UPPER BOW RIVER HAZARD STUDY FLOOD RISK INVENTORY AND ASSESSMENT

FINAL REPORT

Prepared for:

Alberta Government

Alberta Environment and Parks

06 December 2022

NHC Ref. No. 3001178

nhc
northwest hydraulic consultants
water resource specialists

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Prepared for:

Alberta Environment and Parks
Edmonton, Alberta

Prepared by:

Northwest Hydraulic Consultants Ltd.
North Vancouver, BC

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EXECUTIVE SUMMARY

Alberta Environment and Parks (AEP) retained Northwest Hydraulic Consultants Ltd. (NHC) in September 2015 to complete a river hazard study for the Bow River. The roughly 118 km long study reach extends from the Banff National Park boundary, located approximately 5 km upstream of the Town of Canmore, to Bearspaw Dam, near the City of Calgary western boundary. Within the Town of Canmore, the study area incorporates Policeman Creek, a channel roughly 6.5 km long situated on the Bow River floodplain and running parallel to the Bow River main channel. In addition, the study area includes three tributaries: the lower 1 km long reach of Exshaw Creek at the Hamlet of Exshaw; the lower 6 km of Bighill Creek at the Town of Cochrane; and the lower 5 km of Jumpingpound Creek at the Town of Cochrane.

The study is being conducted under the provincial Flood Hazard Identification Program (FHIP). Project stakeholders include the provincial government, local authorities, and the public.

The overall objectives of this project are to identify and assess river related hazards and enhance public safety along the Bow River and the three tributaries included in the study area. The intent is to reduce potential future flood damages and disaster assistance costs to the federal, provincial, and local governments, including First Nations. New floodplain maps will inform land use planning decisions, assist with developing flood mitigation options and facilitate emergency response planning.

The Upper Bow River Hazard Study has been structured into eight major project components. This report summarizes the work of the seventh component: Flood Risk Inventory and Assessment. The objectives of this study component are to compile and interpret available spatial data, inventory and categorize buildings and infrastructure, and compute flood risk statistics for lands, buildings, infrastructure, and populations at risk.

Cadastral data for the majority of the study area was provided by AEP through AltaLIS, a commercial provider of Alberta base mapping data. The dataset included cadastral blocks and lots, cadastral hydrography, cadastral plans, cadastral rights-of-way, and land parcels with unique parcel identifiers. Supplementary cadastral and infrastructure data was provided by local authorities. Census boundaries and population data for 2016 were obtained from Statistics Canada. All inventory data were assembled in a geodatabase.

Statistics are presented for open water flood inundation areas, ice jam flood inundation areas, and governing flood hazard areas. 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, including single family, multi-family, retirement homes, and mobile homes;

- The number of non-residential buildings at risk, including hospitals, schools, commercial, industrial, government buildings, water treatment facilities, and other major non-residential buildings;
- The number of bridges at risk;
- The number of culverts at risk;
- Total kilometres of roadway and railway at risk; and
- The estimated population at risk.

In the M.D. of Bighorn, for the 5-year to 1000-year open water flood scenarios and for the governing design flood, the small pond at the wastewater treatment plant is at risk, but the large pond is not at risk. Several culverts are at risk for open water floods with return periods of 10-years and greater and for the governing design flood. Sections of the Canadian Pacific Railway are at risk for the 2-year to 1000-year open water floods and for the governing design flood. Sections of the Trans-Canada Highway and Highway 1A are at risk for the 100-year to 1000-year open water floods and for the governing design flood. Improvements to the Highway 1A culvert completed in 2019 as part of the Exshaw Creek Flood Mitigation Project are not reflected in this report.

In the Town of Canmore, residential neighbourhoods behind the Canmore Town Dike and the Canmore Mine Dike are at risk for the 5-year to 1000-year open water floods and for the governing design flood. At the 200-year return period both the Mine Dike and the Town Dike are at risk of being overtopped and flooding residential buildings and streets behind these flood control structures. At the 2-year return period, the land around the Canmore wastewater treatment plant is at risk of flooding due to potential failure of the Canmore Town Dike. Although the wastewater treatment plant buildings are at least partly above flood levels up to and including the 1000-year return period, if full building footprints are considered, then the wastewater treatment plant is at risk of flooding due to direct inundation at the 5-year return period and greater. The Canmore wastewater treatment plant is at risk of inundation for the governing design flood, including two primary buildings and several secondary structures. In Canmore, pedestrian and road bridges across Policeman Creek are at risk for return periods of 5-years and greater.

In the Stoney Nakoda First Nation and in Rocky View County there are minimal flooding impacts to infrastructure under all return periods.

In the Town of Cochrane, the residential neighbourhood of Bow Meadows is at risk from direct inundation for the 200-year return period and greater for open water floods. Pedestrian bridges across Bighill Creek are at risk for open water floods starting at the 10-year return period and for the governing design flood. A paved road bridge across Jumpingpound Creek along George Fox Trail is at risk for open water floods starting at the 100-year return period and for the governing design flood.

CREDITS AND ACKNOWLEDGEMENTS

Northwest Hydraulic Consultants Ltd. (NHC) would like to express appreciation to Alberta Environment and Parks (AEP) for initiating this project, making available background information and providing advice and support throughout the work. Key AEP representatives were Jane Eaket, P.Eng. (Project Manager) and Peter Onyshko, P.Eng. (Alternate Project Manager).

Special thanks are expressed to individuals from the Town of Canmore, the Municipal District of Bighorn, and the Town of Cochrane for providing inventory data for this study.

The following NHC personnel were part of the study team and participated in the risk inventory and assessment component of the study. Monica Mannerström, P.Eng. (Project Manager) ensured the overall direction of the project and risk assessment work. Casey Yang (British Columbia Institute of Technology, GIS Practicum Student) assembled the inventory data, planned the analysis methodology, and created a geoprocessing tool to automate the analysis steps. Casey's work was supervised by Sarah North (GIS Specialist). Sarah North, Ilana Klinghoffer (Geoscientist), Ian Eddy (GIS Analyst), Mary Bachynsky (Engineer), and Makamum Mahmood (Engineer) completed the inventory and analysis.

This report was authored primarily by Sarah North and Robyn Andrishak (Hydraulic Engineer). Dan Healy reviewed the report.

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1 INTRODUCTION

1.1 Project Background

Alberta Environment and Parks (AEP) retained Northwest Hydraulic Consultants Ltd. (NHC) in September 2015 to complete a river hazard study for the Bow River, along a reach extending from the Banff National Park boundary at the upstream end to Bearspaw Dam at the downstream end. The study is being conducted under the provincial Flood Hazard Identification Program (FHIP).

The Bow River has experienced severe flooding in the past, with three extreme events occurring from the late 1800s to early 1900s, two around 1930, and, more recently, in 2013.

For the Bow River reach within the current study limits, provincial flood hazard mapping was previously prepared for Cochrane (Alberta Environment, 1986, 1990), Canmore (W-E-R Agra, 1993), and Municipal District (M.D.) of Bighorn (Acres, 1996). The Cochrane study reach covered 21 km of the Bow River (from Bearspaw Dam to upstream of the Town of Cochrane boundary) and the lower 4.5 to 5 km reaches of Jumpingpound and Bighill Creeks (two tributaries discharging to the Bow River within the Town of Cochrane limits). The M.D. of Bighorn study includes a 15 km reach of the Bow River from the west boundary of Bow Valley Provincial Park to Dead Man's Flats and includes the lower one kilometre reach of Exshaw Creek. The Canmore study covered a 20 km reach of Bow River from Dead Man's Flats, through the Town of Canmore (including Policeman Creek), to the Banff National Park boundary.

AEP identified a need to update and expand the coverage of this mapping following the 2013 floods. Stakeholders of the present project are the Government of Alberta, the Town of Canmore, the M.D. of Bighorn, Stoney Nakoda First Nation, Rocky View County, the Town of Cochrane, and the public.

1.2 Project Objectives

The overall objectives of this project are to identify and assess river related hazards and enhance public safety along the Bow River and three tributaries included in the study area. The intent is to reduce potential future flood damages and disaster assistance costs to the federal, provincial, and local governments, as well as First Nations. The updated flood mapping will also inform land use planning decisions, assist with developing flood mitigation options and facilitate emergency response planning.

Specific study components, as outlined in the AEP Upper Bow River Hazard Study Terms of Reference, are:

- survey and base data collection;
- hydraulic model development, calibration and validation;
- open water flood inundation map production;
- open water flood hazard identification;

- ice jam assessment and associated flood hazard identification;
- governing flood hazard map production;
- flood risk assessment and inventory; and
- channel stability investigation.

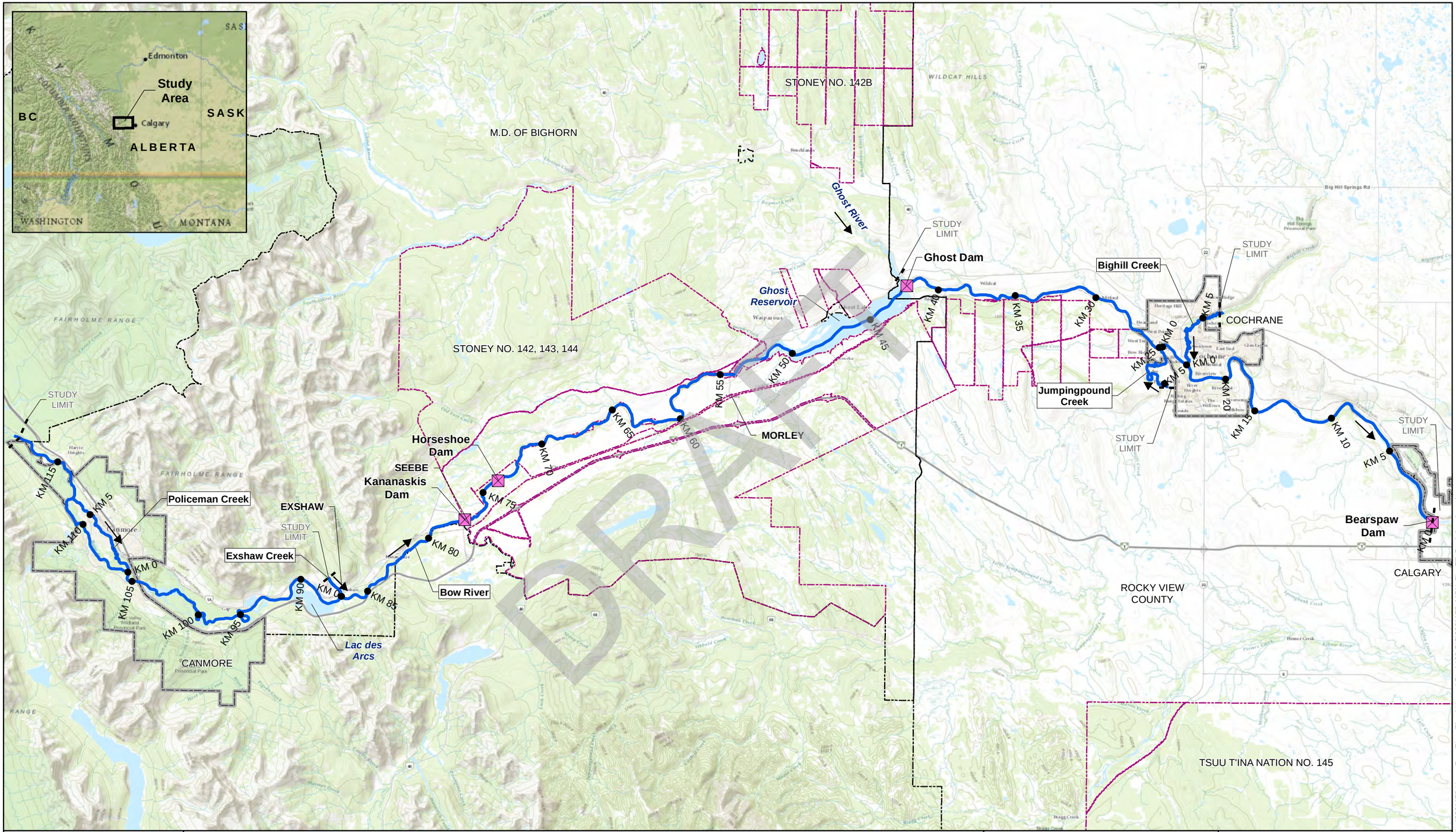
The results of each component will be summarized in individual stand-alone reports. This report describes the results from the flood risk assessment and inventory phase of the project and forms the seventh report of the Upper Bow River Hazard Study. The objectives of the flood risk assessment and inventory are to compile and interpret available spatial data, inventory and categorize buildings and infrastructure, and compute flood risk statistics for lands, buildings, infrastructure, and populations at risk.

1.3 Study Area and Reach

From the Bow River headwaters at Bow Lake (Elev. 1940 m), just north of Lake Louise, the river flows in a south-easterly to easterly direction over nearly 600 km before draining into the South Saskatchewan River. The Upper Bow River study area comprises a roughly 118 km long reach, extending from the Banff National Park boundary, located approximately 5 km upstream of the Town of Canmore, to Bearspaw Dam, near the City of Calgary western boundary. Within the Town of Canmore, the study area incorporates Policeman Creek, an inlet controlled high water channel roughly 6.5 km long situated on the floodplain and running parallel to the Bow River main channel. In addition, the study area includes three tributaries:

- the lower 1 km long reach of Exshaw Creek at the Hamlet of Exshaw;
- the lower 6 km of Bighill Creek at the Town of Cochrane; and
- lower 5 km of Jumpingpound Creek at the Town of Cochrane.

Flow is regulated both on the Bow River main stem and on several tributaries. In addition to the Bearspaw Dam at the downstream end, the Ghost, Horseshoe Falls, and Kananaskis dams also impound the river. The study area is shown in Figure 1.



Alberta Government

nhc northwest hydraulic consultants

Model Stream Network (with stationing)

Dam

Summer Village

Town

City

First Nation Reserve

County or Municipal District

DATA SOURCES: Basemap from Esri & NRCAN.

SCALE - 1:200,000

0 1 2 3 4 5 6 7 8 KM

N

Coordinate System: NAD 1983 3TM 114
Units: METRES

Job: 3001178

Date: 07-MAR-2019

UPPER BOW RIVER HAZARD STUDY

STUDY AREA

FIGURE 1

MSN: \\mainfile-van\Projects\Active\3001178 Upper Bow River Flood Hazard Study\90 GIS\3001178_MSN_Fig_T7_StudyArea1.mxd

2 AVAILABLE DATA

Available spatial data assembled and used for this analysis are summarized below. Supporting information and digital files are provided as Appendix A.

2.1 Cadastral

Cadastral data for the majority of the study area was provided by AEP through AltaLIS, a commercial provider of Alberta base mapping data. The dataset included cadastral blocks and lots, cadastral hydrography, cadastral plans, cadastral rights-of-way, and land parcels with unique parcel identifiers. The M.D. of Bighorn and the Town of Cochrane provided further information on the land ownership or land use types for each parcel, separating the land parcels within these two communities by private, Crown, and municipal land ownership. Land use designations for Canmore and Cochrane were obtained from Calgary Region Open Data (2016a and 2016b). The Stoney Nakoda First Nation cadastral data were obtained from GeoGratis (2015), which provides open access data from Natural Resources Canada.

2.2 Infrastructure

The M.D. of Bighorn, Cochrane, and Canmore were contacted in order to acquire the most accurate building data. The Stoney Nakoda First Nation and Rocky View County were not contacted for data, as the small number of buildings in the floodplain within these communities were readily identified from orthoimagery (see Section 3.2.1). For the M.D. of Bighorn, building footprints and their centroids were available for multiple hamlets, including Lac des Arcs, Dead Man's Flats, Exshaw, Harvie Heights, and the Grotto area. Cochrane provided building footprints and a set of polygon shapefiles that identified noteworthy buildings (schools, hotels, and points of interest). Building footprints for Canmore were obtained from Calgary Region Open Data (2016a and 2017). Building footprints were converted into centroids and compiled together in one dataset.

Bridges and culverts were mapped by NHC based on field surveys and reference data received from Alberta Transportation. Centroid points for the bridges and culverts were used for the analysis.

There were several possible sources for the roadway and railway networks, including municipal, provincial, and national datasets. The National Road Network (NRN) from Statistics Canada (2015) and National Railway Network (NRWN) from Natural Resources Canada (2015) were selected for the flood risk assessment, as they provided the most complete and consistent coverage of the study area.

2.3 Census

Census boundaries and population data for 2016 were obtained from Statistics Canada (2016). The smallest geographic areas for which population and dwelling counts are provided are referred to as census dissemination blocks. Their boundaries are defined as areas "bounded on all sides by roads and/or boundaries of standard geographic areas" (Statistics Canada, 2016). For confidentiality reasons,

if the total population is under 15, Statistics Canada rounds the population count to a base of 5. A random rounding algorithm is used to either round upwards or downwards in count value, meaning the count will always end in 0 or 5. In doing so, population counts will always be within 5 of the actual values.

3 INTERPRETED SPATIAL DATA

3.1 Aerial Photography

Orthoshop Geomatics Ltd. (OGL) collected colour aerial imagery for the study area on June 3rd, 2016, and used this imagery to generate colour-balanced ortho-rectified mosaics. A complete description of the aerial imagery acquisition and data processing procedures can be found in the Survey and Base Data Collection Report (NHC, 2017), provided under separate cover.

Data preparation for the current task began prior to collection and delivery of the 2016 orthoimagery. For the early stages of spatial data preparation, 2013 orthoimagery supplied by AEP was used. Data were updated using 2016 orthoimagery, once it became available.

3.2 Residential Structures

3.2.1 Digitization

Centroids for the majority of residential structures were derived from data supplied by the M.D. of Bighorn, Cochrane, and Canmore, as described in Section 2.2. Centroids for structures not included in the data supplied were digitized based on the available orthoimagery. The same digitization was completed for residential structures on Stoney Nakoda lands and in Rocky View County. For each structure observed in the orthoimagery, ArcGIS was used to manually digitize a point in the approximate centre. Google Maps and Google Street View were used to help confirm that each structure was residential.

3.2.2 Classification

The building datasets provided by the local authorities do not identify building type; however, this information was required for the flood risk assessment. Land use designations were used to identify residential districts and structures. Only primary residential structures are reported in the statistics. For example, when two residential buildings were located within the same land parcel, it was generally a garage and house. Only the house would be considered as a primary structure and included in the analysis. Examples of secondary structures are: residential garages, sheds, and outbuildings on a farm. Four sub-categories of residential structures were created: single family homes, multi-unit residential buildings, retirement homes, and mobile homes (Table 1). Residential structure sub-category was determined based on examination of the orthoimagery.

Table 1 Residential Structure Categories

Category	Sub-Category
Residential	Single family
	Multi-family
	Retirement home
	Mobile home

3.3 Non-residential Structures

3.3.1 Digitization

Centroids for non-residential buildings were digitized using the same methodology as described for residential buildings. Google Maps and Google Street View were used to help confirm that the identified buildings were non-residential.

3.3.2 Classification

As with residential structures, land use designations were used to identify non-residential districts. Documentation of water treatment plants and wastewater treatment plants found online[1] was used to confirm classification of treatment facilities identified from data supplied by local authorities, orthophoto interpretation, and Google Street View.

Sub-categories were created for non-residential buildings, as shown in Table 2.

Table 2 Non-residential Structure Categories

Category	Sub-Category
Non-residential	Hospital
	School
	Commercial
	Industrial
	Government buildings
	Water Treatment Facility
	Other major non-residential buildings

[1] Canmore Wastewater Treatment Facility described by City of Canmore at https://canmore.ca/municipal-services/public-utilities/utility-operations; Morley Wastewater Treatment Plant described by Tritech Water Infrastructure Solutions at http://www.tritechgroup.ca/recent-work/morley-wwtp/; and Cochrane Water Treatment Plant described by City of Cochrane at https://www.cochrane.ca/265/Water-Treatment-Plant.

4 FLOOD RISK ASSESSMENT AND INVENTORY

4.1 Methodology

Statistics were generated for open water flood inundation areas (2-, 5-, 10-, 20-, 35-, 50-, 75-, 100-, 200-, 350-, 500-, 750-, and 1000-year return periods), ice jam flood inundation areas (50-, 100-, and 200-year return periods), and the governing flood hazard areas. For the open water and ice jam flood inundation scenarios, areas of direct flood inundation, potential inundation due to flood control structure failure, and isolated inundation were assessed. For the governing flood hazard, statistics associated with the floodway, flood fringe, high hazard flood fringe, and protected flood fringe zones were computed separately.

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.

Potential flood control structure failure areas are defined as those areas that could become flooded in the event a structure protecting the area has failed. For a given flood scenario, if water overtops portions of a flood control structure, then the areas behind that structure were treated as direct flood inundation areas. At lower return period floods, when water surface elevations did not indicate overtopping, the areas behind the flood control structure were considered inundated due to potential flood control structure failure. This does not imply failure of flood control structures is expected to occur.

Isolated inundation areas are defined as areas in the floodplain that have ground elevations below adjacent flood levels but have no direct hydraulic or overland flow connection to the actively flowing river channel. Flooding of isolated areas could occur due to subsurface flow through porous media or flooding of buried pipes and culverts. Inundated areas behind embankments not identified as dedicated flood control structures, such as roads and berms, were considered isolated areas. Railway embankments were considered permeable due to the presence of culverts or porous fill material. It was assumed the water surface elevation on the outside of the railway embankments would be equal to that of the adjacent actively flowing river channel.

The inundation extents for each flood scenario were superimposed on the inventory data to assess:

- The number of land parcels at risk;
- The number of residential buildings at risk, including single family, multi-family, retirement homes, and mobile homes;
- The number of non-residential buildings at risk, including hospitals, schools, commercial, industrial, government buildings, water treatment facilities, and other major non-residential buildings;
- The number of bridges at risk;

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

All land parcels that intersect the flood extents were deemed to be at risk. Land parcels at risk of flooding that fully or partially lie within the boundaries of a local authority were included in the count for that local authority. Since some land parcels crossed the boundaries of local authorities, as illustrated in Figure 2, the total number of affected land parcels does not necessarily equal the sum of the land parcels at risk within each local authority.

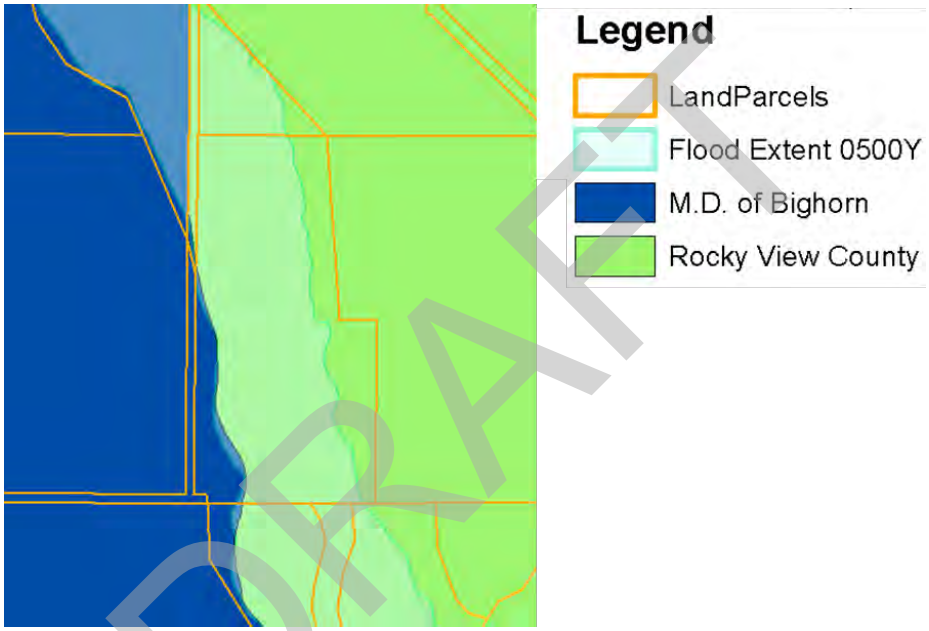


Figure 2 Example of a land parcel crossing the boundary of more than one local authority. The land parcel in this image falls within the M.D. of Bighorn and Rocky View County.

Residential and non-residential building centroids that lie within the flood extents were deemed to be at risk. Since building centroids were used for this analysis instead of building footprints, buildings that partially intersect the flood extent may not be considered at risk. Results were classified by primary building category and sub-category. Secondary structures such as garages on land parcels with a primary structure were not included.

Bridges were considered to be at risk if the flood level reached the bridge low chord elevation for the associated flood scenario. Bridge clearance levels were determined by calculating the difference between the bridge low chord elevation and the water surface elevation for each flood scenario.

Culverts were considered to be at risk if the flood level was higher than the approach road elevation for the associated flood scenario. Culverts conveying local drainage or watercourses other than the Bow

River, Policeman Creek, Exshaw Creek, Jumpingpound Creek, or Bighill Creek were not included in this analysis.

The total length of roadways and railways within the flood extent was calculated. Roadway and railway were represented by polylines and consequently, where the lengths represent the centreline lengths of at-risk roadway and railway. The lengths of at-risk bridges were not included in the total lengths of at-risk roadway and railway.

The estimated population at risk was determined by multiplying the total population within each census dissemination block by the proportion (i.e. percentage) of the block's area that falls within the flood extents. Some census blocks encompassed water features such as rivers and lakes that are not populated; therefore, these features were masked out of the census dissemination blocks using Alberta provincial hydrography obtained from AltaLIS (2016). In cases where this resulted in a census dissemination block being split into multiple parts, the population of the dissemination census block was allocated between each part based on their relative areas.

All results are reported by local authority and aggregate total. The local authorities include:

- M.D. of Bighorn;
- Town of Canmore;
- Stoney Nakoda First Nation;
- Rocky View County; and
- Town of Cochrane.

Since ice jam flood inundation mapping was completed for a portion of the study area between Ghost and Bearspaw dams, results for the ice jam flood scenarios are only reported for the local authorities of Stoney Nakoda First Nation, Rocky View County, and Town of Cochrane.

4.2 Results

The results of the flood risk assessment presented below are for the various open water, ice jam, and governing design flood scenarios investigated in this study.

Maps of the open water flood inundation areas can be found in the Open Water Flood Inundation Map Library, provided as a separate document in conjunction with the Open Water Flood Inundation Mapping Report (NHC, 2018). That report also provides a summary of the data and methodology used to prepare the open water flood inundation maps.

Maps of the ice jam flood inundation areas can be found in the Ice Jam Flood Inundation Map Library, provided as a separate document in conjunction with the Ice Jam Modelling Assessment and Flood Hazard Identification Report (NHC, 2022a). That report also provides a summary of the data and methodology used to prepare the ice jam flood inundation maps.

Maps of the design flood hazard inundation areas can be found as an appendix within the Governing Design Flood Hazard Mapping Report (NHC, 2022b). That report also provides a summary of the data and methodology used to prepare the flood hazard maps.

4.2.1 Land Parcels

Table 3a and Figure 3a provide summary statistics for the number of land parcels at risk due to direct inundation.

Canmore has the most land parcels at risk for all open water flood scenarios, and the number of land parcels at risk within Canmore as a proportion of the total increases from about 38% for the 2-year flood up to 71% for the 1000-year flood. For the 200-year return period, both the Canmore Mine Dike and the Canmore Town Dike are at risk of being overtopped, resulting in the flooding of residential land behind them.

The M.D. of Bighorn has the second highest number of land parcels at risk for open water flood scenarios up to the 500-year return period. For the 2-year return period, 279 land parcels are at risk; however, none of these land parcels contain buildings at risk (Table 4a and Table 5a).

Cochrane has the second highest number of land parcels at risk of direct inundation for the 750- and 1000-year open water floods. In Cochrane, the land parcels at risk for open water floods less than the 200-year return period do not contain buildings. Statistics for the number of buildings at risk are discussed in Sections 4.2.2 and 4.2.3. For the remainder of the areas, land parcels at risk are typically located in areas where buildings and other infrastructure is limited.

There are land parcels at risk for the 50-, 100-, and 200-year ice jam floods. Rocky View County has the highest number of land parcels at risk from ice jam floods for all return periods, and there are 118 land parcels at risk for the 100-year ice jam flood. Cochrane has the second highest number of land parcels at risk from ice jam floods and there are 78 land parcels at risk for the 100-year ice jam flood. The majority of these land parcels do not contain buildings.

Table 3b provides summary statistics for the number of land parcels at risk due to potential flood control structure failure. In Canmore, the Town Dike, located on the left (northeast) side of the river, protects a large portion of downtown Canmore, extending from the Canmore Golf and Curling Club to upstream of the wastewater treatment plant. The Mine Dike protects the area on the right (southwest) side of the river and extends from the TransAlta Rundle Plant outlet to West Canmore Park, near the intersection of Rummel Place and Three Sisters Drive. At the 2-year return period, the Rundle neighbourhood is at risk due to potential failure of the Canmore Mine Dike. At the 5-year return period, sections of the Riverside and South Canmore neighbourhoods are at risk due to potential failure of the Canmore Town Dike. Land within fairway 6 of the Canmore Golf and Curling Club and large portions of the land around the Canmore Wastewater Treatment Plant are at risk of inundation at the 5-year return period flood.

Table 3c and Figure 3b provide summary statistics for the number of land parcels at risk for the governing design flood. Canmore has the highest number of land parcels at risk for the governing design flood, both in the floodway and flood fringe areas. Canmore contains 71% (1490) of the total land parcels at risk in the study area for the governing design flood, followed by M.D. of Bighorn (329), Rocky View County (149), and Cochrane (122). The majority of land parcels at risk for the governing design flood scenario do not contain buildings.

Appendix B provides a more detailed summary of land parcels at risk by the following subcategories: direct flood inundation, potential inundation due to flood control structure failure, and potential isolated area inundation.

Table 3a Land parcels at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Number of Land Parcels by Local Authority					Total[2]
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	279	297	32	140	69	780
5-Yr Open Water	302	352	34	143	75	869
10-Yr Open Water	308	384	34	144	76	909
20-Yr Open Water	311	430	35	145	79	962
35-Yr Open Water	311	427	36	146	81	960
50-Yr Open Water	317	464	37	146	83	1006
75-Yr Open Water	321	480	37	146	98	1041
100-Yr Open Water	329	578	38	146	114	1164
200-Yr Open Water	337	1597	39	152	153	2234
350-Yr Open Water	377	1790	39	155	212	2529
500-Yr Open Water	379	2173	39	157	305	3009
750-Yr Open Water	381	2302	39	158	392	3228
1000-Yr Open Water	388	2403	39	160	428	3374
50-Yr Ice Jam[1]	n/a	n/a	6	116	76	186
100-Yr Ice Jam[1]	n/a	n/a	7	118	78	191
200-Yr Ice Jam[1]	n/a	n/a	7	118	80	193

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. The total is derived from a separate count of at-risk land parcels across the total study area and is not necessarily equivalent to the sum of the land parcels in each local authority.

Table 3b Land parcels at risk for open water and ice jam flood scenarios – potential flood control structure failure

Flood Scenario	Number of Land Parcels by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	67	0	0	0	67
5-Yr Open Water	0	289	0	0	0	289
10-Yr Open Water	0	584	0	0	0	584
20-Yr Open Water	0	805	0	0	0	805
35-Yr Open Water	0	882	0	0	3	885
50-Yr Open Water	0	908	0	0	7	915
75-Yr Open Water	0	974	0	0	0	974
100-Yr Open Water	0	951	0	0	1	952
200-Yr Open Water	0	149	0	0	0	149
350-Yr Open Water	0	136	0	0	0	136
500-Yr Open Water	0	12	0	0	0	12
750-Yr Open Water	0	12	0	0	0	12
1000-Yr Open Water	0	5	0	0	0	5
50-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
100-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
200-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 3c Land parcels at risk for the governing design flood scenario

Flood Scenario	Number of Land Parcels by Local Authority					Total[3]
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood[1]	329	1490	38	149	122	2087
Floodway	249	231	37	143	87	709
Flood Fringe[2]	197	1398	22	107	87	1814
High Hazard Flood Fringe	138	117	6	36	26	325
Protected Flood Fringe	0	952	0	0	0	952

Notes:

1. The number of land parcels at risk for the Governing Design Flood scenario is not necessarily equivalent to the sum of the land parcels at risk for all zones because a single land parcel can be at risk for the floodway, flood fringe, and flood fringe sub-zones.
2. Flood fringe includes high hazard and protected flood fringe-sub zones.
3. The total is derived from a separate count of at-risk land parcels across the total study area and is not necessarily equivalent to the sum of the land parcels in each local authority.

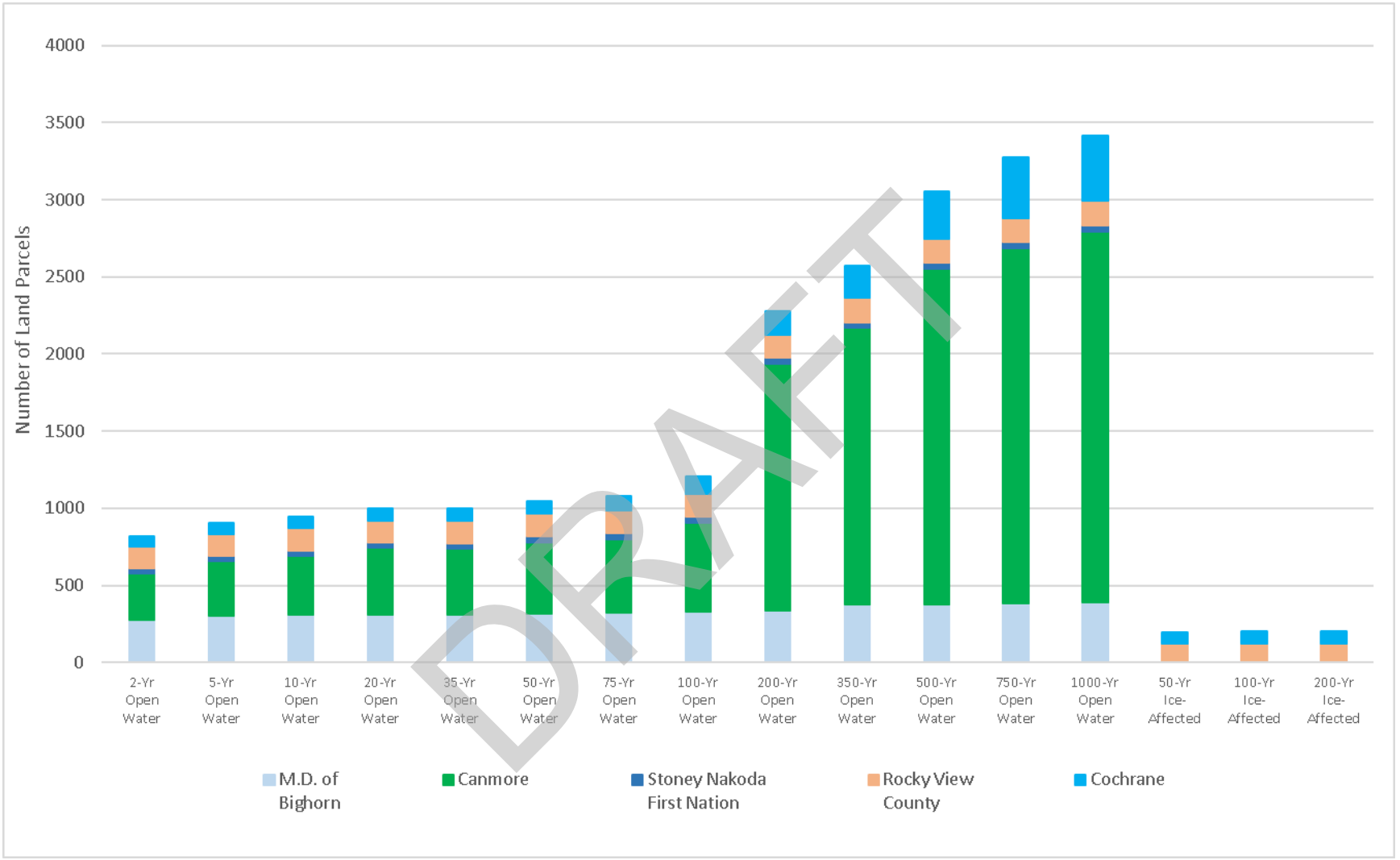


Figure 3a Land parcels at risk for the open water and ice jam flood scenarios – direct inundation

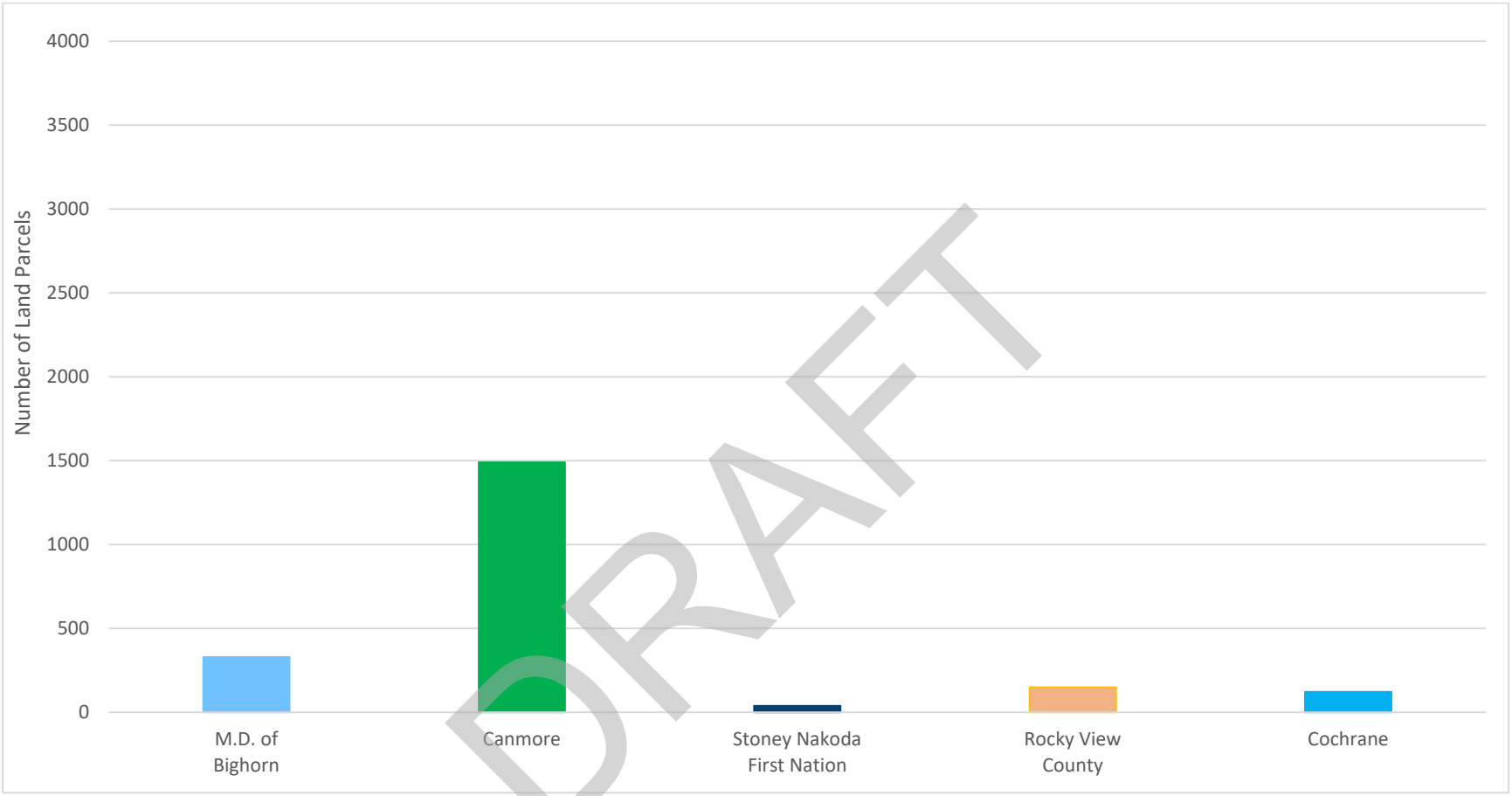


Figure 3b Land parcels at risk for the governing design flood scenario

4.2.2 Residential Buildings

Table 4a and Figure 4a provide summary statistics for the number of residential buildings at risk due to direct inundation, while Table 4b provides summary statistics for the number of residential buildings at risk due to potential flood control structure failure. The statistics are grouped by local authority. Appendix C provides a more detailed summary of residential buildings by the following subcategories: single family (SF), multi-family (MF), retirement home (RH), and mobile home (MH).

Canmore has the most residential buildings at risk due to direct inundation for all open water flood scenarios. The majority of residential buildings at risk in the Town of Canmore are in the South Canmore, Riverside, Fairholm, Lion's Park, Spring Creek, and Larch neighbourhoods between the Canadian Pacific Railway line and the Canmore Town Dike, as well as in the Rundle neighbourhood west of the Canmore Mine Dike. At the 200-year return period, both the Mine Dike and the Town Dike are at risk of being overtopped and flooding residential areas behind the flood control structures. There are 344 residential buildings at risk for the 200-year flood and 649 residential buildings at risk for the 1000-year flood.

Canmore is the only local authority with residential buildings at risk due to potential flood control structure failure (Table 4b). The number of residential buildings at risk ranges from four buildings at the 2-year return period up to 274 buildings at the 75-year return period. At the 5-year return period, the Rundle neighbourhood is at risk due to potential failure of the Mine Dike and sections of residential areas in the neighbourhood of South Canmore are at risk due to potential failure of the Town Dike. At the 75-year return period, the majority of buildings at risk are located behind the Mine Dike in the Rundle neighbourhood and behind the Town Dike in the South Canmore, Riverside, and Fairholm neighbourhoods.

Cochrane has the second most residential buildings at risk due to direct inundation under the 200- to 1000-year open water floods (Table 4a). The Jumpingpound Creek Dike, which runs along the east bank of the creek downstream of the George Fox Trail Bridge, could be overtopped at the 200-year return period, which would flood the residential neighbourhood of Bow Meadows. Approximately half the residences east of Jumpingpound Creek are at risk at the 500-year return period, and most residences east of Jumpingpound Creek are at risk at the 1000-year return period. Towards the downstream end of Cochrane a number of residences along Riverview Circle, located in the residential development near the Cochrane Golf Club in the Riverview neighbourhood, are at risk for the 500-year and larger floods.

In the M.D. of Bighorn, there are about 25 residential buildings at risk of direct inundation for the 350- to 1000-year open water floods. There are no residential buildings at risk due to potential flood control structure failure in the M.D. of Bighorn.

There are very few residential buildings at risk for the ice jam flood scenarios. In Cochrane, there is one residential building at risk for the 200-year ice jam; in Rocky View County, there is one residential building at risk for the 200-year ice jam.

Table 4c and Figure 4b provide summary statistics for the number of residential buildings at risk for the governing design flood. Canmore has the most residential buildings at risk for the governing design flood. There are 319 residential buildings at risk in Canmore and the majority of these buildings are located in the areas behind the Town Dike and the Mine Dike. The majority of residential buildings at risk in Canmore are single family residences. There is one single family residential building at risk in Cochrane. There is one single family residential structure at risk in Rocky View County. There are no residential buildings at risk in the M.D. of Bighorn and Stoney Nakoda First Nation for the governing design flood.

Table 4a Residential buildings at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Number of Residential Buildings by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	0	0	0	0	0
5-Yr Open Water	0	6	0	0	0	6
10-Yr Open Water	0	9	0	0	0	9
20-Yr Open Water	0	10	0	1	0	11
35-Yr Open Water	0	14	0	1	0	15
50-Yr Open Water	0	17	0	1	0	18
75-Yr Open Water	0	18	0	1	0	19
100-Yr Open Water	0	63	0	1	0	64
200-Yr Open Water	0	344	0	1	12	357
350-Yr Open Water	24	412	0	1	31	468
500-Yr Open Water	24	523	0	1	50	598
750-Yr Open Water	25	602	0	1	79	707
1000-Yr Open Water	25	649	0	1	104	779
50-Yr Ice Jam[1]	n/a	n/a	0	1	1	2
100-Yr Ice Jam[1]	n/a	n/a	0	1	1	2
200-Yr Ice Jam[1]	n/a	n/a	0	1	1	2

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 4b Residential buildings at risk for open water and ice jam flood scenarios – potential flood control structure failure

Flood Scenario	Number of Residential Buildings by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	4	0	0	0	4
5-Yr Open Water	0	26	0	0	0	26
10-Yr Open Water	0	91	0	0	0	91
20-Yr Open Water	0	159	0	0	0	159
35-Yr Open Water	0	209	0	0	0	209
50-Yr Open Water	0	237	0	0	0	237
75-Yr Open Water	0	274	0	0	0	274
100-Yr Open Water	0	256	0	0	0	256
200-Yr Open Water	0	45	0	0	0	45
350-Yr Open Water	0	30	0	0	0	30
500-Yr Open Water	0	3	0	0	0	3
750-Yr Open Water	0	3	0	0	0	3
1000-Yr Open Water	0	0	0	0	0	0
50-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
100-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
200-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 4c Residential buildings at risk for the governing design flood scenario

Flood Scenario	Number of Residential Buildings by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	0	319	0	1	1	321
Floodway	0	0	0	1	1	2
Flood Fringe[1]	0	319	0	0	0	319
High Hazard Flood Fringe	0	1	0	0	0	1
Protected Flood Fringe	0	256	0	0	0	256

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

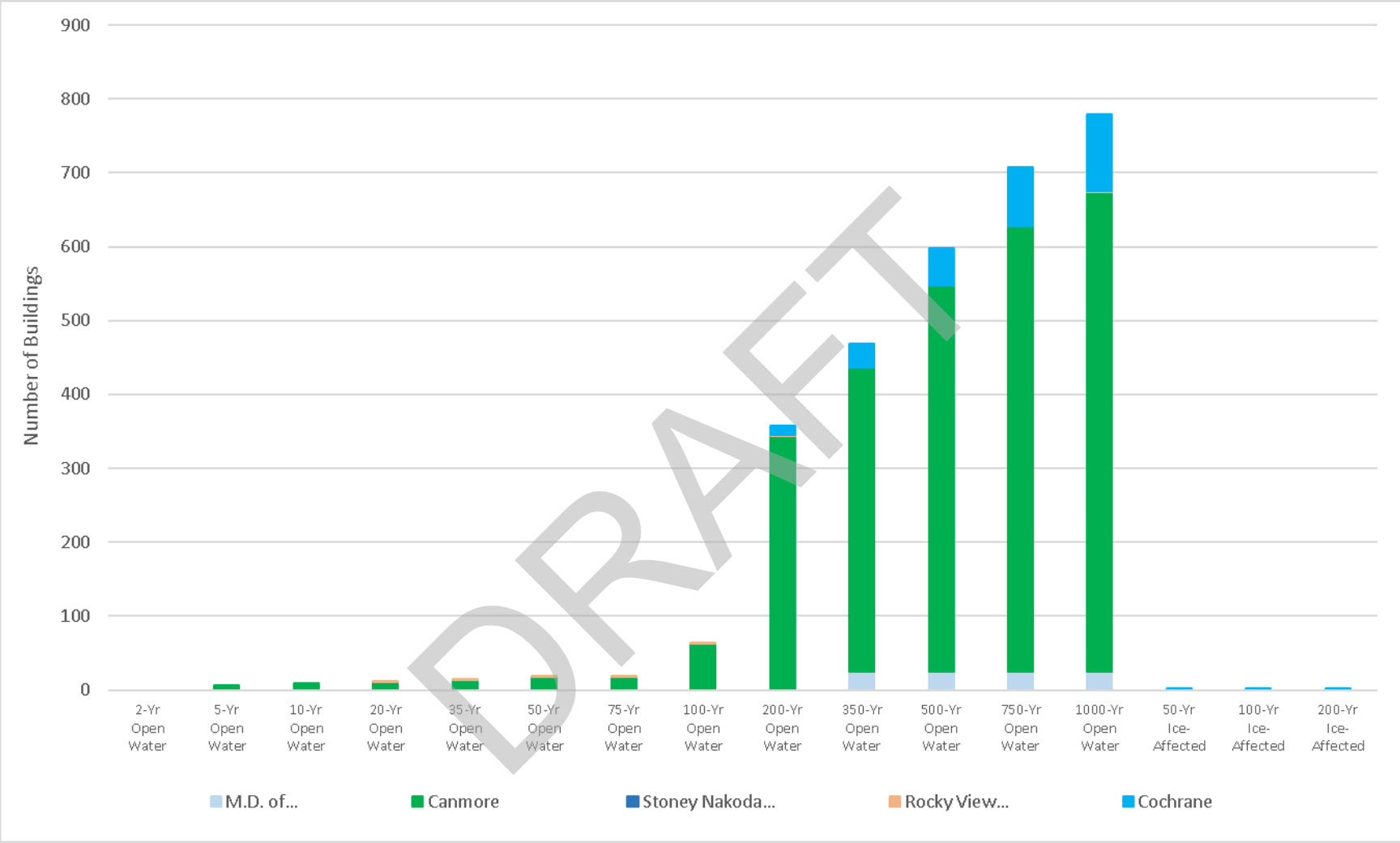


Figure 4a Residential buildings at risk for the open water and ice jam flood scenarios – direct inundation

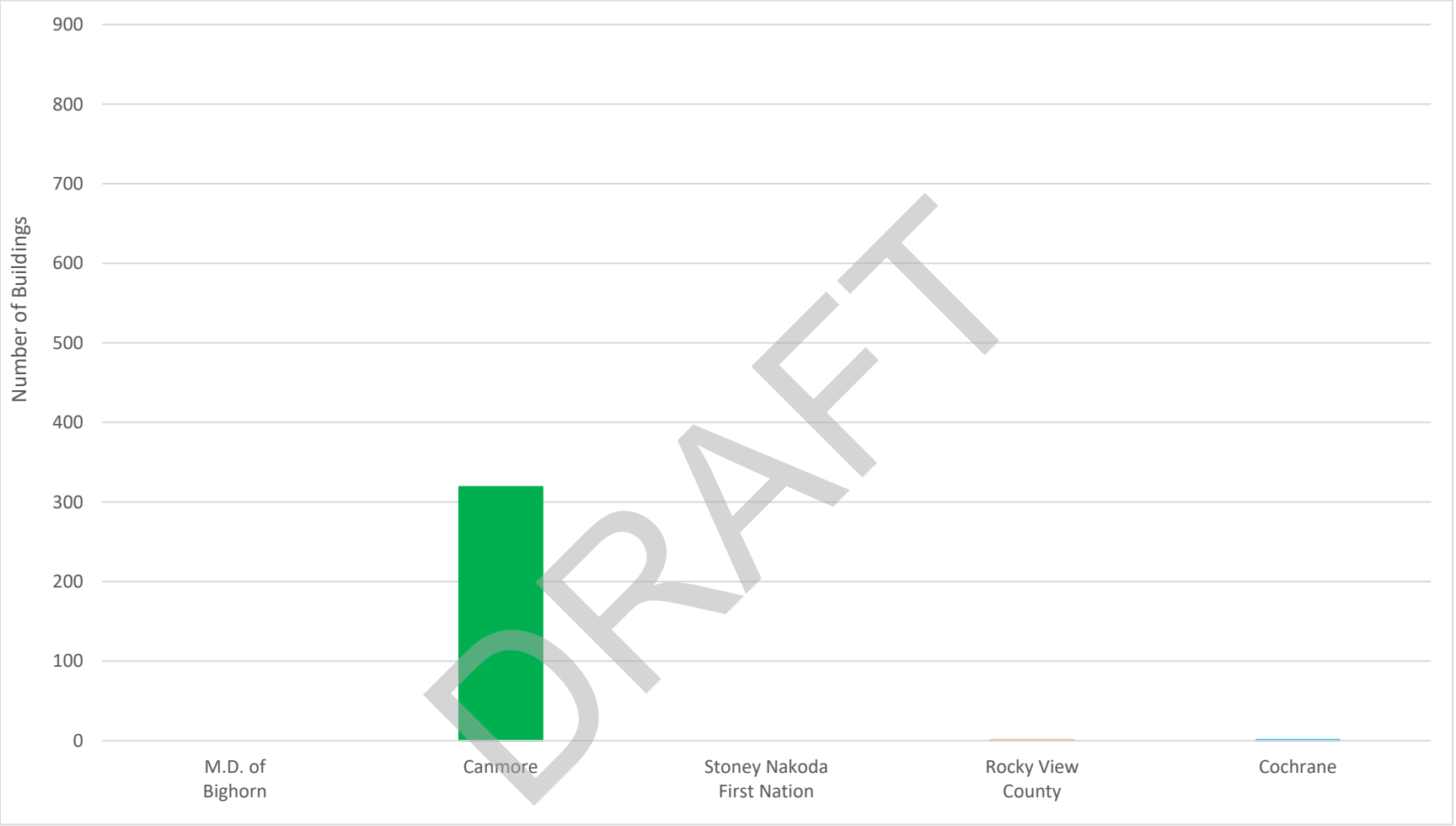


Figure 4b Residential buildings at risk for the governing design flood scenario

4.2.3 Non-residential buildings

Table 5a and Figure 5a provide summary statistics for the number of non-residential buildings at risk due to direct inundation, while Table 5b provides summary statistics for the number of non-residential buildings at risk due to potential flood control structure failure. The statistics are grouped by local authority. Appendix D provides a more detailed summary of non-residential buildings by the following subcategories: hospital and health centre (H/HC), school (SCH), commercial (COM), industrial (IND), government (GOV), water treatment plant (WTP), and other major non-residential buildings (OTR).

For all local authorities, no hospitals or schools are at risk of flooding for all scenarios.

Canmore has the most non-residential buildings at risk due to direct inundation for the 200-year to 1000-year open water floods. At the 200-year return period and greater, the Town Dike is at risk of being overtopped and flooding non-residential buildings in areas behind the dike. At the 500-year return period and greater, a large part of the downtown area in the Town Centre neighbourhood is at risk, including a number of commercial businesses, one industrial building, and one government building. At the 5-year return period and greater, land around the southeast side of the Canmore wastewater treatment plant is at risk of flooding due to direct inundation. Although the wastewater treatment plant buildings are at least partly above flood levels up to and including the 1000-year return period, if full building footprints are considered, then the wastewater treatment plant is at risk of flooding at the 5-year to 1000-year return periods.

Canmore is the only local authority with non-residential buildings at risk due to potential flood control structure failure (Table 5b). There are buildings classified as other major non-residential buildings at risk due to potential flood control structure failure at the 10-year to 350-year open water floods. At the 35-year to 100-year return periods commercial and other major non-residential buildings are at risk due to potential failure of the Town Dike. At the 2-year and 5-year return periods, the land around the Canmore wastewater treatment plant is at risk of flooding due to potential failure of the Town Dike, while the wastewater treatment plant buildings themselves are safe from inundation due to potential flood control structure failure up to and including the 1000-year return period.

The M.D. of Bighorn has the most non-residential buildings at risk due to direct inundation for the 5-year to 100-year open water floods. In Exshaw, at the 5-year to 1000-year return periods, the small pond at the wastewater treatment plant is at risk, but the large pond is not at risk. At the 5-year to 1000-year return periods, several industrial buildings on the left bank of the Bow River, downstream of Exshaw Creek, are at risk.

In Cochrane, there are one to two non-residential buildings at risk due to direct inundation for the 75-year to 750-year open water floods, and these buildings are classified as other major non-residential buildings. At the 1000-year return period, two buildings classified as other major non-residential buildings and one industrial building near the Spray Lake Sawmills Family Sports Centre are at risk.

Cochrane is the only local authority with non-residential buildings at risk for ice jam flooding. There is one non-residential building, located on the left bank of the Bow River east of the River Avenue Bridge, at risk for the 50-, 100-, and 200-year ice jam floods. This building falls within the other major non-residential building classification.

Table 5c and Figure 5b provide summary statistics for the number of non-residential buildings at risk for the governing design flood. Canmore has the most non-residential buildings at risk for the governing design flood. There are 15 non-residential buildings at risk in Canmore, including commercial, industrial, and other major non-residential buildings. The majority of these buildings are located in the area behind the Town Dike. The Canmore Wastewater Treatment Plant is at risk of inundation in the floodway area for the governing design flood. This includes two primary wastewater treatment facility buildings and several smaller secondary structures, which were not included in the statistics because of their secondary nature. The M.D. of Bighorn has the second most non-residential buildings at risk for the governing design flood. There are 14 industrial buildings at risk on the left bank of the Bow River, downstream of Exshaw Creek. In Exshaw, the small pond at the wastewater treatment plant is at risk, but the large pond is not at risk. In Cochrane, there is one non-residential building on the left bank of the Bow River east of the River Avenue Bridge at risk for the governing design flood.

Table 5a Non-residential buildings at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Number of Non-residential Buildings by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	0	0	0	0	0
5-Yr Open Water	4	0	0	0	0	4
10-Yr Open Water	6	0	0	0	0	6
20-Yr Open Water	7	2	0	0	0	9
35-Yr Open Water	8	2	0	0	0	10
50-Yr Open Water	11	3	0	0	0	14
75-Yr Open Water	13	3	0	0	1	17
100-Yr Open Water	14	3	0	0	1	18
200-Yr Open Water	14	15	0	0	1	30
350-Yr Open Water	14	19	0	0	2	35
500-Yr Open Water	15	27	0	0	2	44
750-Yr Open Water	15	37	0	0	2	54
1000-Yr Open Water	15	43	0	0	3	61
50-Yr Ice Jam[1]	n/a	n/a	0	0	1	1
100-Yr Ice Jam[1]	n/a	n/a	0	0	1	1
200-Yr Ice Jam[1]	n/a	n/a	0	0	1	1

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 5b Non-residential buildings at risk for open water and ice jam flood scenarios – potential flood control structure failure

Flood Scenario	Number of Non-residential Buildings by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	0	0	0	0	0
5-Yr Open Water	0	0	0	0	0	0
10-Yr Open Water	0	2	0	0	0	2
20-Yr Open Water	0	1	0	0	0	1
35-Yr Open Water	0	2	0	0	0	2
50-Yr Open Water	0	6	0	0	0	6
75-Yr Open Water	0	6	0	0	0	6
100-Yr Open Water	0	9	0	0	0	9
200-Yr Open Water	0	3	0	0	0	3
350-Yr Open Water	0	1	0	0	0	1
500-Yr Open Water	0	0	0	0	0	0
750-Yr Open Water	0	0	0	0	0	0
1000-Yr Open Water	0	0	0	0	0	0
50-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
100-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
200-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 5c Non-residential buildings at risk for the governing design flood scenario

Flood Scenario	Number of Non-residential Buildings by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	14	15	0	0	1	30
Floodway	0	3	0	0	1	4
Flood Fringe[1]	14	12	0	0	0	26
High Hazard Flood Fringe	0	1	0	0	0	1
Protected Flood Fringe	0	9	0	0	0	9

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

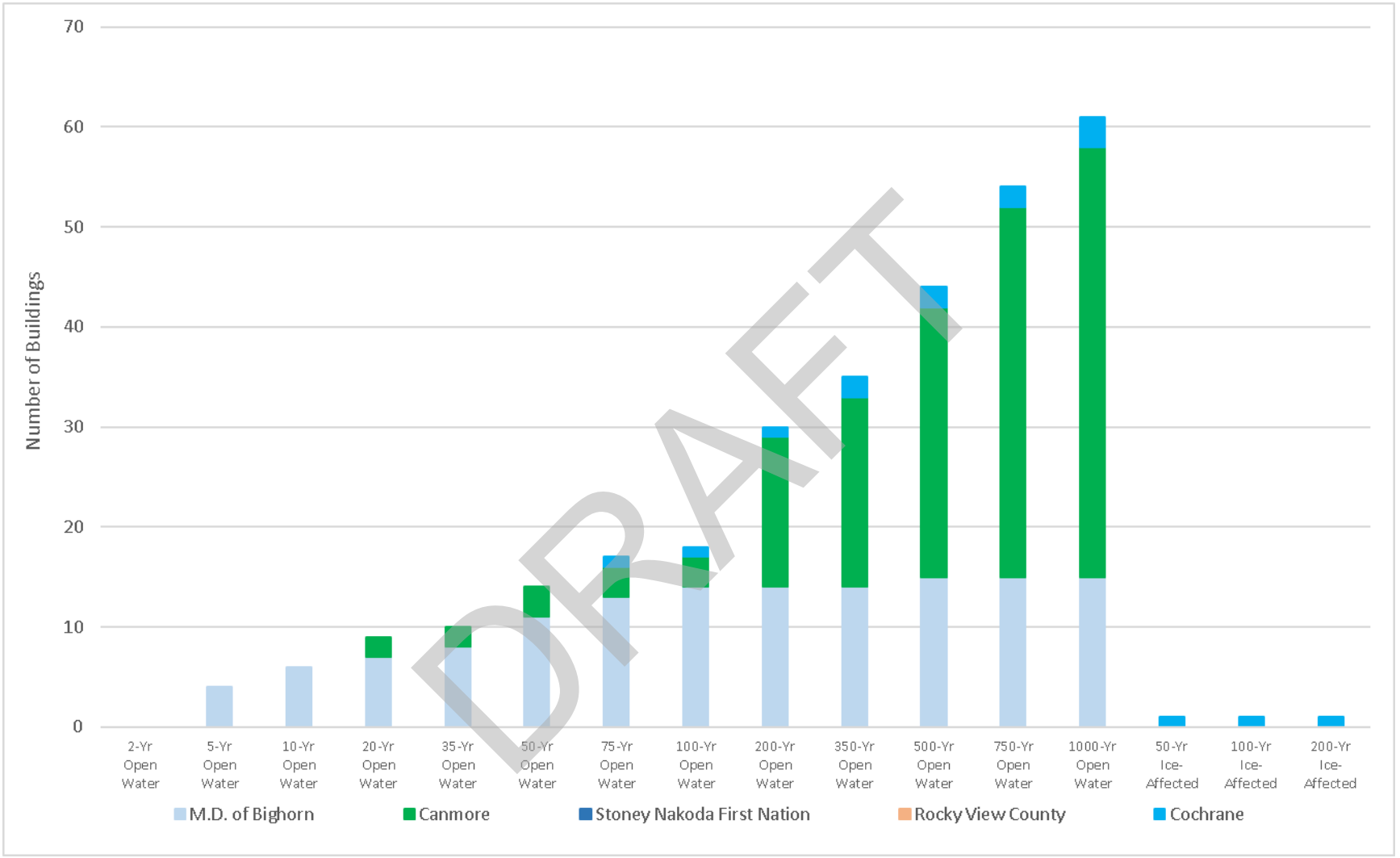


Figure 5a Non-residential buildings at risk for the open water and ice jam flood scenarios – direct inundation

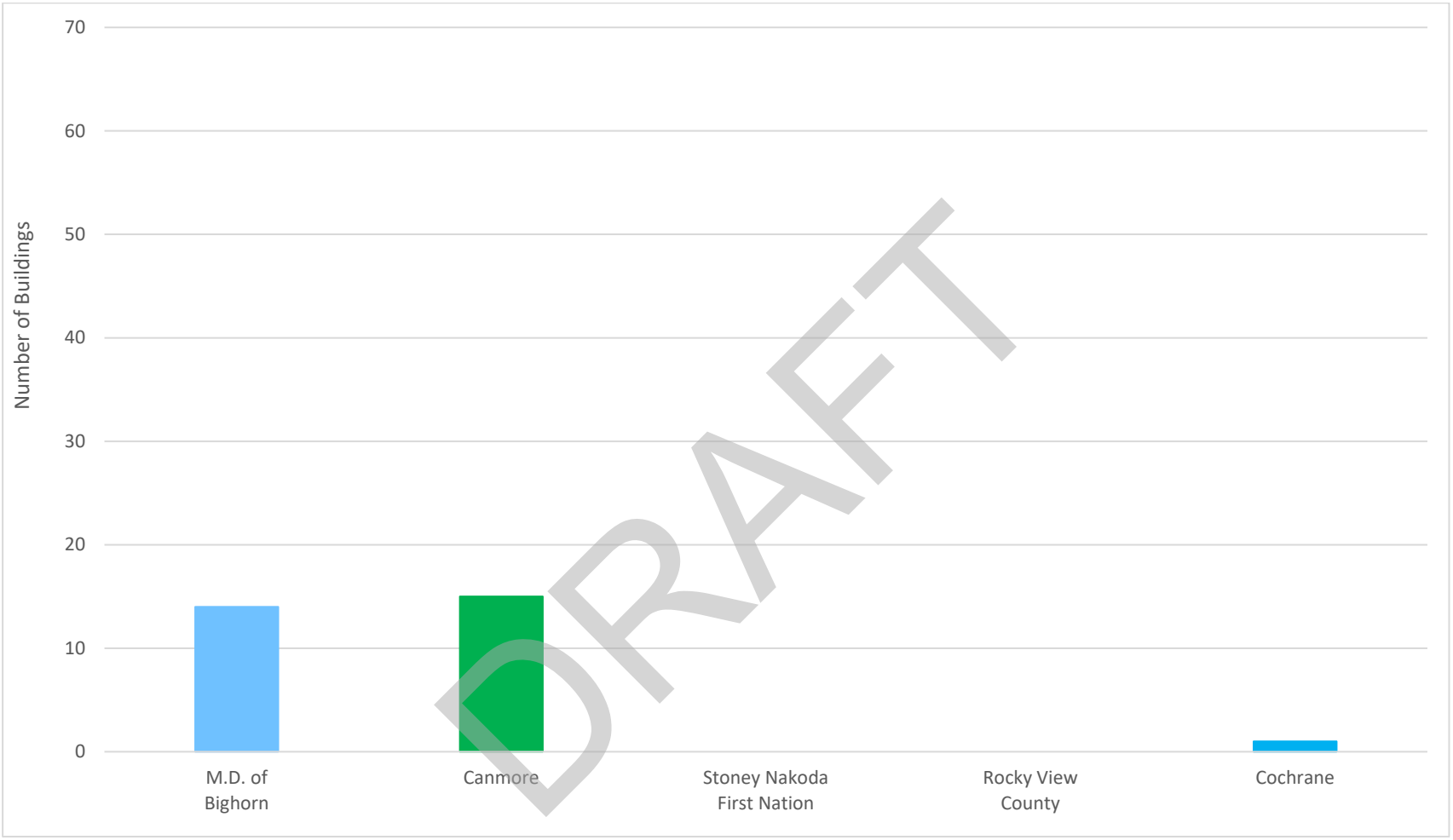


Figure 5b Non-residential buildings at risk for the governing design flood scenario

4.2.4 Bridges

Table 6a and Figure 6a provide summary statistics by local authority, 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 of the bridge. Refer to NHC (2017) for bridge structure details. Appendix E provides a more detailed summary of the bridges at risk grouped by the following subcategories: direct flood inundation, potential inundation due to flood control structure failure, and potential isolated area inundation. Appendix E also provides a detailed summary of bridge clearance levels for each flood scenario for the Bow River, Policeman Creek , Exshaw Creek, Jumpingpound Creek, and Bighill Creek.

In Canmore pedestrian and road bridges across Policeman Creek are at risk for return periods of 5-years and greater. At the 500-year return period and higher, the Bridge Road bridge across the Bow River is at risk.

In Cochrane, pedestrian bridges across Bighill Creek are at risk of direct inundation flooding starting at the 10-year return period. The River Avenue bridge across the Bow River and the Bow Valley Trail bridge across Bighill Creek are at risk of direct inundation flooding at the 750-year and 1000-year return periods. A paved road bridge across Jumpingpound Creek along George Fox Trail is at risk starting at the 100-year return period.

Cochrane is the only local authority with a bridge at risk for ice jam flooding. A pedestrian bridge across Bighill Creek along a walking trail between the Bow River and Griffin Road West is at risk for the 50-, 100-, and 200-year ice jam floods.

There are no bridges at risk due to potential flood control structure failure.

Table 6b and Figure 6b provide summary statistics showing the number of bridges at risk due to the governing design flood. In Cochrane, several pedestrian bridges across Bighill Creek are at risk for the governing design flood. A paved road bridge across Jumpingpound Creek along George Fox Trail is also at risk. In Canmore, several pedestrian bridges across Policeman Creek are at risk for the governing design flood. A pedestrian bridge across a side channel of the Bow River along Spur Line Trail is also at risk.

Table 6a Number of bridges at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Number of Bridges by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	0	0	0	0	0
5-Yr Open Water	0	2	0	0	0	2
10-Yr Open Water	0	2	0	0	2	4
20-Yr Open Water	0	3	0	0	5	8
35-Yr Open Water	0	4	0	0	6	10
50-Yr Open Water	0	4	0	0	8	12
75-Yr Open Water	0	5	0	0	8	13
100-Yr Open Water	0	6	0	0	9	15
200-Yr Open Water	0	6	0	0	10	16
350-Yr Open Water	0	7	0	0	10	17
500-Yr Open Water	0	11	0	0	10	21
750-Yr Open Water	0	13	0	0	12	25
1000-Yr Open Water	0	13	0	0	12	25
50-Yr Ice Jam[1]	n/a	n/a	0	0	1	1
100-Yr Ice Jam[1]	n/a	n/a	0	0	1	1
200-Yr Ice Jam[1]	n/a	n/a	0	0	1	1

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 6b Number of bridges at risk for the governing design flood scenario

Flood Scenario	Number of Bridges by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	0	6	0	0	10	16
Floodway	0	6	0	0	10	16
Flood Fringe[1]	0	0	0	0	0	0
High Hazard Flood Fringe	0	0	0	0	0	0
Protected Flood Fringe	0	0	0	0	0	0

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

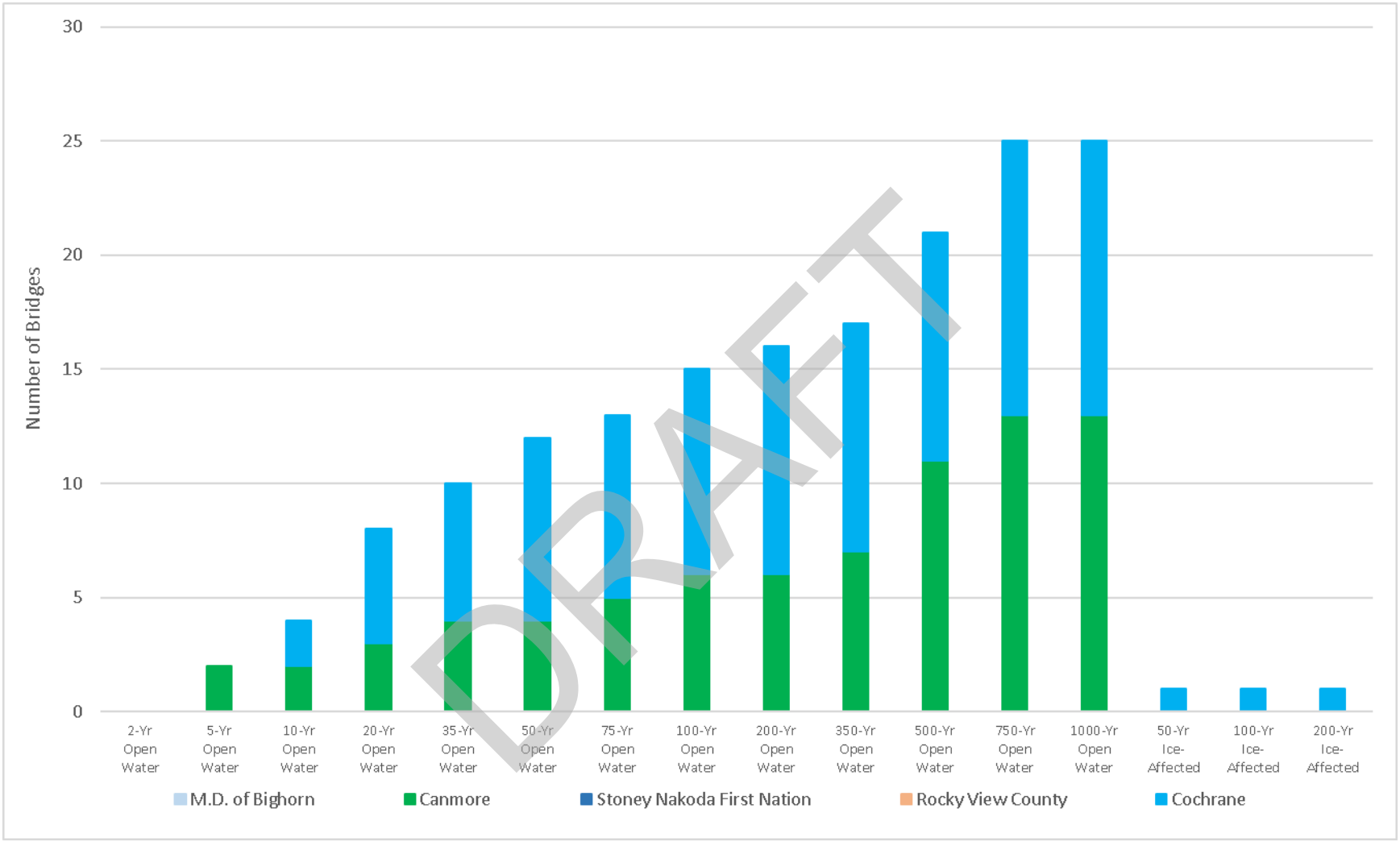


Figure 6a Number of bridges at risk for the open water and ice jam flood scenarios – direct inundation

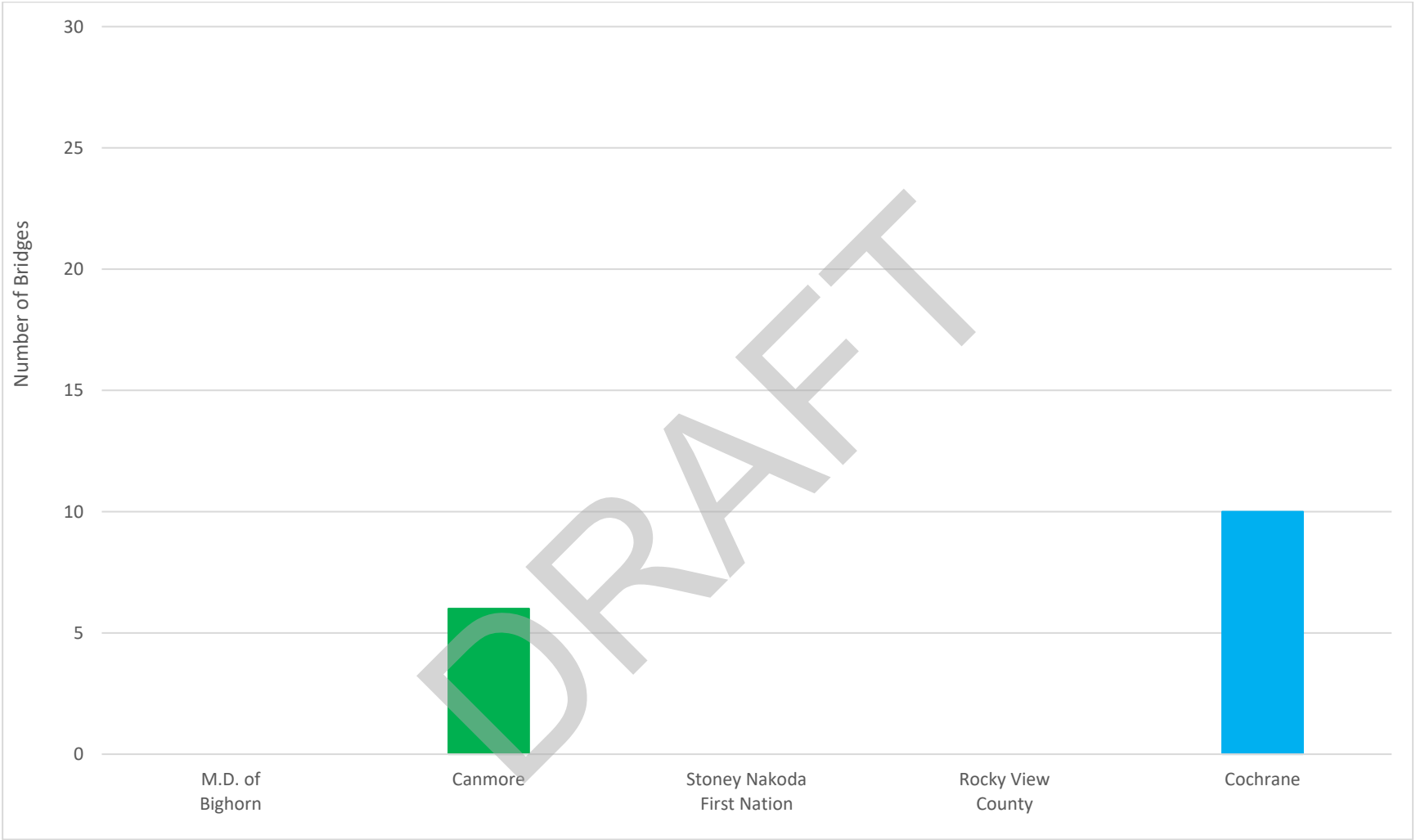


Figure 6b Number of bridges at risk for the governing design flood scenario

4.2.5 Culverts

Table 7a and Figure 7a provide summary statistics by local authority, showing the number of culverts at risk due to direct inundation. Culverts are assumed to be at risk once the road surface above the culvert is inundated, as at the time structure data were collected for this study. Appendix F provides a more detailed summary of the culverts at risk grouped by the following subcategories: direct flood inundation, potential inundation due to flood control structure failure, and potential isolated area inundation. Culverts conveying local drainage or watercourses other than the Bow River, Policeman Creek, Exshaw, Creek, Jumpingpound Creek, or Bighill Creek were not included in this analysis.

The M.D. of Bighorn has the highest number of culverts at risk due to direct inundation for open water floods. In the M.D. of Bighorn, the Highway 1A culvert on Exshaw Creek is at risk for all return periods. Although improvements to the Highway 1A culvert and the downstream rail and Diamond Avenue bridges were completed in 2019 as part of the Exshaw Creek Flood Mitigation Project, the effects of that work are not reflected here. Several other culverts along the Bow River in the Lac des Arcs and Gap Lake area are at risk for return periods of 10-years and greater.

In Canmore, a culvert on Policeman Creek at the Canmore Golf and Curling Club is at risk due to direct inundation for the 35-year return period and larger open water floods.

In Cochrane, a culvert on a side channel to the Bow River, upstream of the Highway 22 bridge is at risk due to direct inundation for all open water floods.

Cochrane is the only local authority with a culvert at risk due to ice jam floods. This culvert is located on a side channel to the Bow River, upstream of the Highway 22 bridge.

There are no culverts at risk due to potential flood control structure failure.

Table 7b and Figure 7b provide summary statistics for the number of culverts at risk for the governing design flood. In the M.D. of Bighorn, the Highway 1A culvert on Exshaw Creek, and several other culverts along the Bow River in the Lac des Arcs and Gap Lake area are at risk for the governing design flood. In Cochrane, a culvert on a side channel to the Bow River, upstream of the Highway 22 bridge is at risk. In Canmore, a culvert on Policeman Creek at the Canmore Golf and Curling Club is at risk.

Table 7a Number of culverts at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Number of Culverts by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	2	0	0	0	1	3
5-Yr Open Water	7	0	0	0	1	8
10-Yr Open Water	8	0	0	0	1	9
20-Yr Open Water	10	0	0	0	1	11
35-Yr Open Water	11	1	0	0	1	13
50-Yr Open Water	11	1	0	0	1	13
75-Yr Open Water	11	1	0	0	1	13
100-Yr Open Water	12	1	0	0	1	14
200-Yr Open Water	13	1	0	0	1	15
350-Yr Open Water	13	1	0	0	1	15
500-Yr Open Water	13	1	0	0	1	15
750-Yr Open Water	13	2	0	0	1	16
1000-Yr Open Water	14	4	0	0	1	19
50-Yr Ice Jam[1]	n/a	n/a	0	0	1	1
100-Yr Ice Jam[1]	n/a	n/a	0	0	1	1
200-Yr Ice Jam[1]	n/a	n/a	0	0	1	1

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 7b Number of culverts at risk for the governing design flood scenario

Flood Scenario	Number of Culverts by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	12	1	0	0	1	14
Floodway	12	1	0	0	1	14
Flood Fringe[1]	0	0	0	0	0	0
High Hazard Flood Fringe	0	0	0	0	0	0
Protected Flood Fringe	0	0	0	0	0	0

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

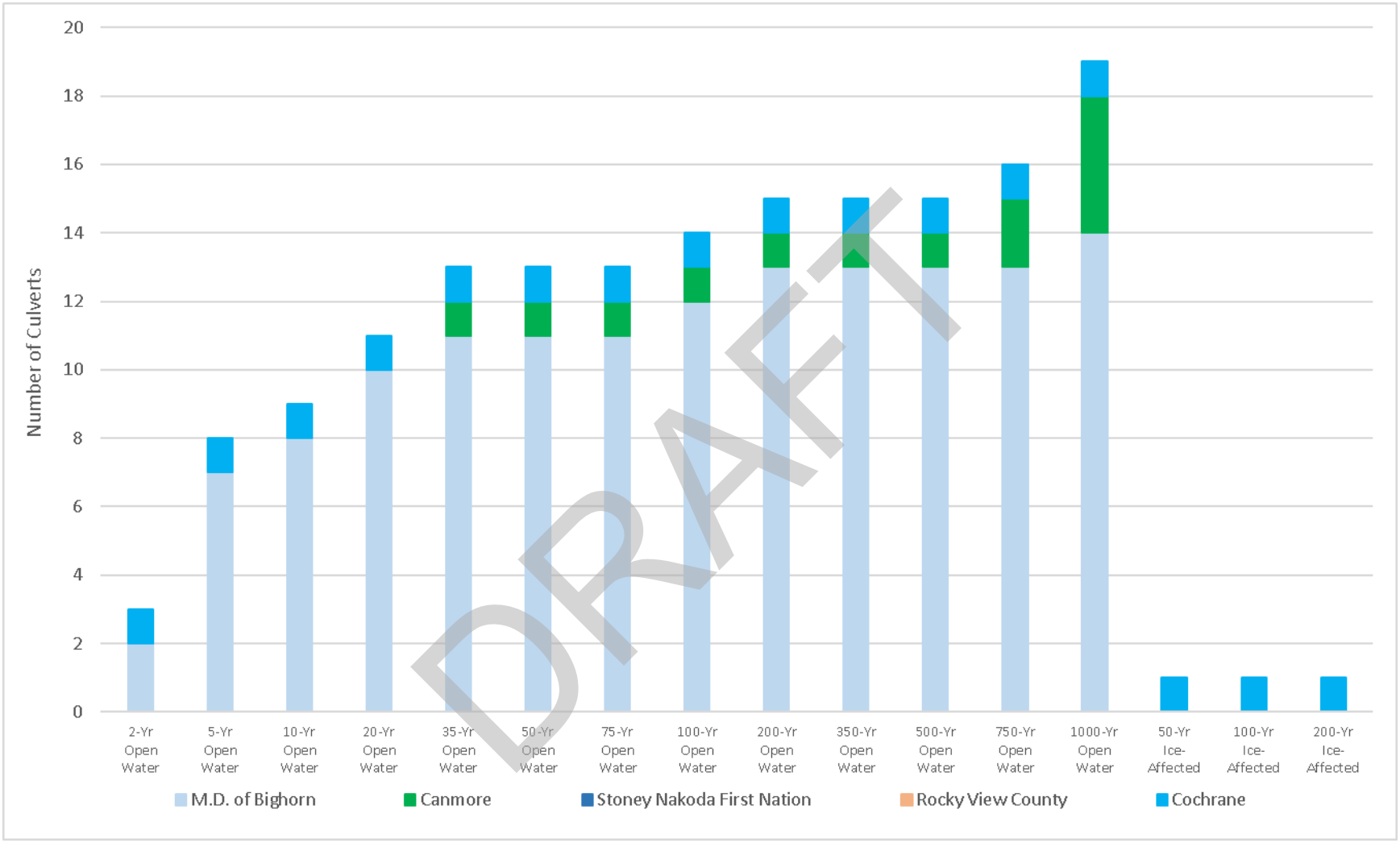


Figure 7a Number of culverts at risk for the open water and ice jam flood scenarios – direct inundation

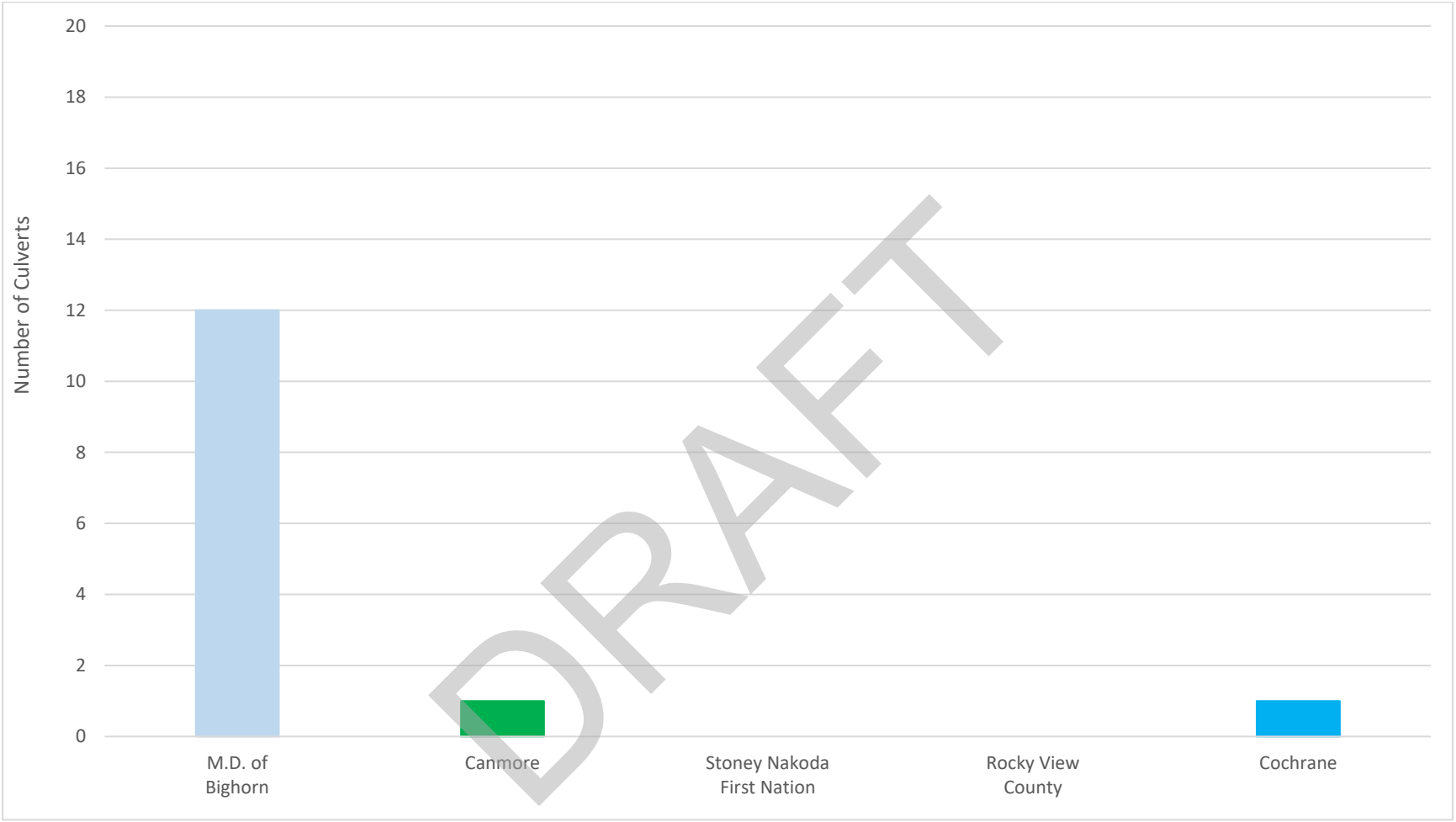


Figure 7b Number of culverts at risk for the governing design flood scenario

4.2.6 Railway

Table 8a and Figure 8a provide summary statistics by local authority, showing the number of kilometres of railway at risk due to direct inundation. The statistics represent the cumulative length of railway inundated for each flood scenario, excluding rail bridges. Appendix G provides a more detailed summary of railway at risk grouped by the following subcategories: direct flood inundation, potential inundation due to flood control structure failure, and potential isolated area inundation.

The M.D. of Bighorn has the most railway at risk due to direct inundation for all open water floods. Within the M.D. of Bighorn the railway follows the river channel and runs along the north side of the Bow River adjacent to Highway 1A. At the 5-year return period and higher, flooding of the railway may occur in patches along the Bow Valley from the Graymont Quarry to Lac des Arcs. As the return period increases, the length of railway at risk of direct inundation increases from 1.9 km at the 5-year open water flood to as high as 15.3 km at the 1000-year flood.

In Rocky View County, there is railway at risk due to direct inundation for the 500-year to 1000-year open water floods. At the 1000-year flood, 1.0 km of railway is at risk along the south side of the Bow River near Mitford.

There is no railway at risk due to potential flood control structure failure or ice jam flooding.

Table 8b and Figure 8b provide summary statistics for the number of kilometres of railway at risk for the governing design flood. The M.D. of Bighorn is the only local authority with railway at risk for the governing design flood. A large portion of the railway that runs along the north side of the Bow River from the Graymont Quarry to Lac des Arcs is at risk for the governing design flood. There is also a section of at-risk railway on the north side of the Bow River near the Graymont-Exshaw Plant.

Table 8a Railway at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Kilometres of Railway by Local Authority (km)					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0.0	0.0	0.0	0.0	0.0	0.0
5-Yr Open Water	1.9	0.0	0.0	0.0	0.0	1.9
10-Yr Open Water	3.8	0.0	0.0	0.0	0.0	3.8
20-Yr Open Water	5.7	0.0	0.0	0.0	0.0	5.7
35-Yr Open Water	7.4	0.0	0.0	0.0	0.0	7.4
50-Yr Open Water	8.0	0.0	0.0	0.0	0.0	8.0
75-Yr Open Water	8.9	0.0	0.0	0.0	0.0	8.9
100-Yr Open Water	9.6	0.0	0.0	0.0	0.0	9.6
200-Yr Open Water	12.2	0.0	0.0	0.0	0.0	12.2
350-Yr Open Water	13.8	0.0	0.0	0.0	0.0	13.8
500-Yr Open Water	14.6	0.0	0.0	0.1	0.0	14.6
750-Yr Open Water	15.0	0.0	0.0	0.5	0.0	15.5
1000-Yr Open Water	15.3	0.0	0.0	1.0	0.0	16.3
50-Yr Ice Jam[1]	n/a	n/a	0.0	0.0	0.0	0.0
100-Yr Ice Jam[1]	n/a	n/a	0.0	0.0	0.0	0.0
200-Yr Ice Jam[1]	n/a	n/a	0.0	0.0	0.0	0.0

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 8b Railway at risk for the governing design flood scenario

Flood Scenario	Kilometres of Railway by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	9.7	0.0	0.0	0.0	0.0	9.7
Floodway	5.1	0.0	0.0	0.0	0.0	5.1
Flood Fringe[1]	4.5	0.0	0.0	0.0	0.0	4.5
High Hazard Flood Fringe	0.9	0.0	0.0	0.0	0.0	0.9
Protected Flood Fringe	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

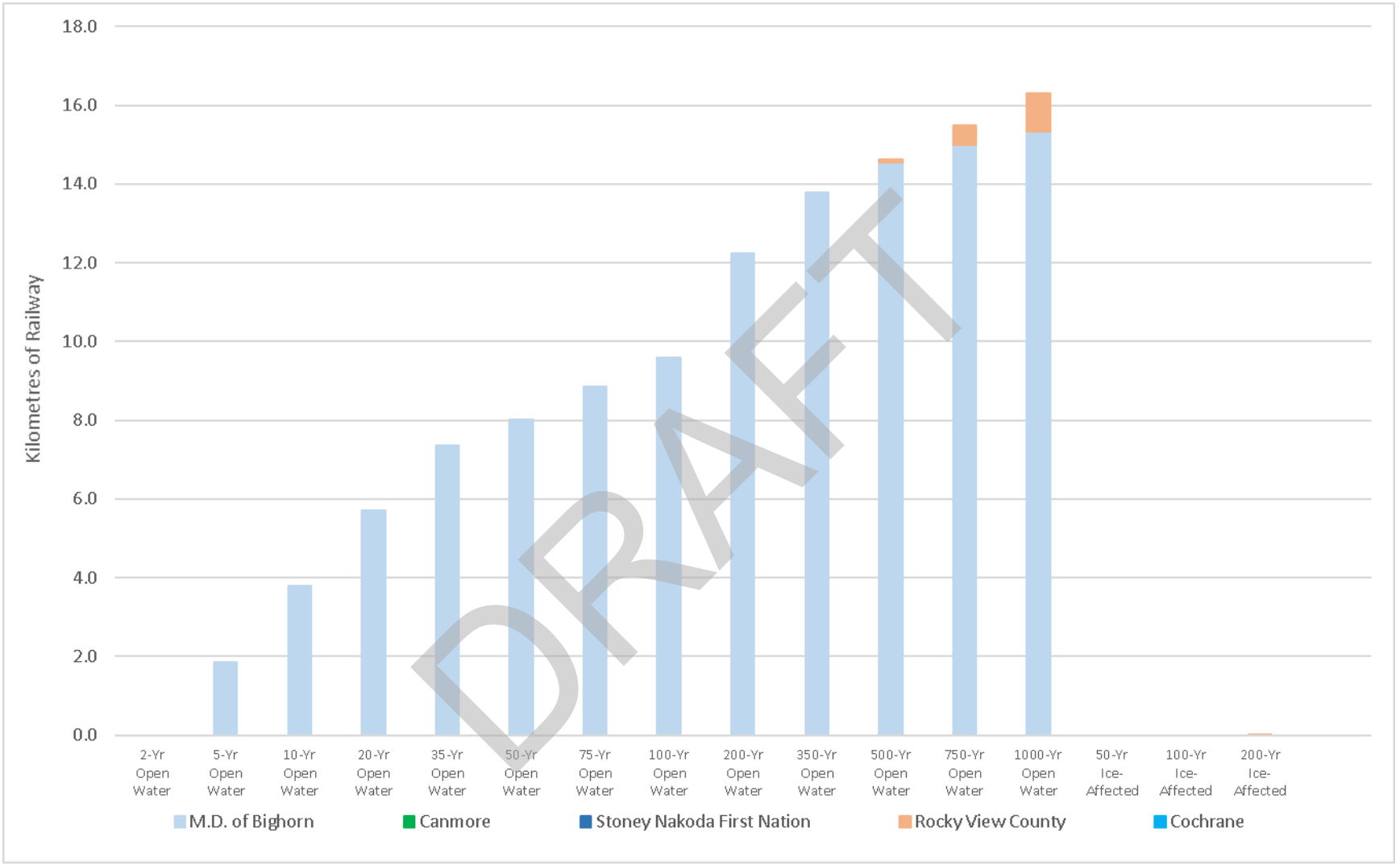


Figure 8a Railway at risk for the open water and ice jam flood scenarios – direct inundation

Figure 8b Railway at risk for the governing design flood scenario

4.2.7 Roadway

Table 9a and Figure 9a provide summary statistics for the number of kilometres of roadway at risk due to direct inundation, while Table 9b provides summary statistics for the number of kilometres of roadway at risk due to potential flood control structure failure. The statistics represent the cumulative length of roadway, excluding bridges, inundated for each flood scenario grouped by local authority. Appendix H provides a more detailed summary of roadway at risk grouped by the following subcategories: direct flood inundation, potential inundation due to flood control structure failure, and potential isolated area inundation.

Canmore has the most roadway at risk of direct inundation for the 5-year to 20-year and 200-year to 1000-year return periods for open water floods. For the 5-year to 100-year return periods, residential streets in the neighbourhood around Lion's Park are at risk. For the 100-year return period, portions of roadway north of Millennium Park are also at risk. For the 200-year return period, the Canmore Town Dike may become completely overtopped inundating numerous residential streets between the rail line and the Canmore Town Dike, including streets in the South Canmore, Riverside, Town Centre, Spring Creek, Lion's Park, and Larch neighbourhoods. For the 200-year return period, the Canmore Mine Dike may also become overtopped inundating Rundle Crescent and a large portion of Rundle Drive.

Canmore is the only local authority that has roadway at risk of flooding due to potential flood control structure failure. For the 5-year to 100-year return periods for open water floods, sections of the Canmore Mine Dike and Canmore Town Dike are at risk of potential failure which may lead to flooding of streets in the Rundle, South Canmore, and Larch neighbourhoods. For the 200-year and 350-year floods, the southern sections of the Town Dike may be overtopped, while the northern sections of the dike are at risk of potential failure. This potential failure may lead to flooding of residential streets in the Larch neighbourhood around Larch Avenue and 11 Avenue.

The M.D. of Bighorn has the most roadway at risk of direct inundation for the 35-year to 100-year return periods and the second-most roadway at risk of direct inundation for the remaining return periods for open water flood scenarios. For the 100-year return period, parts of the Trans-Canada Highway south of Gap Lake and at Lac des Arcs are at risk. Also, sections of Highway 1A west of Exshaw are at risk for the same event. Additional sections of Highway 1A and the Trans-Canada Highway west of Exshaw are at risk as return periods increase. For the 350-year and higher return periods, sections of Highway 1A east of Exshaw are also at risk.

Within the Town of Cochrane, flooding of residential streets in the Bow Meadows neighbourhood increases with return period for the 75-year and above for open water flood scenarios. For the 1000-year return period, most residential streets in the Bow Meadows neighbourhood are at risk due to direct inundation.

In Rocky View County, sections of Ranche Road east of Range Road 42 are at risk due to direct inundation for the 200-year to 1000-year open water flood scenarios. The section of Ranche Road in Rocky View County that is at risk of direct inundation lies near the boundary between Rocky View County

and Cochrane, just outside the Cochrane town limits. At the 1000-year return period, there is 0.2 km of roadway at risk in Rocky View County.

The Town of Cochrane is the only local authority with roadway at risk for ice jam flooding. At the 50-, 100- and 200-year ice jam flood scenarios, sections of Range Road 42 and part of the road into Riverfront Park are at risk of flooding.

Table 9c and Figure 9b provide summary statistics for the number of kilometres of roadway at risk for the governing design flood. The Town of Canmore has the most roadway (9.1 km) at risk for the governing design flood. The roadway at risk of inundation in Canmore includes several residential streets between the rail line and the Town Dike, including streets in the South Canmore, Riverside, Town Centre, Spring Creek, Lion's Park, and Larch neighbourhoods. Rundle Crescent and a large portion of Rundle Drive in the Rundle neighbourhood are also at risk of inundation. The M.D. of Bighorn has the second most roadway at risk for the governing design flood. There are 3.4 km of roadway at risk in the M.D. of Bighorn. In the M.D. of Bighorn, sections of the Trans-Canada Highway are at risk in several locations, including between Highway 1A and Highway 742, south of Gap Lake, and south of Lac des Arcs. Sections of Highway 1A that run north of Gap Lake and north of Lac des Arcs are also at risk. In the Town of Cochrane, 0.4 km of roadway are at risk, including residential streets in the Bow Meadows neighbourhood.

Table 9a Roadway at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Kilometres of Roadway by Local Authority (km)					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0.0	0.0	0.0	0.0	0.0	0.0
5-Yr Open Water	0.2	0.4	0.0	0.0	0.0	0.6
10-Yr Open Water	0.4	0.7	0.0	0.0	0.1	1.2
20-Yr Open Water	0.8	1.0	0.0	0.0	0.1	1.8
35-Yr Open Water	1.4	1.2	0.0	0.0	0.1	2.7
50-Yr Open Water	2.0	1.3	0.0	0.0	0.1	3.4
75-Yr Open Water	2.5	1.5	0.0	0.0	0.2	4.2
100-Yr Open Water	3.4	2.4	0.0	0.0	0.3	6.1
200-Yr Open Water	4.9	9.1	0.0	0.1	0.5	14.6
350-Yr Open Water	6.5	12.4	0.0	0.1	1.2	20.2
500-Yr Open Water	7.3	17.2	0.0	0.2	1.6	26.3
750-Yr Open Water	8.5	18.9	0.0	0.2	2.4	29.9
1000-Yr Open Water	9.4	20.1	0.0	0.2	2.8	32.5
50-Yr Ice Jam[1]	n/a	n/a	0.0	0.0	0.1	0.1
100-Yr Ice Jam[1]	n/a	n/a	0.0	0.0	0.2	0.2
200-Yr Ice Jam[1]	n/a	n/a	0.0	0.0	0.3	0.3

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 9b Roadway at risk for open water and ice jam flood scenarios – potential flood control structure failure

Flood Scenario	Kilometres of Roadway by Local Authority (km)					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0.0	0.0	0.0	0.0	0.0	0.0
5-Yr Open Water	0.0	1.0	0.0	0.0	0.0	1.0
10-Yr Open Water	0.0	2.3	0.0	0.0	0.0	2.3
20-Yr Open Water	0.0	3.7	0.0	0.0	0.0	3.7
35-Yr Open Water	0.0	5.0	0.0	0.0	0.0	5.0
50-Yr Open Water	0.0	5.8	0.0	0.0	0.0	5.8
75-Yr Open Water	0.0	6.7	0.0	0.0	0.0	6.7
100-Yr Open Water	0.0	6.7	0.0	0.0	0.0	6.7
200-Yr Open Water	0.0	2.0	0.0	0.0	0.0	2.0
350-Yr Open Water	0.0	1.9	0.0	0.0	0.0	1.9
500-Yr Open Water	0.0	0.1	0.0	0.0	0.0	0.1
750-Yr Open Water	0.0	0.1	0.0	0.0	0.0	0.1
1000-Yr Open Water	0.0	0.0	0.0	0.0	0.0	0.0
50-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
100-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
200-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table 9c Roadway at risk for the governing design flood scenario

Flood Scenario	Kilometres of Roadway by Local Authority					Total
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	3.4	9.1	0.0	0.0	0.4	12.9
Floodway	0.0	0.0	0.0	0.0	0.1	0.1
Flood Fringe[1]	3.3	9.1	0.0	0.0	0.3	12.8
High Hazard Flood Fringe	0.1	0.0	0.0	0.0	0.0	0.1
Protected Flood Fringe	0.0	6.7	0.0	0.0	0.0	6.7

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

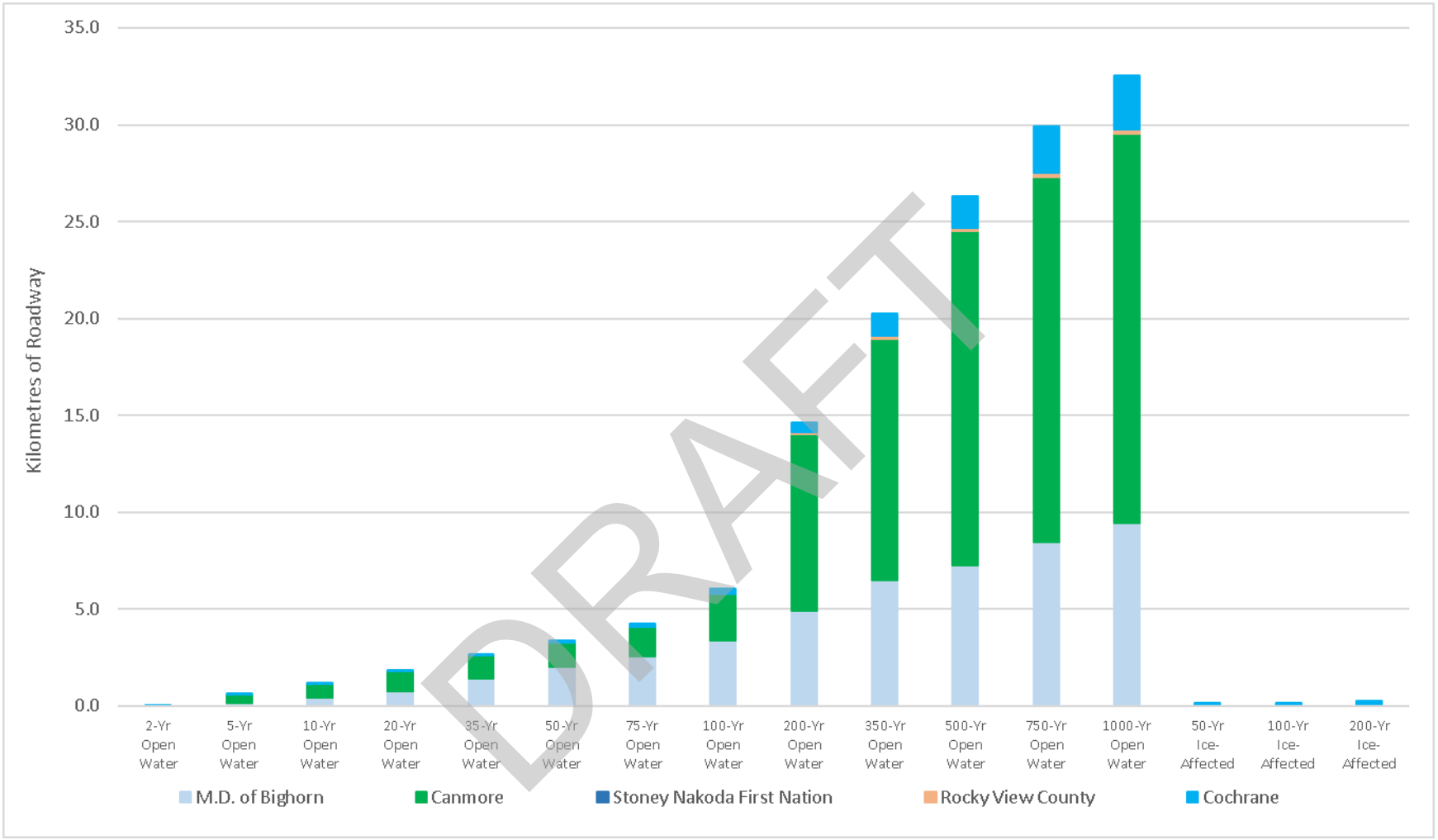


Figure 9a Roadway at risk for the open water and ice jam flood scenarios – direct inundation

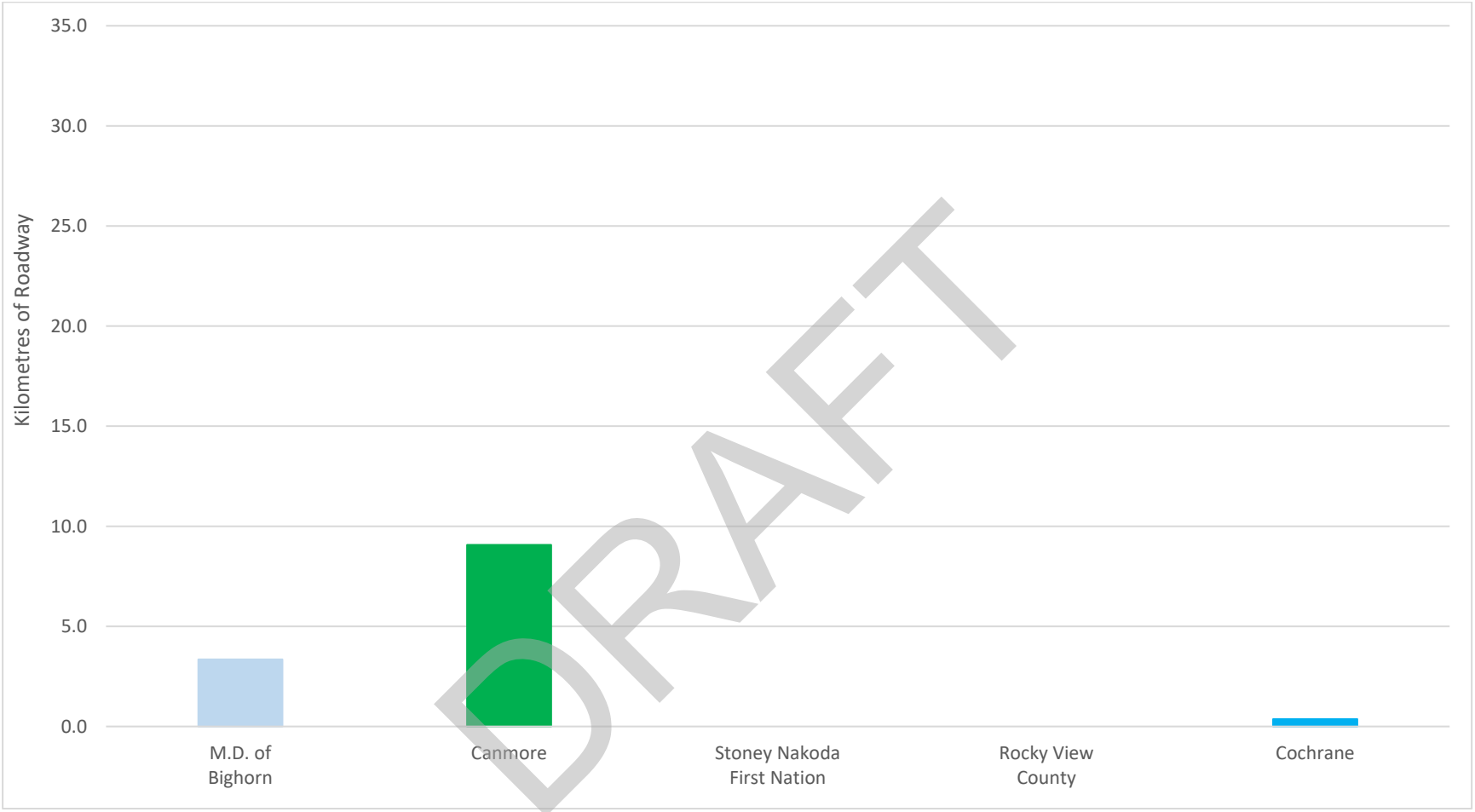


Figure 9b Roadway at risk for the governing design flood scenario

4.2.8 Population

Table 10a and Figure 10a provide summary statistics for the estimated population at risk due to direct inundation, while Table 10b provides summary statistics for the estimated population at risk due to potential flood control structure failure. The statistics are grouped by local authority. The values were calculated based on the percentage of each census dissemination block that intersects the flood extent, multiplied by the total population within each dissemination block. It is worth noting that census blocks in Rocky View County and the Stoney Nakoda First Nation cover relatively large areas and buildings are not evenly spaced throughout census blocks. Consequently, where a significant portion of the census block is inundated, the population at risk may have limited exposure to flooding, if few buildings are at risk. Appendix I provides a more detailed summary of population at risk by the following subcategories for each return period: direct flood inundation, potential inundation due to flood control structure failure, and potential isolated area inundation.

Canmore has the highest population at risk due to direct inundation for all open water floods. The population at risk in Canmore ranges from 470 people for the 2-year return period up to 3160 people for the 1000-year return period. Although there are 470 people at risk for the 2-year return period, there are no residential buildings at risk for this flood scenario, indicating that the population at risk may have limited direct exposure to flooding. For the 200-year return period, a large portion of the Canmore Town Dike and the Canmore Mine Dike may become overtopped, putting 1910 people at risk for this return period. The majority of the population at risk is located in the South Canmore, Riverside, Fairholm, Town Centre, Lion's Park, Spring Creek, and Larch neighbourhoods between the Town Dike and the rail line, and in the Rundle neighbourhood west of the Mine Dike.

Canmore is the only local authority that has population at risk due to potential flood control structure failure. Population at risk due to potential failure of the Town Dike and Mine Dike ranges from 50 people for the 2-year return period to 910 people for the 100-year return period. For the 200-year return period, the majority of the Town Dike is at risk of being overtopped, resulting in a decrease in the number of people at risk due to potential flood control structure failure. For this return period, the northern part of the dike is, however, still at risk of potential failure, putting 170 people at risk in the Fairholm and Larch neighbourhoods.

Cochrane has the second highest population at risk due to direct inundation for all open water flood extents. Population at risk ranges from 170 people for the 2-year return period up to 1450 people for the 1000-year return period. There are, however, no residential buildings at risk in Cochrane for the 2-year to 100-year return periods, indicating that the population at risk may have limited direct exposure to flooding for these return periods.

There are fewer than five people at risk due to potential flood control structure failure for any given return period in Cochrane. For the 35- and 50-year return periods, there is population at risk in the Bow Meadows neighbourhood due to potential failure of the Jumpingpound Creek Dike; however, the number of people at risk is less than 5 people, so the population at risk in Table 10b is rounded to zero. For the 100-year return period, there is population at risk in the Riverview neighbourhood due to

potential failure of the Riverfront Park nature playground berm; however, the number of people at risk is less than 5 people, so the population at risk in Table 10b is rounded to zero. There is no population at risk due to potential flood control structure failure in Cochrane for the remaining open water and ice jam flood scenarios.

Population at risk due to direct inundation within the M.D. of Bighorn ranges from 80 people for the 2-year return period up to 150 people for the 1000-year return period for open water floods. There is no population at risk in the M.D. of Bighorn due to potential flood control structure failure.

Population at risk due to direct inundation within Rocky View County ranges from 20 people for the 2-year return period up to 70 people for the 1000-year return period for open water floods. For the 20-year to 1000-year return periods, there is one single family residence and zero non-residential buildings at risk of direct inundation, indicating that the population at risk in Rocky View County may have limited direct exposure to flooding. There is no population at risk in Rocky View County due to potential flood control structure failure.

Population at risk due to direct inundation within the Stoney Nakoda First Nation ranges from 10 people for the 2-year return period up to 30 people for the 1000-year return period for open water floods. It is worth noting that there are no buildings at risk within the areas inundated, which indicates the population at risk may have limited direct exposure to flooding. There is no population at risk due to potential flood control structure failure.

There are people at risk of ice jam flooding in two local authorities: Cochrane and Rocky View County. Population at risk in Cochrane ranges from 650 people for the 50-year return period to 700 people for the 200-year return period. There is only one residential building at risk in Cochrane for each ice jam flood return period, indicating that the population at risk may have limited direct exposure to flooding. There are 60 people at risk in Rocky View County for the 50-, 100-, and 200- year return periods. There is one single family residence at risk in Rocky View County for each ice jam flood return period, indicating that the majority of the population at risk may have limited direct exposure to flooding.

Table 10c and Figure 10b provide summary statistics for the estimated number of people at risk for the governing design flood. Canmore has the highest population at risk for the governing design flood. There are 1850 people at risk, and the majority of the population at risk is located in the South Canmore, Riverside, Fairholm, Town Centre, Lion's Park, Spring Creek, Larch, and Rundle neighbourhoods. In Cochrane, there are 870 people at risk for the governing design flood. There is, however, only one residential building at risk in Cochrane for this flood scenario, indicating that the population at risk may have limited direct exposure to flooding. There are 60 people at risk in Rocky View County and 50 people at risk in the M.D. of Bighorn, and there are 20 people at risk in the Stoney Nakoda First Nation. In each of these three local authorities, there are either one or zero residential buildings at risk, indicating that some of this population at risk may have limited direct exposure to flooding.

Table 10a Estimated population at risk for open water and ice jam flood scenarios – direct inundation

Flood Scenario	Estimated Population by Local Authority[2]					Total[3]
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	40	380	10	20	170	610
5-Yr Open Water	40	570	10	20	280	920
10-Yr Open Water	40	650	10	20	370	1100
20-Yr Open Water	40	740	20	40	490	1330
35-Yr Open Water	50	780	20	40	560	1450
50-Yr Open Water	50	820	20	50	600	1530
75-Yr Open Water	50	840	20	50	670	1630
100-Yr Open Water	50	930	20	50	740	1800
200-Yr Open Water	50	1910	20	60	880	2920
350-Yr Open Water	90	2290	30	60	1050	3520
500-Yr Open Water	100	2700	30	70	1180	4070
750-Yr Open Water	100	2960	30	70	1340	4500
1000-Yr Open Water	110	3100	30	70	1450	4760
50-Yr Ice Jam[1]	n/a	n/a	0	60	650	710
100-Yr Ice Jam[1]	n/a	n/a	0	60	680	740
200-Yr Ice Jam[1]	n/a	n/a	0	60	700	760

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Populations at risk were rounded to the nearest ten.
3. The total population at risk does not necessarily equal the sum of the population at risk for each local authority because populations at risk were rounded to the nearest ten after calculating the totals.

Table 10b Estimated population at risk for open water and ice jam flood scenarios – potential flood control structure failure

Flood Scenario	Estimated Population by Local Authority[2]					Total[3]
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
2-Yr Open Water	0	50	0	0	0	50
5-Yr Open Water	0	170	0	0	0	170
10-Yr Open Water	0	420	0	0	0	420
20-Yr Open Water	0	610	0	0	0	610
35-Yr Open Water	0	750	0	0	0	750
50-Yr Open Water	0	820	0	0	0	820
75-Yr Open Water	0	930	0	0	0	930
100-Yr Open Water	0	910	0	0	0	910
200-Yr Open Water	0	170	0	0	0	170
350-Yr Open Water	0	70	0	0	0	70
500-Yr Open Water	0	10	0	0	0	10
750-Yr Open Water	0	10	0	0	0	10
1000-Yr Open Water	0	10	0	0	0	10
50-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
100-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a
200-Yr Ice Jam[1]	n/a	n/a	n/a	n/a	n/a	n/a

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Populations at risk were rounded to the nearest ten.
3. The total population at risk does not necessarily equal the sum of the population at risk for each local authority because populations at risk were rounded to the nearest ten after calculating the totals.

Table 10c Estimated population at risk for the governing design flood scenario

Flood Scenario	Estimated Population by Local Authority[1]					Total[3]
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	
Governing Design Flood	50	1850	20	60	870	2840
Floodway	40	520	10	50	720	1350
Flood Fringe[2]	0	1330	10	10	150	1490
High Hazard Flood Fringe	0	40	0	0	20	60
Protected Flood Fringe	0	910	0	0	0	910

Notes:

1. Populations at risk were rounded to the nearest ten.
2. Flood fringe includes high hazard and protected flood fringe-sub zones.
3. The total population at risk does not necessarily equal the sum of the population at risk for each local authority because populations at risk were rounded to the nearest ten after calculating the totals.

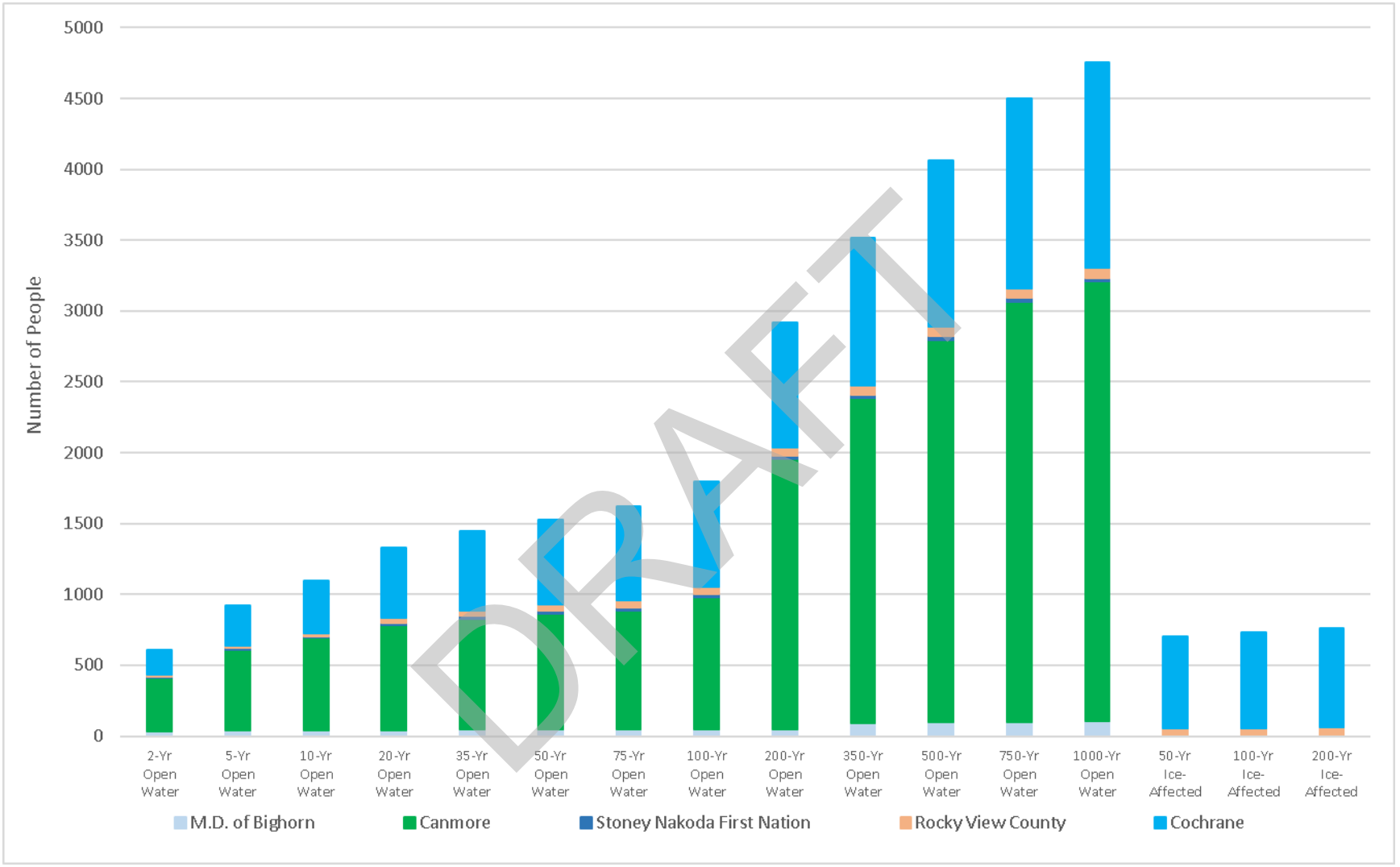


Figure 10a Population at risk for the open water and ice jam flood scenarios – direct inundation

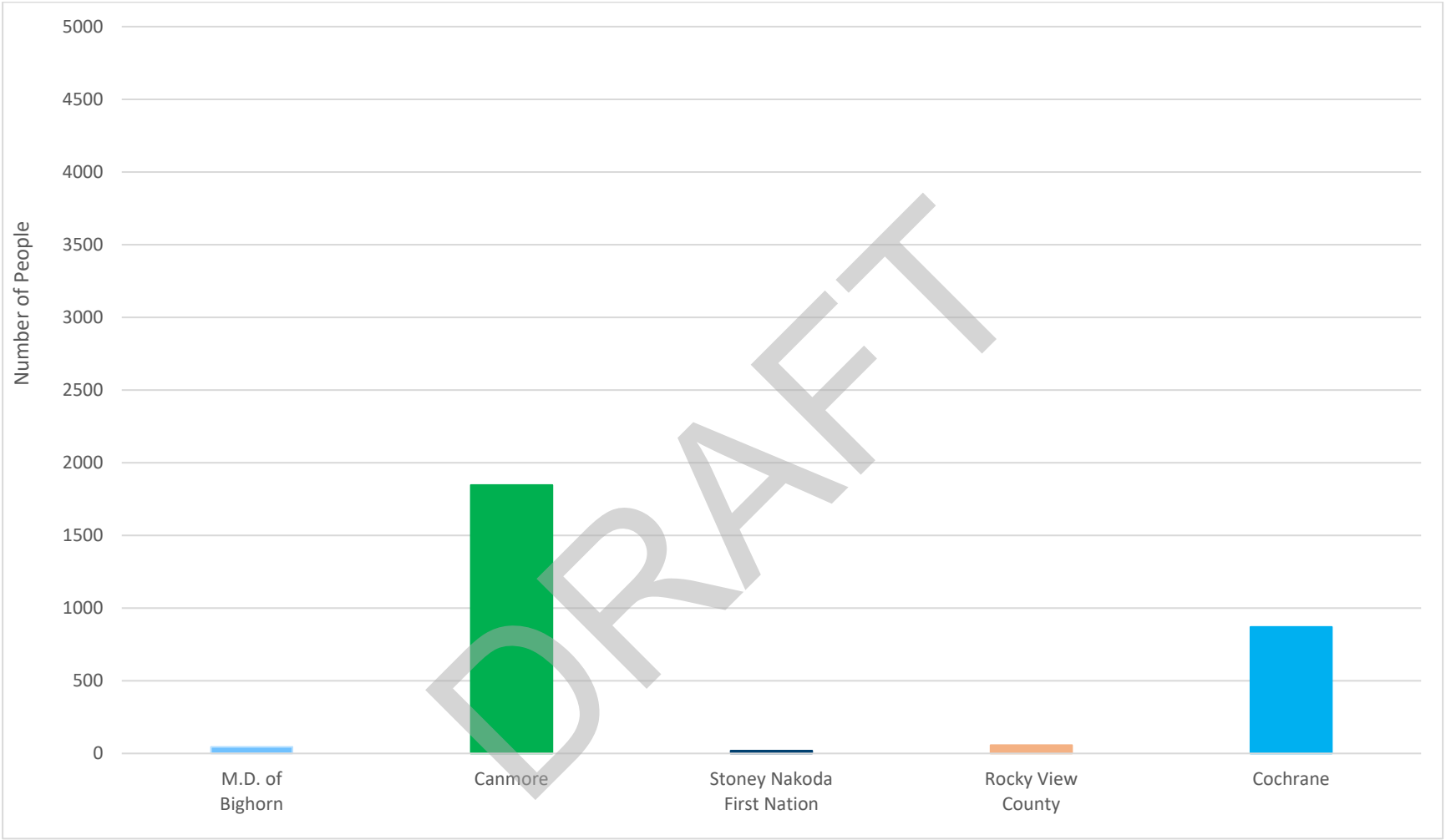


Figure 10b Population at risk for the governing design flood scenario

5 CONCLUSIONS

The objectives of this study were to assess river flood-related hazards along a 118 km reach of the Bow River (including Policeman Creek), 1 km of Exshaw Creek, 6 km of Bighill Creek, and 5 km of Jumpingpound Creek. The Upper Bow River Hazard Study was divided into eight major project components. 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.

No hospitals or schools were found to be at risk of flooding for any of the flood scenarios analyzed. A summary of infrastructure at risk by local authority is provided below.

M.D. of Bighorn

In the M.D. of Bighorn, about 25 single family homes near Heart Mountain Drive are at risk of direct inundation for the 350- to 1000-year return periods. In Exshaw, for the 5-year to 1000-year open water flood scenarios and for the governing design flood, the small pond at the wastewater treatment plant is at risk, but the large pond is not at risk. There are no bridges at risk in the M.D. of Bighorn. The Highway 1A culvert on Exshaw Creek is at risk due to direct inundation for all open water flood scenarios and for the governing design flood. Improvements to the Highway 1A culvert completed in 2019 as part of the Exshaw Creek Flood Mitigation Project are not reflected in this report. Several other culverts along the Bow River in the Lac des Arcs and Gap Lake area are at risk for open water floods with return periods of 10-years and greater and for the governing design flood. Sections of the Canadian Pacific Railway from the Graymont Quarry to Lac des Arcs are at risk for the 2-year to 1000-year open water floods and for the governing design flood. Sections of the Trans-Canada Highway south of Gap Lake and at Lac des Arcs are at risk for the 100-year to 1000-year open water floods and for the governing design flood. Sections of the Trans-Canada Highway between Highway 1A and Highway 742 are also at risk for the governing design flood. For the 100-year to 1000-year open water floods and for the governing design flood, sections of Highway 1A west of Exshaw are at risk. For the 350-year return period, sections of Highway 1A east of Exshaw are at risk.

Town of Canmore

In the Town of Canmore, for the 5-year to 1000-year open water floods and for the governing design flood, the South Canmore, Riverside, Fairholm, Lion's Park, and Spring Creek neighbourhoods between the rail line and the Canmore Town Dike are at risk, as well as the Rundle neighbourhood west of the Canmore Mine Dike. For the 200-year return period, both the Mine Dike and the Town Dike are at risk of being overtopped and flooding residential buildings and streets behind these flood control structures. For return periods of 500-years and greater, the majority of the downtown area is at risk from direct inundation, including a number of commercial businesses, an industrial building, and a government building. For the 2-year return period, the land around the Canmore Wastewater Treatment Plant is at risk of flooding due to potential failure of the Canmore Town Dike. Although the wastewater treatment plant buildings are at least partly above flood levels up to and including the 1000-year return period, if

full building footprints are considered, then the wastewater treatment plant is at risk of flooding due to direct inundation at the 5-year return period and greater. The Canmore wastewater treatment plant is at risk of inundation for the governing design flood. Two primary wastewater treatment facility buildings and several smaller secondary structures are at risk of inundation in the floodway area for the governing design flood. In Canmore, pedestrian and road bridges across Policeman Creek are at risk for return periods of 5-years and greater due to direct flood inundation. For the 500-year return period and higher, Bridge Road bridge across the Bow River is at risk. Several pedestrian bridges across Policeman Creek and one pedestrian bridge across a side channel of the Bow River are at risk for the governing design flood. One culvert on Policeman Creek at the Canmore Golf and Curling Club is at risk for the 35-year return period and greater as well as for the governing design flood. There is no railway at risk in Canmore.

Stoney Nakoda First Nation

Within the Stoney Nakoda First Nation there are minimal flooding impacts to infrastructure for all return periods. For all inundation scenarios there are no buildings, bridges, culverts, railway, or roadway at risk.

Rocky View County

In the local authority of Rocky View County, there are minimal flooding impacts to infrastructure for all return periods and no non-residential buildings, bridges, or culverts at risk. There is one single family residence at risk in Rocky View County for the 20-year open water flood and for the governing design flood. For the 1000-year open water flood, one kilometre of railway is at risk along the south side of the Bow River near Mitford and 0.2 km of Ranche Road east of Range Road 42 is at risk due to direct inundation.

Town of Cochrane

In the Town of Cochrane, the residential neighbourhood of Bow Meadows is at risk from direct inundation for the 200-year open water flood. Approximately half the residences in the Bow Meadows neighbourhood are at risk for the 500-year return period and most residences in this area are at risk for the 1000-year return period. Towards the downstream end of Cochrane, a number of residences along Riverview Circle, near the Cochrane Golf Club in the neighbourhood of Riverview, are at risk for return periods of 500-years and greater. There are three non-residential buildings at risk for the 1000-year open water flood, including one industrial building and two buildings classified as other major non-residential buildings. The River Avenue bridge across the Bow River and the Bow Valley Trail bridge across Bighill Creek are at risk of direct inundation flooding for the 750- and 1000-year return periods. Pedestrian bridges across Bighill Creek are at risk for open water floods starting at the 10-year return period and for the governing design flood. A paved road bridge across Jumpingpound Creek on George Fox Trail is at risk for the 100-year return period and greater open water floods and the governing design flood. A culvert on a side channel to the Bow River, upstream of the Highway 22 bridge is at risk due to direct inundation for all open water floods, ice jam floods, and for the governing design flood. There is no railway at risk in the Town of Cochrane. Residential streets in the neighbourhood of Bow Meadows

are at risk for the 75-year return period and greater for open water floods and for the governing design flood. For the 1000-year return period, all residential streets in the neighbourhood of Bow Meadows are at risk due to direct inundation. For the 50-, 100- and 200-year ice jam floods, sections of Range Road 42 and part of the road into Riverfront Park are at risk of flooding.

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APPENDIX A
DIGITAL FILES

Digital files supplied via FTP

Table A1. Flood Risk Inventory and Assessment – Digital Data Deliverables

CATEGORY	TITLE	DESCRIPTION	KEY ATTRIBUTE DESCRIPTION	FOLDER or GDB	FILE
RISK ASSESSMENT DATA					
	Land Parcels	Land parcel boundaries within the study area. Data from AEP via AltaLIS and NRCan via GeoGratis. Esri file geodatabase polygon feature class.	PID = unique parcel ID (where available); LINC = document number (where available); TYPE = ownership type (where available); SOURCE = source of land ownership data; PIN = unique First Nations parcel ID (where available).	UpperBowRHS_RiskAssessment.gdb\	LandParcels
	Building Points	Centroid point locations of residential and non-residential buildings. Sources include building footprints and points provided by municipalities, and locations identified from orthophotos. Esri file geodatabase point feature class.	LOCATION = community where the buildings is located; CATEGORY = building type (RESIDENTIAL or NON-RESIDENTIAL); SUB-CATEGORY = building sub-type (e.g., SINGLE FAMILY, INDUSTRIAL, etc.); STATUS = whether point is included or excluded from analysis; LOCAL_AUTHORITY = local authority name.	UpperBowRHS_RiskAssessment.gdb\	BuildingPts
	Bridges	Bridges within the study area, based on field surveys. Esri file geodatabase point feature class.	NHC_ID = unique point ID assigned by NHC; StreamName = stream name for hydraulic modelling, or "side channel" for features not directly on modelled reaches; RiverStation = stream chainage; Municipality = municipality where bridge is located; RoadTrail = road or trail name; Owner = owner of structure, where known; OwnerID = ID assigned by owner; Type = bridge type (e.g., pedestrian, road); Desc = bridge description (e.g., timber, concrete, steel); HECMax_LC = maximum low chord elevation from HEC-RAS model (this value is used for comparison to flood water surface elevation to determine if structure is impacted by flooding); HECMin_LC = minimum low chord elevation from HEC-RAS model; WSE_????Y = water surface elevation for various flood scenarios.	UpperBowRHS_RiskAssessment.gdb\	Bridges
	Culverts	Point locations of culverts, based on field surveys. Esri file geodatabase point feature class.	NHC_ID = unique point ID assigned by NHC; StreamName = stream name for hydraulic modelling, or "side channel" for features not directly on modelled reaches; RiverStation = stream chainage; Municipality = municipality or general location; Road_Trail = road or trail name; Owner = owner of structure; OwnerID = ID assigned by owner;	UpperBowRHS_RiskAssessment.gdb\	Culverts

CATEGORY	TITLE	DESCRIPTION	KEY ATTRIBUTE DESCRIPTION	FOLDER or GDB	FILE
			InModel = indicates whether structure will be included in hydraulic model; ModelComment = explains why feature is not included in model; Photo = indicates whether there is a field photo of the structure.		
	Census Dissemination Blocks	Census dissemination blocks that intersect the study area. 2016 census dissemination block polygons and geographic attribute table were downloaded from Statistics Canada and merged. Esri file geodatabase polygon feature class.	DBUID = unique dissemination block ID; DBPOP2016 = the population of the dissemination block in 2016.	UpperBowRHS_RiskAssessment.gdb\	CensusPopulation
	Community Boundaries	Communities intersecting the study area. These boundaries include: Improvement District No. 9 (Banff), Rocky View County, Municipal District of Bighorn No. 8, Kanakaskis Improvement District, Stoney First Nations Reserves # 142, 143, 144, City of Calgary, and Towns of Cochrane and Canmore. Esri file geodatabase polygon feature class.	TYPE = type of boundary;NAME = name of community.	UpperBowRHS_RiskAssessment.gdb\	CommunityBoundaries
	Railway	Railway lines within the study area. Data is from the National Railway Network downloaded from NRCan. This data was compiled with the collaboration of the federal, provincial, territorial governments and private sector. Esri file geodatabase line feature class.	TRACKNAME = name of track; TRACKCLASS = track classification; USETYPE = use of railway line; OPERATOENA = name of operator.	UpperBowRHS_RiskAssessment.gdb\	Railways
	Roadway	Roadway centrelines within the study area. Data is from the National Roadway Network downloaded from NRCan. This data was compiled with the collaboration of the federal, provincial, territorial and municipal governments. Esri file geodatabase line feature class.	ACQTECH = how the road data was acquired; PROVIDER = road ownership; ROADCLASS = type of road; RTNUMBER1 = route number; RTENAME1EN = route name in English; R_PLACENAM = location of road; NAME = name of road.	UpperBowRHS_RiskAssessment.gdb\	Roads

APPENDIX B
LAND PARCELS AT RISK

Table B1. Land parcels at risk for the open water and ice jam flood scenarios

Flood Scenario	Number of Land Parcels by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total[2]
2-Yr Open Water						
direct inundation	279	297	32	140	69	780
potential flood control structure failure	0	67	0	0	0	67
potential isolated area inundation	112	123	9	14	10	268
5-Yr Open Water						
direct inundation	302	352	34	143	75	869
potential flood control structure failure	0	289	0	0	0	289
potential isolated area inundation	100	252	4	12	11	379
10-Yr Open Water						
direct inundation	308	384	34	144	76	909
potential flood control structure failure	0	584	0	0	0	584
potential isolated area inundation	87	142	7	16	17	269
20-Yr Open Water						
direct inundation	311	430	35	145	79	962
potential flood control structure failure	0	805	0	0	0	805
potential isolated area inundation	82	86	8	10	14	200
35-Yr Open Water						
direct inundation	311	427	36	146	81	960
potential flood control structure failure	0	882	0	0	3	885
potential isolated area inundation	83	68	5	7	13	176
50-Yr Open Water						
direct inundation	317	464	37	146	83	1006
potential flood control structure failure	0	908	0	0	7	915
potential isolated area inundation	87	90	7	12	20	216
75-Yr Open Water						
direct inundation	321	480	37	146	98	1041
potential flood control structure failure	0	974	0	0	0	974
potential isolated area inundation	86	114	3	15	20	238
100-Yr Open Water						
direct inundation	329	578	38	146	114	1164
potential flood control structure failure	0	951	0	0	1	952
potential isolated area inundation	81	95	3	16	17	212
200-Yr Open Water						
direct inundation	337	1597	39	152	153	2234
potential flood control structure failure	0	149	0	0	0	149
potential isolated area inundation	83	82	2	10	33	210
350-Yr Open Water						
direct inundation	377	1790	39	155	212	2529
potential flood control structure failure	0	136	0	0	0	136
potential isolated area inundation	52	127	6	5	22	212
500-Yr Open Water						
direct inundation	379	2173	39	157	305	3009
potential flood control structure failure	0	12	0	0	0	12
potential isolated area inundation	48	117	5	6	52	228
750-Yr Open Water						
direct inundation	381	2302	39	158	392	3228
potential flood control structure failure	0	12	0	0	0	12
potential isolated area inundation	47	128	5	6	79	265
1000-Yr Open Water						
direct inundation	388	2403	39	160	428	3374
potential flood control structure failure	0	5	0	0	0	5
potential isolated area inundation	46	165	6	5	84	306
50-Yr Ice Jam[1]						
direct inundation	n/a	n/a	6	116	76	186
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	6	14	20
100-Yr Ice Jam[1]						
direct inundation	n/a	n/a	7	118	78	191
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	8	9	17
200-Yr Ice Jam[1]						
direct inundation	n/a	n/a	7	118	80	193
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	6	9	15

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. The total is derived from a separate count of at-risk land parcels across the total study area and is not necessarily equivalent to a sum of the land parcels in each local authority

Table B2. Land parcels at risk for the governing design flood scenario

Flood Scenario	Number of Land Parcels by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total[2]
Governing Design Flood[1]	329	1490	38	149	122	2087
Floodway	249	231	37	143	87	709
Flood Fringe	197	1398	22	107	87	1814
High Hazard Flood Fringe	138	117	6	36	26	325
Protected Flood Fringe	0	952	0	0	0	952

Notes:

1. The number of land parcels at risk for the Governing Design Flood scenario is not necessarily equivalent to a sum of the land parcels at risk for the Floodway and Flood Fringe scenarios because a single land parcel can be at risk for both the Floodway and Flood Fringe scenarios.
2. The total is derived from a separate count of at-risk land parcels across the total study area and is not necessarily equivalent to a sum of the land parcels in each local authority.

APPENDIX C
RESIDENTIAL BUILDINGS AT RISK

Table C1. Residential buildings at risk for the open water and ice jam flood scenarios

Flood Scenario	Number of Residential Buildings[1] by Local Authority																										
	M.D. of Bighorn					Canmore					Stoney Nakoda First Nation					Rocky View County					Cochrane					Total				
2-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	**0**	4	0	0	0	**4**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	4	0	0	0	**4**
potential isolated area inundation	2	0	0	0	**2**	2	0	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	4	0	0	0	**4**
5-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	6	0	0	0	**6**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	6	0	0	0	**6**
potential flood control structure failure	0	0	0	0	**0**	26	0	0	0	**26**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	26	0	0	0	**26**
potential isolated area inundation	6	0	0	0	**6**	8	0	0	0	**8**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	14	0	0	0	**14**
10-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	9	0	0	0	**9**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	9	0	0	0	**9**
potential flood control structure failure	0	0	0	0	**0**	90	1	0	0	**91**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	90	1	0	0	**91**
potential isolated area inundation	12	0	0	0	**12**	4	0	1	0	**5**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	16	0	1	0	**17**
20-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	9	1	0	0	**10**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	10	1	0	0	**11**
potential flood control structure failure	0	0	0	0	**0**	154	5	0	0	**159**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	154	5	0	0	**159**
potential isolated area inundation	13	0	0	0	**13**	6	0	1	0	**7**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	19	0	1	0	**20**
35-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	14	0	0	0	**14**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	15	0	0	0	**15**
potential flood control structure failure	0	0	0	0	**0**	198	11	0	0	**209**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	198	11	0	0	**209**
potential isolated area inundation	15	0	0	0	**15**	0	0	1	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	15	0	1	0	**16**
50-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	16	0	1	0	**17**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	17	0	1	0	**18**
potential flood control structure failure	0	0	0	0	**0**	225	12	0	0	**237**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	225	12	0	0	**237**
potential isolated area inundation	16	0	0	0	**16**	0	0	1	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	16	0	1	0	**17**
75-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	17	0	1	0	**18**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	18	0	1	0	**19**
potential flood control structure failure	0	0	0	0	**0**	261	13	0	0	**274**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	261	13	0	0	**274**
potential isolated area inundation	17	0	0	0	**17**	0	0	1	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	17	0	1	0	**18**
100-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	62	0	1	0	**63**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	63	0	1	0	**64**
potential flood control structure failure	0	0	0	0	**0**	241	15	0	0	**256**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	241	15	0	0	**256**
potential isolated area inundation	18	0	0	0	**18**	0	0	1	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	18	0	1	0	**19**
200-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	0	0	0	0	**0**	330	12	2	0	**344**	0	0	0	0	**0**	1	0	0	0	**1**	12	0	0	0	**12**	343	12	2	0	**357**
potential flood control structure failure	0	0	0	0	**0**	40	5	0	0	**45**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	40	5	0	0	**45**
potential isolated area inundation	22	0	0	0	**22**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	22	0	0	0	**22**

Flood Scenario	Number of Residential Buildings[1] by Local Authority																										
	M.D. of Bighorn					Canmore					Stoney Nakoda First Nation					Rocky View County					Cochrane					Total				
350-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	24	0	0	0	**24**	397	13	2	0	**412**	0	0	0	0	**0**	1	0	0	0	**1**	31	0	0	0	**31**	453	13	2	0	**468**
potential flood control structure failure	0	0	0	0	**0**	25	5	0	0	**30**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	25	5	0	0	**30**
potential isolated area inundation	2	0	0	0	**2**	1	1	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	3	1	0	0	**4**
500-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	24	0	0	0	**24**	488	20	2	13	**523**	0	0	0	0	**0**	1	0	0	0	**1**	50	0	0	0	**50**	563	20	2	13	**598**
potential flood control structure failure	0	0	0	0	**0**	3	0	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	3	0	0	0	**3**
potential isolated area inundation	3	0	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	3	0	0	0	**3**
750-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	25	0	0	0	**25**	566	21	2	13	**602**	0	0	0	0	**0**	1	0	0	0	**1**	79	0	0	0	**79**	671	21	2	13	**707**
potential flood control structure failure	0	0	0	0	**0**	3	0	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	3	0	0	0	**3**
potential isolated area inundation	3	0	0	0	**3**	3	0	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	6	0	0	0	**6**
1000-Yr Open Water	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	25	0	0	0	**25**	611	22	2	14	**649**	0	0	0	0	**0**	1	0	0	0	**1**	104	0	0	0	**104**	741	22	2	14	**779**
potential flood control structure failure	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
potential isolated area inundation	4	0	0	0	**4**	3	0	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	7	0	0	0	**7**
50-Yr Ice-Jam[2]	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	**0**	1	0	0	0	**1**	1	0	0	0	**1**	2	0	0	0	**2**
potential flood control structure failure	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**
potential isolated area inundation	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
100-Yr Ice-Jam[2]	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	**0**	1	0	0	0	**1**	1	0	0	0	**1**	2	0	0	0	**2**
potential flood control structure failure	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**
potential isolated area inundation	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
200-Yr Ice-Jam[2]	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**	SF	MF	RH	MH	**Σ**
direct inundation	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	**0**	1	0	0	0	**1**	1	0	0	0	**1**	2	0	0	0	**2**
potential flood control structure failure	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**
potential isolated area inundation	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**

Notes:

1. Residential buildings are grouped by the following subcategories – single family (SF), multi-family (MF), retirement home (RH), and mobile home (MH).
2. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table C2. Residential buildings at risk for the governing design flood scenario

Flood Scenario	Number of Residential Buildings[1] by Local Authority																									
	M.D. of Bighorn					Canmore					Stoney Nakoda First Nation					Rocky View County					Cochrane					Total				
	SF	MF	RH	MH	Σ	SF	MF	RH	MH	Σ	SF	MF	RH	MH	Σ	SF	MF	RH	MH	Σ	SF	MF	RH	MH	Σ	SF	MF	RH	MH	Σ
Governing Design Flood	0	0	0	0	**0**	303	15	1	0	**319**	0	0	0	0	**0**	1	0	0	0	**1**	1	0	0	0	**1**	305	15	1	0	321
Floodway	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	1	0	0	0	**1**	1	0	0	0	**1**	2	0	0	0	2
Flood Fringe[2]	0	0	0	0	**0**	303	15	1	0	**319**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	303	15	1	0	319
High Hazard Flood Fringe	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	1	0	0	0	1
Protected Flood Fringe	0	0	0	0	**0**	241	15	0	0	**256**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	241	15	0	0	256

Notes:

1. Residential buildings are grouped by the following subcategories – single family (SF), multi-family (MF), retirement home (RH), and mobile home (MH).
2. Flood fringe includes high hazard and protected flood fringe sub-zones.

APPENDIX D
NON-RESIDENTIAL BUILDINGS AT RISK

Table D1. Non-residential buildings at risk for the open water and ice jam flood scenarios

Flood Scenario	Number of Non-residential Buildings[1] by Local Authority																																															
	M.D. of Bighorn								Canmore								Stoney Nakoda First Nation								Rocky View County								Cochrane								Total							
2-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**
5-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	3	0	1	0	**4**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	3	0	1	0	**4**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**
10-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	5	0	1	0	**6**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	5	0	1	0	**6**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	2	**2**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	2	**2**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**
20-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	6	0	1	0	**7**	0	0	0	0	0	0	2	**2**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	6	0	1	2	**9**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**
potential isolated area inundation	0	0	0	4	0	0	0	**4**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	4	0	0	0	**4**
35-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	7	0	1	0	**8**	0	0	0	0	0	0	2	**2**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	7	0	1	2	**10**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	1	**2**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	1	**2**
potential isolated area inundation	0	0	0	4	0	0	0	**4**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	4	0	0	0	**4**
50-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	10	0	1	0	**11**	0	0	0	0	0	0	3	**3**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	10	0	1	3	**14**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	3	0	0	0	3	**6**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	3	0	0	0	3	**6**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**

Flood Scenario	Number of Non-residential Buildings[1] by Local Authority															
	M.D. of Bighorn								Canmore							
75-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	12	0	1	0	**13**	0	0	0	0	0	0	3	**3**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	3	0	0	0	3	**6**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**
100-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	13	0	1	0	**14**	0	0	0	0	0	0	3	**3**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	5	0	0	0	4	**9**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**
200-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	13	0	1	0	**14**	0	0	8	0	0	0	7	**15**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	3	**3**
potential isolated area inundation	0	0	0	3	0	0	0	**3**	0	0	0	0	0	0	0	**0**
350-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	13	0	1	0	**14**	0	0	10	0	0	0	9	**19**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**
potential isolated area inundation	0	0	0	4	0	0	0	**4**	0	0	0	0	0	0	0	**0**
500-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	14	0	1	0	**15**	0	0	14	1	1	0	11	**27**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	4	0	0	0	**4**	0	0	1	0	0	0	0	**1**
750-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	14	0	1	0	**15**	0	0	22	1	1	0	13	**37**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	4	0	0	0	**4**	0	0	1	0	0	0	1	**2**

Flood Scenario	Number of Non-residential Buildings[1] by Local Authority															
	Stoney Nakoda First Nation								Rocky View County							
75-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
100-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
200-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
350-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
500-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
750-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**

Flood Scenario	Number of Non-residential Buildings[1] by Local Authority															
	Cochrane								Total							
75-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	1	**1**	0	0	0	12	0	1	4	**17**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	3	0	0	0	3	**6**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**
100-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	1	**1**	0	0	0	13	0	1	4	**18**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	5	0	0	0	4	**9**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**
200-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	1	**1**	0	0	8	13	0	1	8	**30**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	3	**3**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	3	0	0	0	**3**
350-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	2	**2**	0	0	10	13	0	1	11	**35**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	0	4	0	0	0	**4**
500-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	2	**2**	0	0	14	15	1	1	13	**44**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	1	4	0	0	0	**5**
750-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	0	0	0	2	**2**	0	0	22	15	1	1	15	**54**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	0	0	0	0	**0**	0	0	1	4	0	0	1	

Flood Scenario	Number of Non-residential Buildings[1] by Local Authority																																															
	M.D. of Bighorn								Canmore								Stoney Nakoda First Nation								Rocky View County								Cochrane								Total							
1000-Yr Open Water	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	0	0	0	14	0	1	0	**15**	0	0	25	1	1	0	16	**43**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	1	0	0	2	**3**	0	0	25	16	1	1	18	**61**
potential flood control structure failure	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
potential isolated area inundation	0	0	0	5	0	0	0	**5**	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	1	5	0	0	0	**6**
50-Yr Ice-Jam[2]	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	1	**1**
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
potential isolated area inundation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
100-Yr Ice-Jam[2]	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	1	**1**
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
potential isolated area inundation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
200-Yr Ice-Jam[2]	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ
direct inundation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	1	**1**
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
potential isolated area inundation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**

Notes:

1. Non-residential buildings are grouped by the following subcategories: hospital and health centre (H/HC), school (SCH), commercial (COM), industrial (IND), government (GOV), water treatment plant (WTP), and other major non-residential buildings (OTR).
2. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table D2. Non-residential buildings at risk for the governing design flood scenario

Flood Scenario	Number of Non-residential Buildings[1] by Local Authority																																				Total								
	M.D. of Bighorn									Canmore								Stoney Nakoda First Nation								Rocky View County								Cochrane													
	H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ		H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ		H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ		H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ		H/HC	SCH	COM	IND	GOV	WTP	OTR	Σ	
Governing Design Flood	0	0	0	13	0	1	0	**14**		0	0	5	0	0	2	8	**15**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	1	**1**		0	0	5	0	13	0	0	3	9	**30**
Floodway	0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	3	**3**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	1	**1**		0	0	0	0	0	0	2	2	4	**8**
Flood Fringe[2]	0	0	0	13	0	1	0	**14**		0	0	5	0	0	0	7	**12**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	5	0	13	0	1	7	26	**52**
High Hazard Flood Fringe	0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	1	**1**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	1	1	1	**3**
Protected Flood Fringe	0	0	0	0	0	0	0	**0**		0	0	5	0	0	0	4	**9**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	0	0	0	0	0	**0**		0	0	5	0	0	0	0	4	9	**18**

Notes:

1. Non-residential buildings are grouped by the following subcategories: hospital and health centre (H/HC), school (SCH), commercial (COM), industrial (IND), government (GOV), water treatment plant (WTP), and other major non-residential buildings (OTR).
2. Flood fringe includes high hazard and protected flood fringe sub-zones.

APPENDIX E
BRIDGES AT RISK

Table E1. Number of bridges at risk for the open water and ice jam flood scenarios

Flood Scenario	Number of Bridges by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
2-Yr Open Water						
direct inundation	0	0	0	0	0	0
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
5-Yr Open Water						
direct inundation	0	2	0	0	0	2
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
10-Yr Open Water						
direct inundation	0	2	0	0	2	4
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
20-Yr Open Water						
direct inundation	0	3	0	0	5	8
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
35-Yr Open Water						
direct inundation	0	4	0	0	6	10
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
50-Yr Open Water						
direct inundation	0	4	0	0	8	12
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
75-Yr Open Water						
direct inundation	0	5	0	0	8	13
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
100-Yr Open Water						
direct inundation	0	6	0	0	9	15
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
200-Yr Open Water						
direct inundation	0	6	0	0	10	16
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
350-Yr Open Water						
direct inundation	0	7	0	0	10	17
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
500-Yr Open Water						
direct inundation	0	11	0	0	10	21
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
750-Yr Open Water						
direct inundation	0	13	0	0	12	25
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
1000-Yr Open Water						
direct inundation	0	13	0	0	12	25
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
50-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0	1	1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	0	0
100-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0	1	1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	0	0
200-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0	1	1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	0	0

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table E2. Number of bridges at risk for the governing design flood scenario

Flood Scenario	Number of Bridges by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
Governing Design Flood	0	6	0	0	10	16
Floodway	0	6	0	0	10	16
Flood Fringe	0	0	0	0	0	0

Table E3. Bridge clearance levels for bridges on Policeman Creek for the open water, ice jam, and governing design flood scenarios

NHC ID	River Station (m)	Local Authority	Low Chord (m)	Bridge Type	Open Water Flood Level Clearance[2] (m)												Ice Jam[1] Flood Level Clearance[2] (m)			Governing Design Flood Level Clearance[2] (m)		
					2-Yr	5-Yr	10-Yr	20-Yr	35-Yr	50-Yr	75-Yr	100-Yr	200-Yr	350-Yr	500-Yr	750-Yr	1000-Yr	50-Yr	100-Yr	200-Yr	Floodway	Flood Fringe	Governing Design Flood
60	5,252	Canmore	1311.26	Pedestrian bridge	0.18	**-0.16**	**-0.21**	**-0.23**	**-0.28**	**-0.30**	**-0.31**	**-0.32**	**-0.35**	**-0.40**	**-0.45**	**-0.53**	**-0.58**	n/a	n/a	n/a	**-0.44**	n/a	**-0.44**
61	5,103	Canmore	1311.30	Pedestrian bridge	0.22	**-0.12**	**-0.17**	**-0.19**	**-0.24**	**-0.25**	**-0.26**	**-0.27**	**-0.29**	**-0.34**	**-0.37**	**-0.43**	**-0.47**	n/a	n/a	n/a	**-0.27**	n/a	**-0.27**
65	4,853	Canmore	1310.09	Pedestrian bridge	0.36	0.21	0.17	0.00	**-0.14**	**-0.17**	**-0.22**	**-0.23**	**-0.27**	**-0.33**	**-0.43**	**-0.49**	**-0.55**	n/a	n/a	n/a	**-0.41**	n/a	**-0.41**
66	4,717	Canmore	1310.16	Pedestrian bridge	0.65	0.52	0.44	0.36	0.29	0.24	0.19	0.15	0.05	**-0.11**	**-0.19**	**-0.30**	**-0.36**	n/a	n/a	n/a	0.05	n/a	0.05
4	4,328	Canmore	1309.45	Pedestrian bridge	1.26	1.13	1.05	0.96	0.90	0.85	0.80	0.76	0.65	0.49	0.30	**-0.05**	**-0.24**	n/a	n/a	n/a	0.67	n/a	0.67
47	3,876	Canmore	1308.78	Paved road bridge	1.32	1.18	1.07	0.97	0.87	0.81	0.74	0.68	0.53	0.31	0.01	**-0.15**	**-0.25**	n/a	n/a	n/a	0.43	n/a	0.43
46	3,699	Canmore	1308.20	Paved road bridge	0.95	0.80	0.71	0.64	0.59	0.55	0.50	0.47	0.33	0.11	**-0.12**	**-0.26**	**-0.35**	n/a	n/a	n/a	0.33	n/a	0.33
45	3,147	Canmore	1308.45	Pedestrian bridge	1.83	1.71	1.61	1.49	1.39	1.32	1.24	1.15	0.92	0.68	0.52	0.36	0.26	n/a	n/a	n/a	0.70	n/a	0.70
2	2,793	Canmore	1307.98	Paved road bridge	1.80	1.63	1.51	1.37	1.25	1.17	1.10	1.02	0.80	0.58	0.47	0.30	0.18	n/a	n/a	n/a	0.79	n/a	0.79
43	1,552	Canmore	1306.53	Gravel road bridge	1.25	0.96	0.80	0.65	0.54	0.48	0.40	0.35	0.21	0.09	**-0.01**	**-0.11**	**-0.18**	n/a	n/a	n/a	0.30	n/a	0.30
302	5,668	Canmore	1312.31	Pedestrian bridge	0.74	0.53	0.40	0.27	0.15	0.08	**-0.04**	**-0.10**	**-0.30**	**-0.37**	**-0.39**	**-0.45**	**-0.48**	n/a	n/a	n/a	**-0.14**	n/a	**-0.14**
303	5,648	Canmore	1311.94	Pedestrian bridge	0.53	0.39	0.29	0.20	0.12	0.07	0.02	**-0.04**	**-0.18**	**-0.29**	**-0.68**	**-0.72**	**-0.74**	n/a	n/a	n/a	-0.15	n/a	**-0.15**

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Bridge clearance levels represent the difference between the water surface elevation and the bridge low chord elevation. Negative clearance values, shown in bold text, indicate that the bridge has no clearance for the given flood scenario.

Table E4. Bridge clearance levels for bridges on the Bow River for the open water, ice jam, and governing design flood scenarios

NHC ID	River Station (m)	Local Authority	Low Chord (m)	Bridge Type	Open Water Flood Level Clearance[2] (m)													Ice Jam[1] Flood Level Clearance[2,](m)			Governing Design Flood Level Clearance[2] (m)		
					2-Yr	5-Yr	10-Yr	20-Yr	35-Yr	50-Yr	75-Yr	100-Yr	200-Yr	350-Yr	500-Yr	750-Yr	1000-Yr	50-Yr	100-Yr	200-Yr	Floodway	Flood Fringe[3]	Governing Design Flood
31	109223	Canmore	1310.75	Paved road bridge	1.54	1.21	1.00	0.80	0.64	0.54	0.43	0.35	0.15	0.01	**-0.11**	**-0.32**	**-0.44**	n/a	n/a	n/a	0.35	n/a	0.35
55	109929	Canmore	1310.90	Pedestrian bridge	0.82	0.42	0.16	**-0.10**	**-0.31**	**-0.43**	**-0.57**	**-0.68**	**-0.92**	**-1.06**	**-1.18**	**-1.31**	**-1.38**	n/a	n/a	n/a	**-0.68**	n/a	**-0.68**
51	109929	Canmore	1312.39	Pedestrian bridge	2.30	1.89	1.62	1.36	1.16	1.04	0.90	0.79	0.56	0.42	0.29	0.17	0.09	n/a	n/a	n/a	0.65	n/a	0.65
32	104549	Canmore	1305.32	Highway bridge	3.43	3.17	3.00	2.84	2.71	2.63	2.54	2.47	2.32	2.18	2.09	1.99	1.93	n/a	n/a	n/a	0.30	n/a	0.30
42	104509	Canmore	1305.32	Highway bridge	3.49	3.23	3.08	2.93	2.81	2.74	2.66	2.60	2.46	2.33	2.26	2.17	2.11	n/a	n/a	n/a	0.43	n/a	0.43
30	79676	M.D. of Bighorn	1283.32	Rail bridge	2.68	2.48	2.33	2.17	2.04	1.95	1.85	1.78	1.59	1.43	1.32	1.19	1.10	n/a	n/a	n/a	1.78	n/a	1.78
8	77639	M.D. of Bighorn	1283.53	Highway bridge	3.31	3.30	3.29	3.27	3.26	3.25	3.23	3.22	3.19	3.16	3.13	3.10	3.07	n/a	n/a	n/a	2.79	n/a	2.79
17	27374	Rocky View County	1134.97	Rail bridge	6.02	5.59	5.27	4.92	4.63	4.45	4.23	4.08	3.68	3.34	3.10	2.83	2.64	3.08	2.85	2.74	2.34	n/a	2.34
15	23403	Cochrane	1126.04	Highway bridge	5.76	5.15	4.70	4.25	3.85	3.60	3.29	3.05	2.50	2.06	1.78	1.44	1.23	2.53	2.32	2.23	1.73	n/a	1.73
12	21225	Cochrane	1120.50	Paved road bridge	4.51	4.05	3.67	3.26	2.90	2.67	2.38	2.16	1.61	1.13	0.78	**-0.11**	**-0.33**	1.05	0.88	0.81	**-0.32**	n/a	**-0.32**
70	109212	Canmore	1310.75	Pedestrian bridge	1.57	1.24	1.03	0.83	0.67	0.58	0.46	0.38	0.19	0.04	**-0.05**	**-0.18**	**-0.28**	n/a	n/a	n/a	0.38	n/a	0.38
11	54457	Stoney Nakoda First Nation	1196.08	Highway bridge	4.22	4.18	4.14	4.08	4.03	3.99	3.93	3.88	3.76	3.63	3.53	3.42	3.31	n/a	n/a	n/a	3.88	n/a	3.88

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Bridge clearance levels represent the difference between the water surface elevation and the bridge low chord elevation. Negative clearance values, shown in bold text, indicate that the bridge has no clearance for the given flood scenario.
3. There are no bridges on the Bow River within the flood fringe area.

Table E5. Bridge clearance levels for bridges on Exshaw Creek for the open water, ice jam, and governing design flood scenarios

NHC ID	River Station (m)	Local Authority	Low Chord (m)	Bridge Type	Open Water Flood Level Clearance[2] (m)													Ice Jam[1] Flood Level Clearance[2,](m)			Governing Design Flood Level Clearance[2] (m)		
					2-Yr	5-Yr	10-Yr	20-Yr	35-Yr	50-Yr	75-Yr	100-Yr	200-Yr	350-Yr	500-Yr	750-Yr	1000-Yr	50-Yr	100-Yr	200-Yr	Floodway	Flood Fringe[3]	Governing Design Flood
25	155	M.D. of Bighorn	1295.14	Paved road bridge	2.43	2.10	1.87	1.64	1.45	1.33	1.18	1.08	0.81	0.59	0.43	0.25	0.09	n/a	n/a	n/a	0.64	n/a	0.64
24	111	M.D. of Bighorn	1294.65	Paved road bridge	2.27	1.98	1.80	1.61	1.46	1.36	1.25	1.17	0.95	0.79	0.68	0.54	0.44	n/a	n/a	n/a	0.88	n/a	0.88
304	451	M.D. of Bighorn	1307.43	Pedestrian bridge	2.12	1.85	1.68	1.54	1.43	1.36	1.27	1.21	1.03	0.88	0.80	0.71	0.59	n/a	n/a	n/a	1.14	n/a	1.14

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Bridge clearance levels represent the difference between the water surface elevation and the bridge low chord elevation.
3. There are no bridges on Exshaw Creek within the flood fringe area.

Table E6. Bridge clearance levels for bridges on Jumpingpound Creek for the open water, ice jam, and governing design flood scenarios

NHC ID	River Station (m)	Local Authority	Low Chord (m)	Bridge Type	Open Water Flood Level Clearance[2] (m)													Ice Jam[1] Flood Level Clearance[2] (m)			Governing Design Flood Level Clearance[2] (m)		
					2-Yr	5-Yr	10-Yr	20-Yr	35-Yr	50-Yr	75-Yr	100-Yr	200-Yr	350-Yr	500-Yr	750-Yr	1000-Yr	50-Yr	100-Yr	200-Yr	Floodway	Flood Fringe[3]	Governing Design Flood
16	647	Cochrane	1129.53	Paved road bridge	3.12	2.47	1.97	1.46	1.01	0.73	0.07	**-0.15**	**-0.65**	**-1.12**	**-1.40**	**-1.67**	**-1.86**	2.67	2.51	2.35	**-0.54**	n/a	**-0.54**

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Bridge clearance levels represent the difference between the water surface elevation and the bridge low chord elevation. Negative clearance values, shown in bold text, indicate that the bridge has no clearance for the given flood scenario.
3. There are no bridges on Jumpingpound Creek within the flood fringe area.

Table E7. Bridge clearance levels for bridges on Bighill Creek for the open water, ice jam, and governing design flood scenarios

NHC ID	River Station (m)	Local Authority	Low Chord (m)	Bridge Type	Open Water Flood Level Clearance[2] (m)													Ice Jam[1] Flood Level Clearance[2] (m)			Governing Design Flood Level Clearance[2] (m)		
					2-Yr	5-Yr	10-Yr	20-Yr	35-Yr	50-Yr	75-Yr	100-Yr	200-Yr	350-Yr	500-Yr	750-Yr	1000-Yr	50-Yr	100-Yr	200-Yr	Floodway	Flood Fringe[3]	Governing Design Flood
312	2754	Cochrane	1142.20	Rail bridge	2.36	1.87	1.61	1.37	1.21	1.12	1.01	0.93	0.78	0.67	0.60	0.52	0.47	n/a	n/a	n/a	0.93	n/a	0.93
76	1207	Cochrane	1131.35	Pedestrian bridge	0.82	0.57	0.40	0.24	0.10	**-0.02**	**-0.13**	**-0.21**	**-0.34**	**-0.44**	**-0.50**	**-0.56**	**-0.60**	n/a	n/a	n/a	**-0.34**	n/a	**-0.34**
77	992	Cochrane	1129.80	Pedestrian bridge	1.43	1.16	0.98	0.81	0.68	0.61	0.53	0.47	0.38	0.28	0.22	0.16	0.13	n/a	n/a	n/a	0.47	n/a	0.47
71	208	Cochrane	1121.50	Pedestrian bridge	1.10	0.78	0.62	0.19	**-0.28**	**-0.56**	**-0.93**	**-1.20**	**-1.84**	**-2.33**	**-2.65**	**-3.03**	**-3.27**	**-1.16**	**-1.33**	**-1.42**	**-1.33**	n/a	**-1.33**
308	4360	Cochrane	1150.00	Pedestrian bridge	0.69	0.34	0.12	**-0.11**	**-0.27**	**-0.36**	**-0.44**	**-0.51**	**-0.66**	**-0.78**	**-0.85**	**-0.93**	**-0.99**	n/a	n/a	n/a	**-0.61**	n/a	**-0.61**
309	3794	Cochrane	1145.60	Pedestrian bridge	0.55	0.20	0.07	**-0.04**	**-0.10**	**-0.16**	**-0.21**	**-0.24**	**-0.32**	**-0.38**	**-0.42**	**-0.46**	**-0.49**	n/a	n/a	n/a	**-0.24**	n/a	**-0.24**
310	3385	Cochrane	1143.78	Pedestrian bridge	1.03	0.51	0.23	0.08	0.00	**-0.04**	**-0.08**	**-0.11**	**-0.12**	**-0.16**	**-0.18**	**-0.22**	**-0.22**	n/a	n/a	n/a	**-0.11**	n/a	**-0.11**
313	2158	Cochrane	1137.64	Pedestrian bridge	1.43	0.97	0.69	0.45	0.25	0.16	0.14	0.10	**-0.02**	**-0.06**	**-0.09**	**-0.12**	**-0.14**	n/a	n/a	n/a	0.10	n/a	0.10
315	1722	Cochrane	1135.14	Pedestrian bridge	0.75	0.20	**-0.12**	**-0.40**	**-0.56**	**-0.61**	**-0.66**	**-0.70**	**-0.71**	**-0.82**	**-0.85**	**-0.89**	**-0.92**	n/a	n/a	n/a	**-0.70**	n/a	**-0.70**
316	581	Cochrane	1125.15	Pedestrian bridge	0.48	0.10	**-0.23**	**-0.57**	**-0.88**	**-1.07**	**-1.30**	**-1.46**	**-1.85**	**-2.17**	**-2.38**	**-2.62**	**-2.79**	n/a	n/a	n/a	**-1.48**	n/a	**-1.48**
317	372	Cochrane	1123.13	Pedestrian bridge	0.62	0.23	0.00	**-0.28**	**-0.38**	**-0.42**	**-0.46**	**-0.49**	**-0.56**	**-0.79**	**-1.07**	**-1.44**	**-1.67**	0.47	0.30	0.21	**-0.49**	n/a	**-0.49**
14	2814	Cochrane	1142.46	Highway bridge	2.15	1.66	1.38	1.14	0.96	0.85	0.72	0.63	0.41	0.24	0.07	**-0.08**	**-0.18**	n/a	n/a	n/a	0.63	n/a	0.63

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Bridge clearance levels represent the difference between the water surface elevation and the bridge low chord elevation. Negative clearance values, shown in bold text, indicate that the bridge has no clearance for the given flood scenario.
3. There are no bridges on Bighill Creek within the flood fringe area.

APPENDIX F
CULVERTS AT RISK

Table F1. Culverts at risk for the open water and ice jam flood scenarios

Flood Scenario	Number of Culverts by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
2-Yr Open Water						
direct inundation	2	0	0	0	1	3
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
5-Yr Open Water						
direct inundation	7	0	0	0	1	8
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
10-Yr Open Water						
direct inundation	8	0	0	0	1	9
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
20-Yr Open Water						
direct inundation	10	0	0	0	1	11
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
35-Yr Open Water						
direct inundation	11	1	0	0	1	13
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
50-Yr Open Water						
direct inundation	11	1	0	0	1	13
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
75-Yr Open Water						
direct inundation	11	1	0	0	1	13
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
100-Yr Open Water						
direct inundation	12	1	0	0	1	14
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
200-Yr Open Water						
direct inundation	13	1	0	0	1	15
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
350-Yr Open Water						
direct inundation	13	1	0	0	1	15
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	1	0	0	0	0	1
500-Yr Open Water						
direct inundation	13	1	0	0	1	15
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	1	0	0	0	0	1
750-Yr Open Water						
direct inundation	13	2	0	0	1	16
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	1	0	0	0	0	1
1000-Yr Open Water						
direct inundation	14	4	0	0	1	19
potential flood control structure failure	0	0	0	0	0	0
potential isolated area inundation	0	0	0	0	0	0
50-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0	1	1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	0	0
100-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0	1	1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	0	0
200-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0	1	1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	0	0

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table F2. Culverts at risk for the governing design flood scenario

Flood Scenario	Number of Culverts by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
Governing Design Flood	12	1	0	0	1	14
Floodway	12	1	0	0	1	14
Flood Fringe[1]	0	0	0	0	0	0
High Hazard Flood Fringe	0	0	0	0	0	0
Protected Flood Fringe	0	0	0	0	0	0

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

APPENDIX G
RAILWAY AT RISK

Table G1. Railway at risk for the open water and ice jam flood scenarios

Flood Scenario	Kilometres of Railway by Local Authority (km)					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
2-Yr Open Water						
direct inundation	0.0	0.0	0.0	0.0	0.0	0.0
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
5-Yr Open Water						
direct inundation	1.9	0.0	0.0	0.0	0.0	1.9
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
10-Yr Open Water						
direct inundation	3.8	0.0	0.0	0.0	0.0	3.8
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
20-Yr Open Water						
direct inundation	5.7	0.0	0.0	0.0	0.0	5.7
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
35-Yr Open Water						
direct inundation	7.4	0.0	0.0	0.0	0.0	7.4
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
50-Yr Open Water						
direct inundation	8.0	0.0	0.0	0.0	0.0	8.0
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
75-Yr Open Water						
direct inundation	8.9	0.0	0.0	0.0	0.0	8.9
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
100-Yr Open Water						
direct inundation	9.6	0.0	0.0	0.0	0.0	9.6
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
200-Yr Open Water						
direct inundation	12.2	0.0	0.0	0.0	0.0	12.2
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
350-Yr Open Water						
direct inundation	13.8	0.0	0.0	0.0	0.0	13.8
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
500-Yr Open Water						
direct inundation	14.6	0.0	0.0	0.1	0.0	14.6
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
750-Yr Open Water						
direct inundation	15.0	0.0	0.0	0.5	0.0	15.5
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
1000-Yr Open Water						
direct inundation	15.3	0.0	0.0	1.0	0.0	16.3
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.0	0.0	0.0	0.0	0.0	0.0
50-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0.0	0.0	0.0
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0.0	0.0	0.0
100-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0.0	0.0	0.0
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0.0	0.0	0.0
200-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	0.0	0.0	0.0
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0.0	0.0	0.0

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table G2. Railway at risk for the governing design flood scenario

Flood Scenario	Kilometres of Railway by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
Governing Design Flood	9.7	0.0	0.0	0.0	0.0	9.7
Floodway	5.1	0.0	0.0	0.0	0.0	5.1
Flood Fringe[1]	4.5	0.0	0.0	0.0	0.0	4.5
High Hazard Flood Fringe	0.9	0.0	0.0	0.0	0.0	0.9
Protected Flood Fringe	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

APPENDIX H
ROADWAY AT RISK

Table H1. Roadway at risk for the open water and ice jam flood scenarios

Flood Scenario	Kilometres of Roadway by Local Authority (km)					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
2-Yr Open Water						
direct inundation	0.0	0.0	0.0	0.0	0.0	0.0
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.4	0.2	0.0	0.0	0.0	0.6
5-Yr Open Water						
direct inundation	0.2	0.4	0.0	0.0	0.0	0.6
potential flood control structure failure	0.0	1.0	0.0	0.0	0.0	1.0
potential isolated area inundation	0.8	0.2	0.0	0.0	0.0	0.9
10-Yr Open Water						
direct inundation	0.4	0.7	0.0	0.0	0.1	1.2
potential flood control structure failure	0.0	2.3	0.0	0.0	0.0	2.3
potential isolated area inundation	0.9	0.2	0.0	0.0	0.0	1.1
20-Yr Open Water						
direct inundation	0.8	1.0	0.0	0.0	0.1	1.8
potential flood control structure failure	0.0	3.7	0.0	0.0	0.0	3.7
potential isolated area inundation	1.3	0.4	0.0	0.0	0.0	1.7
35-Yr Open Water						
direct inundation	1.4	1.2	0.0	0.0	0.1	2.7
potential flood control structure failure	0.0	5.0	0.0	0.0	0.0	5.0
potential isolated area inundation	1.0	0.2	0.0	0.0	0.0	1.2
50-Yr Open Water						
direct inundation	2.0	1.3	0.0	0.0	0.1	3.4
potential flood control structure failure	0.0	5.8	0.0	0.0	0.0	5.8
potential isolated area inundation	1.0	0.2	0.0	0.0	0.0	1.3
75-Yr Open Water						
direct inundation	2.5	1.5	0.0	0.0	0.2	4.2
potential flood control structure failure	0.0	6.7	0.0	0.0	0.0	6.7
potential isolated area inundation	1.1	0.2	0.0	0.0	0.0	1.2
100-Yr Open Water						
direct inundation	3.4	2.4	0.0	0.0	0.3	6.1
potential flood control structure failure	0.0	6.7	0.0	0.0	0.0	6.7
potential isolated area inundation	1.1	0.1	0.0	0.0	0.0	1.2
200-Yr Open Water						
direct inundation	4.9	9.1	0.0	0.1	0.5	14.6
potential flood control structure failure	0.0	2.0	0.0	0.0	0.0	2.0
potential isolated area inundation	1.2	0.1	0.0	0.0	0.1	1.5
350-Yr Open Water						
direct inundation	6.5	12.4	0.0	0.1	1.2	20.2
potential flood control structure failure	0.0	1.9	0.0	0.0	0.0	1.9
potential isolated area inundation	0.6	0.2	0.0	0.0	0.0	0.9
500-Yr Open Water						
direct inundation	7.3	17.2	0.0	0.2	1.6	26.3
potential flood control structure failure	0.0	0.1	0.0	0.0	0.0	0.1
potential isolated area inundation	0.6	0.1	0.0	0.0	0.1	0.9
750-Yr Open Water						
direct inundation	8.5	18.9	0.0	0.2	2.4	29.9
potential flood control structure failure	0.0	0.1	0.0	0.0	0.0	0.1
potential isolated area inundation	0.8	0.4	0.0	0.0	0.2	1.4
1000-Yr Open Water						
direct inundation	9.4	20.1	0.0	0.2	2.8	32.5
potential flood control structure failure	0.0	0.0	0.0	0.0	0.0	0.0
potential isolated area inundation	0.7	0.5	0.0	0.0	0.2	1.4
50-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0.0	0.0	0.1	0.1
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0.0	0.0	0.0	0.0
100-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0.0	0.0	0.2	0.2
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0.0	0.0	0.0	0.0
200-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0.0	0.0	0.3	0.3
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0.0	0.0	0.0	0.0

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.

Table H2. Roadway at risk for the governing design flood scenario

Flood Scenario	Kilometres of Roadway by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total
Governing Design Flood	3.4	9.1	0.0	0.0	0.4	12.9
Floodway	0.0	0.0	0.0	0.0	0.1	0.1
Flood Fringe[1]	3.3	9.1	0.0	0.0	0.3	12.8
High Hazard Flood Fringe	0.1	0.0	0.0	0.0	0.0	0.1
Protected Flood Fringe	0.0	6.7	0.0	0.0	0.0	6.7

Notes:

1. Flood fringe includes high hazard and protected flood fringe sub-zones.

APPENDIX I
POPULATION AT RISK

Table I1. Population at risk for the open water and ice jam flood scenarios

Flood Scenario	Estimated Population[2] at Risk by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total[3]
2-Yr Open Water						
direct inundation	40	380	10	20	170	610
potential flood control structure failure	0	50	0	0	0	50
potential isolated area inundation	10	40	0	0	20	60
5-Yr Open Water						
direct inundation	40	570	10	20	280	920
potential flood control structure failure	0	170	0	0	0	170
potential isolated area inundation	20	70	0	0	20	110
10-Yr Open Water						
direct inundation	40	650	10	20	370	1100
potential flood control structure failure	0	420	0	0	0	420
potential isolated area inundation	20	50	0	0	30	100
20-Yr Open Water						
direct inundation	40	740	20	40	490	1330
potential flood control structure failure	0	610	0	0	0	610
potential isolated area inundation	30	50	0	0	30	110
35-Yr Open Water						
direct inundation	50	780	20	40	560	1450
potential flood control structure failure	0	750	0	0	0	750
potential isolated area inundation	30	50	0	0	40	130
50-Yr Open Water						
direct inundation	50	820	20	50	600	1530
potential flood control structure failure	0	820	0	0	0	820
potential isolated area inundation	40	60	0	0	50	150
75-Yr Open Water						
direct inundation	50	840	20	50	670	1630
potential flood control structure failure	0	930	0	0	0	930
potential isolated area inundation	40	30	0	0	60	130
100-Yr Open Water						
direct inundation	50	930	20	50	740	1800
potential flood control structure failure	0	910	0	0	0	910
potential isolated area inundation	40	40	0	0	60	140
200-Yr Open Water						
direct inundation	50	1910	20	60	880	2920
potential flood control structure failure	0	170	0	0	0	170
potential isolated area inundation	40	30	0	0	80	150
350-Yr Open Water						
direct inundation	90	2290	30	60	1050	3520
potential flood control structure failure	0	70	0	0	0	70
potential isolated area inundation	10	30	0	0	90	130
500-Yr Open Water						
direct inundation	100	2700	30	70	1180	4070
potential flood control structure failure	0	10	0	0	0	10
potential isolated area inundation	10	30	0	0	110	150
750-Yr Open Water						
direct inundation	100	2960	30	70	1340	4500
potential flood control structure failure	0	10	0	0	0	10
potential isolated area inundation	10	40	0	0	170	220
1000-Yr Open Water						
direct inundation	110	3100	30	70	1450	4760
potential flood control structure failure	0	10	0	0	0	10
potential isolated area inundation	10	50	0	0	190	240
50-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	60	650	710
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	20	20
100-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	60	680	740
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	20	20
200-Yr Ice-Jam[1]						
direct inundation	n/a	n/a	0	60	700	760
potential flood control structure failure	n/a	n/a	n/a	n/a	n/a	n/a
potential isolated area inundation	n/a	n/a	0	0	20	20

Notes:

1. The reach affected by ice jams is the 40 km sub-reach of the Bow River extending from Ghost Dam to Bearspaw Dam.
2. Populations at risk were rounded to the nearest ten.
3. The total population at risk does not necessarily equal the sum of the population at risk for each local authority because populations at risk were rounded to the nearest ten after calculating the totals.

Table I2. Population at risk for the governing design flood scenario

Flood Scenario	Estimated Population[1] at Risk by Local Authority					
	M.D. of Bighorn	Canmore	Stoney Nakoda First Nation	Rocky View County	Cochrane	Total[2]
Governing Design Flood	50	1850	20	60	870	2840
Floodway	40	520	10	50	720	1350
Flood Fringe[3]	0	1330	10	10	150	1490
High Hazard Flood Fringe	0	40	0	0	20	60
Protected Flood Fringe	0	910	0	0	0	910

Notes:

1. Populations at risk were rounded to the nearest ten.
2. The total population at risk does not necessarily equal the sum of the population at risk for each local authority because populations at risk were rounded to the nearest ten after calculating the totals.
3. Flood fringe includes high hazard and protected flood fringe sub-zones.

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