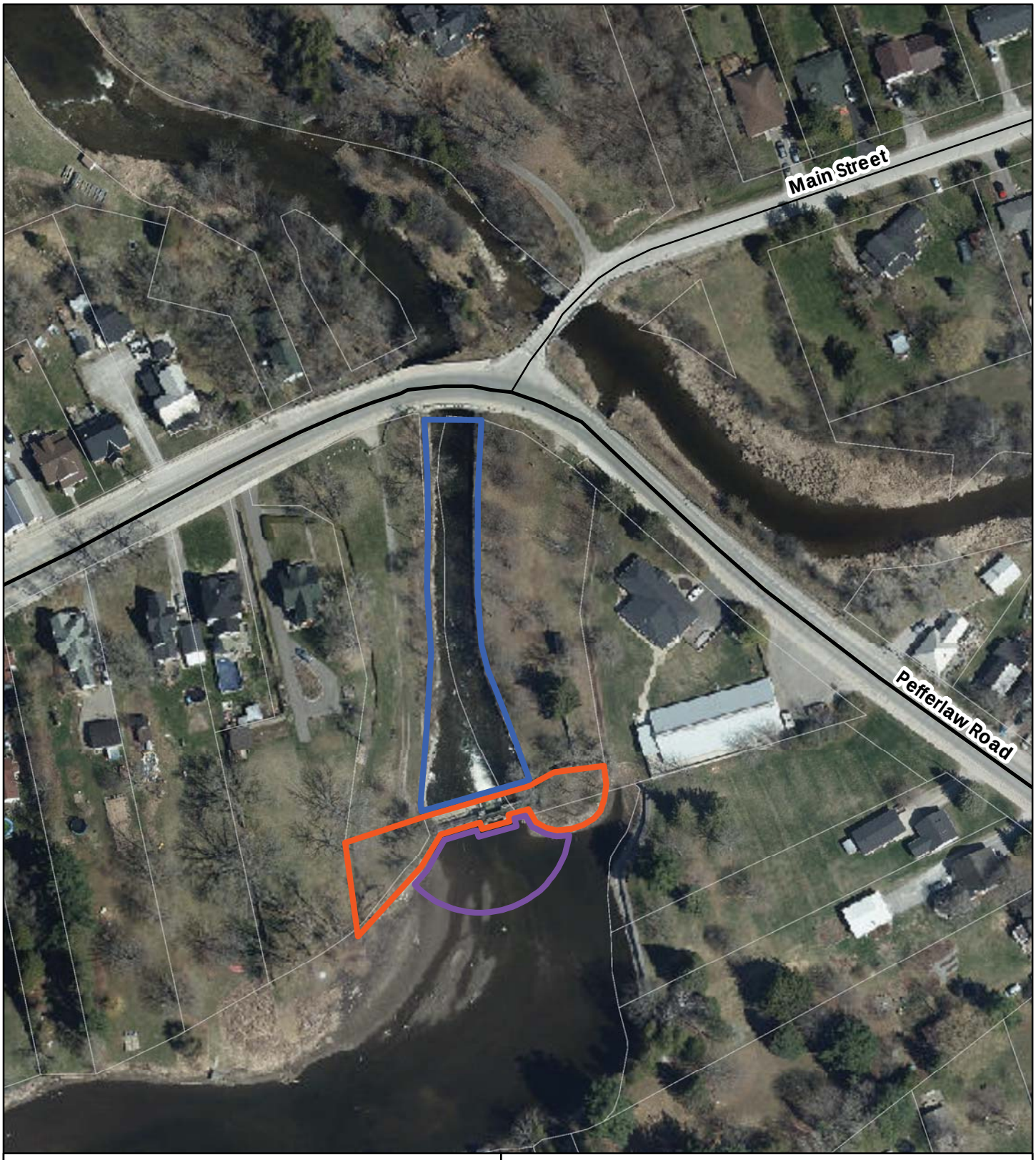
Based on the information collected, the activities at various times of the year may consist of:

- Fishing from a boat
- Boating (under power)
- Canoeing/Kayaking/ Rowing
- Swimming/Diving
- Skating
- Ice Fishing
- Fishing from Shore
- Walking
- Climbing
- Picnicking
- Skiing
- Snowshoeing
- Biking

In general, the hazards identified at the site include:

- Strong currents or undertows
- Presence of spillway with stoplogs
- Steep or slippery banks
- Falling from height > 3 m
- Thin ice
- Open holes or tripping

Members of the public are generally assumed to have access to portions of all component areas. The dam and the areas up and downstream are popular places to visit and recreate due to the presence of the Pefferlaw River, municipal park land and close proximity of residential dwellings.



Legend

Ontario Roads	Component Areas
Highway	Headpond
Ramp	Structure
Arterial	Tailrace
Local	
Resource	

N

NAD 1983 UTM Zone 17N
1:1,500

Created in ArcMap 10.7
Queens Printer for Ontario, 2022

0 15 30 60 m

Figure 4 - Component Areas

Drawn By:	DG
Checked By:	DG
Map Date:	2022-04-21
Project Number:	5381
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4.0 Operational Procedures

The dam currently is operated by the Town staff under an agreement with the LSRCA. If the proposed land transfer is completed, then the Town staff will be solely responsible for dam operations. In general, the types of operations conducted at the site include:

- Seasonal operation of the stoplogs and flashboards using manual and mechanical procedures, including a removable winch system.
- Operation of stoplogs and flashboards, as required, in response to flood events.
- Removal of debris.
- Monthly monitoring of the dam through the operating and winter seasons.

Dam operations are conducted in accordance with the Pefferlaw Dam Operations Manual (LSRCA, 2022). With respect to stoplog installation and removal, the Operation Manual states that operators are to:

> *Ensure that the area is clear of unauthorized persons while performing the task.*

5.0 Risk Assessment

The PSRA was completed for each of the identified component areas using the Risk Assessment Worksheet developed by the CDA. Copies of the Risk Assessment Worksheets for the Pefferlaw Dam are included in **Appendix B**.

5.1 Headpond

5.1.1 Activities and Hazards

The activities and hazards presented in **Table 4** have been identified for the Headpond component area based on the information provided by the Town and LSRCA staff and collected by Wills during the site visit.

Table 4 – Headpond Activities and Hazards

Activity Descriptions	Potential Hazards
Headpond	
From Water / Ice	
• Fishing from Boat • Boating (under power) • Canoeing/Kayaking/Rowing • Swimming	• Strong currents of undertows • Presence of spillway with stoplogs • Steep or slippery banks

Activity Descriptions	Potential Hazards
• Skating • Ice Fishing	• Strong currents of undertows • Presence of spillway with stoplogs • Steep or slippery banks • Thin ice
From Shore/Structure	
• Fishing from shore • Walking • Picnicking • Skiing • Snowshoeing • Biking • Swimming/Diving	• Steep or slippery banks • Open holes or tripping

There are three main dam components that contribute to the potential hazards in this component area: the stoplog sluiceway, the concrete weir with flashboards and the east concrete weir. The upstream side of the stoplog spillway, concrete weir and overflow weir are shown, under spring conditions, in **Photo 19**, **Photo 20** and **Photo 21**, respectively.

The potential hazards in the headpond for the activities from water/ice include strong currents or undertows, the presence of the spillway with stoplogs, steep or slippery banks and thin ice. During normal (summer) operating conditions, the stoplogs are installed and water is flowing over the stoplogs as well as the flashboards. There are potentially strong currents or undertows in this area that could result in a member of the public being drawn into the structure. During higher flow events, such as in the spring or after major precipitation events, the current has the potential to draw boats in towards the structure. If a boat were to come into contact with the dam, they could get stuck up against the dam or could be swept through the sluiceway or over one of the weirs to the downstream side. There is also the potential for the boat to capsize in the turbulent water. In all cases, it is anticipated that the most likely outcome would be the requirement for rescue and medical treatment.

The potential hazards in the headpond for the activities from shore/structure include steep or slippery banks and open holes and tripping. These hazards are present in most areas along the shorelines of lakes and rivers and are not considered to be unique to the dam site, though they are caused by the presence of the waterbody created by the dam. Encountering the identified hazards along the shore would most likely result in no injuries. An aerial view of the headpond area is shown in **Photo 22**.

Photo 19 – Stoplog Sluiceway

Photo 20 – Concrete Weir with Flashboards

Photo 21 – East Concrete Weir

Photo 22 – Headpond Area

5.1.2 Review of Existing Public Safety Measures

There are a number of public safety measures in place that have the potential to mitigate public safety hazards within the Headpond component area, including:

- **Public Safety Signs** – There is an upstream facing public safety sign (36 inches x 53 inches) mounted to the railing on the upstream side of the concrete structure. The sign is large enough to be visible from upstream and generally meets the current recommendations for signs outlined in the Best Management Practices for Public Safety Around Dams (MNR, 2011). The sign includes the LSRCA's logo and phone number and directs people to call "911" in the event of an emergency.
- **Operational Procedures** – The Operations Manual (LSRCA, 2022) outlines operational procedures that require dam operators to ensure that the area is clear of unauthorized persons before dam operations take place.

The location of the existing public safety measures are shown in **Figure 5** and the sign index is included in **Appendix C**.

Photo 23 – Upstream Facing Public Safety Sign

5.1.3 Discussion of Risk Assessment Results

The ILRs were assigned for each identified activity based on the information provided by the Town and LSCRA staff. Additionally, some assumptions were made by Wills. The ICRs were assigned for each identified activity based on Wills' assessment of the most likely outcome if a member of the public were to be exposed to the identified hazard. The RR is the multiplication of the ILR and ICR and the RL is selected based on the dam owner's risk tolerance. The PSRA results are summarized in **Section 5.5** and the detailed PSRA Worksheet is provided in **Appendix B**.

One activity, canoeing/kayaking/rowing, has been assigned an RL of High for this component area. This is a result of a high ILR and medium ICR. The ICR of 3 was assigned for this activity because it is assumed that getting stuck against or going through the dam in a boat is more likely to result in rescue and medical treatment than it is to result in a fatality, for this size of dam.

Thirteen activities, fishing from boat, boating (under power), swimming/diving, skating, ice fishing, fishing from shore, walking, picnicking, skiing, snowshoeing, and biking, have been assigned a RLs of Low for this component area. This is the result of having either a relatively low ILRs and/or ICRs.

5.2 Structure

5.2.1 Activities and Hazards

The activities and hazards presented in **Table 5** have been identified for the Structure component area based on the information provided by the Town and LSRCA staff and collected by Wills during the site visit.

Table 5 – Structure Activities and Hazards

Activity Descriptions	Potential Hazards
Structure	
From Shore/Structure	
• Fishing • Walking • Climbing • Picnicking • Skiing • Snowshoeing • Biking • Swimming/diving	• Presence of spillway with stoplogs • Steep or slippery banks • Falling from height >3 metres • Open holes or tripping

There are two main dam components that contribute to the potential hazards in this component area, the deck of the stoplog sluiceway and the earth embankments. The deck of the stoplog sluiceway is shown in **Photo 12** and **Photo 13** and the earth embankments are shown in **Photo 7** and **Photo 8**. It is noted that while public access to the bridge and dam deck was restricted at the time of our inspection, the PSRA assumes that the steel truss bridge and dam deck is open to public access, with the existing public safety measures in place, in order to assess the risk for a situation that may arise in the future.

The potential hazard that applies to the majority of the activities within the Structure component area is falling from heights over 3 m. Adequate railings are provided on the for the majority of the steel truss bridge (**Photo 24**), and there is chain link fencing installed on the wingwalls, however, there are stoplogs stacked on the operational section of the steel truss. If climbed, the railing would not be high enough to protect against falling from heights (**Photo 13**).

The primary hazards on the earth embankments include steep or slippery slopes and open holes or tripping. As shown in **Photo 7**and **Photo 8**, the embankments have some uneven surfaces (tripping) and could be slippery under certain conditions.

5.2.2 Review of Existing Public Safety Measures

There are a number of public safety measures in place that have the potential to mitigate public safety hazards within the Structure component area, including:

- **Public Safety Signs** – There are small (24 inch by 24 inch) public safety signs installed on the temporary fencing that blocks access to the steel truss bridge (**Photo 25** and **Photo 26**). These signs generally meet the current recommendations for signs outlined in the Best Management Practices for Public Safety Around Dams (MNR, 2011); however, the signs do not indicate the potential hazards and the LSRCA logo has been spray painted white.

- **Fencing/Railings** – The deck railings are formed as part of the truss bridge where welded wire mesh has been added to the inside of the truss to cover the gaps between the truss sections (**Photo 24**). There is chain link fencing along the tops of the wingwalls as well as temporary fencing sections at the access points to the truss bridge (**Photo 25** and **Photo 26**).
- **Locks on Flow Control Equipment** – The stoplog gain cover and stored stoplogs are locked to prevent unauthorized access to the flow control equipment (**Photo 27**).
- **Operational Procedures** – The Operations Manual (LSRCA, 2022) outlines operational procedures that require dam operators to ensure that the area is clear of unauthorized persons before dam operations take place.

The location of the existing public safety measures are shown in **Figure 5** and the sign index is included in **Appendix C**.

Photo 24 – Typical Truss Bridge Railing

Photo 25 – Fencing and Sign on Left Side

Photo 26 – Fencing and Sign on Right Side

Photo 27 – Typical Stoplog and Gain Cover Locks

5.2.3 Discussion of Risk Assessment Results

The ILRs were assigned for each identified activity based on the information provided by the Town and LSRCA staff. Additionally, some assumptions were made by Wills. The ICRs were assigned for each identified activity based on Wills' assessment of the most likely outcome if a member of the public were to be exposed to the identified hazard. The RR is the multiplication of the ILR and ICR and the RL is selected based on the dam owner's risk tolerance. The PSRA results are summarized in **Section 5.5** and the detailed PSRA Worksheet is provided in **Appendix B**.

Four activities, walking, fishing from shore/structure, climbing and biking, have been assigned RLs of Medium for this component area. This is generally the result of medium to high ILRs combined with low to medium ICRs. Again, it is noted that this PSRA has assumed that the steel truss bridge is open to the public with the existing public safety measures in place.

Four activities, picnicking, skiing, snowshoeing and swimming/diving, have been assigned RLs of Low for this component area. This is a result of low to medium ILRs and low ICRs. While it is understood from background research that these activities may happen in the area, they are assumed to be infrequent.

5.3 Tailrace

5.3.1 Activities and Hazards

The activities and hazards presented in **Table 6** have been identified for the Tailrace component area based on the information provided by the Town and LSRCA staff and collected by Wills during the site visit.

Table 6 – Tailrace Activities and Hazards

Activity Descriptions	Potential Hazards
Tailrace	
From Water/Ice	
• Canoeing/Kayaking/Rowing • Swimming/Diving	• Strong currents or undertows • Steep or slippery banks • Open holes or tripping
From Shore/Structure	
• Fishing from Shore/Structure • Walking • Climbing • Picnicking • Biking	• Steep or slippery banks • Open holes or tripping
• Skiing	• Steep or slippery banks

Activity Descriptions	Potential Hazards
• Snowshoeing	• Open holes or tripping
• Swimming/Diving	• Strong currents or undertows • Steep or slippery banks • Open holes or tripping

The site components that contribute to the potential hazards in this component area include the stoplog sluiceway (Photo 10 – Sluiceway**Photo 10**) and the retaining walls on both sides of the tailrace channel (**Photo 28**).

The potential hazards in the tailrace include the strong currents or undertows created by the flow through the sluiceway, steep or slippery banks and open holes or tripping. This area is easily accessible by members of the public. If members of the public access the retaining walls on both sides of the channel, they could be at risk of injury through tripping in open holes in the rocks or by encountering slippery surfaces.

Photo 28 – Tailrace Channel and Retaining Walls

5.3.2 Review of Existing Public Safety Measures

There are a number of public safety measures in place that have the potential to mitigate public safety hazards within the Tailrace component area, including:

- **Public Safety Signs** – There is a downstream facing public safety sign (36 inches x 53 inches) mounted to the railing on the downstream side of the concrete structure. The sign is large enough to be visible from downstream and generally meets the current recommendations for signs outlined in the Best Management Practices for Public Safety Around Dams (MNR, 2011). The sign includes the LSRCA's phone number and directs people to call "911" in the event of an emergency. The LSRCA logo has been spray painted white.

  A "NO DIVING FROM BRIDGE, SHALLOW WATER" sign is also located on the downstream side of the dam to the left of Pier 1 (West Pier). The sign is not a

standard public safety around dams sign and is in very poor condition. The signs are shown in **Photo 19** and **Photo 30**.

- **Operational Procedures** – The Operations Manual (LSRCA, 2022) outlines operational procedures that require dam operators to ensure that the area is clear of unauthorized persons before dam operations take place.
- **Vehicle Barricades** – There are gates and boulders that prevent unauthorized vehicles from gaining entry to the dam site and tailrace area (**Photo 2** and **Photo 3**).

The location of the existing public safety measures are shown in **Figure 5** and the sign index is included in **Appendix C**.

Photo 29 – Downstream Facing Public Safety Sign

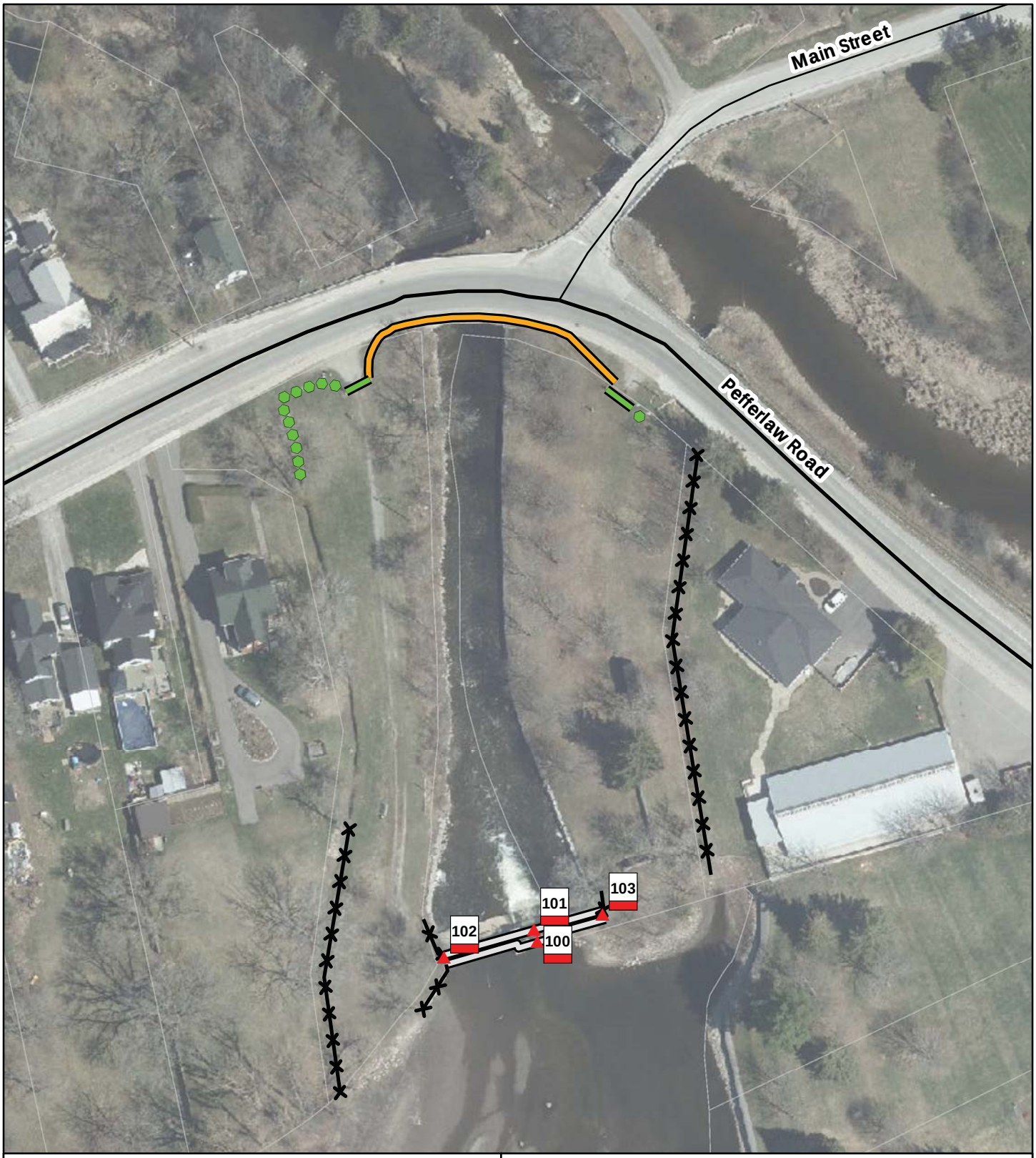
Photo 30 - Downstream Facing Public Safety Sign

5.3.3 Discussion of Risk Assessment Results

The ILRs were assigned for each identified activity based on the information provided by the Town and LSCRA staff. Additionally, some assumptions were made by Wills. The ICRs were assigned for each identified activity based on Wills' assessment of the most likely outcome if a member of the public were to be exposed to the identified hazard. The RR is the multiplication of the ILR and ICR, and the RL is selected based on the dam owner's risk tolerance. The PSRA results are summarized in **Section 5.5** and the detailed PSRA Worksheet is provided in **Appendix B**.

Two activities, canoeing/kayaking/rowing and walking, have been assigned RLs of Medium for this component area. This is the result of relatively high ILRs and low ICRs.

Eleven activities, swimming/diving, fishing from shore, climbing, picnicking, skiing, snowshoeing, biking and swimming/diving from the shore/structure, have been assigned RLs of Low for this component area. This is the result of either of the ILR or ICR values being relatively low while the other is only moderately higher.



Legend

Ontario Roads
- Highway
- Ramp
- Arterial
- Local
- Resource

Linear Public Safety Measures
- Fence
- Stone Barricade
- Guardrail
- Railing
- Vehicle Gate

Existing Public Safety Signs

N

NAD 1983 UTM Zone 17N
1:1,000

Created in ArcMap 10.7
Queens Printer for Ontario, 2022

0 10 20 40 m

Figure 5 - Existing Public Safety Measures

Drawn By:	DG
Checked By:	DG
Map Date:	2022-04-21
Project Number:	5381
Map File:	220421-5381

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5.4 Recommended Public Safety Measures

Based on the results of the site visit and PSRA, Wills has identified a number of opportunities where the modification/replacement of existing public safety measures or the addition of new public safety measures has the potential to reduce the RL for some activities and component areas. The recommended public safety measures are provided in **Table 7** and shown in **Figure 6** and the detailed recommendations, along with cost estimates and prioritization, are provided in **Section 6.0**.

The High-risk activity of canoeing/kayaking/rowing in the Headpond component area could be reduced to Medium, or possibly even low, with the installation of private hazard buoys and the installation of a properly signed portage route at a location that is outside of the Headpond component area.

For the Structure component area, while the additional public safety measures are not expected to reduce the frequency at which people cross the structure, it is anticipated that some of the Medium risk activities could be reduced to Low through the installation of new permanent signage and the removal of the stoplogs from the operating deck when they are not in use and public access to the deck is open.

5.5 Summary of Risk Assessment Results

A summary of the PSRA results and recommended risk reduction measures is included in **Table 7** and the detailed Risk Assessment Worksheets are included in **Appendix B**.

Overall, the PSRA for the Pefferlaw Lake Dam has determined that in its current state, 1 High risk, 6 Medium risks and 24 Low risks exist. If the recommended risk reduction measures are implemented, it is anticipated that there would be 0 High risks, 4 Medium risks and 27 Low risks. We recommend that the risk reduction measures be implemented following a staged approach, which is further described in **Section 6.2**.

Table 7 – Summary of Risk Assessment and Suggested Risk Reduction Measures

Activity Location	Activity Description	Potential Hazards	Existing Risk				Suggested New Risk Reduction Measures	Potential Future Risk			
			ILR	ICR	RR	RL		ILR	ICR	RR	RL
Headpond											
From Water/Ice	Fishing from Boat	• Strong currents or undertows • Presence of spillway with stoplogs • Steep or slippery banks	1	3	**3**	**Low**	• Replace upstream facing public safety sign. • Update Operation and Maintenance Manual. • Install private hazard buoys upstream. • Establish portage route around dam. • Undertake public education with local user groups.	1	3	**3**	**Low**
	Boating (under power)		1	3	**3**	**Low**		1	3	**3**	**Low**
	Canoeing/Kayaking/Rowing		5	3	**15**	**High**		2	3	**6**	**Medium**
	Swimming		1	3	**3**	**Low**		1	3	**3**	**Low**
	Skating	• Strong currents or undertows • Presence of spillway with stoplogs • Steep or slippery banks • Thin ice	1	3	**3**	**Low**		1	3	**3**	**Low**
	Ice Fishing		1	3	**3**	**Low**		1	3	**3**	**Low**
From Shore/Structure	Fishing from Shore	• Steep or slippery banks • Open holes or tripping	4	1	**4**	**Low**		4	1	**4**	**Low**
	Walking		1	1	**1**	**Low**		1	1	**1**	**Low**
	Picnicking		1	1	**1**	**Low**		1	1	**1**	**Low**
	Skiing		1	1	**1**	**Low**		1	1	**1**	**Low**
	Snowshoeing		1	1	**1**	**Low**		1	1	**1**	**Low**
	Biking		1	1	**1**	**Low**		1	1	**1**	**Low**
	Swimming/Diving		1	1	**1**	**Low**		1	1	**1**	**Low**
Structure											
From Shore/Structure	Fishing	• Presence of spillway with stoplogs • Steep or slippery banks • Falling from height >3m • Open holes or tripping	4	2	**8**	**Medium**	• Add permanent public safety signs to the left and right sides of the steel truss bridge. • Remove stoplogs from operating deck when not in use and deck is open to public. • Update Operation and Maintenance Manual.	2	2	**4**	**Low**
	Walking		5	1	**5**	**Medium**		5	1	**5**	**Medium**
	Climbing		3	3	**9**	**Medium**		1	3	**3**	**Low**
	Picnicking		4	1	**4**	**Low**		3	1	**3**	**Low**
	Skiing		2	2	**4**	**Low**		2	2	**4**	**Low**
	Snowshoeing		2	2	**4**	**Low**		2	2	**4**	**Low**
	Biking		5	1	**5**	**Medium**		5	1	**5**	**Medium**
	Swimming/Diving		1	3	**3**	**Low**		1	3	**3**	**Low**

Table 7 – Summary of Risk Assessment and Suggested Risk Reduction Measures

Activity Location	Activity Description	Potential Hazards	Existing Risk				Suggested New Risk Reduction Measures	Potential Future Risk			
			ILR	ICR	RR	RL		ILR	ICR	RR	RL
Tailrace											
From Water/Ice	Canoeing/Kayaking/Rowing	• Strong currents or undertows • Steep or slippery banks • Open holes or tripping	3	2	**6**	**Medium**	• Replace downstream facing public safety sign. • Remove faded and outdated signs. • Update Operation and Maintenance Manual.	1	2	**2**	**Low**
	Swimming/Diving		1	3	**3**	**Low**		1	3	**3**	**Low**
From Shore/Structure	Fishing from Shore	• Steep or slippery banks • Open holes or tripping	4	1	**4**	**Low**		3	1	**3**	**Low**
	Walking		5	1	**5**	**Medium**		5	1	**4**	**Medium**
	Climbing		1	2	**2**	**Low**		1	2	**2**	**Low**
	Picnicking		4	1	**4**	**Low**		4	1	**4**	**Low**
	Biking		1	2	**2**	**Low**		1	1	**2**	**Low**
	Skiing	• Steep or slippery banks • Open holes or tripping	2	1	**2**	**Low**		2	1	**2**	**Low**
	Snowshoeing		2	1	**2**	**Low**		2	1	**2**	**Low**
	Swimming/Diving	• Strong currents or undertows • Steep or slippery banks • Open holes or tripping	1	3	**3**	**Low**		1	3	**3**	**Low**

6.0 Recommendations, Prioritization and Costs

6.1 Recommendations

As described in **Section 5.4**, Wills has identified a number of opportunities where the modification/replacement of existing public safety measures or the addition of new public safety measures has the potential to reduce the RL for some activities and component areas. The potential future risk (RL reduction) is shown in **Table 7**, assuming that the proposed measures are implemented. There are also some recommendations that will not reduce the RL; however, they are still expected to provide an overall improvement to public safety. The detailed recommendations are described below and shown in **Figure 6**.

Signage

1. Replace the large upstream facing public safety sign with a new large "DANGER, Dam Ahead, Keep Out" sign. The new sign should be installed in accordance with the Best Management Practices for Public Safety Around Dams (MNR, 2011) and should include:
    - Pictographs for no boating, no swimming, no skating and no fishing.
    - The name of the dam.
    - The dam owner's logo and name.
    - The statement "In An Emergency Call 911".
2. Replace the large downstream facing public safety sign with a new large "DANGER, Dam Outflow, Keep Out" sign. The new sign should be installed in accordance with the Best Management Practices for Public Safety Around Dams (MNR, 2011) and should include:
    - Pictographs for no boating, no swimming, no wading and no fishing.
    - The name of the dam.
    - The dam owner's logo and name.
    - The statement "In An Emergency Call 911".
3. Install new permanent public safety signs (small) at the access points to the left and right sides of the steel truss bridge. The new signs should read "DANGER, Access Beyond This Point May Result In Drowning" and should be installed in accordance with the Best Management Practices for Public Safety Around Dams (MNR, 2011). The signs should also include:
    - Pictographs for no boating, no swimming, no wading and no fishing.
    - The name of the dam.
    - The dam owner's logo and name.
    - The statement "In An Emergency Call 911".
4. Remove the "NO DIVING FROM BRIDGE, SHALLOW WATER" sign from the downstream side of the steel truss bridge.

5. Work with local user groups to establish a safe and effective portage route around the dam that stays outside of the Headpond component area and install portage signs in accordance with the Guidelines for Public Safety Around Dams, Technical Bulletin: Signs for Public Safety Around Dams (CDA, 2011).

Booms and Buoys

6. Install private hazard buoys at the boundary of the Headpond component area in accordance with the Guidelines for Public Safety Around Dams, Technical Bulletin: Booms and Buoys for Public Safety Around Dams CDA, 2011).

Operational Controls (Procedures)

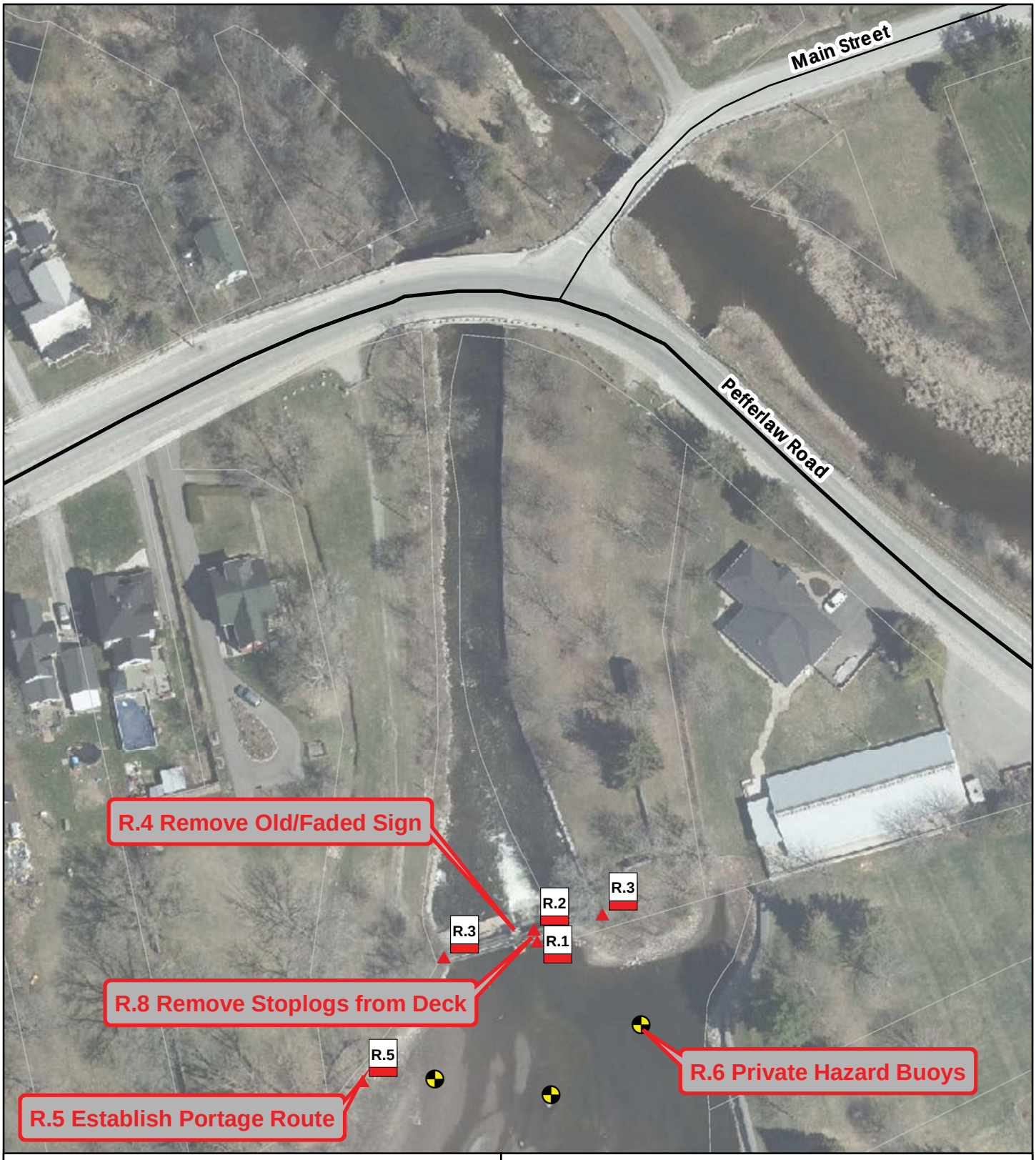
7. Update the Operations Manual, as follows:
    - Add to all appropriate procedures, the requirement to check the Headpond, Structure, and Tailrace component areas for members of the public prior to undertaking any operations.
    - Include procedures for how to deal with members of the public in the event of their presence when the dam needs to be operated.
    - Update the Operations Manual to include a section for public safety that includes the requirement for the Town staff to record and report public safety activities and incidents. The public safety activities/incidents can be documented using a Microsoft Excel spreadsheet. The CDA Public Safety Incident Report form should be used to record and document all incidents.
8. Remove stoplogs from the operating deck when the public has access to the steel truss bridge.

Public Education

9. Undertake public safety around dams education with local user groups.

Public Safety Plan

10. The Best Management Practices for Public Safety Around Dams (MNR, 2011) states that a Public Safety Plan (PSP) should be prepared once the dam owner has completed a Public Safety Risk Assessment and determined that a public safety hazard exists. Once completed, this Risk Assessment will form the basis of the PSP. In general, the PSPs include a site description, details of the Public Safety Risk Assessment, details of the public safety measures, an inspection and maintenance schedule, details on record management requirements and details on incident reporting. The PSP is an important part of the implementation of the Managed System Approach to Public Safety Around Dams, as discussed in the Best Management Practices for Public Safety Around Dams (MNR, 2011). Based on the results of the PSRA, we recommend that a PSP be prepared for the Pefferlaw Dam. This work could be completed after the planned dam rehabilitation work is completed.



Legend

Ontario Roads
- Highway
- Ramp
- Arterial
- Local
- Resource

- Proposed Public Safety Sign
- Proposed Safety Buoy

N

NAD 1983 UTM Zone 17N
1:1,000

Created in ArcMap 10.7
Queens Printer for Ontario, 2022

0 10 20 40 m

Figure 6 - Proposed Public Safety Measures

Drawn By:	DG
Checked By:	DG
Map Date:	5/27/22
Project Number:	5381
Map File:	220421-5381

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6.2 Staged Implementation of Public Safety Measures

Public safety measures should generally be implemented following a staged approach. The purpose of following a staged approach is to demonstrate due diligence while balancing other factors such as cost and need. The process for the staged approach can be summarized as follows:

1. Implement new/revised public safety measures.
2. Monitor and keep records of the types of activities and frequency of those activities being undertaken by members of the public within each component area.
3. Review the information at the time of the next Public Safety Assessment (5 years) to determine if the public safety measures that were previously implemented have been effective.
    a. If the previously implemented public safety measures have been effective, continue the monitoring and review cycle as described above.
    b. If the previously implemented public safety measure have not been effective, implement additional/revised public safety measures and continue the monitoring and review cycle described above.

Notwithstanding the above, if a significant public safety issue is identified during the monitoring and record keeping phase, the Town may choose to implement additional public safety measures sooner than the next Public Safety Assessment in order to demonstrate due diligence and enhance public safety at the dam. The effectiveness of these public safety measures would then be considered as part of the next Public Safety Assessment.

6.3 Prioritization and Costs

Wills has developed a prioritization order for each of the recommendations. Since we are dealing with public safety around dams, the public safety measures should to be implemented as soon as practical in order to protect members of the public and warn them of the hazards associated with the dam. The prioritized list of recommendations, along with cost estimates for each recommendation, is provided in **Table 8**.

For the cost estimates, it is assumed that the Town would install the signage and buoys with their own staff and that operational or procedural public safety measures will be undertaken by the Town staff or by consultants. The costs in **Table 8** are estimates only and could vary significantly (+65%, -35%). Cost estimate breakdowns for applicable items are included in **Appendix D**.

Table 8 – Prioritization and Costs

Priority No.	Category	Recommendation No. and Description		Estimated Cost
1	Signage	5.	Establish Portage Route	$1,210
2	Public Education	9.	Undertake Public Education with Local User Groups	$0 (In House)
3	Operational Controls (Procedures)	8.	Remove Stoplogs from Operating Deck	$0 (In House)
4	Operational Controls (Procedures)	7.	Update Operations and Maintenance Manual	$5,000
5	Signage	3.	Install New Signs on Left and Right Sides of Steel Truss Bridge.	$1,210
6	Signage	1.	Replace Upstream Public Safety Sign	$1,980
7	Signage	2.	Replace Downstream Public Safety Sign	$1,980
8	Signage	4.	Remove Old/Faded Sign.	$0 (In House)
9	Booms and Buoys	6.	Install Private Hazard Buoys	$14,850
10	Public Safety Plan	10.	Prepare Public Safety Plan	$5,000

7.0 Conclusion

This PSRA for the Pefferlaw Dam was completed in accordance with the recommendations of the Best Practices for Public Safety Around Dams (MNR, 2011) and the Canadian Dam Association Guidelines for Public Safety Around Dams (CDA, 2011).

Based on the Risk Assessment Worksheet and the recommended risk tolerance, 1 High risk, 6 Medium risks and 24 Low risks exist at the Pefferlaw Dam. There are a number of existing public safety measures in place including signage, railings, fencing and operational controls (though not adequate).

Wills has identified a number of opportunities where the modification/replacement of existing public safety measures or the addition of new public safety measures has the potential to reduce the RL for some activities and component areas. There are also some recommendations that will not reduce the RL; however, they are still expected to provide an overall improvement to public safety. If the recommended risk reduction measures are implemented, there would be 0 High risks, 4 Medium risks and 27 Low risks. We recommend that the risk reduction measures be implemented following a staged approach. The staged approach has a focus on keeping the public safe while improving the Town's public safety due diligence. Future reviews and monitoring by the Town staff will then determine whether additional control measures are required such as additional barriers/fencing, signs, booms, patrols, etc.

Given that there are potential public safety hazards at the site, the preparation of a Public Safety Plan would be prudent. The Town could consider completing this once the planned dam rehabilitation works are completed.

Respectfully Submitted,

David Green, P.Eng.
Assistant Manager,
Water Resources Engineering

DG/jh

Appendix A

Background Information

Appendix B

Risk Assessment Worksheets

Appendix C

Sign Index

Appendix D

Cost Estimates

Appendix E

CDA Public Safety Incident Report Form