Priddis River Hazard Study

Flood Risk Assessment and Inventory Report

December 5, 2021

Prepared for:

Alberta Environment and Parks

Prepared by:

Stantec Consulting Ltd.

Sign-off Sheet

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Executive Summary

Alberta Environment and Parks (AEP) commissioned Stantec Consulting Ltd. (Stantec) in August 2017 to undertake the Priddis River Hazard Study. The primary purpose of the study is to identify and assess river and flood hazards along Fish and Priddis Creeks. The study area includes about 30 km of Fish Creek, between Range Road 40 (288 St W) and Tsuut'ina Nation; and about 20 km of Priddis Creek, between its confluence with Fish Creek and Tsuut'ina Nation.

This study is being conducted under the provincial Flood Hazard Identification Program (FHIP), the goals of which include enhancement of public safety and reduction of future flood damages through the identification of river and flood hazards. Project stakeholders include the Government of Alberta, local authorities and the public. Key municipal stakeholders include the Foothills County, including the Hamlets of Priddis and Priddis Greens. The Priddis River Hazard Study includes multiple components and deliverables. This report details the findings of the Flood Risk Assessment and Inventory task. This Report uses information and findings from the Design Flood Hazard Mapping Report, the Hydraulic Modelling and Flood Inundation Mapping Report, and the Survey and Base Data Collection Report. All flood hazard identification and mapping fulfilled FHIP criteria, the Priddis River Hazard Study Terms of Reference and FHIP Guidelines.

The objectives of the Flood Risk Inventory and Assessment task involves compiling and interpreting spatial data, inventorying and categorizing buildings and infrastructure, and computing flood risk statistics for lands, buildings, infrastructure and populations at risk. This task is limited to a basic inventory and desktop categorization of risks and does not include a comprehensive risk assessment incorporating potential financial and social losses as per the FHIP Guidelines.

Cadastral data for the study area was provided by AEP through AltaLIS. The dataset included cadastral blocks and lots, cadastral hydrography, cadastral plans, cadastral rights-of-way, and land parcels with unique parcel identifiers. Census boundaries and population data were obtained from Statistics Canada. All inventory data was assembled in a geodatabase.

Statistics are presented for open water flood inundated areas from 13 different return period floods and flood hazard areas from the design flood. The inundation extents for each flood scenario were superimposed on the inventory data to compute the following values within the boundaries of each local authority:

- The number of land parcels at risk
- The number of residential buildings at risk
- The number of non-residential buildings at risk, including commercial, industrial, and other major non-residential buildings
- The number of bridges at risk
- The number of culverts at risk
- Total kilometres of roadway at risk

- The estimated population at risk

Notable results of the flood risk assessment for the 13 open water flood scenarios are summarized below:

- Residential buildings are at risk of flooding during the 20-year flood event and greater, while non-residential buildings are at risk for floods greater than the 10-year flood event. There is 1 residential building within the floodway and 11 within the flood fringe. No buildings are within the high-hazard flood fringe.
- Priddis Creek overtops the bridge (PC-BRDG-9) and Highway 22 near Coalmine Road W for flood events greater than the 20-year event.
- Fish Creek does not overtop the bridge (FC-BRDG-1) at Highway 22 near Priddis Valley Road W until the 350-year flood event however there would be flood impacts to the highway during the 200-year flood event and greater.
- The intersection of Priddis Valley Road W and 186 Ave W is inundated during the 35-year flood event and greater while the Priddis Community Hall is inundated at flood events greater than the 50-year flood event. Fish Creek overtops 186 Ave West at the culvert (FC-CULVT-1) during the 50-year flood event and greater.
- The culvert under 240 St W (FC-CULVT-2) is not overtopped until flood events greater than the 100-year flood event.

Acknowledgements

The Priddis River Hazard Study was managed on behalf of AEP by Muhammad Durrani, M.Eng., P.Eng., with support from Jane Eaket, M.Sc., P.Eng., of the River Engineering and Technical Services Section.

The following personnel from Stantec contributed to this component of the study:

- Matt Wood, P. Eng., CPESC – Project Manager, Lead Project Engineer
- James Bigelow, P.Eng.- Project Engineer and Hydraulic Modeling Lead
- Catalina Tandara, CET – CAD Lead
- Marty Anderson, B.Sc. GIS Technician – GIS Support
- Michael Uniacke, P.Eng. – Independent Technical Review

The project team acknowledges assistance provided by personnel of the following agencies and their consultants:

- Informatics Branch, AEP
- Hamlet of Priddis
- Hamlet of Priddis Greens
- Robert Miller, Foothills County
- Water Survey of Canada

1.0 INTRODUCTION

The Priddis River Hazard Study was conducted by Stantec Consulting Ltd. (Stantec) on behalf of the Government of Alberta, in accordance with the study-specific terms of reference and applicable provincial guidelines.

1.1 STUDY BACKGROUND

Alberta Environment and Parks (AEP) commissioned Stantec in August 2017 to undertake the Priddis River Hazard Study. The study is being conducted under the provincial Flood Hazard Identification Program (FHIP), the goals of which include enhancement of public safety and reduction of future flood damages through the identification of river and flood hazards (AENV, 2011). Project stakeholders include the Government of Alberta, local authorities and the public. The key municipal stakeholders include Foothills County, and the Hamlets of Priddis and Priddis Greens.

1.2 STUDY OBJECTIVES

The primary purpose of the Priddis River Hazard Study is to identify and assess river and flood hazards along Fish and Priddis Creeks. The study includes multiple components and deliverables.

1.3 STUDY AREA & REACH

For the purpose of this study the study area is comprised of three model reaches of mainstem channel, which were named as: lower Fish Creek; upper Fish Creek; and Priddis Creek.

River stationing for the Fish Creek component starts at the downstream end of the study area at the first surveyed cross section and extends to the upstream end of the study area (Figure 1). River stationing was measured along a line that passed through the surveyed thalweg points. At reaches where the creek experienced bends between two surveyed thalweg points, the line was measured from the 2016 orthographic aerial image. The study area includes approximately 30 km of Fish Creek and 20 km of Priddis Creek.

The downstream end of the study area is located at the edge of the Tsuut'ina Nation boundary. No surveying was completed within Tsuut'ina Nation lands.

The lower Fish Creek reach extends upstream from the Tsuut'ina Nation boundary to the Priddis Creek confluence and includes the following major landmarks:

- the Tsuut'ina Nation boundary at 0+000 m;
- the Highway 22 crossing at 6+935 m;
- the Range Road 32 (Priddis Valley Road W) crossing at 7+571 m; and,
- the confluence with Priddis Creek at 7+782 m.

The upper Fish Creek reach extends upstream from the Priddis Creek confluence and includes the following landmarks:

- the 186 Ave W crossing at 7+909 m; and,

- the upstream end of the study area at 32+136 m.

River stationing for the Priddis Creek reach starts at the Fish Creek confluence and extends to the upstream end of the study area.

The Priddis Creek reach extends upstream from its confluence with Fish Creek and includes the following major landmarks:

- the confluence with Fish Creek at 0+000 m;
- the Highway 22 crossing at 15+110 m; and,
- the upstream end of the study area at 19+120 m.

Author: Emilie Hewko

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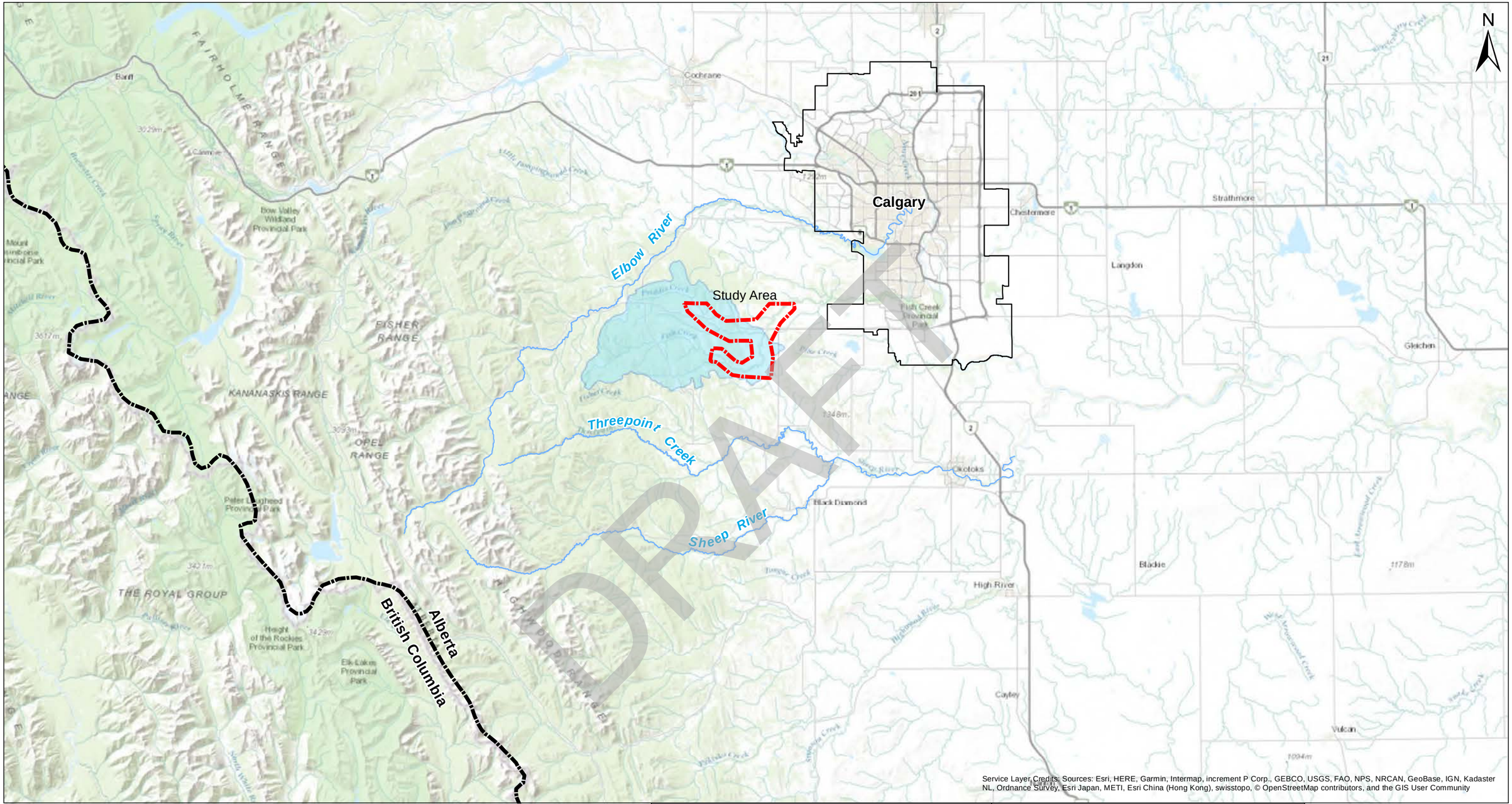

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Legend

- Watercourse
- Study Boundary
- Calgary City Limits
- Drainage Area

Projection: NAD 1983 3TM 114
Source: Stantec Consulting Ltd., Contains information licensed under the Open Government license.
Spatial Data Warehouse Ltd.,
Imagery: 2017

Alberta Government

Priddis River Hazard Study

10 5 0 10
Kilometers
1:500,000

Location Map Key Plan

DATE:	QA/QC:
July, 2019	M.A.

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01/10/2019

Stantec

2.0 AVAILABLE SPATIAL DATA

Available spatial data assembled and used for this analysis are summarized below. Supporting information and digital files are provided as part of the digital study file for the project.

2.1 CADASTRAL

The cadastral data for the study area was obtained from AltaLIS, a commercial provider of Alberta base mapping data. The dataset included cadastral hydrography, cadastral plans, cadastral rights-of-way, cadastral blocks and lots, and land parcels with unique parcel identifiers.

2.2 INFRASTRUCTURE

Building centroids were mapped using 2018 aerial imagery provided by AEP. Bridges and culverts were mapped by Stantec based on field surveys and reference data received from Alberta Transportation. Centroid points of the bridges and culverts were used for the analysis.

The roadway network data was based on provincial and municipal datasets. No railways are located within the study area.

2.3 CENSUS

Census boundaries and population data for 2016 were based on data from Statistics Canada (2016). The population of the entire Foothills County (known as M.D. of Foothills No. 31 at the time of the census) was 22,766 people across 8,689 private dwellings. The average household size was 2.7 people per household.

3.0 INTERPRETED SPATIAL DATA

3.1 AERIAL PHOTOGRAPHY

On behalf of AEP, Orthoshop Geomatics Ltd. (OGL) collected colour aerial imagery for the study area on July 13, 2018 and August 1, 2018. OGL used this imagery to generate colour-balanced ortho-rectified mosaics of the study area.

3.2 RESIDENTIAL STRUCTURES

On behalf of AEP, Orthoshop Geomatics Ltd. (OGL) collected colour aerial imagery for the study area on July 13, 2018 and August 1, 2018. OGL used this imagery to generate colour-balanced ortho-rectified mosaics of the study area. This data was used to identify and locate residential and non-residential structures.

3.2.1 Digitization

The majority of the centroids for residential structures were digitized based on the OGL aerial imagery data supplied by AEP. ArcGIS was used to manually digitize a point in the approximate centre for each structure observed in the orthoimagery. In some locations, Google Maps and Google Street View were used to help the digitization and identification of some structures.

3.2.2 Classification

Land use designations were used to identify residential districts and structures. When two residential buildings were located within the same land parcel, Stantec assumed that it was a secondary structure and not a house. Only the house would be considered as a primary structure and included in the analysis. Examples of noted secondary structures that were identified within the study area, yet not considered non-residential structures, included sheds, barns, outbuildings and garages. Single family residential structures were the only category of residential structures identified within the study area.

3.3 NON-RESIDENTIAL STRUCTURES

3.3.1 Digitization

Centroids for non-residential buildings were digitized using the same approach as described for residential buildings. Google Maps and Google Street View were used to help the digitization and identification of some structures.

4.0 FLOOD RISK ASSESSMENT AND INVENTORY

4.1 METHODOLOGY

Flood risk statistics were determined for the direct open water flood inundation areas (2-, 5-, 10-, 20-, 35-, 50-, 75-, 100-, 200-, 350-, 500-, 750-, and 1000-year return periods) and the governing flood hazard areas (floodway, flood fringe and high hazard flood fringe). Direct flood inundation areas are defined as those areas that are part of the actively-flowing river channel or flooded overbank areas connected to the actively-flowing river channel.

Areas inundated due to potential flood control structure failure were not assessed, as there are no flood control structures in the study area.

Stantec compiled the following statistics for the number and type of land parcels, buildings, infrastructure and population at risk under the above noted flood scenarios including:

- The number of land parcels at risk;
- The number of residential buildings at risk;
- The number of non-residential buildings at risk, including commercial, industrial, and other major non-residential buildings;

- The number of bridges at risk;
- The number of culverts at risk;
- Total kilometres of roadway at risk; and
- The estimated population at risk.

Land parcels that fully lie, partially lie or intersect the flood inundation areas or extents were considered to be at risk.

Centroids of residential and non-residential buildings within the flood inundation areas or extents were considered to be at risk. Secondary structures such as sheds, garages or outbuildings on land parcels with a primary structure were not included in the assessment.

Bridges were considered to be at risk if the flood level was equal to or greater than the bridge low chord elevation for the associated flood scenario.

Culverts were considered to be at risk if the flood level was equal to or greater than the approach road crest elevation for the associated flood scenario. Culverts outside of the main channels of Fish Creek or Priddis Creek were not included in this assessment.

Length of roadways (along the centroid of the road) within the flood inundation areas or extents were considered to be at risk. Bridges are assessed under a different category (as identified above) and therefore the lengths of roadway atop bridges was not included in the total lengths of the roadway at risk.

The estimated population at risk was determined by multiplying the average number of people per household (2.7 people) by the number of households that fall within the flood inundation areas or extents.

4.2 OPEN WATER FLOOD INUNDATION AREAS

The flood risk assessment results are presented below for the various open water and governing design flood scenarios investigated as part of this study.

The Open Water Flood Inundation Map Library provides maps of the open water flood inundation areas that were prepared as part of the Hydraulic Modelling and Flood Inundation Mapping Report (Stantec, 2021). Details regarding the preparation and results of the maps are provided in that report.

The Flood Hazard Maps provide maps of the flood hazard areas that were prepared as part of the Design Flood Hazard Mapping Report (Stantec, 2021). Details regarding the preparation and results of the maps are provided in that report.

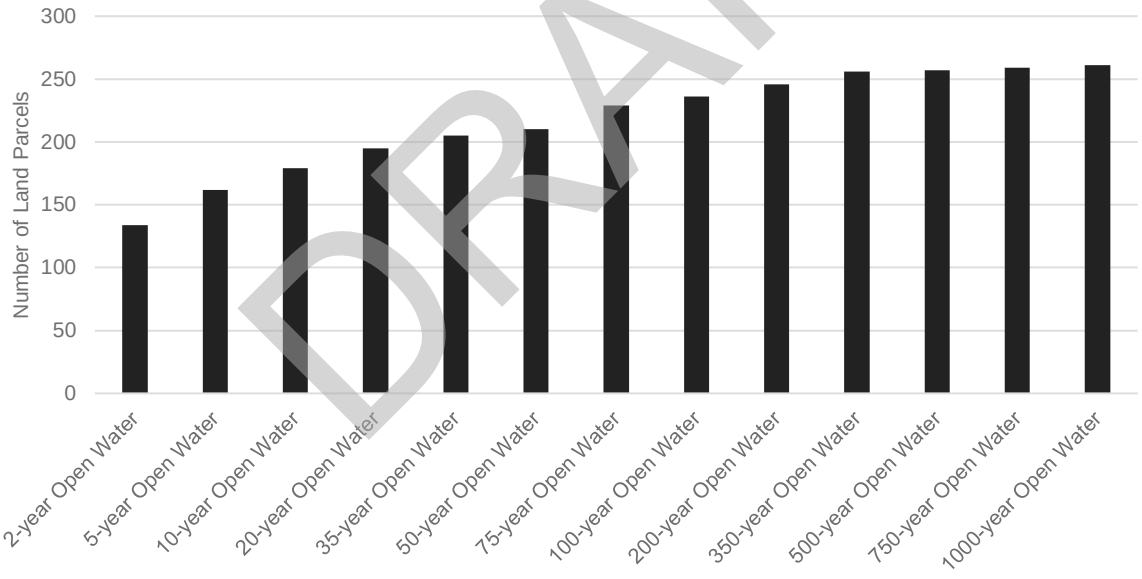
4.2.1 Land Parcels

Table 1 and Figure 2 provide the statistics for the number of land parcels at risk due to direct inundation.

Table 1: Land Parcels at Risk for Various Flood Scenarios

Flood Scenario	Number of Land Parcels Affected
2-year	134
5-year	162
10-year	179
20-year	195
35-year	205
50-year	210
75-year	229
100-year	236
200-year	246
350-year	256
500-year	257
750-year	259
1000-year	261

Figure 2: Land Parcels at risk for Various Flood Scenarios



The number of parcels at risk ranges from 134 during the 2-year flood event up to 261 parcels during the 1000-year flood event. During the 100-year flood event, there are 236 parcels at risk.

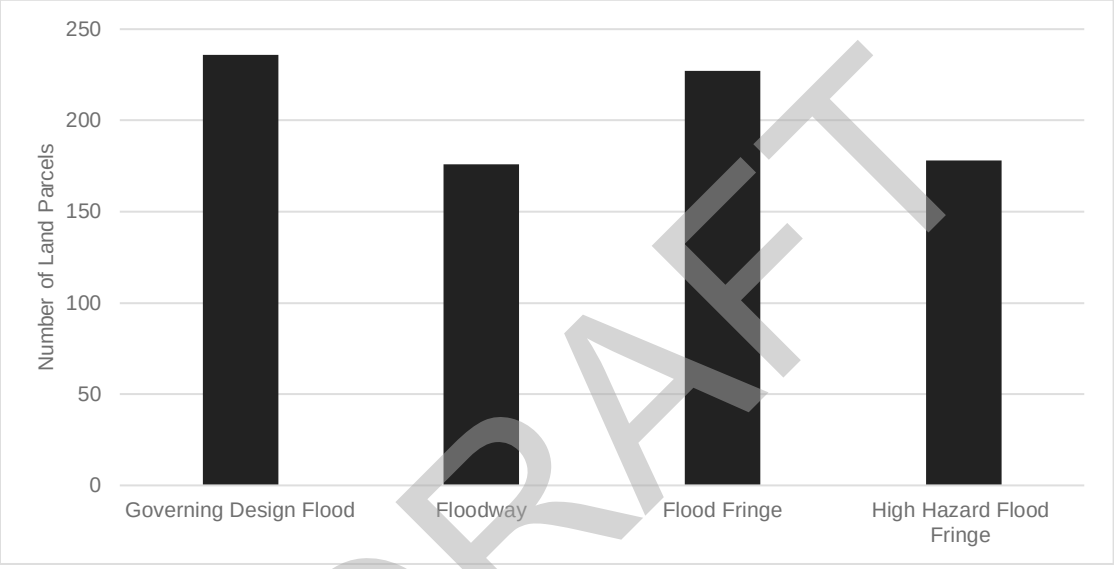
Table 2 and Figure 3 provide summary statistics for the number of land parcels at risk for the governing design flood.

Table 2: Land Parcels at Risk for Governing Design Flood

Flood Scenario	Number of Land Parcels Affected
Governing Design Flood	236
Floodway	176
Flood Fringe	227
High Hazard Flood Fringe	178

Note: The number of land parcels at risk under the Governing Design Flood Scenario is not equal to the sum of the number of floodway, flood fringe and high hazard flood fringe parcels at risk as some land parcels are at risk for both the floodway and flood fringe scenarios.

Figure 3: Land Parcels at risk for Governing Design Flood



4.2.2 Buildings and Infrastructure

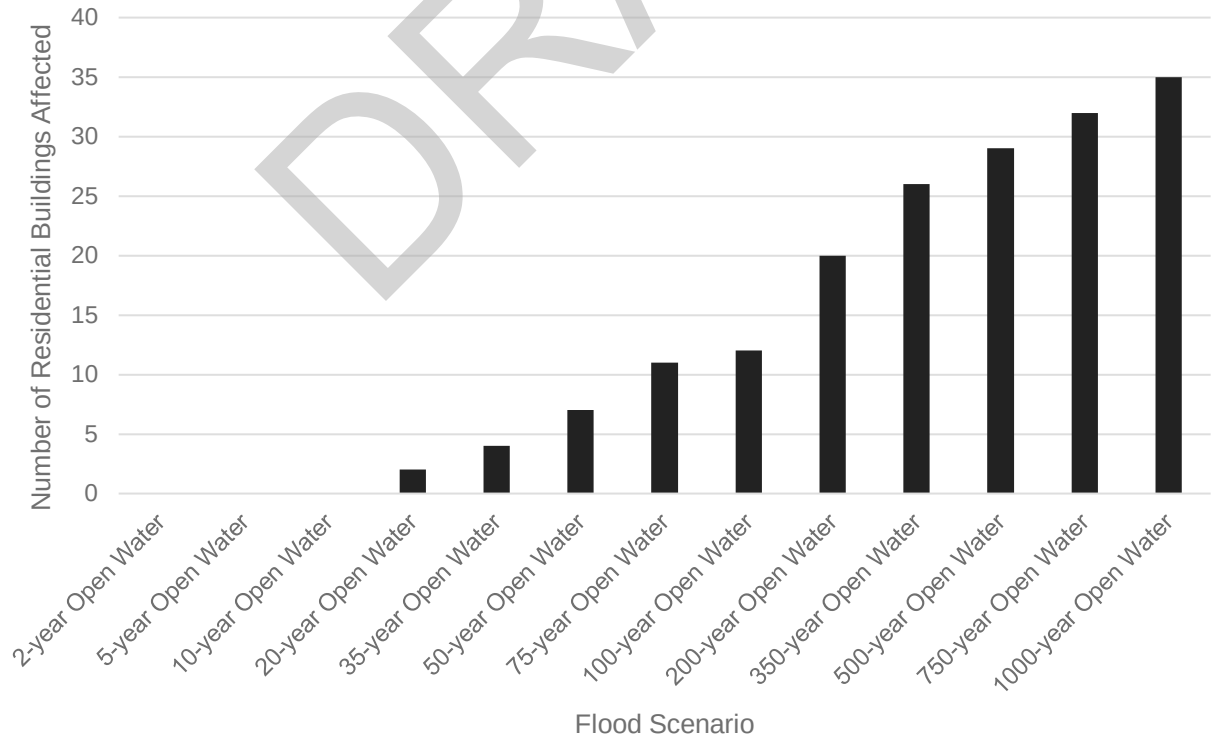
4.2.2.1 Residential Buildings

Table 3 and Figure 4 provide summary statistics for the number of residential buildings at risk due to direct inundation.

Table 3: Residential Buildings at Risk for Various Flood Scenarios

Flood Scenario	Number of Buildings Affected
2-year	0
5-year	0
10-year	0
20-year	2
35-year	4
50-year	7
75-year	11
100-year	12
200-year	20
350-year	26
500-year	29
750-year	32
1000-year	35

Figure 4: Residential Buildings at risk for Various Flood Scenarios



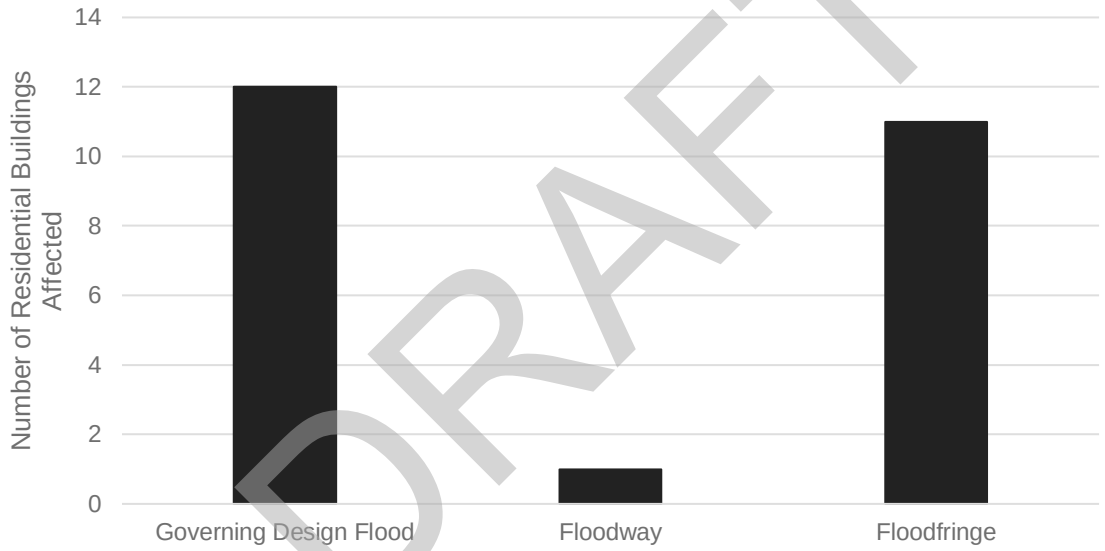
The number of residential buildings at risk range from 0 during the 2-year flood event up to 35 buildings during the 1000-year flood event. During the 100-year flood event, there are 12 residential buildings at risk.

Table 4 and Figure 5 provide summary statistics for the number of residential buildings at risk for the governing design flood.

Table 4: Residential Buildings at risk for Governing Design Flood

Flood Scenario	Number of Buildings Affected
Governing Design Flood	12
Floodway	1
Flood Fringe	11
High Hazard Flood Fringe	0

Figure 5: Residential Buildings at risk for Governing Design Flood



One residential building is at risk within the floodway, 11 residential buildings are at risk within the flood fringe and 0 residential buildings are at risk within the high hazard flood fringe.

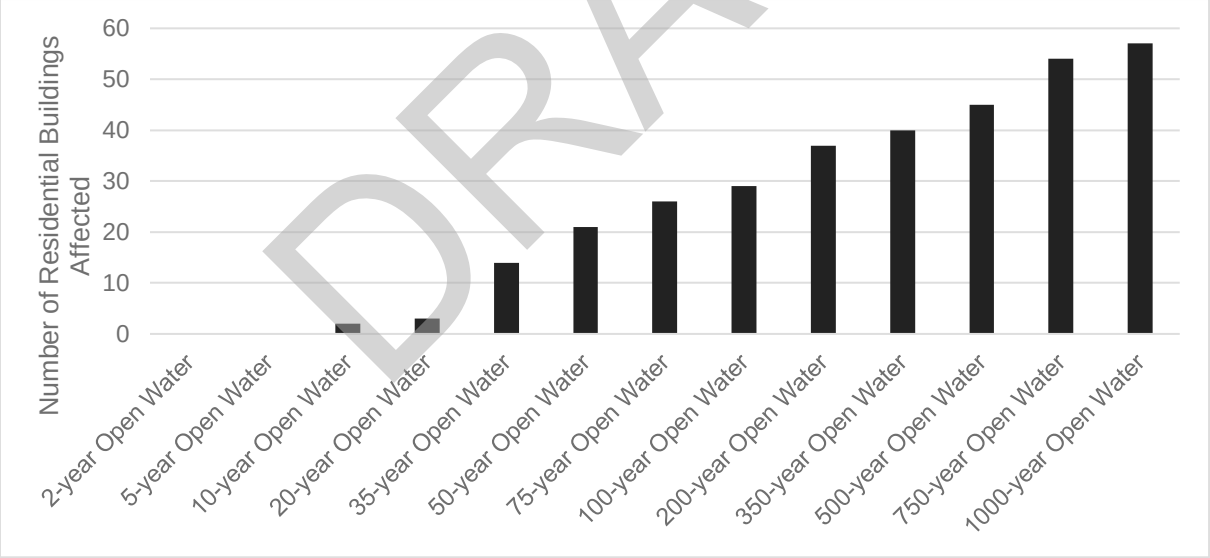
4.2.2.2 Non-residential Buildings

Table 5 and Figure 6 provide summary statistics for the number of non-residential buildings at risk due to direct inundation.

Table 5: Non-Residential Buildings at Risk for Various Flood Scenarios

Flood Scenario	Number of Buildings Affected
2-year	0
5-year	0
10-year	2
20-year	3
35-year	14
50-year	21
75-year	26
100-year	29
200-year	37
350-year	40
500-year	45
750-year	53
1000-year	56

Figure 6: Non-Residential Buildings at risk for Various Flood Scenarios



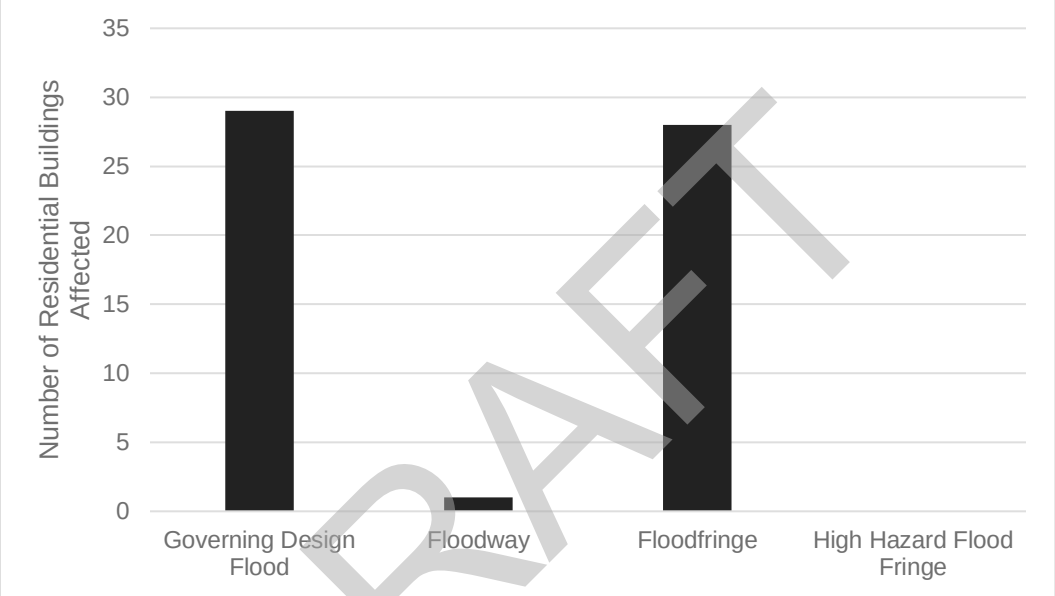
The number of non-residential buildings at risk range from 0 during the 2-year flood event up to 56 buildings during the 1000-year flood event. During the 100-year flood event, there are 29 non-residential buildings at risk.

Table 6 and Figure 7 provide summary statistics for the number of non-residential buildings at risk for the governing design flood.

Table 6: Non-Residential Buildings at risk for Governing Design Flood

Flood Scenario	Number of Buildings Affected
Governing Design Flood	29
Floodway	1
Flood Fringe	28
High Hazard Flood Fringe	0

Figure 7: Non-Residential Buildings at risk for Governing Design Flood



There is 1 non-residential buildings at risk within the floodway, 28 non-residential buildings at risk within the flood fringe and 0 non-residential buildings at risk within the high hazard flood fringe during the governing design flood.

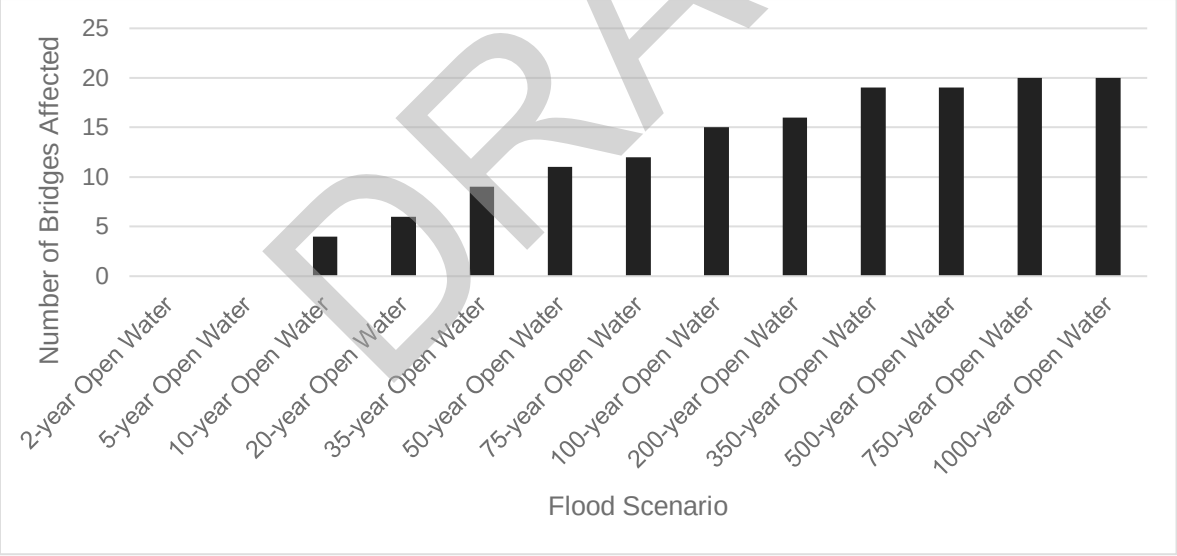
4.2.2.3 Bridges

Table 7 and Figure 8 provide summary statistics showing the number of bridges at risk due to direct inundation. Bridges are assumed to be at risk if flood levels reach the highest low chord elevation of the bridge.

Table 7: Bridges affected for Various Flood Scenarios

Flood Scenario	Number of Bridges Affected
2-year	0
5-year	0
10-year	4
20-year	6
35-year	9
50-year	11
75-year	12
100-year	15
200-year	16
350-year	19
500-year	19
750-year	20
1000-year	20

Figure 8: Bridges affected for Various Flood Scenarios



The number of bridges at risk range from 4 during the 10-year flood event up to 20 bridges during the 1000-year flood event. During the 100-year flood event, there are 15 bridges at risk.

Priddis Creek overtops the bridge (PC-BRDG-9) and Highway 22 near Coalmine Road W for flood events greater than the 20-year event.

Fish Creek does not overtop the bridge (FC-BRDG-1) at Highway 22 near Priddis Valley Road W until the 350-year flood event however there would be flood impacts to the highway during the 200-year flood event and greater.

Table 8 and Figure 9 provide summary statistics for the number of bridges at risk for the governing design flood.

Table 8: Bridges at risk for Governing Design Flood

Flood Scenario	Number of Bridges Affected
Governing Design Flood	15
Floodway	15
Flood Fringe	0
High Hazard Flood Fringe	0

Figure 9: Bridges at risk for Governing Design Flood

There are 15 bridges at risk within the floodway and 0 bridges at risk within the flood fringe and high hazard flood fringe during the governing design flood scenario. Note that only bridges crossing the main Fish Creek and Priddis Creek channels were included in this analysis.

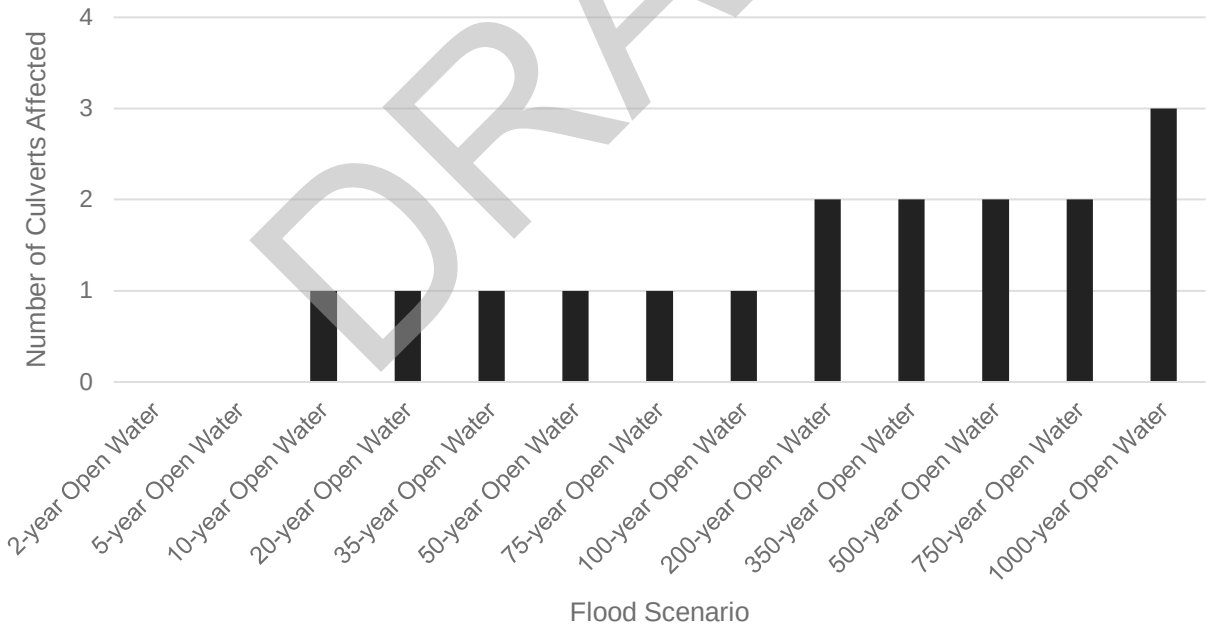
4.2.2.4 Culverts

Table 9 and Figure 10 provide summary statistics showing the number of culverts at risk due to direct inundation. Culverts are assumed to be at risk if flood levels reach the obvert (i.e. crown) of the culvert.

Table 9: Culverts affected for Various Flood Scenarios

Flood Scenario	Number of Culverts Affected
2-year	0
5-year	0
10-year	1
20-year	1
35-year	1
50-year	1
75-year	1
100-year	1
200-year	2
350-year	2
500-year	2
750-year	2
1000-year	3

Figure 10: Culverts affected for Various Flood Scenarios



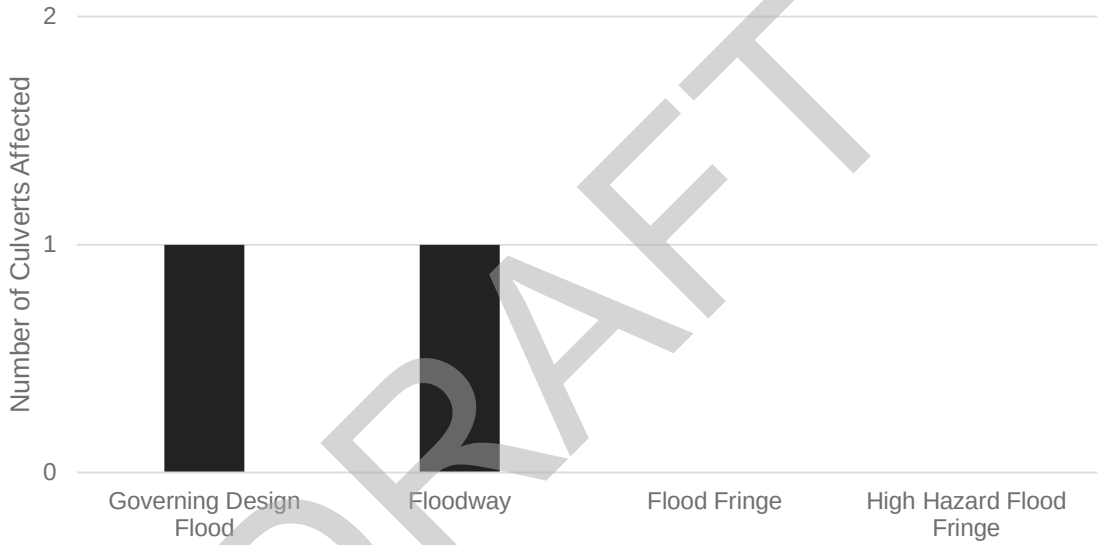
The number of culverts at risk range from 0 during the 2-year flood event up to 3 during the 1000-year flood event. During the 100-year flood event, there is 1 culvert at risk.

Table 10 and Figure 11 provide summary statistics for the number of culverts at risk for the governing design flood.

Table 10: Culverts affected for Governing Design Flood

Flood Scenario	Number of Culverts Affected
Governing Design Flood	1
Floodway	1
Flood Fringe	0
High Hazard Flood Fringe	0

Figure 11: Culverts affected for Governing Design Flood



There is 1 culvert at risk within the floodway and 0 culverts at risk within the flood fringe and high hazard flood fringe during the governing design flood scenario. Note that only culverts within the main Fish Creek and Priddis Creek channels were included in this analysis.

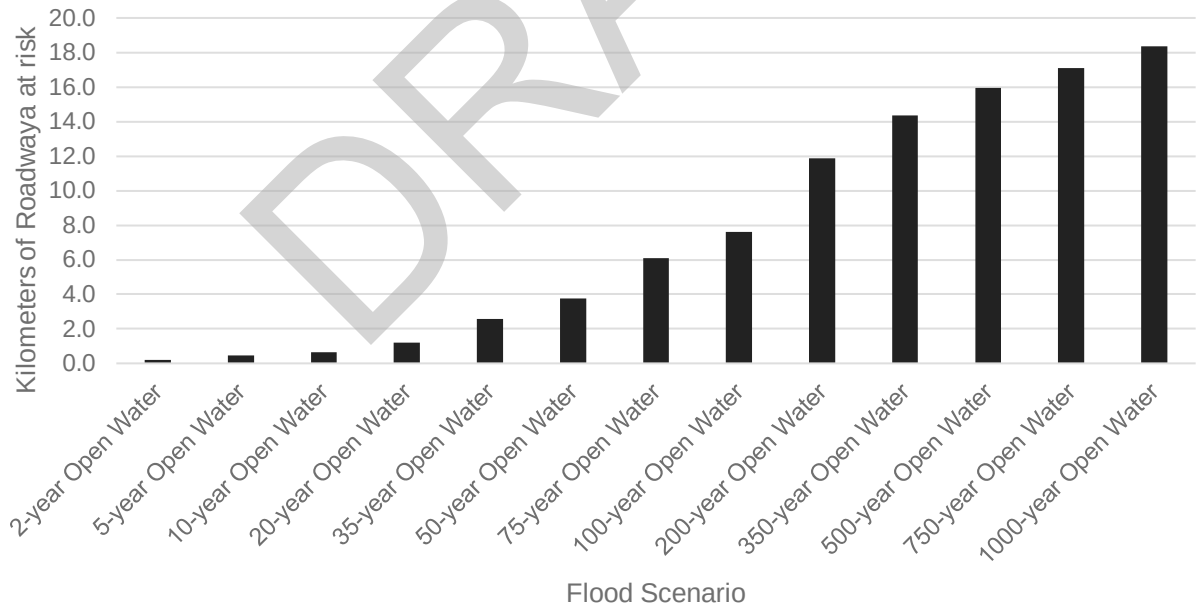
4.2.2.5 Roadway

Table 11 and Figure 12 provide summary statistics showing the number of kilometers of roadway at risk due to direct inundation.

Table 11: Kilometers of roadway at risk for Various Flood Scenarios

Flood Scenario	Number of Kilometers of Roadway at risk
2-year	0.2
5-year	0.5
10-year	0.6
20-year	1.2
35-year	2.6
50-year	3.7
75-year	6.1
100-year	7.6
200-year	11.9
350-year	14.3
500-year	15.9
750-year	17.1
1000-year	18.4

Figure 12: Kilometers of Roadway at risk for Various Flood Scenarios



The kilometers of roadway at risk ranges from 0.2 km during the 2-year flood event up to 18.4 km during the 1000-year flood event. During the 100-year flood event, there is 7.6 km of roadway at risk.

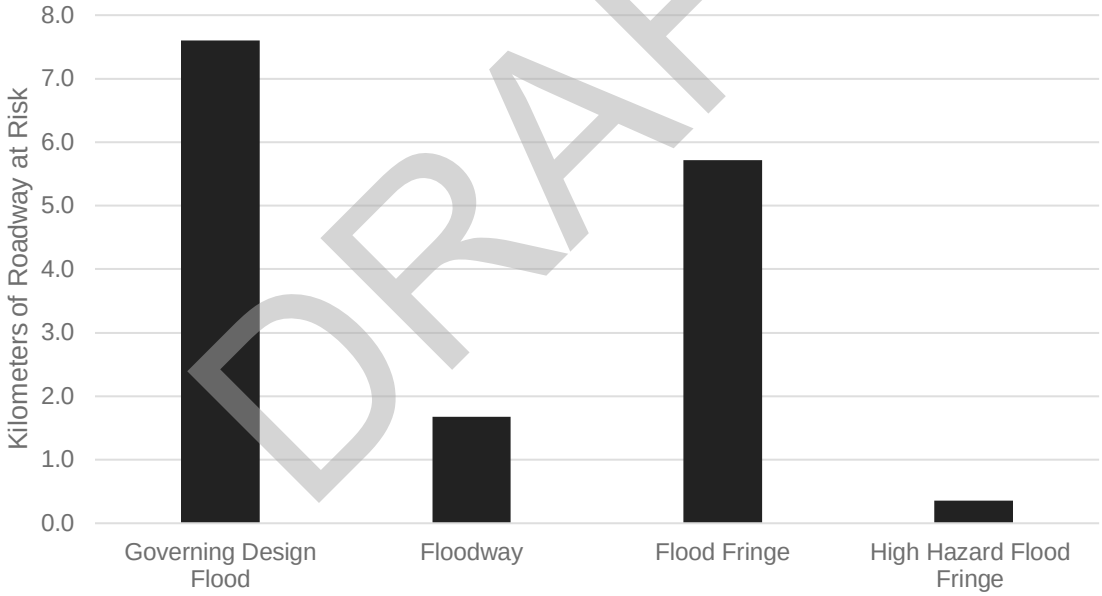
The intersection of Priddis Valley Road W and 186 Ave W is inundated during the 35-year flood event and greater while the Priddis Community Hall is inundated at flood events greater than the 50-year flood event. Fish Creek overtops 186 Ave West at the culvert (FC-CULVT-1) during the 50-year flood event and greater.

Table 12 and Figure 13 provide summary statistics for the number of kilometers of roadway at risk for the governing design flood. Note that the number of kilometers have been rounded to the nearest 0.1 km.

Table 12: Kilometers of roadway at risk for Governing Design Flood

Flood Scenario	Number of Kilometers of Roadway at risk
Governing Design Flood	7.6
Floodway	1.7
Flood Fringe	5.7
High Hazard Flood Fringe	0.4

Figure 13: Kilometers of roadway at risk for Governing Design Flood



There are 1.7 kilometers of roadway at risk within the floodway, 5.7 kilometers of roadway at risk within the flood fringe and 0.4 kilometers of roadway at risk within the high hazard flood fringe during the governing design flood scenario.

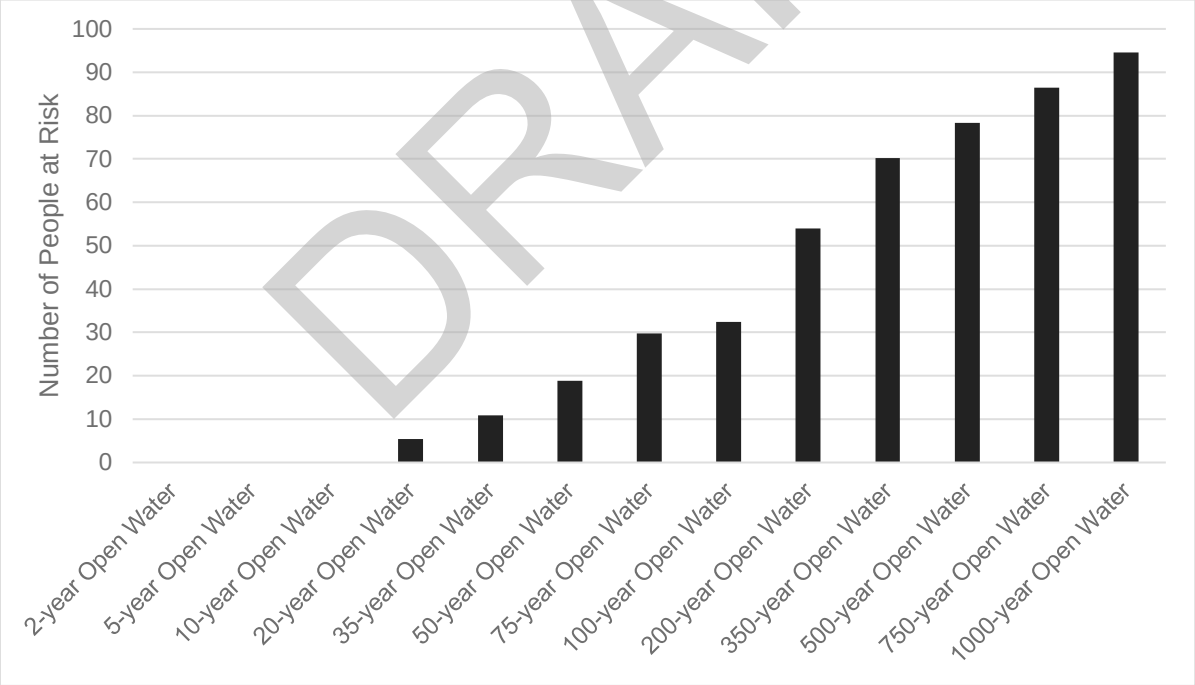
4.2.3 Population

Table 13 and Figure 14 provide summary statistics showing the estimated population at risk due to direct inundation.

Table 13: Population at risk for Various Flood Scenarios

Flood Scenario	Number of People at risk
2-year	0
5-year	0
10-year	0
20-year	5
35-year	11
50-year	19
75-year	30
100-year	33
200-year	54
350-year	70
500-year	78
750-year	86
1000-year	95

Figure 14: Population at risk at risk for Various Flood Scenarios



The population at risk ranges from 0 people during the 2-year flood event up to 95 people during the 1000-year flood event. During the 100-year flood event, there are 33 people at risk.

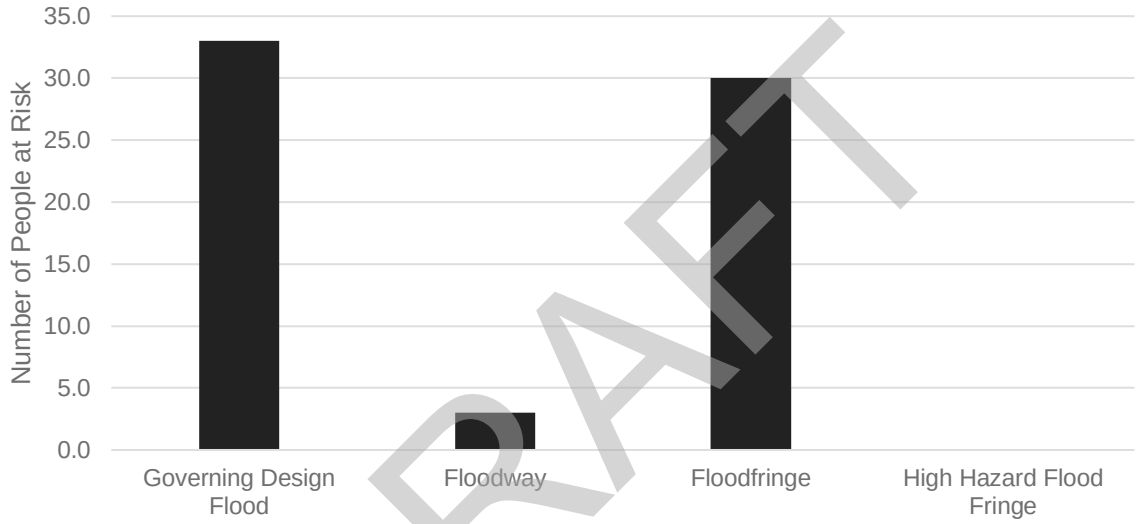
Table 14 and Figure 15 provide summary statistics for the population at risk for the governing design flood.

Table 14: Population at risk for Governing Design Flood

Flood Scenario	Number of People at risk
Governing Design Flood	33
Floodway	3
Flood Fringe	30
High Hazard Flood Fringe	0

*Number of people at risk have been rounded up to the nearest person

Figure 15: Population at risk for Governing Design Flood



Based on the assumptions described herein, approximately 3 people are at risk within the floodway and 30 people are at risk within the flood fringe.

5.0 CONCLUSIONS

This report details the Flood Risk Assessment and Inventory component of the Priddis River Hazard Study. The reports for the previous work components including Survey and Base Data collection, Hydraulic Modelling and Flood Inundation Mapping and Design Flood Hazard Mapping, should be read in conjunction with this report as they provide additional pertinent supporting information. All hydraulic modelling fulfilled FHIP criteria, the Priddis River Hazard Study Terms of Reference and FHIP Guidelines.

This report summarizes the work of the Flood Risk Assessment and Inventory component, for which infrastructure at risk have been summarized and described in this report. A summary of notable infrastructure at risk is provided below:

- Residential buildings are at risk of flooding during the 20-year flood event and greater, while non-residential buildings are at risk for floods greater than the 10-year flood event. There is 1 residential building within the floodway and 11 within the flood fringe during the design 100-year flood. No buildings are within the high-hazard flood fringe.
- Priddis Creek overtops the bridge (PC-BRDG-9) and Highway 22 near Coalmine Road W for flood events greater than the 20-year event.
- Fish Creek does not overtop the bridge (FC-BRDG-1) at Highway 22 near Priddis Valley Road W until the 350-year flood event however there would be flood impacts to the highway during the 200-year flood event and greater.
- The intersection of Priddis Valley Road W and 186 Ave W is inundated during the 35-year flood event and greater while the Priddis Community Hall is inundated at flood events greater than the 50-year flood event. Fish Creek overtops 186 Ave West at the culvert (FC-CULVT-1) during the 50-year flood event and greater.
- The culvert under 240 St W (FC-CULVT-2) is not overtopped until flood events greater than the 100-year flood event.

6.0 REFERENCES

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