Consecon Lake and Creek Flood and Erosion Hazard Mapping

Hydraulics Report

KGS GROUP

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for the Quinte Conservation in accordance with the agreement between KGS Group and Quinte Conservation (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations, and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by Quinte Conservation and unless stated otherwise, KGS Group has not verified the accuracy, completeness, or validity of such information, makes no representation regarding its accuracy, and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group's work.

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1.0 INTRODUCTION

1.1 Objectives of the Study

KGS Group was retained by Quinte Conservation (QC) to update the regulatory floodplain for Consecon Lake and Creek from Melville Road, upstream of Consecon Lake, to the mouth of Consecon Creek at Wellers Bay. The study includes the collection of topographic data, site inspections, hydrologic assessments, hydraulic modeling and analyses, and mapping of the Regulatory Floodplain. The study also includes the preparation of erosion hazard mapping for Consecon Lake.

The study was conducted in accordance with the requirements outlined in the Ontario Ministry of Natural Resources and Forestry (MNRF), and the Flood Hazard Identification and Mapping Program (FHIMP) – Project Eligibility and Requirements. The technical guidelines used were the following:

- Natural Resources Canada Federal Flood Mapping Guidelines Series
- OMNR (2011) Technical Bulletins associated with the Lakes and Rivers Improvement Act (LRIA)
- OMNR Technical Guide – River & Stream Systems: Flooding Hazard Limit (2002)
- OMNR Technical Guide – River & Stream Systems: Erosion Hazard Limit (2002)
- USACE HEC-HMS and HEC-RAS User's Manual and Technical Reference Manual

Following guidance from Environment and Climate Change Canada (ECCC), in this study, recurrent events are referred to with both return periods and AEPs. This is to provide clarity to users of the report, and to the public, regarding the likelihood of a flood event happening in any given year. It highlights the fact that the event referred to as the 100-year flood has a 1% probability of occurring or being exceeded in any given year. The correspondence between return periods and AEPs is provided in Table 1-1. The two nomenclatures are interchangeable in this report. This report describes the hydraulic analyses and modeling conducted as part of the study.

TABLE 1-1: RETURN PERIODS AND AEPS

Return Period	Annual Exceedance Probability (AEP)
2 years	50%
5 years	20%
10 years	10%
20 years	5%
25 years	4%
50 years	2%
100 years	1%
200 years	0.5%
500 years	0.2%

1.2   Criteria for Flood Hazard Limit

Consecon Lake and Consecon Creek are located within Zone 3 in Ontario, as defined in the "Technical Guide – River and Stream Systems: Flood Hazard Limit" (MNRF 2002). Based on that guideline, the Regulatory Flood Event for this watershed is the greater of the 100-year Flood or the flood resulting from the Timmins Storm.

Based on the results obtained as part of this study (KGS, 2024a) the 100-year Flood (1% annual exceedance probability, AEP[1]) is the governing event, and, therefore, it was selected for defining the floodplain (flood hazard limit) for Consecon Lake and Consecon Creek.

1.3   General Description of the Study Area

The Consecon Lake and Creek watershed is located within the jurisdiction of Quinte Conservation with a drainage area of approximately 186 km^2. The Consecon Creek watercourse spans 37 km and begins just north of Picton. It flows towards the west through several large swamp bodies, Consecon Lake, and the hamlet of Consecon, before draining into Wellers Bay. The creek also features several structures along its path including Melville Road Bridge, Whitney Dam, Loyalist Parkway Road Bridge (Highway 33), Consecon Main Street Bridge, Consecon Mill Dam, and Regional Rd 29 Bridge.

The largest water body within the watershed is Consecon Lake. The Millenium Trail Causeway crosses the lake from north to south and separates the clearer eastern portion of the lake -referred to in this report as "upper Consecon Lake"- from its marshy western portion -referred to in this report as "lower Consecon Lake". This causeway was originally a railway trestle bridge which was converted into a hiking trail in 1995. The water levels of Consecon Lake are influenced by the Millennium Trail Causeway and the Whitney Memorial Dam, which was constructed in 1969 for the purpose of managing water levels for recreation (LATHEM, 1985). A short distance below the Whitney Dam, and upstream of Regional Rd 29, there is a small pond, created by the Consecon Mill Dam. These features are shown in Figure 1-1.

The Big Swamp and the Little Swamp, that are located in the eastern (upstream) portions of the watershed, upstream of Consecon Lake, feature depressions of porous organic soils, which provide additional water storage within the watershed and are known to attenuate flows during flood events. These swamps were studied in detail in LATHEM (1985), which found that the swamps would greatly reduce peak flows during flood events, particularly those that occur in the summer. As described in KGS Group (2024a), the effect of the swamps on the hydrologic response of the watershed was considered in the preparation of the hydrologic model developed in this study.

The floodplain mapping area subject of this study is the reach of Consecon Creek from Melville Road to Wellers Bay.

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[1] This flood has a 1% probability of occurring on any given year.

FIGURE 1-1: CONSECON CREEK WATERSHED KEY FEATURES
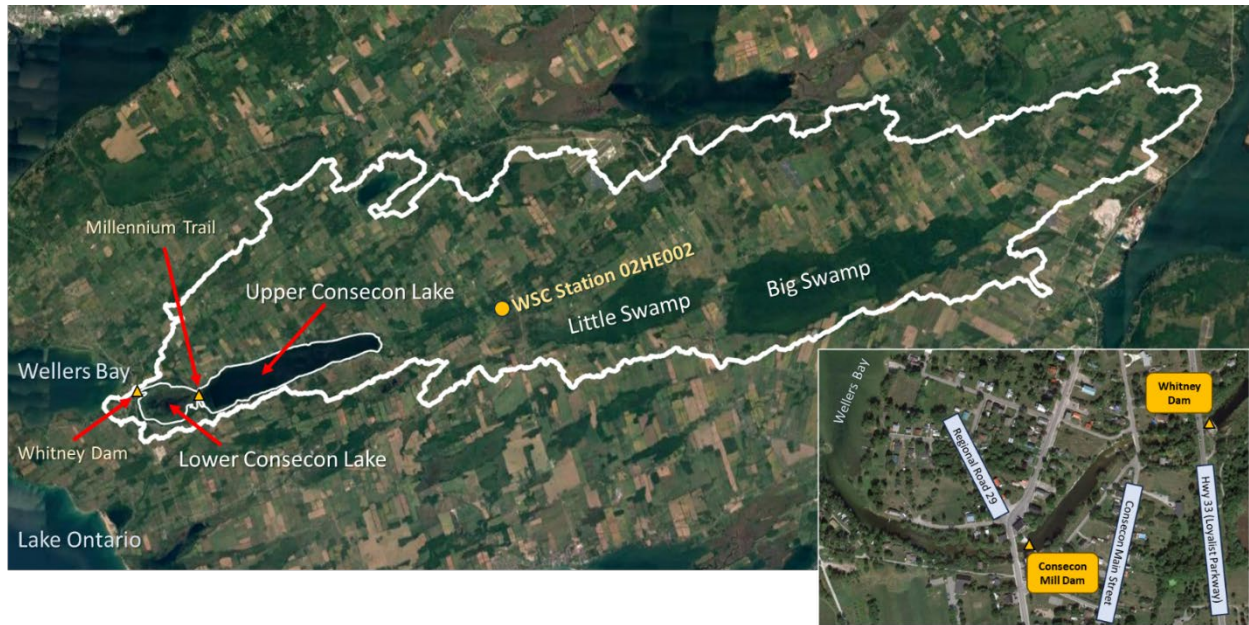
1.4   Previous Studies

Previous hydraulic studies that were identified in this project are:

- LATHEM (1985). Included hydrologic and hydraulics analysis as well as definition of the floodplain. The 100-year Flood event (1% AEP) was selected for definition of the floodplain.
- D. M. WILLS (2021). This study was for dam safety analysis for the Whitney Memorial Dam. As part of the study, the flood flows for the 100-year recurrent event (1% AEP) were simulated and included in an inundation map, along with other flood events that were relevant for the dam safety analysis.

2.0 DATA USED IN THE ANALYSIS

2.1 Topographic and Bathymetric Data

The topographic data used in this study is referenced to the EPSG:2959 – NAD83(CSRS) / UTM Zone 18N projection system and Canadian Geodetic Vertical Datum CGVD2013.

The project floodplain DEM (Figure 2-1) that served as the basis for the study was developed based on the HRDEM (High Resolution Digital Elevation Model), collected by Natural Resources Canada (NRCAN) in 2022 as part of the Belleville/Prince Edward County 2022 LiDAR project. It was supplemented with bathymetric data at structures and crossings, collected by KGS Group, as well as information obtained from available Nautical Charts. Historic bathymetric contours (Dated October 5, 1971) provided by Quinte Conservation provided limited useful information that was also used.

FIGURE 2-1: EXTENT OF THE PROJECT DIGITAL ELEVATION MODEL
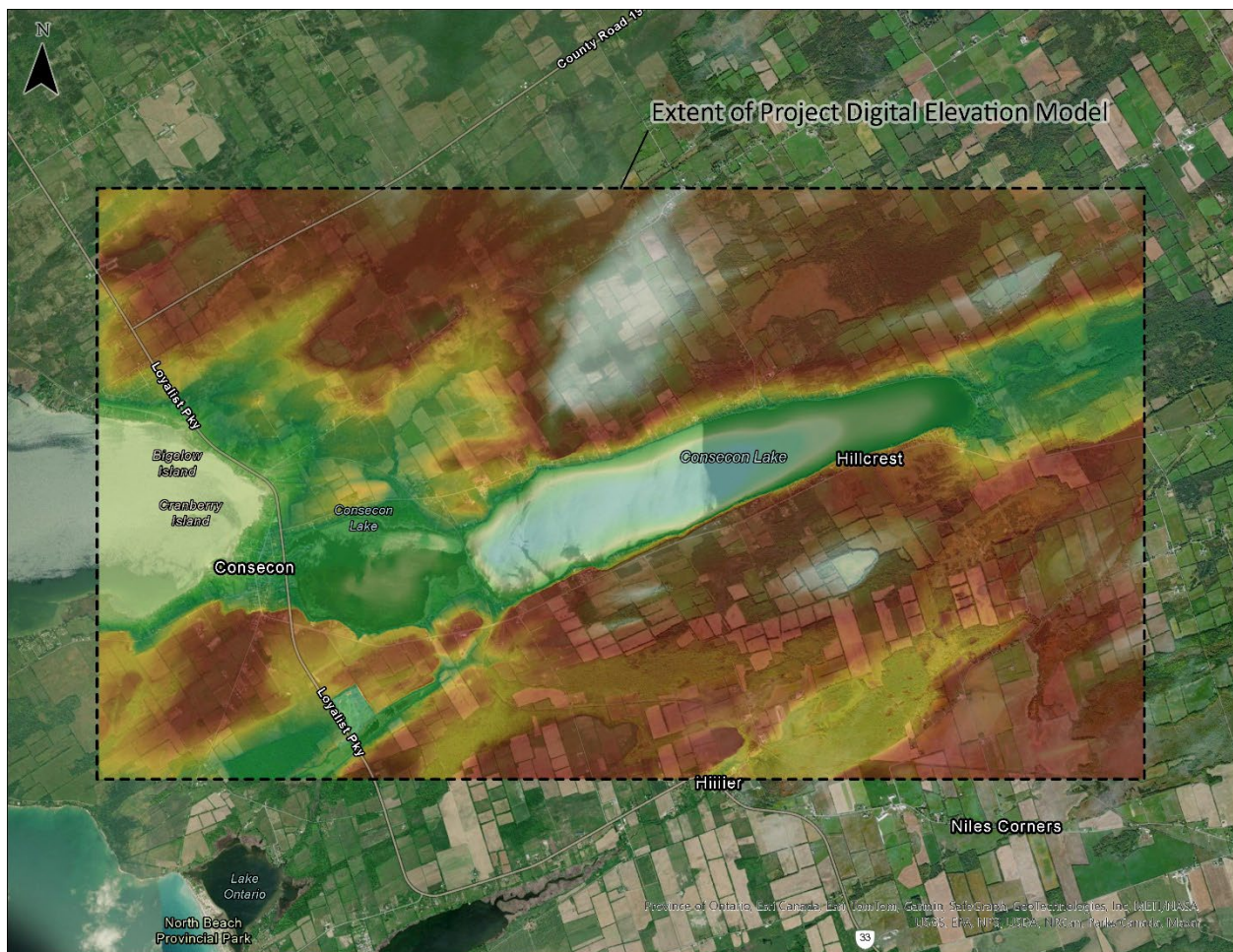
2.2   Hydrologic Data

As part of the floodplain mapping study, a hydrologic analysis of the Consecon Lake and Creek watershed was conducted and is described in the hydrology report (KGS, 2024a). The hydrologic analysis included a flood frequency analysis and hydrologic modelling of the watershed, which was developed using the program HEC-HMS. The model was calibrated and validated, and the results were comparable to that of the flood frequency analysis.

The flows determined with the hydrologic model were input to the hydraulic model described in this report. Table 2-1 provide the peak flow values and Figure 2-2 shows the input locations.

TABLE 2-1: INPUT FLOWS

Hydrologic Model Output Location	Hydraulic Model Input Location	Peak Flow (m³/s) 100-Year (1% AEP)	Time to peak from start of simulation (h)
Junction J05	Inflows to RS_10120 from Consecon Creek	81.4	43
Subbasin Upper Consecon Lake	Lateral Inflows to Upper Consecon Lake	30.4	36
Subbasin B05	Lateral Inflows to Upper Consecon Lake	21.1	45
Subbasin B04	Lateral Inflows to Upper Consecon Lake	7.2	37
Subbasin Lower Consecon Lake	Lateral Inflows to Lower Consecon Lake	15.6	36
Subbasin B03	Lateral Inflows to Lower Consecon Lake	18.0	50
Subbasin B02	Lateral Inflows to Lower Consecon Lake	7.4	36
Subbasin B01	Lateral Inflows to RS_812	7.0	37

FIGURE 2-2: LOCATION OF INPUT FLOWS
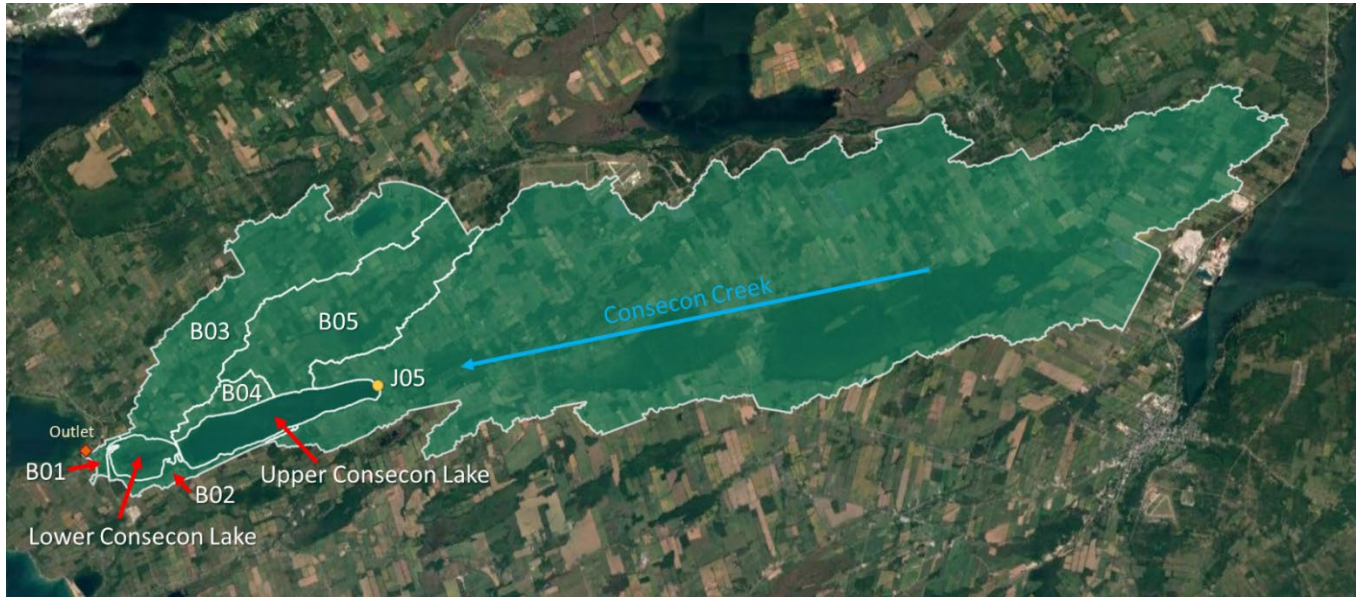
3.0 HYDRAULIC MODELLING

3.1 Model Selection and Preparation

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) model, Version 6.4.1, was used in this study to prepare a hydraulic model of Consecon Lake and Creek. HEC-RAS was developed by the US Army Corps of Engineers (USACE) and is widely used in water resources engineering for modelling open channel and river hydraulics.

The extent of the model prepared as part of this study is from Melville Road to the mouth of Consecon at Wellers Bay. A one-dimensional model was prepared, as required in the scope of work, representing the various elements of the study domain: Consecon Creek, the two portions of Consecon Lake (separated by a small reach of Consecon Creek), and the ditch west of Hwy 33 that joins Consecon Creek upstream of the Consecon Main Street crossing. The model components and their connectivity are listed in Table 3-1.

The model was set to perform hydrodynamic simulation of flow hydrographs, as proposed in the project scope definition. Level pool routing was applied at the storage areas representing upper and lower Consecon Lake and the full dynamic solution of the Saint-Venant Equation was applied to the various channel reaches included in the model. There were no spills identified that would require a two-dimensional analysis. Since the peak flows predominantly follow streamwise directions, the conditions obtained in all reaches were considered to be within the capabilities of a 1D model.

TABLE 3-1: COMPONENTS OF THE HYDRAULIC MODEL AND THEIR CONNECTIVITY

River	Reach	Storage Area	Upstream feature	Downstream feature
Consecon	Melville		Boundary Condition	Upper Consecon Lake
		Upper Consecon Lake	Melville Reach	Millenium Reach
Consecon	Millenium		Upper Consecon Lake	Lower Consecon Lake
		Lower Consecon Lake	Millenium Reach	Consecon Mill Reach
Consecon	Consecon Mill		Lower Consecon Lake	Junction
Consecon	Downstream		Junction	Boundary Condition
Ditch	Ditch		Boundary Condition	Junction

The following sections describe the model preparation for the various reaches defined as part of the Consecon Creek. The reach labelled "Ditch" was added to the model to simulate the conditions on the west side of Hwy 33. This aspect of the hydraulic model is described in Section 3.2.

3.1.1 BOUNDARY CONDITIONS

The downstream boundary condition for the model was the water level at Wellers Bay, which was considered to be constant, independently of the flows in Consecon Creek. The water level assigned at the downstream end of the model was 74.8 m, which is representative of average levels at WSC Station 02HD015 (Lake Ontario at Cobourg). This is the same level that both LATHEM and D. M. WILLS adopted for the mouth of Consecon Creek in their respective studies.

The upstream boundary condition consisted of the input flow hydrographs obtained from the hydrologic analysis (KGS, 2024a) briefly described in Section2.2. These were direct outputs from the hydrologic model, without attenuation from Consecon Lake. The hydrographs from the various sub-catchments flowing into Consecon Lake were combined to allow their input in the hydraulic model as lateral inflows to each of upper Consecon Lake and lower Consecon Lake. Figure 3-1 shows the input hydrograph used as the upstream boundary condition of the model, on Consecon Creek upstream of Consecon Lake. Baseflows were added to allow the model to establish stable initial conditions. Figure 3-2 and Figure 3-3 show the local inflows to the upper and lower portions of Consecon Lake.

FIGURE 3-1: INFLOWS TO CONSECON CREEK UPSTREAM OF CONSECON LAKE
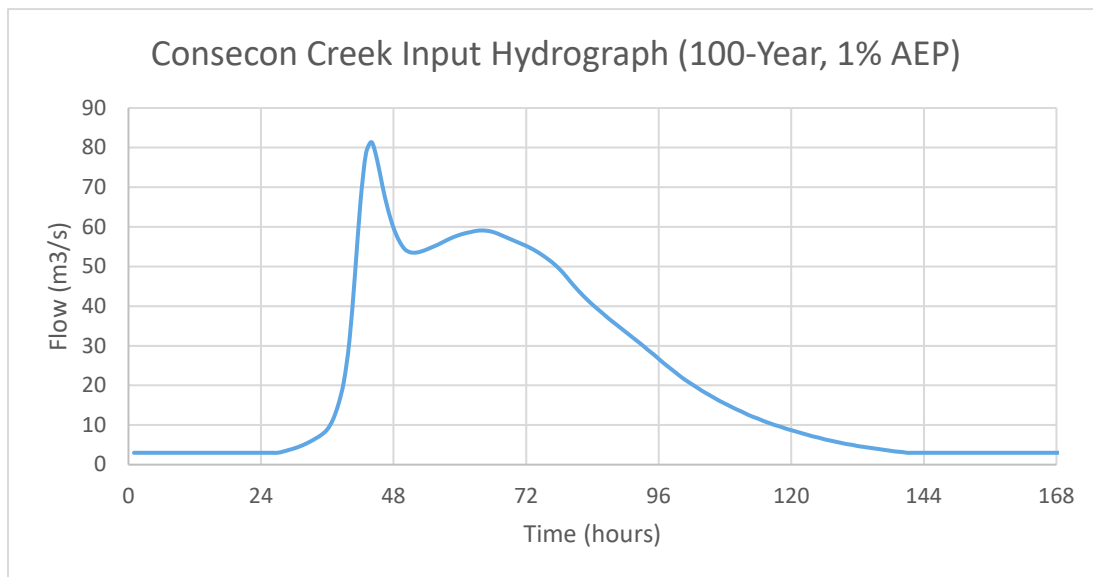
FIGURE 3-2: LOCAL INFLOWS TO UPPER CONSECON LAKE

Lateral Inflows to Upper Consecon Lake (100-Year, 1% AEP)
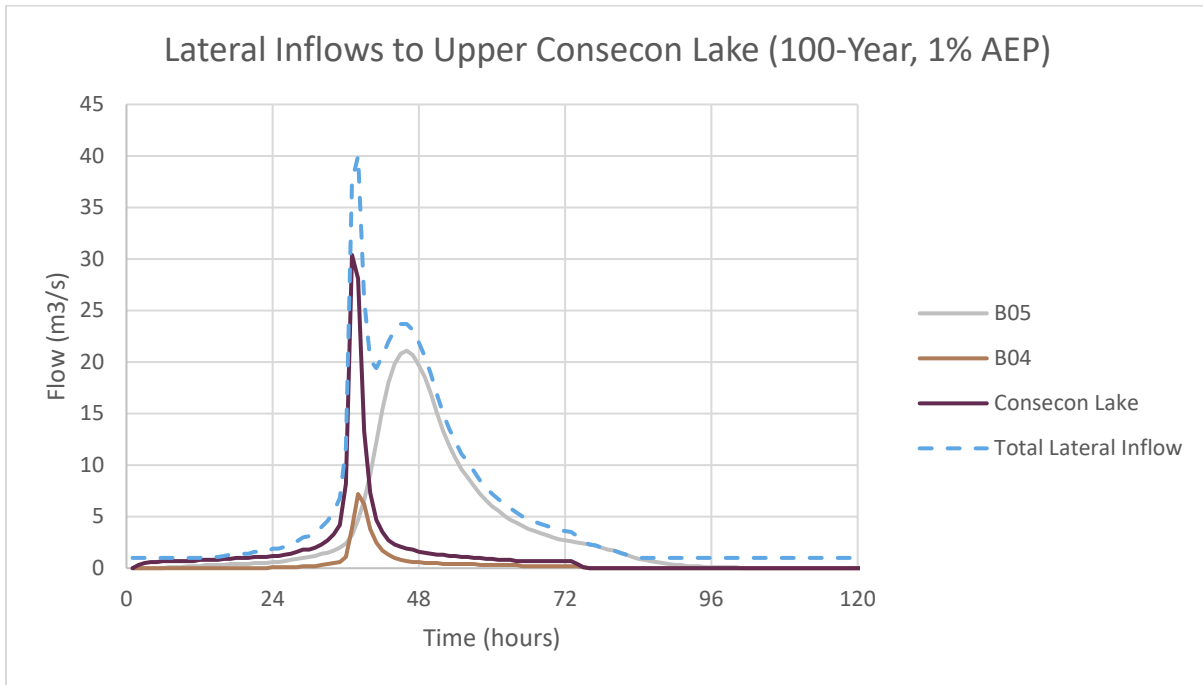
FIGURE 3-3: LOCAL INFLOWS TO LOWER CONSECON LAKE

Lateral Inflows to Lower Consecon Lake (100-Year, 1% AEP)
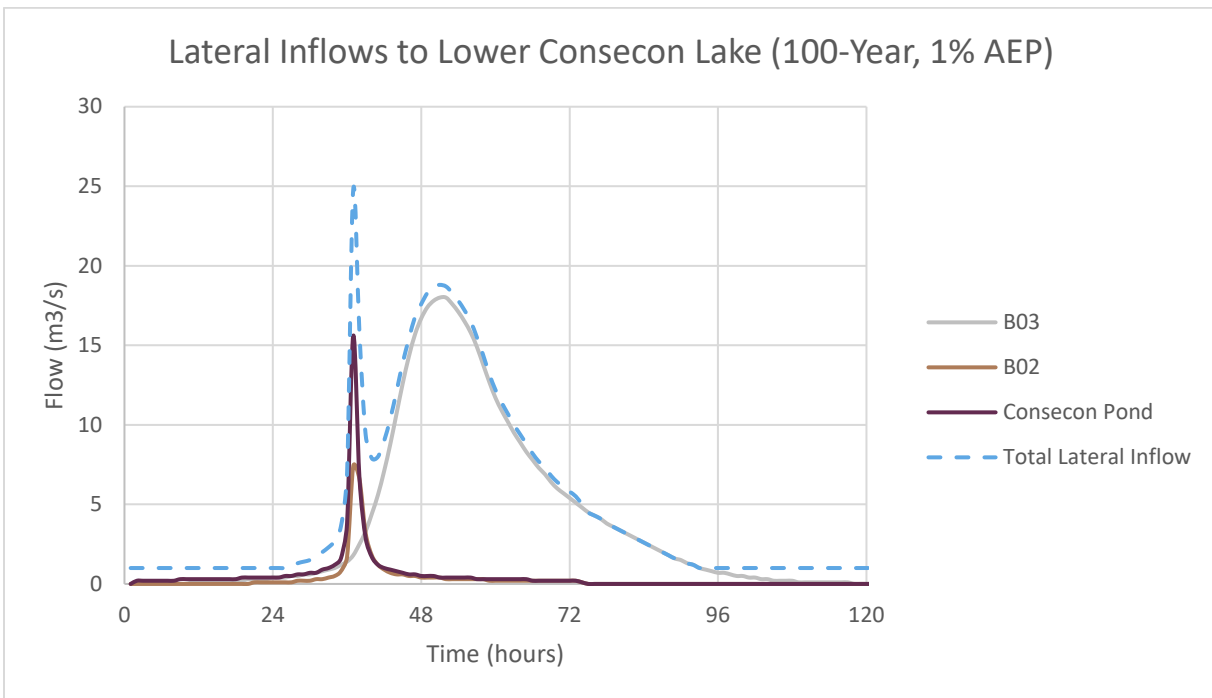
3.1.2 MANNING'S N-VALUES

The Manning's n-values were selected based on photos of the study area obtained from the field survey conducted by KGS Group in 2023. Table 3-2 shows the Manning's n values selected for the hydraulic model. For construction of the HEC-RAS model, Consecon Creek was split into various reaches, which are listed in Table 3-1. A short description and photos showing the typical channel characteristics, for the various reaches, are provided below:

- The upstream reach, Melville, extends from east of the Melville Bridge up to upper Consecon Lake. This reach was generally very weedy with large stones spaced throughout the channel and overbanks composed mainly of wetlands surrounded by dense vegetation and trees (Figure 3-4).
- A short reach of Consecon Creek, Millenium, was included in the model to allow simulation of the causeway separating the two portions of Consecon Lake (Figure 3-5).
- From Whitney Dam to Wellers Bay two reaches were included, Consecon Mill (Figure 3-6) and Downstream. The structures that were modelled within these reaches include three crossings, the Consecon Mill Dam and Whitney Memorial Dam. The portion Whitney Dam is steep and there the Manning's value was set slightly higher than the rest of the reach. It is common to have pool and riffle sequences in steep streams. In there, the Manning's values are typically higher in the riffle areas and lower in the flatter pool areas.

TABLE 3-2: MANNING'S N-VALUES FOR CONSECON CREEK

Reach	River Station	n Channel	n Overbanks
Melville	RS_10120 to RS_9012	0.045	0.070
Millennium	RS_2984	0.030	0.030
Millennium	RS_2967 to RS_2943	0.030	0.050
Consecon Mill	RS_943 to RS_727	0.050	0.080
Downstream	RS_715 to RS_8	0.030	0.060

FIGURE 3-4: MELVILLE MODEL REACH OF CONSECON CREEK
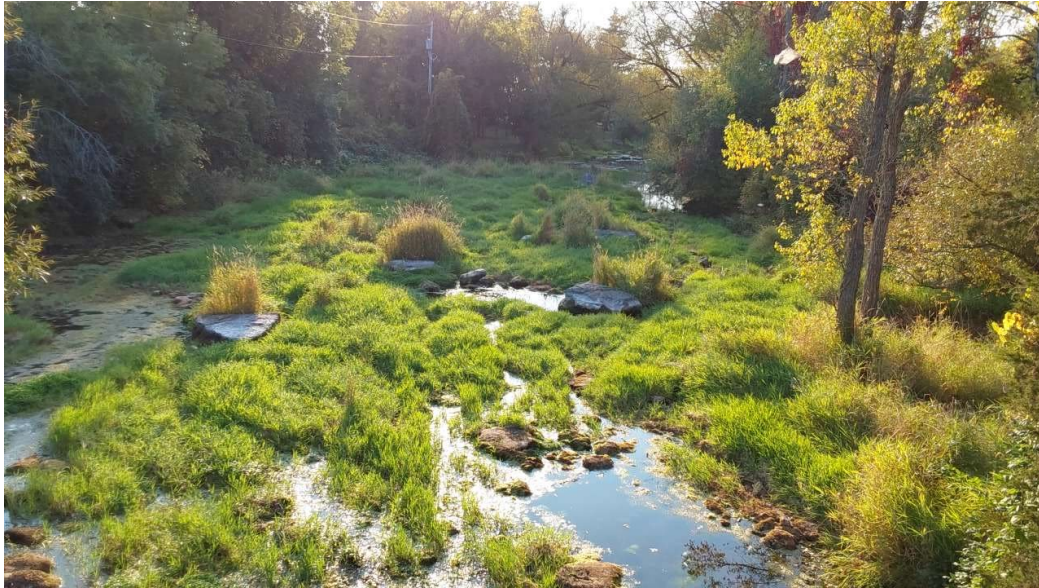
FIGURE 3-5: MILLENIUM MODEL REACH OF CONSECON CREEK

FIGURE 3-6: CONSECON MILL MODEL REACH OF CONSECON CREEK

3.1.3 EXPANSION AND CONTRACTION COEFFICIENTS

Expansion and contraction coefficients used in the model were based on typical values recommended in the HEC-RAS manual. The contraction coefficients were 0.1 for general cross sections and 0.3 for river crossings. The expansion coefficients were 0.3 for general cross sections and 0.5 for river crossings.

3.1.4 CONSECON LAKE

The two portions of Consecon Lake (upper and lower) were modelled as separate storage areas. Stage-storage relationships were obtained for each, using GIS and bathymetric data, and were input to the HEC-RAS model. These are shown in Figure 3-7 for the upper portion of Consecon Lake and Figure 3-8 for the lower portion of Consecon Lake.

Initial water levels were:

- Upper Consecon Lake: El. 79.0 m
- Lower Consecon Lake: El. 78.7 m

The initial water level used at the Upper Consecon Lake matches the average value of records provided by QC. The level used for Lower Consecon Lake is within 0.1 m of the value used in D. M. Wills (2021) to represent "sunny-day" conditions. Baseflows in the hydrographs and initial flow conditions were set to maintain these levels at the initial stages of the simulations, before arrival of the floods, for all the simulated flood scenarios.

FIGURE 3-7: UPPER CONSECON LAKE STORAGE CURVE

Upper Consecon Lake Stage-Storage
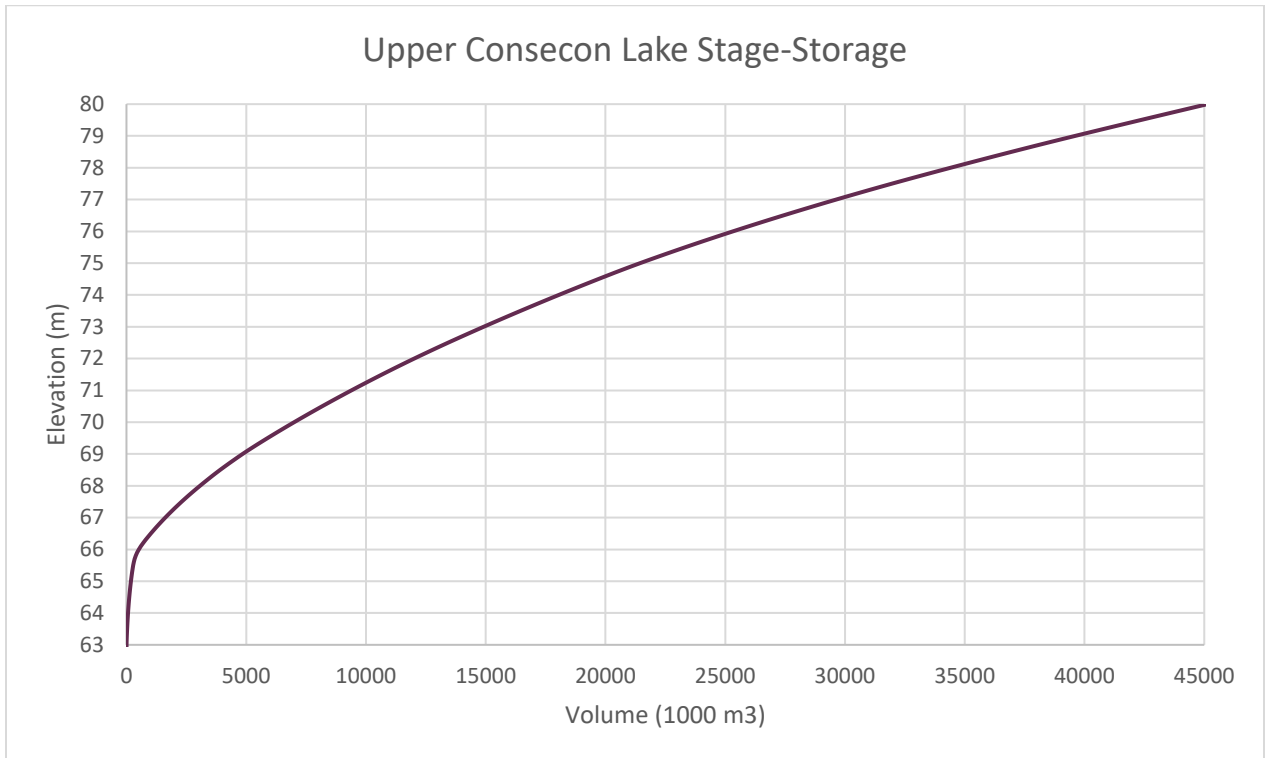
FIGURE 3-8: LOWER CONSECON LAKE STORAGE CURVE

Lower Consecon Lake Stage-Storage
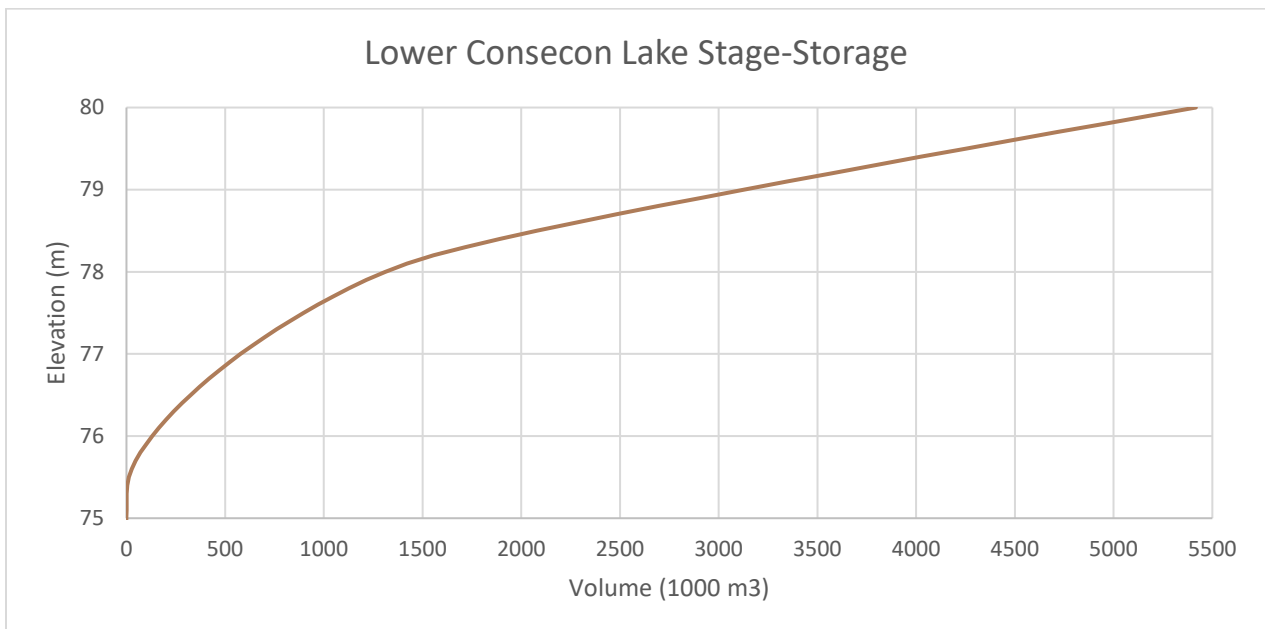
3.1.5 BRIDGES AND DAMS

For the study area from Melville to the mouth of Consecon, there are five bridges and two dams. KGS Group surveyed each of the structures and prepared crossing data sheets, that are provided in Appendix A.

The two dams were simulated in the model as in-line structures, using geometric data obtained from the survey and from the drawings provided by QC. Figure 3-9 shows the Consecon Mill Dam and Figure 3-10 shows the Whitney Memorial Dam.

FIGURE 3-9: CONSECON MILL DAM

FIGURE 3-10: WHITNEY MEMORIAL DAM

The Consecon Mill Dam was assumed to maintain four stoplogs during flood events (as per QC's operating plan and history of dam operation) and the initial water level upstream of the dam for all simulated events corresponded to the crest of the overflow weir, which is at elevation 76.8 m as surveyed by KGS Group using the CGVD2013 datum. This water level is considered representative of initial conditions before the arrival of a flood event. A review of available records of water levels provided by Quinte Conservation indicated that typical springtime water levels of the head pond were roughly around 79 m from the local staff gauge reading which corresponds to approximately 76.8 m with the CGVD2013 datum.

The Whitney Memorial Dam was represented in the HEC-RAS model based on topographic data obtained from the field survey and measurements obtained from the available 2019 AutoCAD drawings.

Two geometries of the Whitney Memorial Dam were modelled in HEC-RAS:

- Whitney Dam under current conditions: with the southern earth embankment removed (Figure 3-11).
- Whitney Dam under former conditions: with the southern earth embankment intact (Figure 3-12).

The representation in the model of the embankment (former condition) was based on the drawing P1-Project 24-6909-from December of 1986, by Totten Sims Hubicki Associates. It must be noted that this drawing does not provide elevations for the nowadays removed embankment. The top elevation of the embankment was set to be the same as the embankment that the drawing shows as proposed on the opposite side of the dam. That elevation is approximately 1.4 m higher than the crest of the adjacent concrete section, as shown in Figure 3-12. The effect of the removed embankment on the water levels was generally less than 0.1 m as discussed in subsequent sections of this report.

FIGURE 3-11: CROSS SECTION 863 IN THE HEC-RAS MODEL-WHITNEY MEMORIAL DAM WITHOUT EMBANKMENT
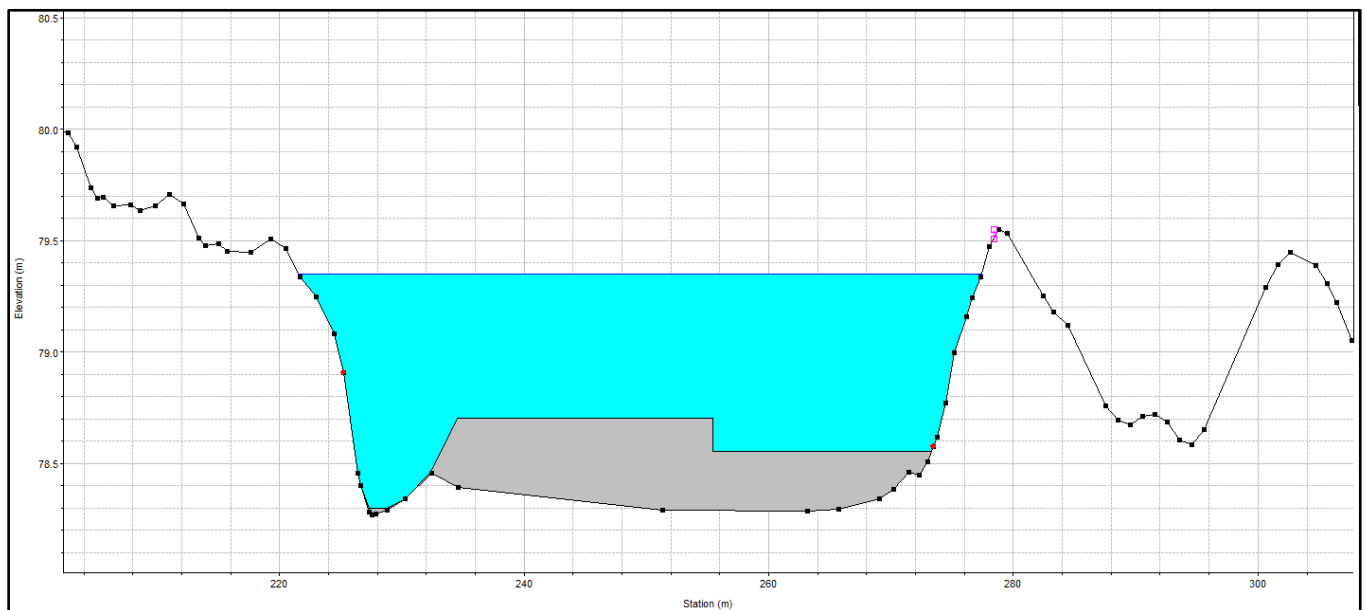
FIGURE 3-12: CROSS SECTION 863 IN THE HEC-RAS MODEL-WHITNEY MEMORIAL DAM WITH EMBANKMENT
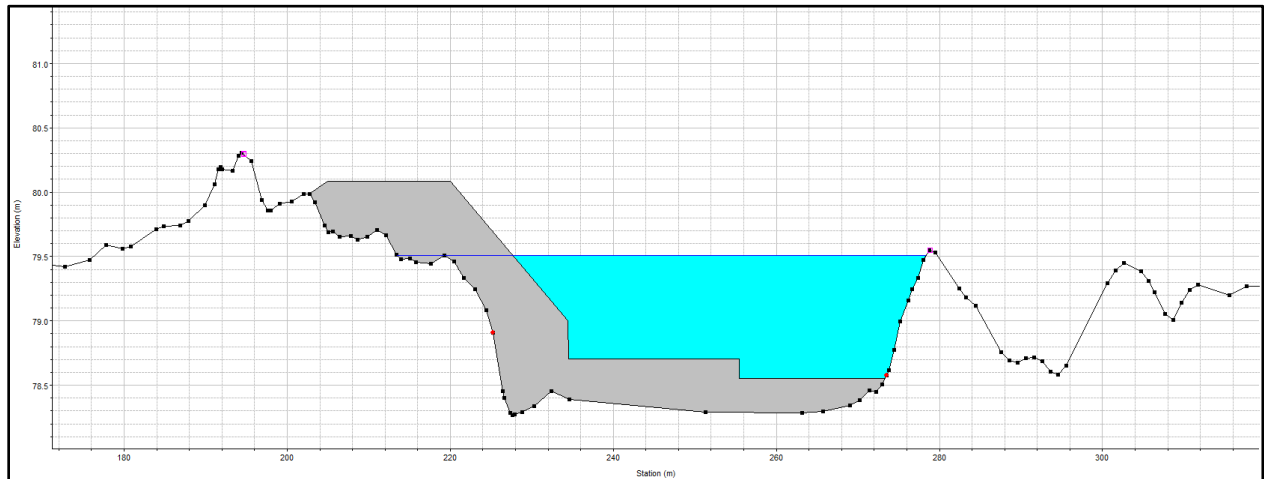
3.2   Flows Under Highway 33

There are low areas to the west of Hwy 33 (Loyalist Parkway) that are hydraulically connected with Consecon Lake, by culverts. This was highlighted by QC as an area of concern, and it was included in the model, as a separate reach (named "Ditch") that follows the alignment of the existing ditch on the west side of the highway. This ditch discharges at Consecon Creek upstream of the Consecon Main Street crossing.

The Ditch reach was set as a one-dimensional feature, resembling the predominant flow direction towards Consecon Creek. Ineffective areas were included to ensure that the conveyance portion of the cross sections did not include areas of stagnant flow or recirculation. The channel geometry and bed level used for this reach were derived from the DEM data. It must be noted that the ditch was assumed to be clean of debris and obstacles. The Manning's N-Value used for this reach was 0.05 for the channel, to acknowledge the vegetation on it, and 0.08 for the overbank.

There is a concrete box culvert on the ditch close to the point in which it joins Consecon Creek. This box culvert was also included in the model with a top elevation that was based on the DEM data and a width of 4 m, based on available imagery. A representative figure of how the ditch west of Hwy 33 was included in the one-dimensional HEC-RAS model is shown in Figure 3-13.

The Ditch reach in the model was connected to the storage area representing lower Consecon Lake with a lateral structure (corresponding to the embankment of Hwy 33). There are two circular CSP culverts with a diameter of 0.95 m that are located in a depressed area adjacent to Hwy 33, approximately 180 m south of

the highway bridge on Consecon Creek. These culverts allow flow passage under the highway between the lake and a low and wet area on the opposite side of the road[2].

Those two CSP culverts were included to the lateral structure representing the embankment of Hwy 33[3]. However, while this model geometry is part of this project's file submission, the results used for the floodplain mapping update, and provided in this report, correspond to a different geometry in which the Hwy 33 embankment was assumed to be washed out. This was done to align with Provincial guidance, by which areas protected by an embankment are not excluded from the floodplain. This model geometry resulted in more conservative flooding than with the existing field conditions. It must be noted that on Consecon Lake levels the difference obtained with these two geometries was insignificant: only 0.02 m on Lower Consecon Lake and no difference in Upper Consecon Lake for the 100-year (1% AEP) Flood. For practical purposes, this report only provides results obtained with the model geometry that assumes the Hwy 33 embankment as if it were washed out.

FIGURE 3-13: MODELLING OF FLOWS WEST OF HWY 33

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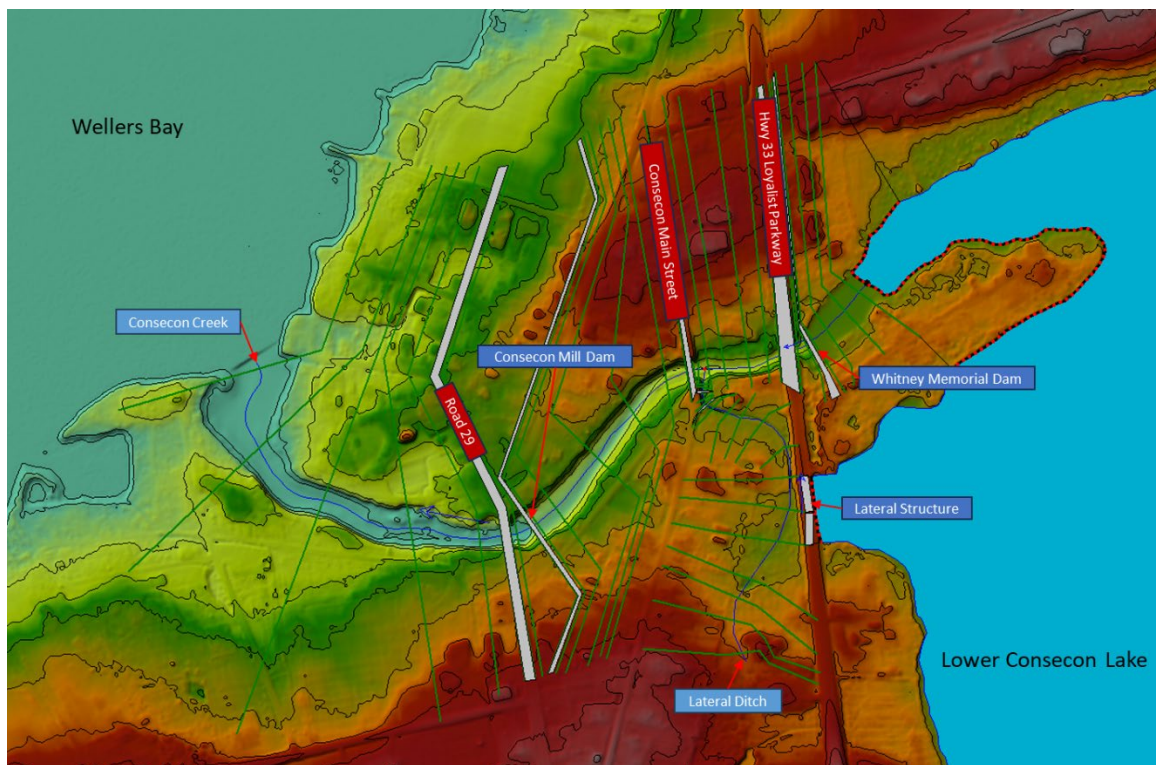
[2] There are other culverts under the highway, nearby; but those are at higher elevations and would not be reached by the lake levels for the floods considered in this study.

[3] Initially the model was prepared with three 30" diameter culverts, based on interim reference values; but the number and size of the culverts in the low area next to the highway were later confirmed with a visit to site.

3.3   Model Results

The hydraulic model was used to simulate recurrent events corresponding to the 2, 10, 20, 50, 100, 200, and 500-Year return periods (See Table 1-1 for corresponding AEPs). The hydraulic model was used to perform unsteady-state simulations, allowing the routing of floods throughout the model domain. This section of the report provides the water levels obtained for the Regulatory Flood and other simulated events. A review of the infrastructure that would be flooded with the water levels reported here is provided in a separate project report dedicated to the floodplain definition (KGS Group, 2024b).

Level-pool flood routing was performed on upper and lower Consecon Lake, which were represented in the model as storage features. Figure 3-14 shows the total inflows going into upper Consecon Lake and the total outflows and water levels obtained with the HEC-RAS model for the Regulatory Flood. Figure 3-15 shows the total inflows, and the model outflows and water levels for Lower Consecon Lake for the Regulatory Flood. The inflows to lower Consecon Lake include the hydrographs that were input to the model (Figure 3-3) plus the outflows from the upper Consecon Lake obtained with the HEC-RAS model within the simulation.

The graphs in these figures were obtained from the simulation assuming present conditions of the Whitney Memorial Dam (without the embankment that existed before but has been removed). The figures were annotated to add the corresponding values obtained with the model that included the former embankment.

Table 3-3 provides a summary of the water levels obtained at Consecon Lake with the two assumptions for the Whitney Memorial Dam (present conditions and former conditions). These values were obtained with the model geometry that includes the Hwy 33 embankment with three CSP culverts.

Tabulated detailed results of the simulations for the 2, 10, 25, 50, and 100-year scenarios with and without the Whitney Dam earth embankment are provided in Appendix B.

FIGURE 3-14: LEVEL POOL ROUTING ON UPPER CONSECON LAKE

Water Level - 100Yr present conditions: 80.02m
Water Level - 100Yr former conditions: 80.02m
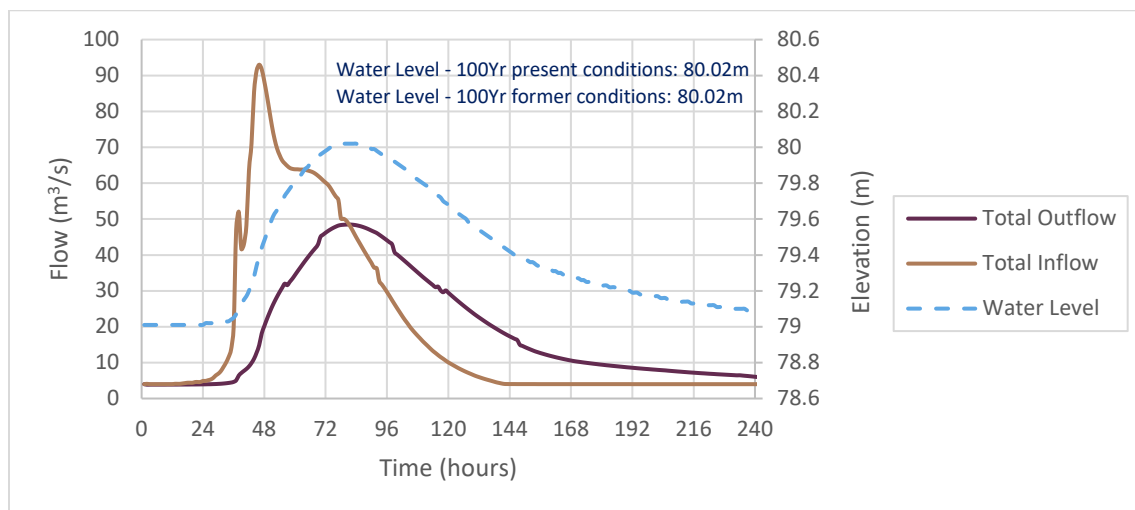
FIGURE 3-15: LEVEL POOL ROUTING ON LOWER CONSECON LAKE

Water Level - 100Yr present conditions: 79.47m

Water Level - 100Yr former conditions: 79.58m
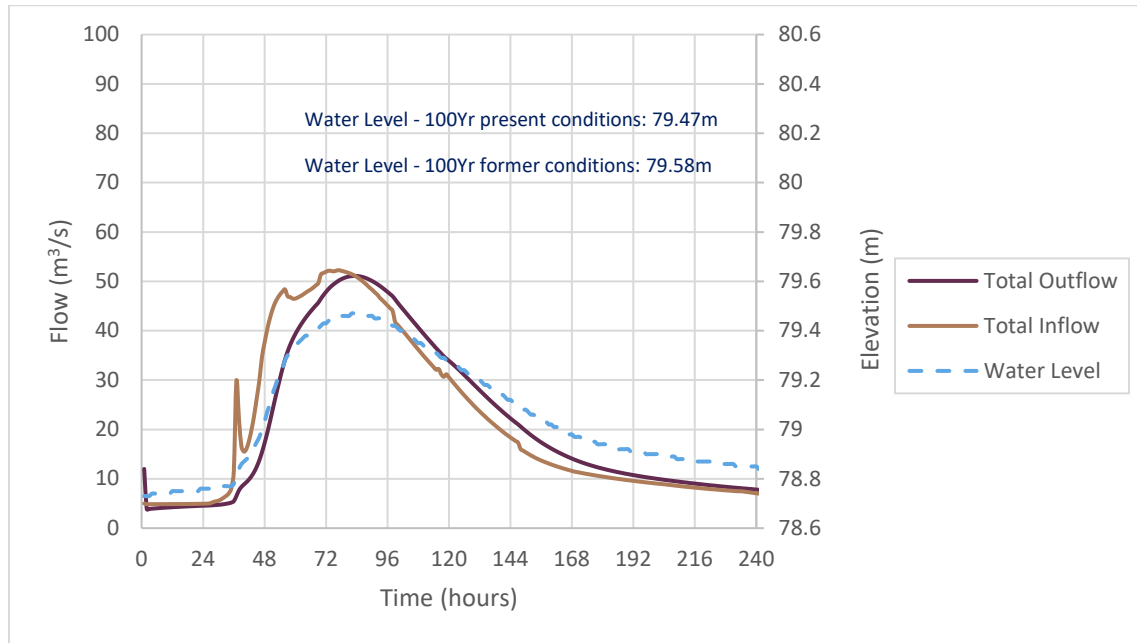
TABLE 3-3: CONSECON LAKE WATER LEVELS

Water Surface Elevation (m)		
Scenario	Lower Consecon Lake	Upper Consecon Lake
2YR Present Conditions	79.05	79.42
2YR Former Conditions	79.10	79.42
10YR Present Conditions	79.23	79.68
10YR Former Conditions	79.27	79.69
25YR Present Conditions	79.31	79.84
25YR Former Conditions	79.36	79.84
50YR Present Conditions	79.37	79.94
50YR Former Conditions	79.43	79.94
100YR Present Conditions	79.44	80.02
100YR Former Conditions	79.49	80.02
200YR Present Conditions	79.50	80.13
200YR Former Conditions	79.54	80.13
500YR Present Conditions	79.56	80.25
500YR Former Conditions	79.60	80.26

This table provides results for present conditions (with the southern earth embankment removed) and former conditions (with the southern earth embankment intact)

The water levels at the lower Consecon Lake did not overtop Hwy 33. However, the flow that would pass through the culverts under the highway, was found to fill the low areas on to the west of the highway. The simulated flood hazard there did not overtop Consecon Main Street. The water levels that the model showed in this area are provided in Table 3-4. The table shows the results obtained with the highway embankment

and with its three CSP culverts. The water levels obtained in this area for regulatory purposes, removing the protection of the Hwy 33 embankment and for the Regulatory Flood (100-year or 1% AEP) were:

- El. 79.44 m with the Whitney Dam under current conditions (with the southern earth embankment removed).
- El. 79.49 m with the Whitney Dam under former conditions (with the southern earth embankment intact).

TABLE 3-4: WATER LEVELS IN THE AREA BETWEEN HWY 33 AND CONSECON MAIN STREET

Water Surface Elevation (m)	
Scenario	Area Between Hwy 33 and Consecon Main Street
2YR Present Conditions	79.05
2YR Former Conditions	79.10
10YR Present Conditions	79.23
10YR Former Conditions	79.27
25YR Present Conditions	79.31
25YR Former Conditions	79.36
50YR Present Conditions	79.37
50YR Former Conditions	79.43
100YR Present Conditions	79.44
100YR Former Conditions	79.49
200YR Present Conditions	79.50
200YR Former Conditions	79.54
500YR Present Conditions	79.56
500YR Former Conditions	79.60

This table provides results for present conditions (with the southern earth embankment removed) and former conditions (with the southern earth embankment intact)

4.0 CLIMATE CHANGE

While there is no scientific consensus on a methodology to consider the potential effect of climate change, the FHIMP guidelines indicate that a good approximation is to use the 200-year (0.5% AEP) event. As proposed for this project and agreed in the scope definition, that event (0.5% AEP) and the 500-year (0.2% AEP) were used for a sensitivity analysis to consider the potential effect of climate change on the floodplain definition for the study area.

A summary of the results of the scenarios used for climate change considerations is provided in Table 4-1 for Upper Consecon Lake and in Table 4-2 for Lower Consecon Lake.

TABLE 4-1: UPPER CONSECON LAKE TOTAL INFLOW VS OUTFLOW

Scenario	Peak Total Inflow	Peak Total Outflow	Peak Water Level
200-Year Present Conditions at Whitney Dam	104.00	55.25	80.13
500-Year Present Conditions at Whitney Dam	117.49	63.32	80.25

TABLE 4-2: LOWER CONSECON LAKE TOTAL INFLOW VS OUTFLOW

Scenario	Peak Total Inflow	Peak Total Outflow	Peak Water Level
200-Year Present Conditions at Whitney Dam	59.15	58.35	79.54
500-Year Present Conditions at Whitney Dam	67.69	67.07	79.61

Additional model results for the 200-year and 500-year scenarios are included in Appendix B.

5.0 REFERENCES

- D.M. Wills (2021), Dam Safety Review Whitney Dam
- KGS Group (2024a). Consecon Lake and Creek Flood and Erosion Hazard Mapping, Hydrology Report
- KGS Group (2024b). Consecon Lake and Creek Flood and Erosion Hazard Mapping, Floodplain Mapping Report
- LATHEM (1985), Consecon Creek: A Quantitative Water Management Study.
- Ontario Ministry of Natural Resources, (OMNR 2002), River & Stream Systems: Flooding Hazard Limit Technical Guide.
- United States Army Corps of Engineers, (USACE, 2016), Hydraulic Reference Manual.

APPENDIX A

Crossing Data Sheets

Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Consecon Main Street Bridge

Structure Type: Vehicular Bridge

Location: UTM Grid (CSRS Zone 18, N: 4874498.9, E: 297972.5)
Consecon Creek: 43.996079268440475, -77.51963412615288

Field Notes: Units in Metres. Elevations provided in site sketch.

Bridge Material	Total Bridge Span	Deck Width	Number of Spans	Number of Piers	Measurement to Bottom of Girder
Concrete	21.415	8.202	1	0	1.29

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

Photo 4: Looking Downstream from Structure

Site Sketch

Consecon Main Street Bridge

x INV = 76.02

↓ u/s

North Bank

21.42

8.2

x Top Bridge Deck = 80.39

South Bank

↓ d/s x INV = 76.10

1.29

▽ WL = 76.68

Elevations in Metres
All elevations are referenced to Natural Resources Cananda - High Precision 3D Benchmark # 823033-Pier3, using UTM18, Nad83(CRSR), vertical datum CGVD2013
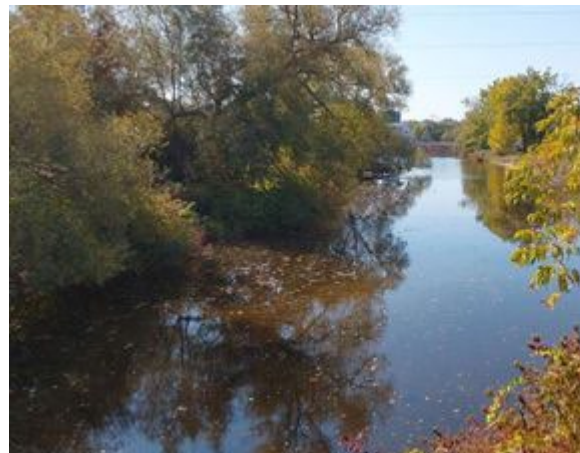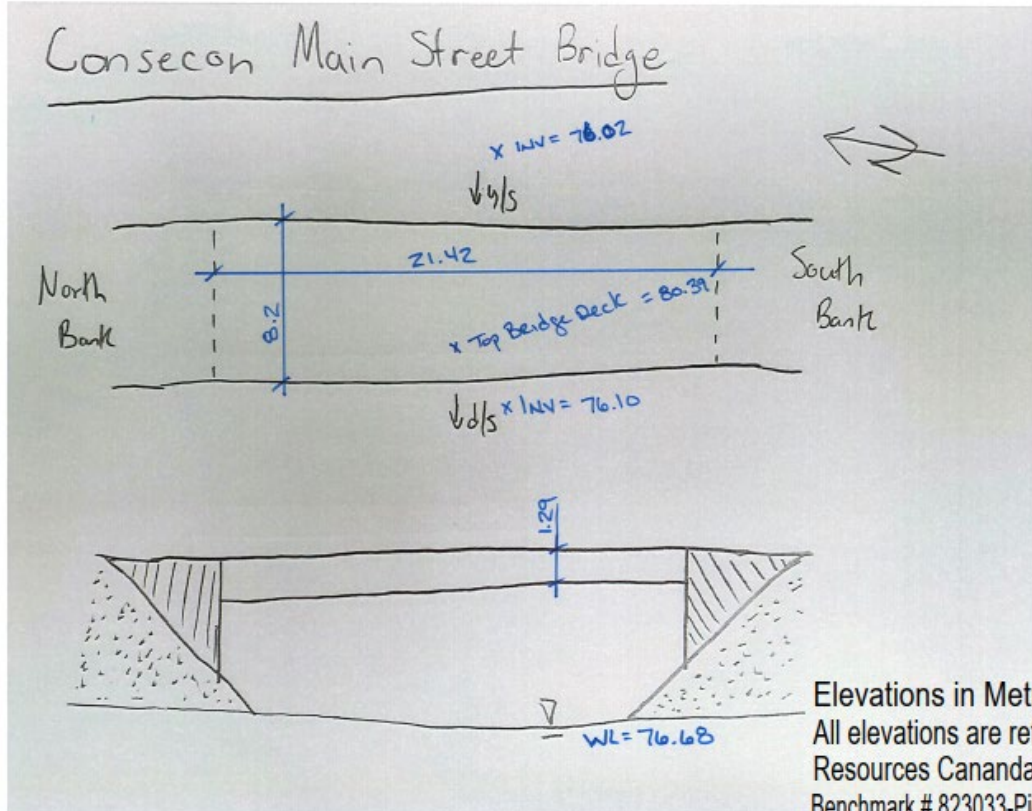
Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Bridge on Loyalist Parkway (Hwy 33)

Structure Type: Vehicular Bridge

Location: UTM Grid (CSRS Zone 18, N: 4874540.5, E: 298087.6)
Consecon Creek: 43.99629151824787, -77.51828765726067

Field Notes: Units in metres. Elevations provided in site sketch.

Bridge Material	Total Bridge Span	Deck Width	Number of Spans	Number of Piers	Measurement to Bottom of Girder
Concrete	18.086	9.624	1	0	1.56

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

Photo 4: Looking Downstream from Structure

Loyalist Parkway Hwy 33 Bridge

X INV = 76.49
↓ u/s
18.09
North Bank — 9.92
X Top Deck = 80.51
South Bank
↓ d/s X INV = 76.69
TO 8TH GIEDEN
1.56
WL = 76.66

Elevations in Metres
All elevations are referenced to Natural Resources Cananda - High Precision 3D Benchmark # 823033-Pier3, using UTM18, Nad83(CRSR), vertical datum CGVD2013
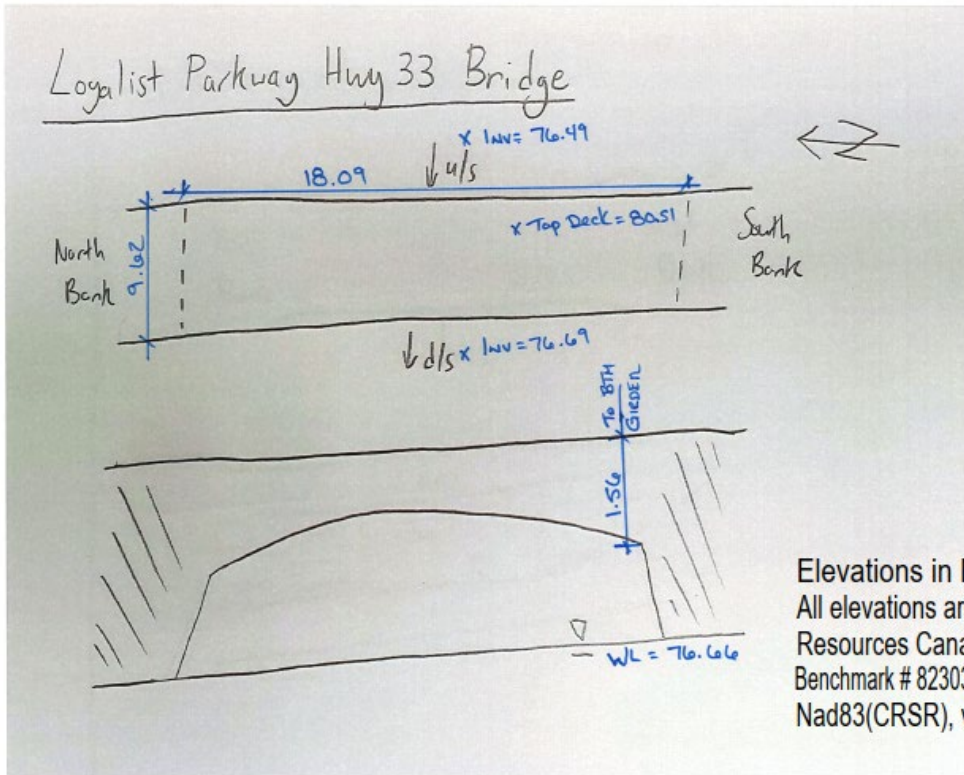
Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Whitney Memorial Dam

Structure Type: Control Structure

Location: UTM Grid (CSRS Zone 18, N: 4874522.1, E: 298110.4)
Consecon Creek: 43.9963919053873, -77.51800869312589

Field Notes: Concrete/embankment dam.
The concrete dam is approximately 30 m wide. It has a concrete overflow weir. The crest elevation of the dam in approximately at El. 78.7 m (CGVD2013)

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

Photo 4: Looking Downstream from Structure

Additional Photos

Drawings

PLAN VIEW
SCALE N.T.S.

EL. 79.02

TWIN Ø300mm
SLUICE GATE

$\underset{\triangle}{A}$ SECTION
SCALE N.T.S.

0.30 m

1.20 m

$\underset{\triangle}{B}$ SECTION
SCALE N.T.S.

0.50 m

EARTH DYKE

ORIGINAL GROUND

$\underset{\triangle}{C}$ SECTION
SCALE N.T.S.
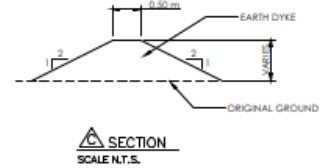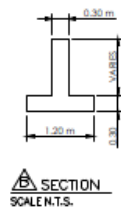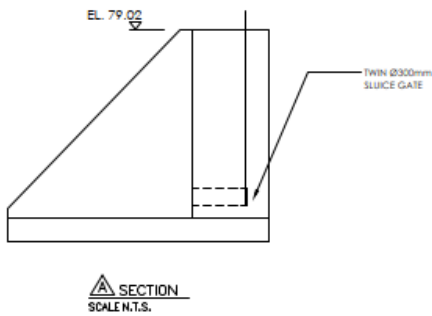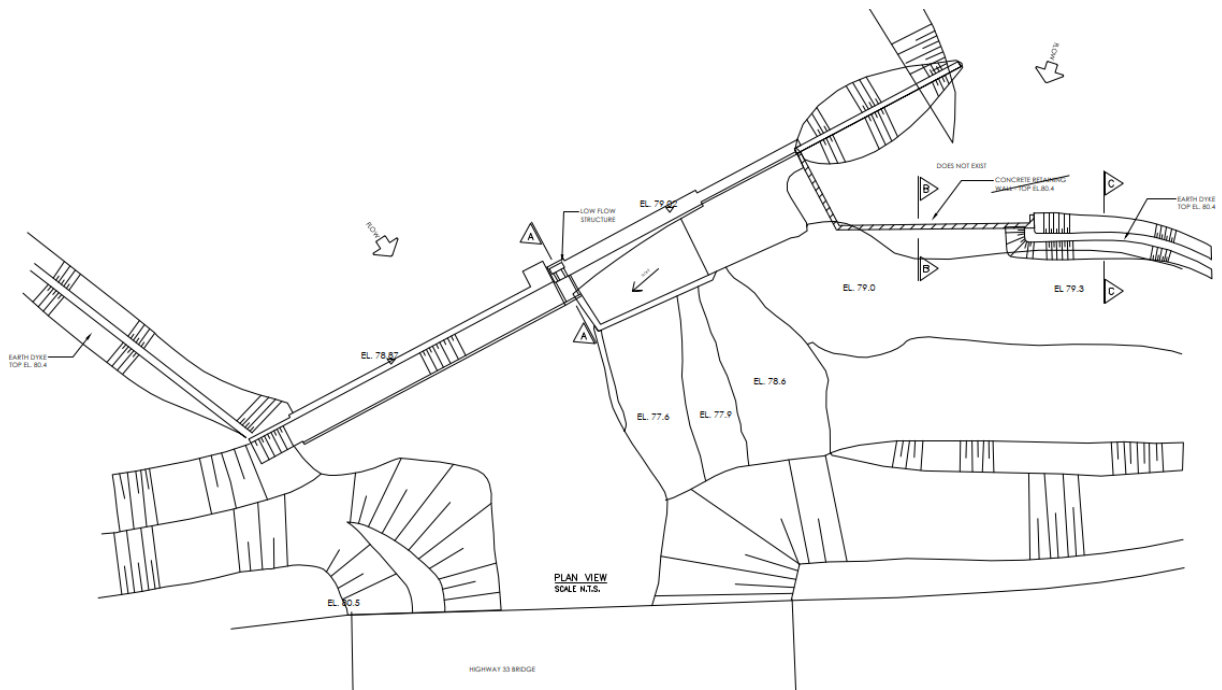
Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Regional Road 29 Bridge

Structure Type: Vehicular Bridge

Location: UTM Grid (CSRS Zone 18, N: 4874350.5, E: 297783.9)
Consecon Creek: 43.99428922543858, -77.52223827066639

Field Notes: Units in Metres. Elevations provided in site sketch.

Bridge Material	Total Bridge Span	Deck Width	Number of Spans	Number of Piers	Measurement to Bottom of Girder
Concrete	23.464	10.856	2	1	0.81

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

Photo 4: Looking Downstream from Structure

Site Sketch

Regional Road 29 Bridge

↓ u/s X INV = 74.40

23.46

North Bank   10.86   South Bank

↓ d/s
X INV = 74.56

0.8

0.9

11.73   6.9

WL = 74.78

Elevations in Metres
All elevations are referenced to Natural
Resources Cananda - High Precision 3D
Benchmark # 823033-Pier3, using UTM18,
Nad83(CRSR), vertical datum CGVD2013
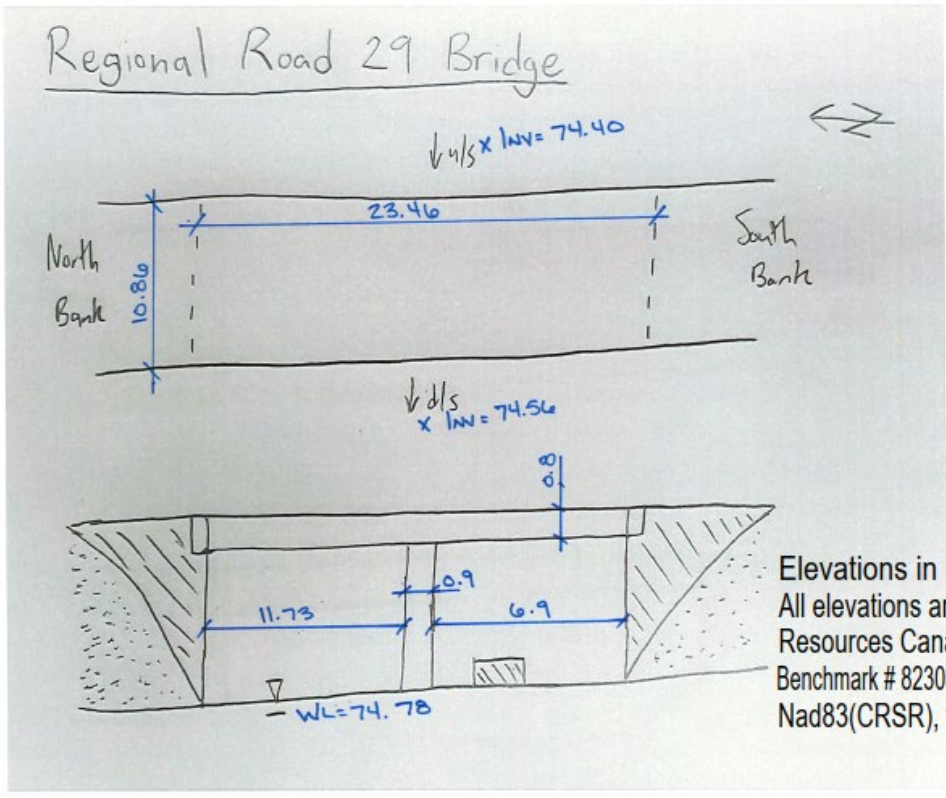
Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Melville Road Bridge

Structure Type: Vehicular Bridge

Location: UTM Grid (CSRS Zone 18, N: 4876406.1, E: 306096.2)
Consecon Creek: 44.015142857034185, -77.41913514391851

Field Notes: Units in metres. Elevations provided in site sketch.

Bridge Material	Total Bridge Span	Deck Width	Number of Spans	Number of Piers	Measurement to Bottom of Girder
Concrete	12.245	10.434	1	0	1.07

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

Photo 4: Looking Downstream from Structure

Melville Road Bridge

↓u/s 12.25

West Bank

10.43

x Top Deck = 82.92

East Bank

↓d/s

1.1 Deck to BTM Girder

Elevations in Metres
All elevations are referenced to Natural
Resources Cananda - High Precision 3D
Benchmark # 823033-Pier3, using UTM18,
Nad83(CRSR), vertical datum CGVD2013

▽ WL = 78.85
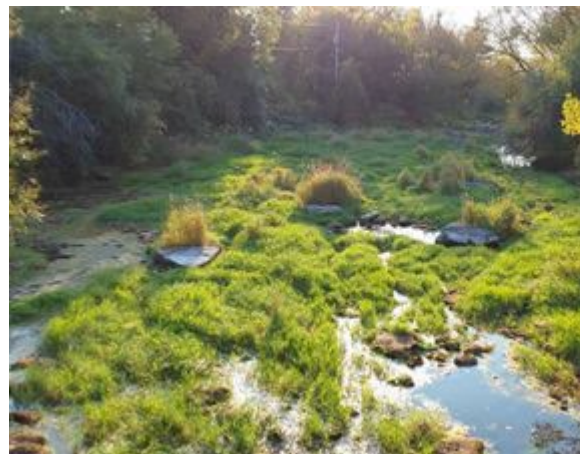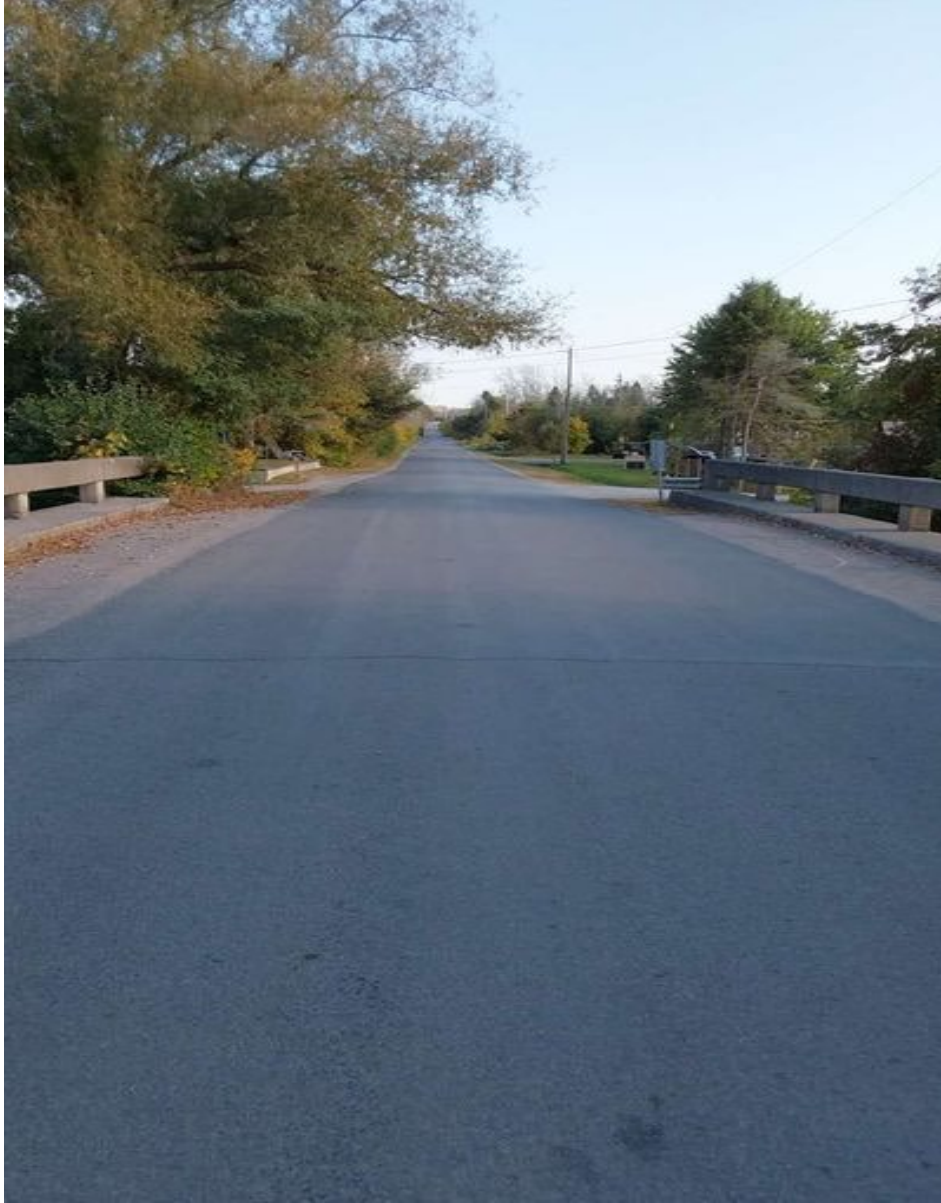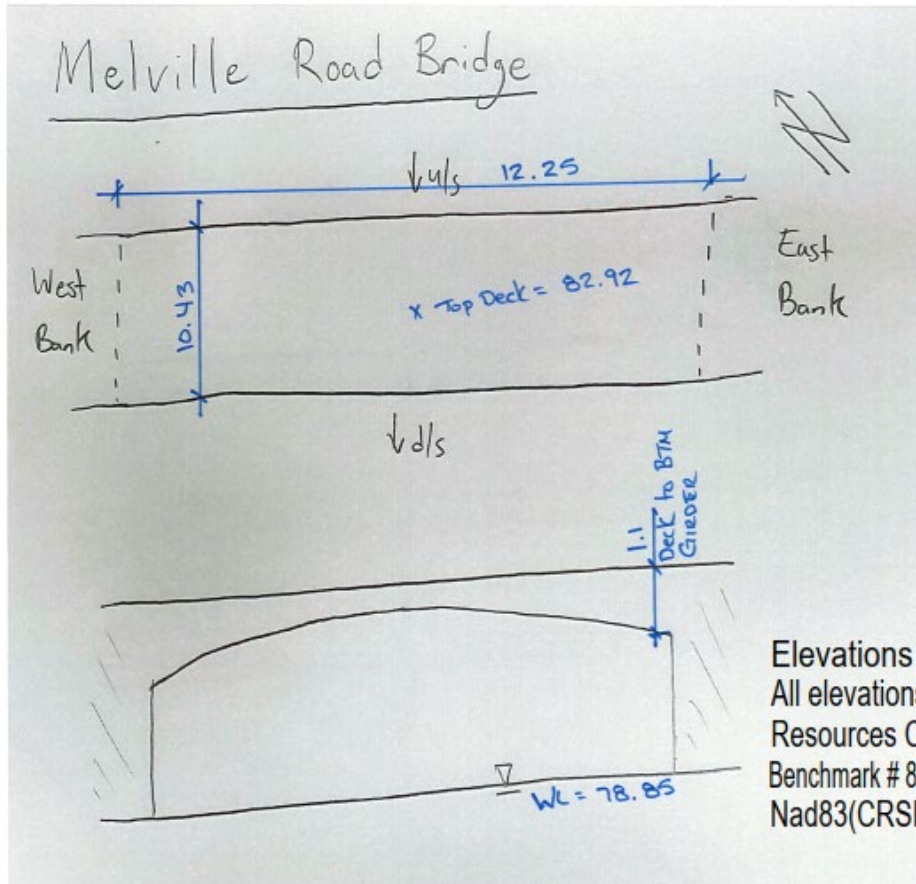
Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Consecon Mill Dam

Structure Type: Concrete Dam

Location: UTM Grid (CSRS Zone 18, N: 4874350.5, E: 297783.9)
Consecon Creek: 43.99441576120672, -77.52189299027243

Field Notes: This structure is a dam.
The dam has one overflow spillway and one sluiceway bay with stoplogs.
Top of retaining wall: 78.3 m (CGVD 2013). The total length of the dam is 47 m.
See drawings for location of retaining wall.

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

Photo 4: Looking Downstream from Structure

Additional Photos

Drawings

SECTION E-E
SCALE 1" = 5'

BRIDGE

EXISTING MILL

RIP-RAP TO ELEV. 104.0 (TYP.)

EXISTING CONCRETE STRUCTURE TO BE REMOVED

GABION GROYNE BANK PROTECTION (TYP.)

ROCK FILL (TYP.)

LIMIT OF CONSTRUCTION (TYP.)

9'X3'X1' GABIONS (TYP.)

1'X1' CONC. BLOCK (TYP.)

FLOW

PLAN - ALTERNATE '3'
SCALE 1" = 20'

Top of Retaining Wall

X₁

Y₁

EL. 109.0

EL. 106.0

EL. 103.5

EL. 104.0

EL. 100.0

ELEVATION - ALTERNATE '3'
SCALE: VERT. 1"=10'
HORIZ. 1"=20'
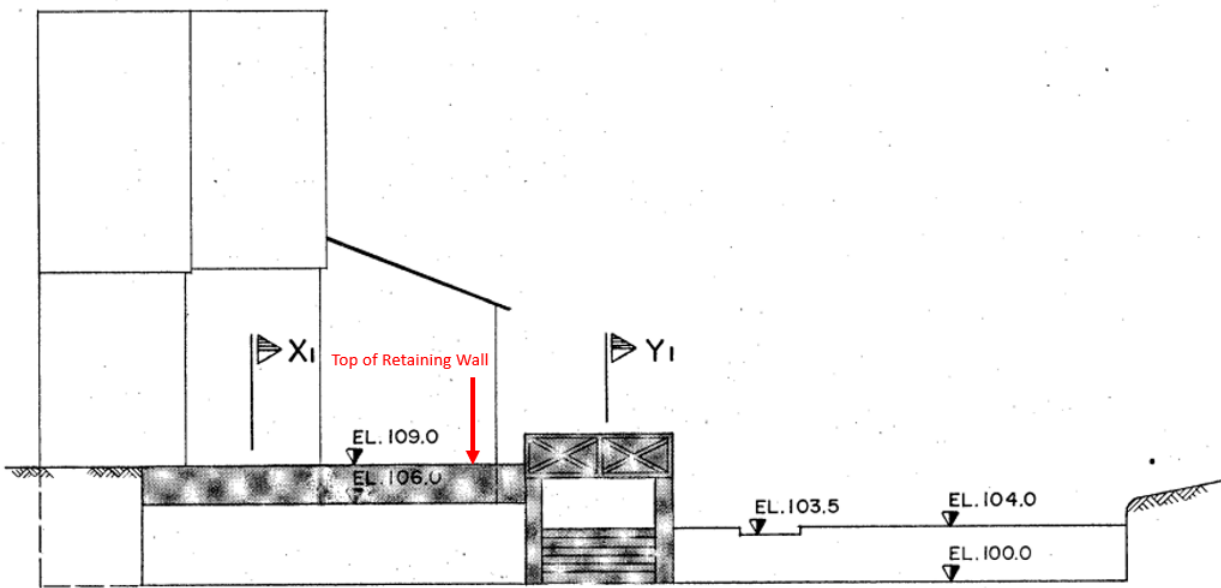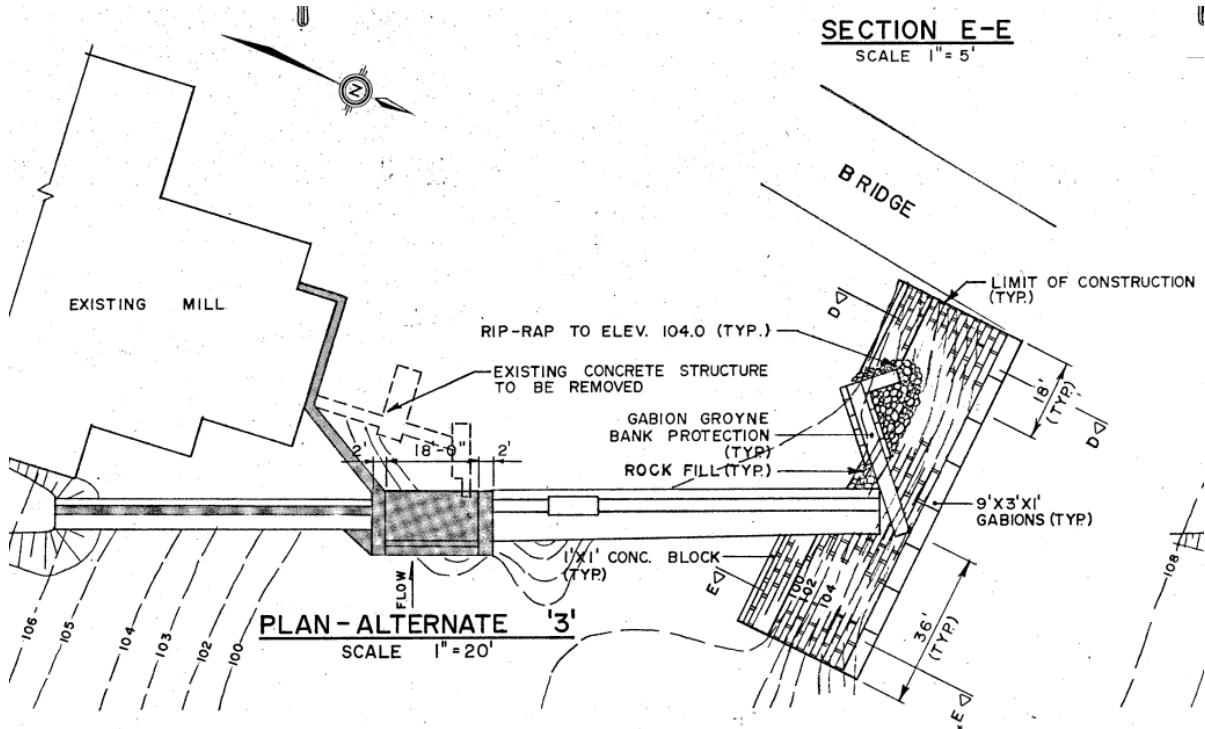
Crossing Data Sheet

Project: Consecon Lake and Creek Flood Hazard and Erosion Mapping

Site Visit Date: October 2, 2023   **Crew:** Jamie Childs & Chris Veneruz

Structure Name: Millenium Trail Causeway Bridge

Structure Type: Pedestrian Bridge

Location: UTM Grid (CSRS Zone 18, N: 4874544.7, E: 300176.9)
Consecon Creek: 43.99688199817968, -77.49225324246957

Field Notes: Wood bridge for ATV, pedestrian, and snowmobile traffic. There are 6 spans.
Units in metres. Elevations provided in site sketch.

Bridge Material	Total Bridge Span	Deck Width	Number of Spans	Number of Piers	Measurement to Bottom of Girder
Wood	27.066	3.939	6	6	0.6

Photo 1: Upstream End of Structure

Photo 2: Downstream End of Structure

Photo 3: Looking Upstream from Structure

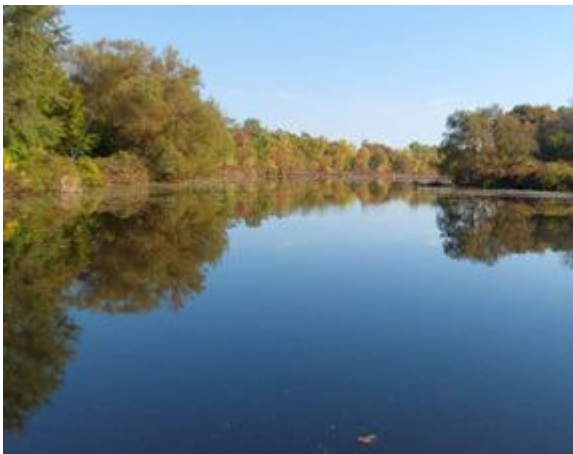**Photo 4: Looking Downstream from Structure**

Millennium Trail Causeway Bridge

↓ u/s

West Bank

27.10

3.94

× Top Deck = 80.69

East Bank

↓ d/s

0.6 Deck to BTM Girder

WL = 78.46

Elevations in Metres
All elevations are referenced to Natural
Resources Cananda - High Precision 3D
Benchmark # 823033-Pier3, using UTM18,
Nad83(CRSR), vertical datum CGVD2013
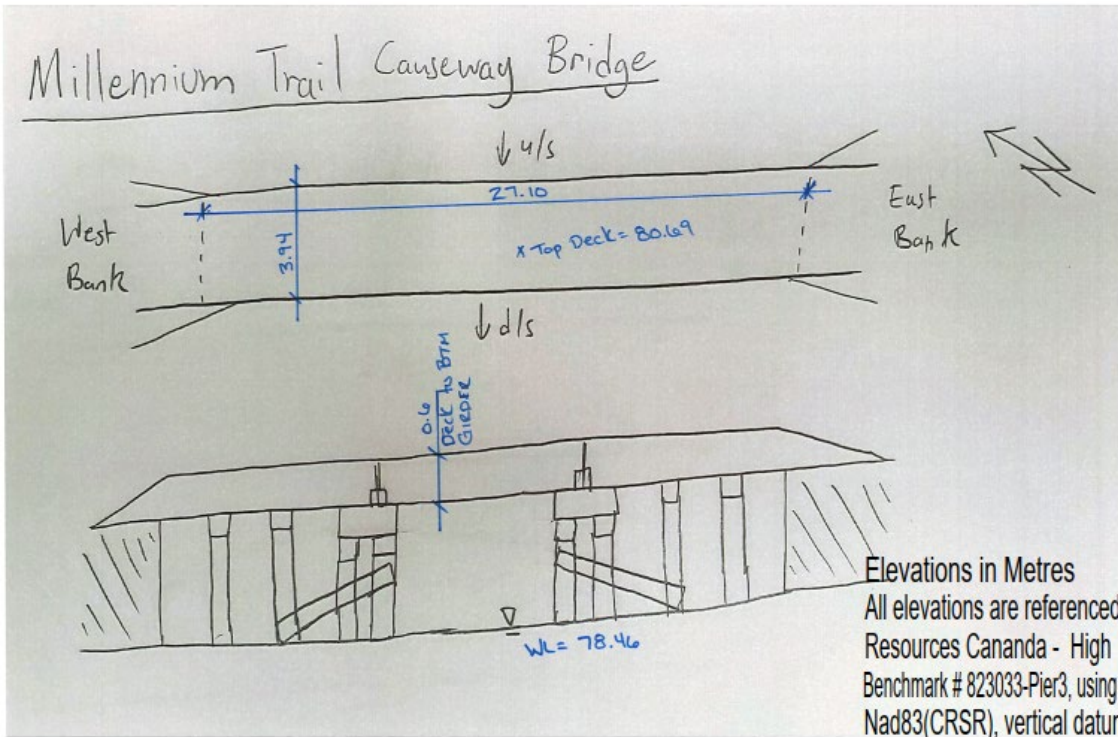
APPENDIX B

Hydraulic Model Outputs

HEC-RAS MODEL OUTPUT – 2 YEAR NO EARTH EMBANKMENT

River Sta	Distance from Whitney Dam (m)	Location	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)
		2-Year No Earth Embankment			
943			17.71	79.05	0.54
866		Upstream of Whitney Dam	17.71	78.95	0.58
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	17.71	77.84	0.73
847	13.0		17.71	77.78	1.52
841	19.0		17.71	77.72	1.56
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		17.71	77.76	0.87
812	48.0		17.71	77.69	1.07
785	75.0		17.71	77.57	0.90
756	104.0		17.71	77.49	0.90
740	116.0		17.71	77.43	0.68
730	121.0		18.23	77.43	0.83
727	133.0		18.23	77.42	0.99
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		18.23	77.40	0.96
688	171.0		18.23	77.38	0.71
635	225.0		18.23	77.36	0.47
569	291.0		18.23	77.36	0.37
494	366.0		18.28	77.35	0.26
466	394.0		18.28	77.35	0.26
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		18.28	75.66	1.94
441	419.0		18.28	75.56	0.86
434	426.0		18.28	75.56	0.91
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		15.00	75.29	1.23
397	463.0		18.28	75.15	1.68
317	544.0		18.28	74.87	0.64
209	651.0		18.28	74.82	0.50
108	753.0		18.27	74.81	0.35
8	853.0	Mouth of Consecon Creek at Wellers Bay	18.27	74.81	0.35

HEC-RAS MODEL OUTPUT – 2 YEAR WITH EARTH EMBANKMENT

River Sta	Distance from Whitney Dam (m)	Location	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)
943			17.65	79.10	0.50
866		Upstream of Whitney Dam	17.65	79.03	0.51
863		Whitney Memorial Dam	Inl Struct		
857	3.0	Downstream of Whitney Dam	17.65	77.84	0.73
847	13.0		17.65	77.78	1.52
841	19.0		17.65	77.72	1.56
836		Hwy 33 Loyalist Pkwy Bridge	Bridge		
831	29.0		17.65	77.75	0.87
812	48.0		17.65	77.69	1.07
785	75.0		17.65	77.57	0.90
756	104.0		17.65	77.49	0.90
740	116.0		17.65	77.44	0.67
730	121.0		18.26	77.44	0.84
727	133.0		18.26	77.42	0.99
721		Consecon Main Street Bridge	Bridge		
715	144.0		18.26	77.40	0.96
688	171.0		18.26	77.38	0.71
635	225.0		18.26	77.36	0.47
569	291.0		18.26	77.36	0.37
494	366.0		18.31	77.35	0.26
466	394.0		18.31	77.35	0.26
462		Consecon Mill Dam	Inl Struct		
458	402.0		18.31	75.66	1.94
441	419.0		18.31	75.56	0.87
434	426.0		18.31	75.56	0.91
429		County Road 29 Bridge	Bridge		
423	437.0		15.00	75.29	1.23
397	463.0		18.31	75.15	1.69
317	544.0		18.31	74.87	0.64
209	651.0		18.31	74.82	0.50
108	753.0		18.31	74.81	0.35
8	853.0	Mouth of Consecon Creek at Wellers Bay	18.31	74.81	0.35

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HEC-RAS MODEL OUTPUT – 10 YEAR NO EARTH EMBANKMENT

River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			29.96	79.23	0.73
866		Upstream of Whitney Dam	29.96	79.08	0.79
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	29.96	78.09	0.93
847	13.0		29.96	78.02	1.79
841	19.0		29.96	77.96	1.96
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		29.96	78.08	1.07
812	48.0		29.96	78.00	1.10
785	75.0		29.96	77.88	0.98
756	104.0		29.96	77.79	1.08
740	116.0		29.96	77.73	0.86
730	121.0		31.47	77.73	1.11
727	133.0		31.47	77.71	1.30
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		31.47	77.70	1.22
688	171.0		31.47	77.67	0.92
635	225.0		31.47	77.66	0.66
569	291.0		31.47	77.64	0.54
494	366.0		31.52	77.64	0.38
466	394.0		31.52	77.64	0.38
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		31.52	75.89	2.06
441	419.0		31.52	75.81	1.13
434	426.0		31.52	75.80	1.20
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		31.52	75.48	1.90
397	463.0		31.52	75.31	2.14
317	544.0		31.52	74.96	0.97
209	651.0		31.52	74.86	0.83
108	753.0		31.52	74.82	0.60
8	853.0	Mouth of Consecon Creek at Wellers Bay	31.52	74.82	0.60

Table title: **10-Year No Earth Embankment**

HEC-RAS MODEL OUTPUT – 10 YEAR WITH EARTH EMBANKMENT

River Sta	Distance from Whitney Dam (m)	Location	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)
**10-Year With Earth Embankment**
943			28.94	79.27	0.67
866		Upstream of Whitney Dam	28.94	79.16	0.68
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	28.94	78.07	0.92
847	13.0		28.94	78.01	1.77
841	19.0		28.94	77.94	1.93
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		28.94	78.06	1.06
812	48.0		28.94	77.98	1.10
785	75.0		28.94	77.86	0.96
756	104.0		28.94	77.78	1.06
740	116.0		28.94	77.72	0.84
730	121.0		30.79	77.72	1.10
727	133.0		30.79	77.69	1.29
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		30.79	77.68	1.21
688	171.0		30.79	77.66	0.91
635	225.0		30.79	77.64	0.65
569	291.0		30.79	77.63	0.53
494	366.0		30.84	77.62	0.37
466	394.0		30.84	77.62	0.38
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		30.85	75.88	2.05
441	419.0		30.84	75.80	1.12
434	426.0		30.84	75.79	1.19
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		30.84	75.47	1.88
397	463.0		30.84	75.31	2.12
317	544.0		30.84	74.95	0.96
209	651.0		30.84	74.86	0.82
108	753.0		30.84	74.82	0.59
8	853.0	Mouth of Consecon Creek at Wellers Bay	30.84	74.82	0.59

HEC-RAS MODEL OUTPUT – 25 YEAR NO EARTH EMBANKMENT

25-Year No Earth Embankment					
River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			35.99	79.31	0.80
866		Upstream of Whitney Dam	35.99	79.14	0.88
863		Whitney Memorial Dam	Inl Struct		
857	3.0	Downstream of Whitney Dam	35.99	78.19	1.02
847	13.0		35.99	78.12	1.91
841	19.0		35.99	78.05	2.14
836		Hwy 33 Loyalist Pkwy Bridge	Bridge		
831	29.0		35.99	78.19	1.18
812	48.0		35.99	78.11	1.11
785	75.0		35.99	78.01	1.01
756	104.0		35.99	77.93	1.14
740	116.0		35.99	77.86	0.92
730	121.0		38.23	77.86	1.21
727	133.0		38.23	77.84	1.42
721		Consecon Main Street Bridge	Bridge		
715	144.0		38.23	77.83	1.32
688	171.0		38.23	77.81	1.00
635	225.0		38.23	77.79	0.74
569	291.0		38.23	77.77	0.61
494	366.0		38.28	77.77	0.43
466	394.0		38.28	77.76	0.44
462		Consecon Mill Dam	Inl Struct		
458	402.0		35.94	75.94	2.14
441	419.0		35.93	75.87	1.22
434	426.0		35.92	75.86	1.30
429		County Road 29 Bridge	Bridge		
423	437.0		38.28	75.56	2.07
397	463.0		38.28	75.38	2.33
317	544.0		38.28	75.01	1.11
209	651.0		38.28	74.89	0.99
108	753.0		38.28	74.83	0.72
8	853.0	Mouth of Consecon Creek at Wellers Bay	38.28	74.83	0.72

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HEC-RAS MODEL OUTPUT – 25 YEAR WITH EARTH EMBANKMENT

River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			35.49	79.36	0.74
866		Upstream of Whitney Dam	35.49	79.23	0.76
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	35.49	78.18	1.01
847	13.0		35.49	78.11	1.90
841	19.0		35.49	78.04	2.13
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		35.49	78.18	1.17
812	48.0		35.49	78.11	1.10
785	75.0		35.49	78.01	1.00
756	104.0		35.49	77.93	1.12
740	116.0		35.49	77.86	0.91
730	121.0		38.19	77.86	1.21
727	133.0		38.19	77.84	1.42
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		38.19	77.83	1.32
688	171.0		38.19	77.80	1.00
635	225.0		38.19	77.78	0.74
569	291.0		38.19	77.77	0.61
494	366.0		38.24	77.77	0.43
466	394.0		38.24	77.76	0.44
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		35.94	75.94	2.14
441	419.0		35.93	75.87	1.22
434	426.0		35.92	75.86	1.30
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		38.24	75.56	2.07
397	463.0		38.24	75.38	2.33
317	544.0		38.24	75.01	1.11
209	651.0		38.24	74.89	0.99
108	753.0		38.24	74.83	0.72
8	853.0	Mouth of Consecon Creek at Wellers Bay	38.24	74.83	0.72

HEC-RAS MODEL OUTPUT – 50 YEAR NO EARTH EMBANKMENT

River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			41.39	79.37	0.86
866		Upstream of Whitney Dam	41.39	79.19	0.95
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	41.39	78.28	1.07
847	13.0		41.39	78.22	1.96
841	19.0		41.39	78.15	2.22
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		41.39	78.28	1.25
812	48.0		41.39	78.21	1.12
785	75.0		41.39	78.12	1.05
756	104.0		41.39	78.04	1.18
740	116.0		41.39	77.97	0.97
730	121.0		44.27	77.97	1.30
727	133.0		44.27	77.95	1.52
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		44.27	77.94	1.40
688	171.0		44.27	77.92	1.07
635	225.0		44.27	77.89	0.81
569	291.0		44.27	77.88	0.67
494	366.0		44.32	77.87	0.47
466	394.0		44.32	77.87	0.49
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		44.32	76.10	2.10
441	419.0		44.32	76.04	1.28
434	426.0		44.32	76.03	1.38
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		44.32	75.62	2.20
397	463.0		44.32	75.45	2.47
317	544.0		44.32	75.05	1.21
209	651.0		44.32	74.91	1.12
108	753.0		44.32	74.84	0.83
8	853.0	Mouth of Consecon Creek at Wellers Bay	44.32	74.84	0.83

Table title: **50-Year No Earth Embankment**

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HEC-RAS MODEL OUTPUT – 50 YEAR WITH EARTH EMBANKMENT

50-Year With Earth Embankment					
River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			41.00	79.43	0.80
866		Upstream of Whitney Dam	41.00	79.28	0.83
863		Whitney Memorial Dam	Inl Struct		
857	3.0	Downstream of Whitney Dam	41.00	78.28	1.07
847	13.0		41.00	78.22	1.94
841	19.0		41.00	78.15	2.20
836		Hwy 33 Loyalist Pkwy Bridge	Bridge		
831	29.0		41.00	78.28	1.24
812	48.0		41.00	78.21	1.11
785	75.0		41.00	78.12	1.04
756	104.0		41.00	78.04	1.17
740	116.0		41.00	77.98	0.96
730	121.0		44.53	77.98	1.30
727	133.0		44.53	77.95	1.52
721		Consecon Main Street Bridge	Bridge		
715	144.0		44.53	77.95	1.40
688	171.0		44.53	77.92	1.07
635	225.0		44.53	77.90	0.81
569	291.0		44.53	77.89	0.67
494	366.0		44.58	77.88	0.48
466	394.0		44.58	77.88	0.49
462		Consecon Mill Dam	Inl Struct		
458	402.0		44.58	76.11	2.09
441	419.0		44.58	76.05	1.28
434	426.0		44.58	76.04	1.38
429		County Road 29 Bridge	Bridge		
423	437.0		44.58	75.63	2.21
397	463.0		44.58	75.45	2.48
317	544.0		44.58	75.05	1.22
209	651.0		44.58	74.91	1.12
108	753.0		44.58	74.84	0.83
8	853.0	Mouth of Consecon Creek at Wellers Bay	44.58	74.84	0.83

HEC-RAS MODEL OUTPUT – 100 YEAR NO EARTH EMBANKMENT

River Sta	Distance from Whitney Dam (m)	Location	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)
943			47.64	79.44	0.92
866		Upstream of Whitney Dam	47.64	79.24	1.02
863		Whitney Memorial Dam	Inl Struct		
857	3.0	Downstream of Whitney Dam	47.64	78.35	1.16
847	13.0		47.64	78.28	2.11
841	19.0		47.64	78.21	2.43
836		Hwy 33 Loyalist Pkwy Bridge	Bridge		
831	29.0		47.64	78.38	1.33
812	48.0		47.64	78.32	1.12
785	75.0		47.64	78.23	1.09
756	104.0		47.64	78.15	1.24
740	116.0		47.64	78.09	1.02
730	121.0		51.67	78.09	1.40
727	133.0		51.67	78.06	1.64
721		Consecon Main Street Bridge	Bridge		
715	144.0		51.67	78.07	1.49
688	171.0		51.67	78.04	1.14
635	225.0		51.67	78.02	0.88
569	291.0		51.67	78.01	0.73
494	366.0		51.72	78.00	0.52
466	394.0		51.72	77.99	0.54
462		Consecon Mill Dam	Inl Struct		
458	402.0		51.72	76.25	2.02
441	419.0		51.72	76.21	1.31
434	426.0		51.72	76.20	1.42
429		County Road 29 Bridge	Bridge		
423	437.0		51.72	75.70	2.34
397	463.0		51.72	75.52	2.62
317	544.0		51.72	75.11	1.33
209	651.0		51.72	74.95	1.27
108	753.0		51.72	74.85	0.95
8	853.0	Mouth of Consecon Creek at Wellers Bay	51.72	74.85	0.95

HEC-RAS MODEL OUTPUT – 100 YEAR WITH EARTH EMBANKMENT

River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			46.89	79.49	0.86
866		Upstream of Whitney Dam	46.90	79.33	0.89
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	46.90	78.35	1.15
847	13.0		46.90	78.28	2.07
841	19.0		46.90	78.21	2.38
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		46.90	78.38	1.31
812	48.0		46.90	78.31	1.11
785	75.0		46.90	78.23	1.07
756	104.0		46.90	78.15	1.22
740	116.0		46.90	78.09	1.00
730	121.0		51.88	78.09	1.40
727	133.0		51.88	78.07	1.64
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		51.88	78.07	1.49
688	171.0		51.88	78.04	1.14
635	225.0		51.88	78.02	0.88
569	291.0		51.88	78.01	0.73
494	366.0		51.93	78.00	0.52
466	394.0		51.93	78.00	0.54
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		51.93	76.26	2.02
441	419.0		51.93	76.21	1.31
434	426.0		51.93	76.20	1.42
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		51.93	75.71	2.35
397	463.0		51.93	75.52	2.62
317	544.0		51.93	75.11	1.33
209	651.0		51.93	74.95	1.27
108	753.0		51.93	74.85	0.96
8	853.0	Mouth of Consecon Creek at Wellers Bay	51.93	74.85	0.96

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HEC-RAS MODEL OUTPUT – 200 YEAR NO EARTH EMBANKMENT

River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			53.52	79.50	0.97
866		Upstream of Whitney Dam	53.52	79.28	1.08
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	53.52	78.42	1.24
847	13.0		53.52	78.34	2.23
841	19.0		53.52	78.26	2.60
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		53.52	78.48	1.39
812	48.0		53.52	78.42	1.13
785	75.0		53.52	78.34	1.12
756	104.0		53.52	78.26	1.27
740	116.0		53.52	78.20	1.06
730	121.0		58.95	78.20	1.49
727	133.0		58.95	78.17	1.73
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		58.95	78.18	1.56
688	171.0		58.95	78.16	1.20
635	225.0		58.95	78.14	0.94
569	291.0		58.96	78.12	0.79
494	366.0		59.00	78.11	0.57
466	394.0		59.00	78.11	0.59
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		59.00	76.38	2.01
441	419.0		59.00	76.34	1.35
434	426.0		59.00	76.33	1.48
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		59.00	75.77	2.49
397	463.0		59.00	75.58	2.77
317	544.0		59.00	75.16	1.43
209	651.0		59.00	74.98	1.41
108	753.0		59.00	74.87	1.07
8	853.0	Mouth of Consecon Creek at Wellers Bay	59.00	74.87	1.07

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HEC-RAS MODEL OUTPUT – 200 YEAR WITH EARTH EMBANKMENT

River Sta	Distance from Whitney Dam	Location	Q Total	W.S. Elev	Vel Chnl
	(m)		(m3/s)	(m)	(m/s)
943			52.70	79.54	0.91
866		Upstream of Whitney Dam	52.70	79.37	0.96
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	52.70	78.42	1.22
847	13.0		52.70	78.34	2.20
841	19.0		52.70	78.26	2.56
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		52.70	78.47	1.38
812	48.0		52.70	78.41	1.12
785	75.0		52.70	78.33	1.10
756	104.0		52.70	78.26	1.25
740	116.0		52.70	78.20	1.04
730	121.0		59.07	78.20	1.49
727	133.0		59.07	78.18	1.73
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		59.07	78.19	1.56
688	171.0		59.07	78.16	1.20
635	225.0		59.07	78.14	0.95
569	291.0		59.07	78.12	0.79
494	366.0		59.12	78.11	0.57
466	394.0		59.12	78.11	0.59
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		59.12	76.38	2.01
441	419.0		59.12	76.34	1.35
434	426.0		59.12	76.33	1.48
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		59.12	75.77	2.49
397	463.0		59.12	75.58	2.77
317	544.0		59.12	75.16	1.43
209	651.0		59.12	74.98	1.41
108	753.0		59.12	74.87	1.08
8	853.0	Mouth of Consecon Creek at Wellers Bay	59.12	74.87	1.08

Table title: **200-Year With Earth Embankment**

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HEC-RAS MODEL OUTPUT – 500 YEAR NO EARTH EMBANKMENT

River Sta	Distance from Whitney Dam (m)	Location	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)
		500-Year No Earth Embankment			
943			60.54	79.56	1.03
866		Upstream of Whitney Dam	60.54	79.33	1.16
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	60.54	78.51	1.29
847	13.0		60.54	78.44	2.31
841	19.0		60.54	78.36	2.71
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		60.54	78.59	1.46
812	48.0		60.54	78.53	1.14
785	75.0		60.54	78.46	1.15
756	104.0		60.54	78.39	1.31
740	116.0		60.54	78.33	1.11
730	121.0		67.52	78.33	1.57
727	133.0		67.52	78.30	1.83
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		67.52	78.31	1.64
688	171.0		67.52	78.28	1.26
635	225.0		67.52	78.26	1.02
569	291.0		67.52	78.25	0.85
494	366.0		67.57	78.24	0.62
466	394.0		67.57	78.23	0.64
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		67.57	76.51	2.04
441	419.0		67.57	76.47	1.41
434	426.0		67.57	76.46	1.56
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		67.57	75.84	2.65
397	463.0		67.57	75.65	2.93
317	544.0		67.57	75.22	1.53
209	651.0		67.57	75.02	1.56
108	753.0		67.57	74.88	1.21
8	853.0	Mouth of Consecon Creek at Wellers Bay	67.57	74.88	1.21

HEC-RAS MODEL OUTPUT – 500 YEAR WITH EARTH EMBANKMENT

River Sta	Distance from Whitney Dam (m)	Location	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)
		500-Year With Earth Embankment			
943			59.65	79.60	0.97
866		Upstream of Whitney Dam	59.65	79.42	1.03
863		**Whitney Memorial Dam**	**Inl Struct**		
857	3.0	Downstream of Whitney Dam	59.65	78.51	1.28
847	13.0		59.65	78.44	2.27
841	19.0		59.65	78.36	2.67
836		**Hwy 33 Loyalist Pkwy Bridge**	**Bridge**		
831	29.0		59.65	78.58	1.44
812	48.0		59.65	78.53	1.13
785	75.0		59.65	78.46	1.13
756	104.0		59.65	78.39	1.30
740	116.0		59.65	78.33	1.09
730	121.0		67.55	78.33	1.57
727	133.0		67.55	78.30	1.83
721		**Consecon Main Street Bridge**	**Bridge**		
715	144.0		67.55	78.31	1.64
688	171.0		67.55	78.29	1.26
635	225.0		67.55	78.26	1.02
569	291.0		67.55	78.25	0.85
494	366.0		67.60	78.24	0.62
466	394.0		67.60	78.23	0.64
462		**Consecon Mill Dam**	**Inl Struct**		
458	402.0		67.60	76.51	2.04
441	419.0		67.60	76.47	1.41
434	426.0		67.60	76.46	1.56
429		**County Road 29 Bridge**	**Bridge**		
423	437.0		67.60	75.84	2.65
397	463.0		67.60	75.65	2.93
317	544.0		67.60	75.22	1.53
209	651.0		67.60	75.02	1.56
108	753.0		67.60	74.88	1.21
8	853.0	Mouth of Consecon Creek at Wellers Bay	67.60	74.88	1.21

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