CITY OF CAMBRIDGE

STRUCTURAL INSPECTION OF RIVERSIDE DAM

INSPECTION REPORT

OCTOBER 16, 2024

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PROJECT NO.: CA0037400.3034.
DATE: OCTOBER 16, 2024

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October 16, 2024

City of Cambridge
50 Dickson Street
Cambridge ON N1R 5W8

Attention: Mr. Scott MacDonald, Project Engineer, Community Development - Engineering & Transportation Services

Dear Sir:

Subject: 2024 Riverside Dam Inspection

WSP Canada Limited prepared the attached Structural Inspection Report summarizing the findings from the visual inspections of the Riverside Dam. The report covers the complete dam structure including spillway, control structures, retaining walls, and sluiceway.

Yours sincerely,

Dante Shawil
Structural Designer

Matthew Galloway, M.Eng., P.Eng.
Manager, Bridges

DS/mg/nk
Encl.

WSP ref.: CA0037400.3034

QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Draft	Final		
Date	October 08, 2024	October 16, 2024		
Prepared by	Dante Shawil	Dante Shawil		
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Authorised by	Matthew Galloway	Matthew Galloway		
Signature				
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SIGNATURES

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Dante Shawil
Bridge Designer

APPROVED[1] BY

Matthew Galloway, M.Eng., P.Eng.
Manager, Bridges

[1] Approval of this document is an administrative function indicating readiness for release and does not impart legal liability on to the Approver for any technical content contained herein. Technical accuracy and fit-for-purpose of this content is obtained through the review process. The Approver shall ensure the applicable review process has occurred prior to signing the document.

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1 KEY PLAN

The plan below shows the location of the Riverside Dam in the City of Cambridge. The Dam is upstream of King Street, spanning the Speed River, adjacent to Riverside Park.

Figure 1: Riverside Dam, Cambridge, Ontario

2 INTRODUCTION

In 2024, WSP Canada Limited was retained by the Corporation of the City of Cambridge (City) to conduct a visual structural inspection of the Riverside Dam. The goal of the inspection was to assess and comment on the progression of deterioration on the dam since the 2022 inspection conducted by WSP, in addition to conducting a standard visual inspection.

The dam is located on the Speed River, just north of the CP Rail spur, servicing the industrial area to the northwest, and north of King Street. The Riverside Dam was constructed circa 1890 and consists of a rubble filled core, covered with a reinforced concrete shell that ranges in thickness from 0.42 m to 0.62 m and with an average of 0.11m cover to rebar. The rebar used for the dam comprises of either 12mm square bar or 10mm round bar. The dam is approximately 65 m long and 1.5 m high (measured from the top of the apron). The width of the top of the dam is 0.78 m. Additionally, the dam consists of two stop log structures, one located towards the north end and one towards the south end of the dam structure. There is also a sluiceway structure located along the north retaining wall (upstream of the dam).

The City of Cambridge retained Sanchez Engineering Inc. to carry out an evaluation of the Riverside Dam in 2008/2009 (ref. Riverside Dam Structural Evaluation and Detailed Design, Sanchez, 2009). The inspection by Sanchez was completed in 2008. The 2008 inspection revealed that the north stop log control structures were in poor to fair condition and the south stop log control structure needed emergency repair which was subsequently carried out by the City of Cambridge after the inspection in 2009. The repair was completed as a stop-gap measure to stabilize the control structure and so prevent potential catastrophic rapid failure of the dam.

In 2014, the City of Cambridge retained AMEC Environment & Infrastructure (Wood Environment & Infrastructure Solutions) to conduct a detailed structural investigation. The 2014 investigation included an inspection of the dam, coring for petrographic investigation, and recommendations on rehabilitation options. It concluded that:

1. The deterioration has advanced since the 2008 Sanchez Engineering Inc. inspection.
2. A two– ten year range on local failure was expected which could compromise the integrity of the dam and annual inspections are recommended.
3. Petrographic examination found that micro and macro cracking were present, and that the rubble core was loosely bound due to a lack of cementitious material; and
4. A review determined that repair of the structure would not be viable.

In 2017/2018, Wood Environment & Infrastructure Solutions (formerly Amec Foster Wheeler Environment & Infrastructure) was retained by the Corporation of the City of Cambridge (City) to conduct a visual structural inspection of the Riverside Dam. The goal of the inspection was to assess and comment on the progression of deterioration of the dam since the 2014 inspection conducted by Wood, in addition to conducting a standard visual inspection.

The 2017/2018 investigation concluded that:

1. The dam remains in poor condition.
2. The dam has continued to deteriorate since the 2014 inspection.
3. The debris buildup throughout the dam should be removed as soon as possible.
4. Based on the advancing deterioration of the structure, a significant local failure would compromise the integrity of the dam.
5. On this basis, it was recommended that inspection of the dam continue to be carried out annually, to monitor the dam's condition and assess short-term risk.

In 2022, WSP Environmental & Infrastructure Limited (formerly Wood Environmental & Infrastructure Solutions) was retained by the Corporation of the City of Cambridge (City) to conduct a visual structural inspection of the Riverside Dam. The goal of the inspection was to assess and comment on the progression of deterioration of the dam since the 2018 inspection conducted by Wood, in addition to conducting a standard visual inspection.

The 2022 investigation concluded that:

1. The dam remains in poor condition.
2. The dam has continued to deteriorate since the 2017/2018 inspection.
3. The debris buildup throughout the dam should be removed as soon as possible.
4. Based on the advancing deterioration of the structure, a significant local failure would compromise the integrity of the dam.
5. On this basis, it was recommended that inspection of the dam continue to be carried out annually, to monitor the dam's condition and assess short-term risk.

The City of Cambridge has requested WSP to carry out visual inspection(s) in 2024 to determine the condition of the structure.

2.1 SCOPE OF WORK

The purpose of this assignment was to carry out a visual inspection of the Riverside Dam to assess existing condition and determine progress of deterioration since the last inspection, in order to identify any critical concerns requiring immediate attention and provide recommendations for potential capital works.

WSP attempted to carry out the inspection on June 20, 2024, but found that the water velocity was too strong for safe access to along the apron. However, photos and notes were taken where possible. WSP returned on August 30, 2024, and was able to complete the inspection.

3 INSPECTION

3.1 STOP LOG STRUCTURES, SLUICEWAY, AND RETAINING WALL

The dam was inspected with access from the Speed River on the downstream side of the dam. Once on the downstream side of the dam, the apron acted as a reliable footing to traverse along the face of the dam.

Photographs from the inspections are attached in Appendix A.

The north stop log structure is a masonry structure with significant sections of the front face missing. The exposed core consists of varying sizes of boulder/cobble rocks with a low strength cement mortar. The joints have opened, and vegetation is growing through the open joints. Several large masonry blocks from the fascia are missing, and others are on the verge of falling off the structure. No loss of blocks was observed since the 2022 inspection. Appendix B provides comparison photos between the 2022 and 2024 inspections.

The top slab of the structure is cracked in several locations.

The timber stop logs are closed; however, they are leaking (refer to Photo 2), resulting in a small flow of water through the raceways. This is typical at both raceways (arches shown in Photo 1) on the North structure. The wooden stop logs appear to be in poor condition.

The south stop log structure is generally in poor condition, with cracks, spalling and disintegration observed on the top face of the structure. A wide horizontal crack was visible in the wall around most of the structure. Debris, especially trees and vegetation, has built up upstream of the stop log structure. To prevent collapse or sliding of the south stop log structure, rip rap was placed directly downstream of the structure and used to block the raceways. As a result, no water flows through the structure.

Note that it was determined too unsafe to climb on the stop log structure, therefore relevant comments have been carried over from the previous inspections and are as follows:

1. The northern wingwall was found to have a medium to wide longitudinal crack along the length of the wall; and
2. A previous underwater investigation found that the concrete of the stop log structure was in fair condition with light to medium scaling.

The retaining wall on the North side of the Speed River, just downstream from the dam is in poor condition. The footing structure is eroded, and the joints are open. Masonry blocks have popped out at several locations and concrete/mortar has eroded from the wall. Water was observed to be flowing behind the blocks.

The retaining wall on the South side (Southeast of the rail bridge) was found to be in poor condition. Due to erosion of the footing structure and loss of masonry blocks, a substantial cavity has formed (see Photo 13) which yields the ground directly behind the wall unsuitable for any loading. Fortunately, the ground behind the retaining wall is an abandoned industrial site so there is no immediate risk, if this area is closed off. In addition to the cavity, several blocks are eroded, and joints have lost their mortar. Following recommendations from the previous inspection in 2022, the City installed several temporary concrete blocks on the ground above the noted cavity to prevent vehicles from parking or operating in this area.

3.2 SPILLWAY STRUCTURE

The downstream face of the dam was inspected by a combination of visual observations (where turbulent water did not obscure the view) and by physically touching the structure. This inspection was conducted by walking along the apron.

Erosion along the face of the spillway was observed. Within the white-water zones, the depth of concrete shell erosion typically ranged from 50 mm to a maximum of 100 mm (adjacent to the south stop log structure). Areas at the bottom of the dam wall and sections of the concrete apron nearest the wall (toe of the dam) have eroded,

and three specific locations were noticed with erosion ranging from 75-150mm. It should be noted that most of the top of the apron was found to have some degree of erosion.

Two exposed rebars were found on the northern portion of the spillway (at the interface between the stop log structure). Concrete spalls were found at multiple locations. Depressions and erosion were observed along the full length.

A Structural Inspection Drawing originating from the 2018 inspection report titled “18-08-23 - Riverside Dam Inspection Report FINAL” has been updated and attached in Appendix ‘C’ addressing the additional changes to the condition of the dam.

4 CONCLUSIONS & RECOMMENDATIONS

The following summarizes the conclusions and recommendations of the investigation:

1. The 2024 inspection has established that the dam remains in poor condition. The dam is in a state in which failure is imminent and is difficult to predict. As such, recommended repairs to the dam should be completed as soon as possible.
2. The 2024 inspection has determined that the dam has continued to deteriorate since the 2022 inspection. Additional concrete erosion and deterioration was observed on the spillway and other elements of the dam structure.
3. Based on the deterioration of the structure, a significant local failure would compromise the integrity of the dam. On this basis, it is recommended that inspection of the dam continues to be carried out annually to monitor the dam's condition and assess short-term risk.

The following work is recommended to completed within the next year (<1 year):

1. For the North Stop Log Structure, it is recommended that the raceways be blocked up as was previously done for the South Stop Log Structure as failure of the stop log structure would compromise the integrity of the dam. The details of this work would need to be determined through a separate design assignment.

The above recommended work will serve multiple purposes to address areas of immediate concern that could compromise the integrity of the dam and concerns that could impact the public, as well as extend the life of the asset.

5 CLOSURE

We trust that this report is adequate for your purposes. If you have any questions or concerns, please feel free to contact the undersigned at your convenience.

Respectfully submitted by:

WSP Environment & Infrastructure Solutions
A Division of WSP Canada Limited

Prepared by: Dante Shawil
Bridge Designer

Signature: 

Reviewed by: Nathan Kranendonk, P.Eng.
Senior Bridge Engineer

Signature: 

Reviewed by: Matthew Galloway, M.Eng., P.Eng.
Manager, Bridges

Signature: 

APPENDIX

A SITE INSPECTION PHOTOGRAPHS

APPENDIX

Photo 1 - Elevation View of North Stop Log Structure

Photo 2 – Timber Stop Logs Leaking

APPENDIX

Photo 3 – South End of North Stop Log Structure

Photo 4 – Face of North Stop Log Structure

APPENDIX

Photo 5 – Cracking along Top of North Stop Log Structure

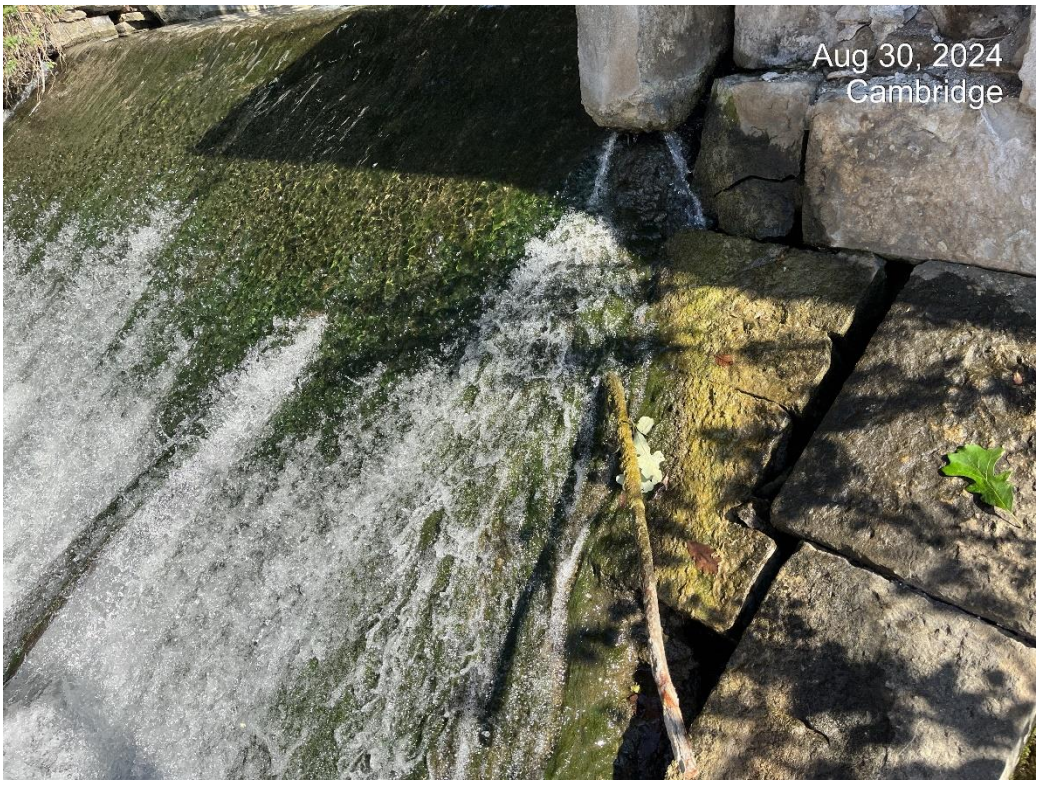


Photo 6 – Exposed Rebar at North End of North Stop Log Structure

APPENDIX

Photo 7 – North Spillway / Retaining Wall – Note Gaps in North Wall

Photo 8 – North Retaining Wall immediately Downstream of Spillway

APPENDIX

Photo 9 – Typical Condition of Spillway – Note White Water Presence due to Erosion/Spalling

Photo 10 – Typical Condition of Spillway – Note White Water Presence due to Erosion/Spalling

APPENDIX

Photo 11 – Typical Condition of Spillway – Note White Water Presence due to Erosion/Spalling

Photo 12 – South Stop Log Structure – South Side

APPENDIX

Photo 13 – South Retaining Wall – Note Cavity

APPENDIX

B CHANGES IN STOP LOG STRUCTURE

APPENDIX

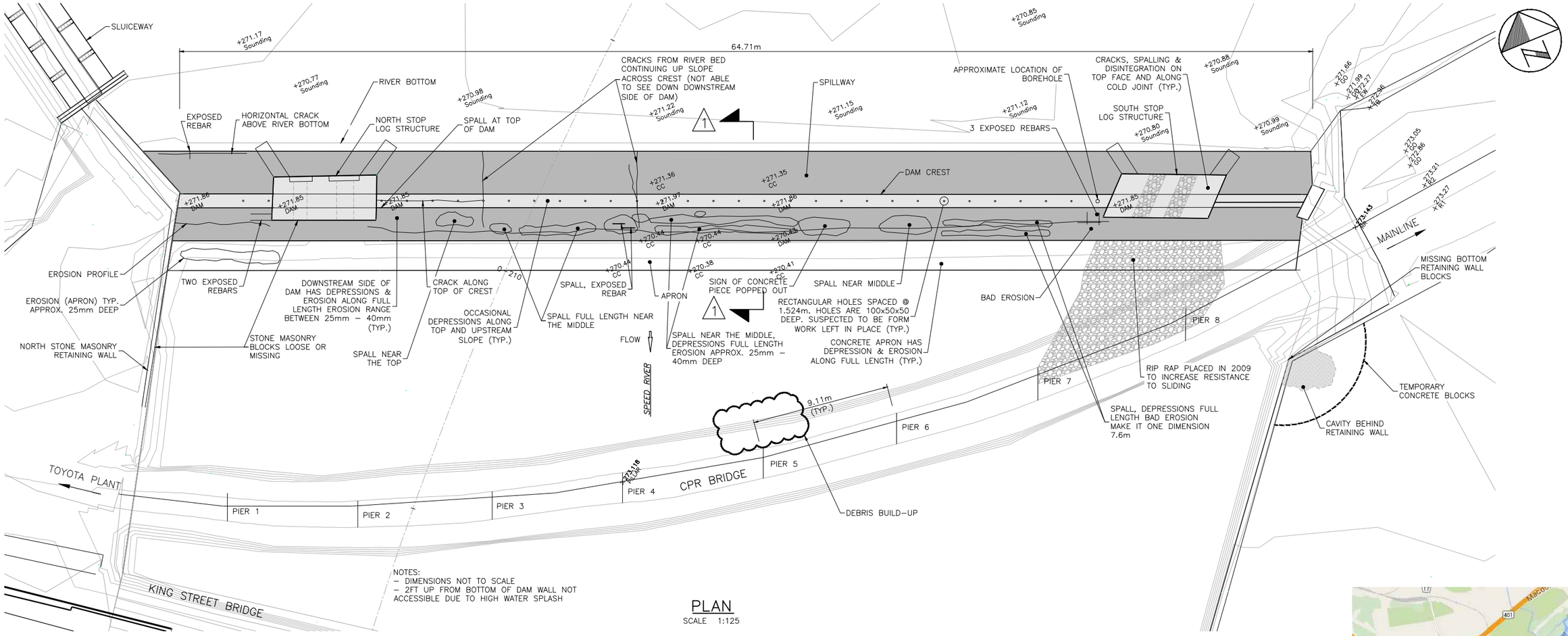
Photo 1 – North Stop Log Structure 2022

APPENDIX

Photo 2 – North Stop Log Structure 2024

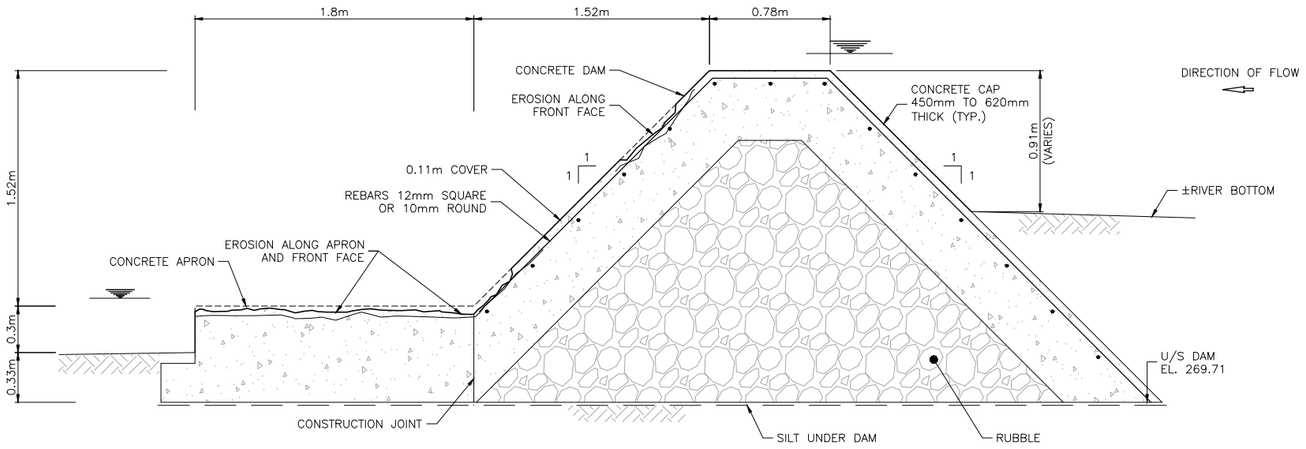
APPENDIX

C STRUCTURAL INSPECTION DRAWING



NOTES:
- DIMENSIONS NOT TO SCALE
- 2FT UP FROM BOTTOM OF DAM WALL NOT ACCESSIBLE DUE TO HIGH WATER SPLASH

PLAN
SCALE 1:125



EXISTING SECTION 1–1
SCALE 1:20

KEY PLAN

NOTES:
1. CONCRETE COVER ±110mm
2. REBAR SPACING IS ASSUMED
3. ROCK ELEVATION AT KING STREET BRIDGE RANGES FROM 268.0m TO 268.4m
4. KING STREET BRIDGE IS LOCATED APPROXIMATE 60m DOWSTREAM.

RIVERSIDE DAM
STRUCTURAL INSPECTION 2024
CITY OF CAMBRIDGE

wsp

OCTOBER 2024 SHEET 1

Plotted: 2024-10-08 Plotted By: wds_nestor.mahecha
Last Saved: 2024-10-08 Last Saved By: wds_nestor.mahecha
Path: P:\2017\Projects\TPB175082 – Structural Inspection Of The Riverside Dam.dwg