Final Inspection Report

Neustadt Flood Control Works
Neustadt Creek

Municipality of West Grey,
County of Grey, Ontario

D.M. Wills Project Number 22-5540

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

February 2023

Prepared for:
Saugeen Valley
Conservation Authority

Summary of Revisions

Rev. No.	Revision Title	Date	Summary of Revisions
1	Draft Report	January 3, 2023	Issued for Client Review
2	Final Report	February 3, 2023	Issued as Final

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

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

1.1 Purpose and Objectives

The Saugeen Valley Conservation Authority's (SVCA's) jurisdiction, the Saugeen watershed, covers an area of approximately 4,675 km^2 and encompasses the counties of Bruce, Dufferin, Grey, Huron and Wellington as well as the Saugeen River, Penetangore River, Teeswater River, Pine River and the shoreline of Lake Huron. Within this jurisdiction, the SVCA's mandate is to undertake watershed-based programs to protect people and property from floods and other natural hazards and to conserve natural resources for economic, social and environmental benefits. This includes the management of flood and erosion control structures.

In cooperation with their municipal partners and regulatory agencies, the SVCA maintains a number of flood and erosion control projects within their jurisdiction. The SVCA is currently responsible for coordinating the inspection, maintenance and repair of 21 flood and erosion control projects, including 10 dam and dyke projects, 7 slope stability and erosion control projects and 4 flood control channelization projects.

D.M. Wills Associates Limited (Wills) was retained by the SVCA to undertake the inspection of 20 flood and erosion control structures. In the past, annual inspections of the SVCA's flood and erosion control structures have been completed in-house by the SVCA; however, it is understood that past inspection documentation has ranged from photo records to the completion of a site inspection form. Given the importance of ensuring that this infrastructure is in good condition and to plan for future maintenance and repairs, the SVCA has recognized that a more formal inspection of the flood and erosion control infrastructure is required in order to re-establish a baseline condition for each structure.

The purpose of these inspections is to thoroughly document the existing condition of the dams through a visual inspection, including the completion of an underwater inspection where possible, identify operator and public safety deficiencies, and provide a prioritized list of recommendations for the remediation of the identified deficiencies, including the development of budget-level cost estimates and a recommended timeline for the completion of each measure.

The subject of this report is the Neustadt Flood Control Works – Neustadt Creek. The Neustadt Flood Control Works – Neustadt Creek inspection was completed on September 20, 2022, in the presence of SVCA staff.

1.2 Site Location and Access

The Neustadt Flood Control Works – Neustadt Creek were accessed via the public road system as well as easements across private property. Wills and SVCA staff parked at the William Street culvert crossing and proceeded downstream on foot. The William Street culvert was accessed from the upstream end, the Adam Street / Stephana Street culvert was accessed from the downstream end and the Queen Street culvert was accessed from the upstream end. The location of the site is shown in **Figure 1**.

1.3 Site Description

The Neustadt Flood Control Works - Neustadt Creek was constructed in 1982 to reduce the frequency of flooding in Neustadt and to minimize erosion. This flood control project involved deepening and widening the existing channel, installation of gabion baskets, replacing and upgrading road crossings and enclosing the channel downstream of Queen Street. Gabion drop structures were included in the overall project work for energy dissipation. The total project length is approximately 600 m, with 300 m being lined with gabion baskets. There are also three road crossings that were constructed as part of this project. The site plan is shown in **Figure 2**. The location of site features is referenced left to right facing upstream.

1.4 Description of Operations

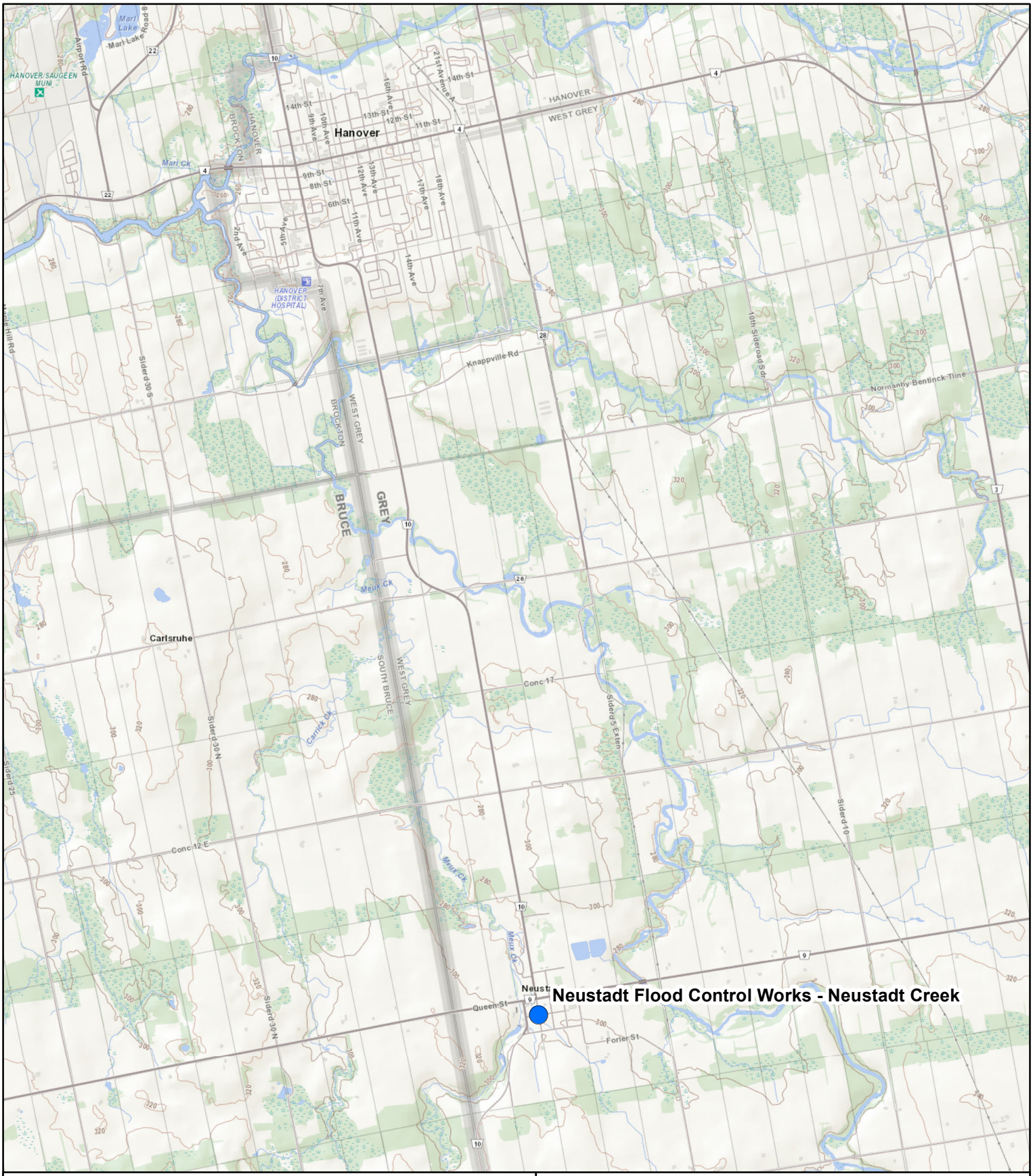
No operations are undertaken for Neustadt Flood Control Works – Neustadt Creek. The project has been designed to function on its own with no external inputs. Maintenance is required from time to time to clean out vegetation and sediment from the channel.

2.0 Inspection Methodology

2.1 Background Review and Fieldwork Preparation

A review of the background information provided by the SVCA was completed prior to Wills' field inspection. This information included available drawings, site access plans, photographs, inspection records and reports. The background review and fieldwork preparation consisted of the following tasks:

- Coordination of access to the site with SVCA staff.
- Review of the available background information.
- Set-up of Modified MNRF Form B-2 (Inspection Form).
- Preparation of a Site-Specific Health and Safety Plan.
- Printing inspection forms and available drawings.



Legend

- Site Location

Meters
0 650 1,300 2,600

Data Sources
Land Information Ontario 2022
Created In: ArcMap 10.7

NAD 1983 UTM Zone 17N 1:50,000

Figure 1 - Location Plan

Drawn By:	GB
Checked By:	DG
Map Date:	12/12/22
Project Number:	22-5540
Map File Number	Figure 1

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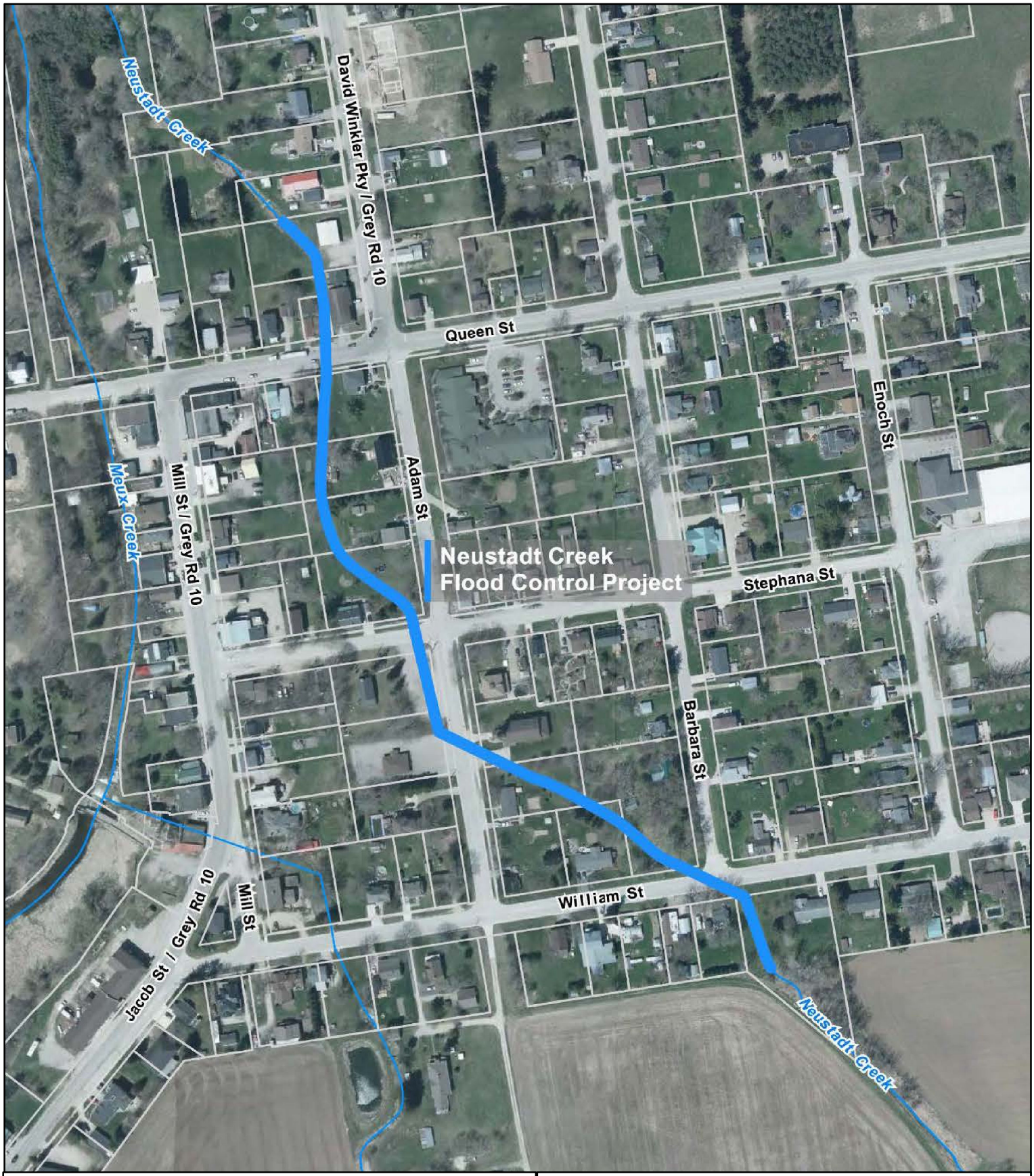

Legend

- Permanent Watercourse
- Parcel Fabric
- Flood Control

Figure 2 - Site Plan

Drawn By:	GB
Checked By:	DG
Map Date:	12/05/22
Project Number:	22-5540
Map File Number	Figure 2

WILLS

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E. wills@dmwills.com

Data Sources
Saugeen Valley Conservation Authority
Created In: ArcMap 10.7
Scale: N.T.S

2.2 Site Condition Assessment

Wills performed a visual and non-destructive inspection of the flood/erosion control works. The methodology for this inspection is summarized as follows:

- Visual inspection, along with recording and classification, of all observable deficiencies according to the Ontario Structure Inspection Manual (OSIM).
- Georeferenced photographs of all aspects of the site.
- Where possible, aerial imagery of the site and up and downstream areas collected using a Remotely Piloted Aircraft System.
- Where possible, underwater video was collected using a pole mounted GoPro camera.
- Review of previously identified deficiencies and their digression over time.
- Completion of Modified MNRF Form B-2 (Inspection Form).

Wills classified the deficiencies, including those in embankment/dyke, slopes, erosion protection, concrete, etc., based on the 2008 OSIM. The OSIM reference checklist used for the inspection is provided in **Appendix C**.

2.3 Assessment of Public and Operator Safety Measures

Wills' inspection of the site included a thorough visual inspection of all public and operator safety measures. The methodology for the inspection and review of the public and operator safety measures is summarized below:

- Visual inventory and inspection of all signage.
- Visual inspection of access route(s).
- Visual inspection of existing public safety measures (i.e. railings).
- Visual inspection of existing operator safety measures (i.e. railings).

The inspection of the public safety measures was carried out in accordance with the methodologies and requirements described in the the Ontario Building Code (OBC). The inspection of the operator safety measures was carried out in accordance with the Occupational Health and Safety Act (OSHA) and the Industrial Establishments Regulation.

3.0 Inspection Findings

3.1 Condition Assessment

Wills performed the inspection of the Neustadt Flood Control Works – Neustadt Creek on September 20, 2022. At the time of the inspection, the weather was sunny and warm.

The inspection results are documented in the photographic record in **Appendix A** and the Modified MNRF Form B2 in **Appendix B**. Digital copies of all photographs and videos from the inspection will be provided to the SVCA by digital file transfer.

In general, the flood control works were observed to be in fair to good condition. The base of many gabion baskets are broken due to corrosion; however, minimal ballast was escaping. There is a build up of vegetation and sediment throughout the majority of the channel sections and a number of deficiencies associated with the culvert crossing structures were identified.

Wills developed the following rating scale in order to provide the SVCA with a high-level assessment of the condition of the various components at the site:

- **1 – Very Poor** – Major deficiencies throughout the component. The structural integrity of the component is likely compromised and/or the component does not function as intended.
- **2 – Poor** – Significant deficiencies throughout component and the component may not function as intended under certain conditions.
- **3 – Fair** – Some deficiencies throughout component that may affect the ability of the component to function as intended if not corrected.
- **4 – Good** – Some localized deficiencies that do not affect the ability of the component to function as intended.
- **5 – Very Good** – No significant deficiencies throughout the component. Only slight imperfections may exist.

Similar to the condition rating system described above, Wills developed the following rating scale in order to provide the SVCA with a high-level understanding of the risk of failure of the various components at the site:

- **1 – Low** – Failure of the component could occur but only in rare/unforeseen events or circumstances.
- **2 – Moderate** – Failure of the component may occur in extreme events or circumstances but is unlikely to occur during normal operations.
- **3 – High** – Failure of the component may occur during normal operations.

A detailed list of the site's components along with the identification of deficiencies, condition ratings and risk ratings is provided in **Table 1.**

3.2 Assessment of Public Safety Measures

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

Minimal public safety measures were identified at the Neustadt Flood Control Works on Neustadt Creek. Based on our site investigation, Wills identified the following potential public safety issues:

- There are no warning signs at the inlets of the culverts and the culvert grates have been removed.
- Railings provided do not meet the current standards and there are no railings in some locations.
- Graffiti was noted within the William Street and Queen Street culverts indicating that some members of the public are entering these potentially hazardous areas.

3.3 Assessment of Operator Safety Measures

Operator safety measures are regulated under the Occupational Health and Safety Act (OHSA). The OHSA and its associated regulations are used to assess the adequacy of operator safety measures. There are two (2) primary operator safety measures, railings and fall protection, the requirements for which depend on specific site conditions.

The Industrial Establishments Regulation of the OHSA (O.Reg. 851) requires a guard rail at the open side of any raised surface. The guard rail must have a top rail located not less than 910 mm and not more than 1070 mm above the surface to be guarded, have a mid rail, have a toe-board that extents at least 125 mm from the surface if tools or other objects may fall on other workers below, be free of splinters and protruding nails and be constructed to meet the structural requirements for guards as set out in the Ontario Building Code. The existing railings do not meet the requirements for a guard rail under O.Reg. 851.

O.Reg. 851 requires a fall arrest system where a worker is exposed to the hazard of falling and the surface to which they might fall is more than 3 m below the position where they are situated. Based on our understanding of the site, there is no potential fall height greater than 3 m; therefore, fall arrest is not required.

Potential operator safety issues include:

- Working around water may require the use of a life jacket or PFD.
- The railings and work platforms on the upstream and downstream sides of the Adam Street / Stephana Street culvert are a hazard for operators and may also be a public safety hazard.

Table 1 – Summary of Inspection Results

Structure	Location	Deficiency / Description	Condition Rating	Risk Rating
Earth Retaining Structures				
Gabion Baskets	Throughout	Base of many baskets are broken due to corrosion, minimal ballast escaping (Photos: 5, 15, 38, 42)	3	2
Flow Conveyance Systems and Structures				
Box Culvert	William Street	Localized light cracking with efflorescence and medium cracking. Graffiti was noted within the culvert. Grates are missing (Photos: 8, 10, 12, 13)	4	2
CSP Culvert	Adam/Stephana Street	Some point deformations in the barrel, corrosion at and below the waterline and some localized perforations in the bottom of the barrel (Photos: 25-26, 27)	3	2
Upstream Headwall	Adam Street	Grate is open (Photo: 24)	4	1
Downstream Headwall	Stephana Street	Grate is open. Light scaling and moss growth on the energy dissipation blocks. (Photo: 31)	4	1
Concrete Box Culvert	Queen Street	Severe delamination in the soffit. No grate on upstream headwall (Photos: 43, 45)	3	2
Elliptical Concrete Culvert	Queen Street	Several joints are leaking creating spalling around these areas. Graffiti was noted within the culvert (Photos: 50-51)	3	2
In-Channel Weirs	Between William Street and Adam Street	None	4	1

Structure	Location	Deficiency / Description	Condition Rating	Risk Rating
Wooden and Metal Structures				
Steel Railing	Upstream Headwall, Adam Street	Steel cracked at base (Photo: 23)	3	1
Steel Grate	Upstream Headwall, Adam Street	None (Photo: 24)	4	1
Access Platform	Upstream Headwall, Adam Street	Light corrosion of steel and light weathering, rot, and decay of timber components (Photo: 22)	3	2
Steel Railing	Downstream Headwall, Stephana Street	None (Photo: 31)	4	1
Access Platform	Downstream Headwall, Stephana Street	Light corrosion of steel and light weathering, rot, and decay of timber components (Photo: 31)	3	1
Erosion, Seepage and Leakage				
CSP Culvert	Adam Street	Pipe joints misaligned causing seepage (Photo: 25)	3	2
Elliptical Concrete Culvert	Queen Street	Joints are leaking throughout pipe (Photos: 50-51)	3	2

4.0 Recommendations

The inspection recommendations along with prioritization and cost estimates for each recommendation are provided in **Table 2.** The degree of accuracy for the cost estimates is approximately +/-50% and are based the best information available at the time of report production. The priorities are classified as "Immediate", "High", "Medium", "Low" and "Ongoing" and are defined as follows:

- **Immediate** – Remedial action that needs to be carried out as soon as possible because the deficiency is an immediate high-risk hazard with a high likelihood of occurrence of loss of life and /or serious environment and/or serious economic consequences.
- **High** – Remedial action is required within the next two years to meet current regulations and is a high-risk hazard.
- **Medium** – These items may include additional work that could improve the performance or issues that may become serious deficiencies. These items typically should be addressed within five years.
- **Low** – These are opportunities to improve safety or deficiencies that may only become a serious deficiency in the long term. The recommendation can be carried out at the SVCA's convenience, or the recommended remedial action is expected to be required six years from now or later.
- **Ongoing** – These items may need to be reviewed and completed on a regular basis to ensure that the function of the structure and public safety measures is maintained.

The recommendations are prioritized based on the risk of occurrence, the significance of potential negative impacts and the resources (cost, time, effort) required to implement. The recommendations have been categorized as Management System, Public Safety, Operator Safety, Minor Maintenance (repairs < $100,000) and Major Maintenance (repairs > $100,000).

Table 2 – Inspection Recommendations

Recommendation	Description of Deficiency	Priority	Estimated Cost	Additional Comments
Management System				
1. Establish a regular frequency for engineering inspections (i.e. five years) as well as routine inspections by staff (i.e. annually).	There are limited past inspection records available and the SVCA would benefit from establishing a regular frequency of engineering inspections (i.e. five years) as well as routine inspections by staff (i.e. annually).	Immediate	$2,500	The estimated cost shown is for the completion of an engineering inspection by a qualified consulting engineering firm and assumes that the SVCA would have a number of flood and erosion control structures inspected as part of the same contract. The cost for a standalone inspection would be estimated as $10,000. It is assumed that the routine inspections would be completed by SVCA staff as part of their regular duties.
2. Monitor the condition of the various culvert and gabion basket sections and undertake localized repairs as required.	A number of small deficiencies were identified throughout the gabion basket and culvert structures.	Ongoing	$0	It is assumed that this would be completed by SVCA staff as part of their regular duties.
3. Confirm the location and the extent of the easements owned by the SVCA and develop communication tools to inform local property owners about the presence of the easement on their property as well as acceptable uses of their lands within the easement.	Private infrastructure, such as pedestrian bridges, drainage pipes, and sheds, have been constructed over top of or adjacent to the gabion basket walls. There are some locations where equipment/tools, construction material and firewood are being stored on the gabion basket walls. Additionally, there is one section of the flood control channel upstream of Queen Street where a wire fence has been installed right to the front edge of the gabion basket wall, making it hard to pass through. The easement limits were not clear during the site inspection.	Ongoing	$0	It is assumed that this would be completed by SVCA staff as part of their regular duties.

Recommendation	Description of Deficiency	Priority	Estimated Cost	Additional Comments
Public Safety				
4. Add public safety signage to each of the culvert headwalls. The signs should read "DANGER KEEP OUT" and the wording should be large enough that it can be seen from outside of the flood control channel.	There are no warning signs at the inlets of the culverts and the culvert grates have been removed.	Immediate	$2,500	It is assumed that this would be completed by SVCA staff as part of their regular duties using purchased materials.
5. Replace the railings on the various concrete headwalls with railings that meet current Ontario Building Code requirements.	The railings that are in place do not meet the Ontario Building Code Requirements.	High	$10,000	
6. Remove the railings and work platforms on the upstream and downstream sides of the Adam Street/Stephana Street culvert. Replace with proper work platforms and railings if these structures are required for SVCA operation.	The railings and work platforms on the upstream and downstream sides of the Adam Street/Stephana Street culvert are a hazard for operators.	High	$0	It is assumed that this would be completed by SVCA staff as part of their regular duties. Cost to replace the work plat forms, if required, would depend on the type of work platform required.
Minor Maintenance				
7. Clear sediment and vegetation from in the channel to ensure that is has the hydraulic capacity required to convey the design flood flows. At the same time, undertake repairs to the bottom row of gabion baskets and remove trees and woody debris from near the top of the gabion basket walls.	There is vegetation growth and sediment accumulation within the flood control channel. This has the potential to affect the hydraulic capacity of the system, reducing the flood protection it is intended to provide.	Medium	$70,000	It is assumed that the SVCA would retain a contractor to carryout this work. Permitting from the DFO and SVCA may be required.

5.0 Conclusion

Wills completed this Inspection Report to provide the SVCA with an understanding of the overall existing condition of the structure, address any potential public or operator safety concerns and provide recommendations to better direct the SVCA with respect to long term management of the structure.

In general, the flood control works were observed to be in fair to good condition. The base of many gabion baskets are broken due to corrosion; however, minimal ballast was escaping. There is a build up of vegetation and sediment throughout the majority of the channel sections and a number of deficiencies associated with the culvert crossing structures were identified.

The flood/erosion control works should continue to be monitored for future deterioration and remedial action should be completed on an as needed basis.

The detailed inspection findings are presented in **Section 3.0** and the recommendations are presented in **Section 4.0**. The following highlights the Urgent, Important and Future priority items for the structure:

Urgent Priority Items

- None.

Important Priority Items

- Establish a regular frequency for engineering inspections (i.e. five years) as well as routine inspections by staff (i.e. annually).
- Add public safety signage to each of the culvert headwalls. The signs should read "DANGER KEEP OUT" and the wording should be large enough that it can be seen from outside of the flood control channel.
- Replace the railings on the various concrete headwalls with railings that meet current Ontario Building Code requirements.
- Remove the railings and work platforms on the upstream and downstream sides of the Adam Street/Stephana Street culvert. Replace with proper work platforms and railings if these structures are required for SVCA operation.
- Monitor the condition of the various culvert and gabion basket sections and undertake localized repairs as required.
- Confirm the location and the extent of the easements owned by the SVCA and develop communication tools to inform local property owners about the presence of the easement on their property as well as acceptable uses of their lands within the easement.

Future Priority Items

- Clear sediment and vegetation from in the channel to ensure that is has the hydraulic capacity required to convey the design flood flows. At the same time,

undertake repairs to the bottom row of gabion baskets and remove trees and woody debris from near the top of the gabion basket walls.

If you have any questions with regards to the information contained herein, please do not hesitate to contact the undersigned.

Respectfully Submitted,

David Green, P.Eng.
Group Leader, Dam Engineering

James Chambers
Project Designer,
Water Resources Engineering

DG/JC/

Appendix A

Photographic Record

Photo 1 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Neustadt Creek Looking Upstream of William Street

Photo 2 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Neustadt Creek Looking Towards William Street

Photo 3 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Upstream End of Gabion Baskets

Photo 4 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Typical Gabion Basket

Photo 5 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Typical Gabion Baskets

Photo 6 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Erosion at Base of Gabion Baskets

Photo 7 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Upstream End of William Street Box Culvert

Photo 8 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of William Street Box Culvert

Photo 9 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Stormwater Outlet in William Street Box Culvert

Photo 10 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of William Street Box Culvert

Photo 11 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of William Street Box Culvert

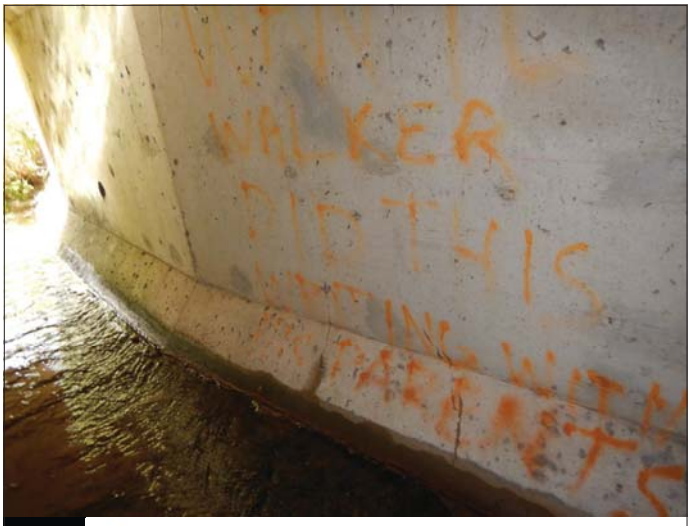

Photo 12 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of William Street Box Culvert

Photo 13 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Downstream End of William Street Box Culvert

Photo 14 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Gabion Baskets Downstream of William Street

Photo 15 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Typical Base of Gabion Basket

Photo 16 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Right Side Gabion Basket

Photo 17 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Left Side Gabion Basket

Photo 18 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Outlet Pipe on Right Bank

Photo 19 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Pedestrian Bridge Across Creek

Photo 20 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Pedestrian Bridge Footing

Photo 21 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Neustadt Creek Looking Downstream Towards Adam Street

Photo 22 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Upstream End of Adam/Stephana Street Culvert

Photo 23 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Upstream End of Adam/Stephana Street Culvert

Photo 24 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Upstream End of Adam/Stephana Street Culvert

Photo 25 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Adam/Stephana Street Culvert

Photo 26 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Adam/Stephana Street Culvert

Photo 27 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Stormwater Outlet in Adam/Stephana Street Culvert

Photo 28 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Adam/Stephana Street Culvert

Photo 29 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Adam Street Looking Downstream

Photo 30 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Downstream End of Adam/Stephana Street Culvert

Photo 31 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Downstream End of Adam/Stephana Street Culvert

Photo 32 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Energy Dissipating Blocks at Downstream End of Culvert

Photo 33 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Neustadt Creek Looking Downstream Towards Queen Street

Photo 34 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Pedestrian Bridge Across Creek

Photo 35 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Pedestrian Bridge Across Creek

Photo 36 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Pedestrian Bridge Across Creek

Photo 37 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Drainage Pipe Outlet to Creek on Left Bank

Photo 38 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Typical Gabion Basket

Photo 39 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Materials Stored on Gabion Baskets, Left Bank

Photo 40 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Wood Pile on Gabion Baskets, Left Bank

Photo 41 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Neustadt Creek Looking Downstream Towards Queen Street

Photo 42 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Base of Gabion Baskets

Photo 43 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Upstream End of Queen Street Culvert

Photo 44 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Queen Street Culvert

Photo 45 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Queen Street Culvert, Soffit

Photo 46 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Queen Street Culvert

Photo 47 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Queen Street Culvert, Transition to Elliptical

Photo 48 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Stormwater Outlet in Queen Street Culvert

Photo 49 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Catch Basin Inlet from Driveway

Photo 50 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Interior of Queen Street Culvert

Photo 51 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Joint in Queen Street Culvert

Photo 52 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Debris in Queen Street Culvert

Photo 53 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Downstream End of Queen Street Culvert

Photo 54 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Neustadt Creek Looking Downstream

Photo 55 - September 20, 2022
Neustadt Flood Control Works - Neustadt Creek
Downstream End of Gabion Baskets

Appendix B

Modified MNRF Form B2

Modified Form B2

Dam Inspection Form

Date:	Tuesday, September 20, 2022
Name:	Neustadt Flood Control Works – Neustadt Creek
Municipality:	Municipality of West Grey, County of Grey
Location:	Lot 2, Concession 13, Geographic Township of Normanby
GPS Coordinates:	499903.00 m E, 4880401.00 m N, UTM Zone 17T
Inspected By:	David Green, P.Eng., Alex Payette, EIT
Weather:	Sunny, warm

1 – Earth Embankments

There are no earth embankments associated with the Neustadt Creek Flood Control Works.

2 – Earth Retaining Structures (concrete, gabion baskets, sheetpile, etc.)

Gabion Baskets – Gabion baskets exist along the length of the flood control channel at all sections where the creek is above ground. Due to excessive vegetation growth, many baskets were difficult to inspect; however, the average condition throughout the length is fair. Along the waterline of the creek (base of the gabion basket walls), many of the baskets are broken due to corrosion; however, there is minimal ballast escaping. It is noted that there is some woody vegetation growth near the top of the gabion baskets at various points along the channel.

Gabion baskets were also present along the bottom of the channel; however, these baskets were difficult to inspect due to vegetation growth and sediment accumulation.

It appears as though a section the flood control channel has been cleaned out. The approximate location of this is behind 368/370 Adam Street. It is unclear who cleaned out this section of the channel or why it was completed.

3 – Flow Conveyance Systems (channels, pipes, etc.)

Pipe/Culvert Structures – There are different culvert structures along the flood control route, including:

> **William Street** – The concrete box culvert sections are generally in good condition with light staining at the culvert unit joints and localized light cracking with efflorescence and medium cracking. The concrete headwalls at the upstream and downstream ends of the culvert are in good condition; however, it was noted that the steel grates were cut off at some point. There is an HDPE storm sewer pipe tied into the side of the concrete box culvert. This pipe appears to be in good condition; however, flow from the pipe has stained the wall of the culvert.

Adam Street/Stephana Street – There is an approximately 120 m long Corrugated Steel Pipe (CSP) culvert that extends from upstream of Adam Street to downstream of Stephana Street. The CSP culvert was generally in fair to good condition, with some point deformations in the barrel, corrosion at and below the waterline and some localized perforations in the bottom of the barrel. Several culvert unit joints were misaligned and there were gaps exposing the coupler. There are a number of small storm pipes that discharge into the culvert. There is additional corrosion/staining at each of the discharge points.

The upstream concrete headwall is in good condition. There is a steel railing on top of the headwall that doesn't meet current standards and the steel is cracked at the base, likely due to water freezing. Within the channel, there is an open steel grate which appears to be in good condition as well as a makeshift access platform with railing. The access platform and railing are in fair condition with light corrosion of the steel components and light weathering, rot, and decay of the timber components. The railing and platform may be an operator/public safety hazard. There are also steel posts helping to brace the gabion baskets against one another. The steel posts are lightly corroded. It is unclear the exact purpose of the steel bracing; however, it is assumed that they were installed because the gabion baskets were noted to be moving inwards toward the channel.

The downstream concrete headwall is in good condition. There is a steel railing on top of the headwall that doesn't meet current standards. On the downstream side of the headwall, there is an open steel grate which appears to be in good condition as well as a makeshift access platform and railing. The access platform and railing are in fair condition with light corrosion of the steel components and light weathering, rot, and decay of the timber components. The railing and platform may be an operator/public safety hazard. There are concrete energy dissipation blocks at the downstream end of the culvert. These blocks appear to be in good condition with light scaling and moss growth.

Queen Street – There is a concrete box culvert that allows the creek to flow under Queen Street. The concrete box culvert transitions to an elliptical concrete culvert on the downstream side of Queen Street. In the box culvert section, there are areas of severe delamination in the soffit. Within the elliptical section, several joints are leaking which is creating spalling around these areas. There are localized areas where sediment is being deposited along the floor of the culvert. Graffiti was noted within the culvert.

The concrete headwalls at the upstream and downstream side of the culvert are in good condition. The railing on the upstream side does not meet current standards and there is no railing on the downstream side.

Weirs – There are three gabion weirs in the channel between the William Street and Adam Street culverts. The weirs allow the channel to drop by between 1.0 ft and 1.5 ft at each location. The weirs were identified by the drops in the channel; however, the

gabion baskets could not be inspected due to the presence of vegetation and sediment.

4 – Catch Basins/Manholes

There are a number of catch basins/catch basin grates that tie into the road crossing culverts. The grates appear to be fair condition with light surface corrosion and the associated concrete structures appear to be in fair condition with light concrete deterioration.

5 – Flap Gates

There are no flap gates associated with the Neustadt Creek Flood Control Works.

6 – Weirs

The gabion basket weirs are described in Section 3 – Flow Conveyance Systems.

7 – Erosion Protection Measures (rock protection, rip-rap, turf reinforcement mat, etc.)

There are no erosion protection measures associated with the Neustadt Creek Flood Control Works.

8 – Erosion

No significant erosion was noted within the flood control channel at the time of the inspection.

9 – Seepage or Leaks

Some leaks were identified in joints of the various culvert sections, as described in Section 3 (Flow Conveyance Systems).

10 – Access Route (location of gate keys, winch handles and keys)

The Neustadt Flood Control Works – Neustadt Creek were accessed via the public road system as well as easements across private property. Wills and SVCA staff parked at the William Street culvert crossing and proceeded downstream on foot. The William Street culvert was accessed through the upstream end, the Adam Street/Stephana Street culvert was accessed from the downstream end and the Queen Street culvert was accessed from the upstream end.

10 – Safety Issues (public and operator)

Public Safety – There are no warning signs at the inlets of the culverts and the culvert grates have been removed. The railings provided do not meet the current standards and there are no railings in some locations. Graffiti was noted within the William Street and Queen Street culverts indicating that some members of the public are entering these potentially hazardous areas.

Operator Safety – The railings and work platforms on the upstream and downstream sides of the Adam Street/Stephana Street culvert are a hazard for operators. This may also be a public safety hazard.

12 – Signage

There is no public safety signage associated with the Neustadt Creek Flood Control Works.

13 – Divestment and/or Decommissioning Opportunities

There are likely limited divestment or decommissioning opportunities for the Neustadt Creek Flood Control Works.

14 – General Remarks

Private infrastructure, such as pedestrian bridges, drainage pipes, and sheds, have been constructed over top of or adjacent to the gabion basket walls. There are some locations where equipment/tools, construction material and firewood are being stored on the gabion basket walls. Additionally, there is one section of the flood control channel upstream of Queen Street where a wire fence has been installed right to the front edge of the gabion basket wall, making it hard to pass through. The easement limits were not clear during the site inspection and should be confirmed by SVCA staff. Direct public messaging may be required to notify property owners acceptable uses within the easement.

15 – Recommendations

- Establish a regular frequency for engineering inspections (i.e. five years) as well as routine inspections by staff (i.e. annually).
- Clear sediment and vegetation from in the channel to ensure that is has the hydraulic capacity required to convey the design flood flows. At the same time, undertake repairs to the bottom row of gabion baskets and remove trees and woody debris from near the top of the gabion basket walls.
- Add public safety signage to each of the culvert headwalls. The signs should read "DANGER KEEP OUT" and the wording should be large enough that it can be seen from outside of the flood control channel.
- Replace the railings on the various concrete headwalls with railings that meet current Ontario Building Code requirements.
- Remove the railings and work platforms on the upstream and downstream sides of the Adam Street/Stephana Street culvert. Replace with proper work platforms and railings if these structures are required for SVCA operation.
- Monitor the condition of the various culvert and gabion basket sections and undertake localized repairs as required.
- Confirm the location and the extent of the easements owned by the SVCA and develop communication tools to inform local property owners about the presence of the easement on their property as well as acceptable uses of their lands within the easement.

Appendix C

OSIM Inspection Deficiency Classifications

OSIM Checklist		
Concrete		
Scaling - loss of portion of concrete surface or mortar due to freeze thaw. Common with non-air entrained concrete or poorly finished concrete.	Light	Loss of mortar up to 5 mm
	Medium	6 to 10 mm, some coarse aggregate visible
	Severe	11 to 20 mm aggregate pocking
	Very Severe	More than 20 mm
Disintegration - breakdown of concrete. Starts as scaling and its disintegration when it's beyond the level of very severe scaling.	Light	Loss of depth up to 25 mm
	Medium	25 to 50 mm
	Severe	50 to 100 mm
	Very Severe	More than 100 mm
Erosion - deterioration of concrete by water, sand or gravel scrubbing against the surface.	Light	Loss of depth up to 25 mm
	Medium	25 to 50 mm
	Severe	50 to 100 mm
	Very Severe	More than 100 mm
Corrosion of Reinforcement	Light	Rust stains on concrete surface
	Medium	Exposed reinforcement, loss of section 10%
	Severe	Loss of reinforcing steel section 10% to 20%
	Very Severe	Loss of section more than 20%
Delamination - discontinuity of the surface concrete, which becomes substantially separated but not completely detached. Hollow sounding when tapped.	Light	Measured area less than 150 mm in any direction
	Medium	150 mm to 300 mm
	Severe	300 mm to 600 mm
	Very Severe	More than 600 mm
Spalling - fragments of concrete become detached.	Light	Measured area less than 150 mm in any direction, or less than 25 mm deep
	Medium	150 mm to 300 mm, or 25 mm to 50 mm deep
	Severe	300 mm to 600 mm, or 50 mm to 100 mm deep
	Very Severe	More than 600 mm, or greater than 100 mm in depth
Crack - linear fracture.	Hairline	Less than 0.1 mm
	Narrow	0.1 mm to 0.3 mm
	Medium	0.3 mm to 1.0 mm
	Wide	More than 1.0 mm
AAR - aggregate reaction with the alkalis in cement, product is highly expansive substance called alkali-silica gel. The expansion of the gel and aggregate under damp conditions causes cracking.	Light	Hairline cracks, widely spaced, no visible expansion of concrete mass
	Medium	Narrow pattern cracks, closely spaced, with visible expansion of concrete mass
	Severe	Medium to wide pattern cracks, closely spaced, with visible expansion and deterioration of concrete
	Very Severe	Wide pattern cracks, closely spaced, with extensive expansion and deterioration of concrete

OSIM Checklist

Concrete Surface Defects		
Stratification - separation of concrete into horizontal layers in over wetted or over vibrated concrete.		
Segregation - differential concentration of the components of mixed concrete resulting in non-uniform properties in mass. Caused by concrete falling from height, with the coarse aggregate setting to the bottom and fine aggregate to the top.		
Cold Joints - caused from delay between placements of successive pours of concrete and incomplete bond develops.		
Deposits - water percolates through the concrete and dissolves or leaches chemicals from it and deposits them on the surface.	Efflorescence	A deposit of salts, usually white and powdery
	Exudation	A liquid or gel-like discharge through pores or cracks in the surface
	Incrustation	A hard crust or coating formed on the concrete surface
	Stalactite	A downward pointing formation hanging from the concrete surface, usually shaped like an icicle
Honeycombing - improper or incomplete vibration, which leaves voids in the concrete where mortar failed to completely fill the space between aggregate.	Light	Measured area less than 150 mm in any direction
	Medium	150 mm to 300 mm
	Severe	300 mm to 600 mm
	Very Severe	more than 600 mm
Pop-outs - shallow, conical depressions caused by small portions of concrete surface breaking away due to frost or expansion of aggregate.	Light	Holes up to 25 mm diameter
	Medium	25 mm to 50 mm
	Severe	50 mm to 100 mm
	Very Severe	More than 100 mm
Abrasion - vehicles or snow plow blades scraping against concrete.		
Wear- dynamic and/or friction forces from vehicles, dirt, debris, sand, water & ice. Surface appears polished.		
Slippery- as a result of polishing of concrete deck by vehicular traffic.		
Steel		
Corrosion - deterioration of steel by chemical or electro-chemical reaction.	Light	Loose rust formation, no noticeable section loss
	Medium	Loose rust with scales or flakes. Up to 10% sectional loss
	Severe	Stratified rust with pitting of metal. 10% to 20% section loss
	Very Severe	Localized perforation or rusting through. More than 20% section loss
Permanent Deformation - bending, buckling, twisting or elongation, or any combination thereof.	Note location of deformation	
Crack - a linear fracture in the surface of steel or weld.	Cracks perpendicular to direction of stress are critical	
Loose Connections - caused by corrosion of connector plates or fasteners, excessive vibration, overstressing, cracking or the failure of the individual fasteners.	Light	up to 5% of fasteners loose or missing
	Medium	5% to 10
	Severe	10% to 20%
	Very Severe	more than 20%

OSIM Checklist		
Wood		
Weathering, Checks, Splits and Shakes - deterioration of wood due to sun, rain, wind, frost and atmospheric pollutants.	Light	tissue separation short and extends less than 5% into member
	Medium	separation long and 5% to 10% into member
	Severe	10% to 20%
	Very Severe	more than 20%
Rot and Decay - breakdown of wood by microorganisms.	Light	slight change in colour, wood cannot be penetrated by sharp object
	Medium	surface discolored with black and brown streak. Hollow sounding when tapped
	Severe	surface fibrous, checked or crumbly with fungal fruiting growing on it
	Very Severe	wood can be crumbled and disintegrated with ease
Insect Damage - tunneling and boring by larvae or mature insects.	Light	occasional exit or entrance hole
	Medium	several entrances and exit holes
	Severe	extensive tunneling and holes
	Very Severe	extensive tunneling, holes and larvae insects present
Abrasion and Wear - deterioration caused by vehicles or snowplow blades scarping against wood.	Light	5% section loss
	Medium	5% to 10% section loss
	Severe	10% to 20%
	Very Severe	more than 20%
Cracking, Splintering, Crushing and Shattering - physical damage from vehicular collision or overloading of member.	Light	5% section loss
	Medium	5% to 10% section loss
	Severe	10% to 20%
	Very Severe	more than 20%
Fire and Chemical Damage – charring.	Light	slight charring and 5% section loss
	Medium	5% to 10% section loss
	Severe	10% to 20%
	Very Severe	more than 20%
Loose Connections - loosened due to repetitive or dynamic loading, wear or decay.	Light	up to 5% of fasteners loose or missing
	Medium	5% to 10
	Severe	10% to 20%
	Very Severe	more than 20%
Masonry		
Crack - incomplete separation into one or more parts with or without space between.	Hairline	less than 0.1 mm
	Narrow	0.1 mm to 0.3 mm
	Medium	0.3 mm to 1.0 mm
	Wide	more than 1.0 mm
Splitting, spalling and disintegration - opening of seams, chipping away of pieces of stones or gradual breakdown of stone.	Light	hairline cracks and minor loss of stone surface up to 50 mm section loss
	Medium	narrow cracks and 50 mm to 100 mm section loss
	Severe	spalling and disintegration of stone with 100 mm to 150 mm section loss
	Very Severe	extensive spalling and disintegration of stone with 100 mm to 150 mm section loss
Loss of mortar and stone - loss of mortar due to frost, erosion, plant	Light	loss of mortar from joints of depth up to 20 mm
	Medium	20 to 50 mm

OSIM Checklist		
growth or softening by water containing dissolved sulfate or chlorides.	Severe	extensive loss of mortar resulting in loss of stone
	Very Severe	extensive loss of stones jeopardizing the stability of structure
Aluminum		
Corrosion - gradual oxidation of the surface in the presence of moisture.	Light	loose rust formation, no noticeable section loss
	Medium	loose rust with scales or flakes. Up to 10% sectional loss
	Severe	stratified rust with pitting of metal. 10% to 20% section loss
	Very Severe	localized perforation or rusting through. More than 20% section loss
Crack - a linear fracture which may extend partially or completely through the material		
Loose Connections - may occur in bolted or riveted connection.	Light	up to 5% of fasteners loose or missing
	Medium	5% to 10
	Severe	10% to 20%
	Very Severe	more than 20%
Coatings		
Coating Related Defects	***Adhesion Related Defects***	
Checking or crazing	Undercutting	
Cracking	Blisters	
Alligatoring	Intercoat delamination	
Chemical attack	Peeling	
Chalking	Underfilm corrosion	
Coating Related Defects		
Bridging	Pinholing	
Edge effects	Runs	
Shadows	Sags	
Overspray	Pinpoint rusting	