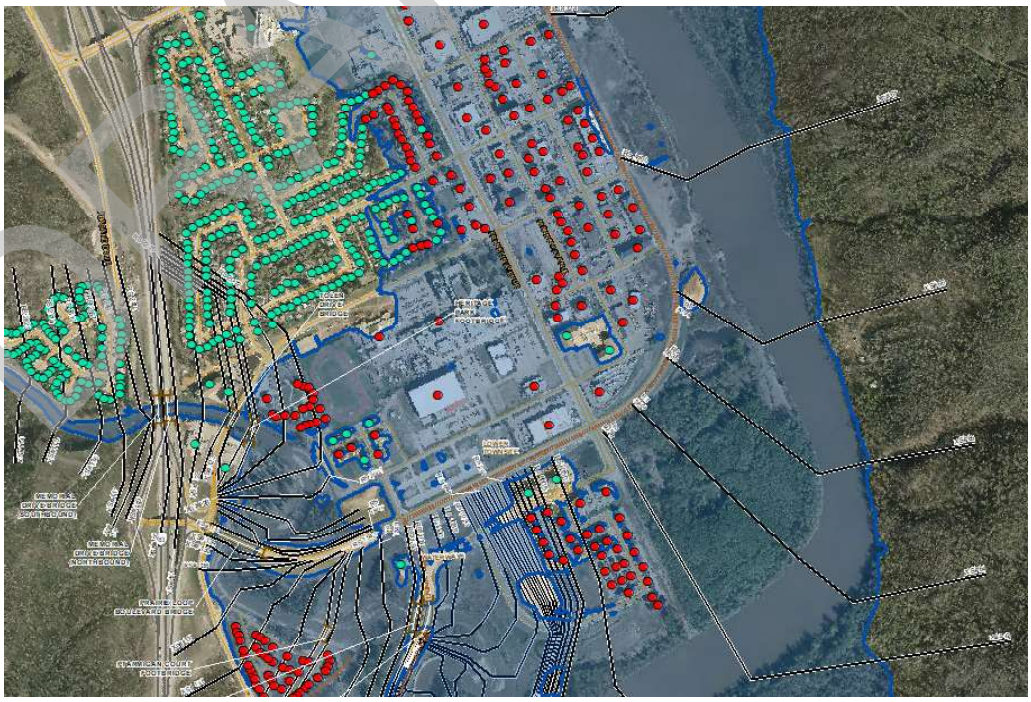
August 2023

FORT MCMURRAY RIVER HAZARD STUDY

Flood Risk Inventory and Assessment Report

Submitted to:
Alberta Environment and Parks
11th Floor, Oxbridge Place
9820 - 106th Street NW
Edmonton, Alberta T5K 2J6



Report Number: 1662603_R0008_Rev 0

REPORT

Golder Associates

Executive Summary

Alberta Environment and Parks (AEP) retained Golder Associates Ltd. (Golder), in collaboration with SG1 Water Consulting Ltd. (SG1) and Hatch Ltd. (Hatch), in September 2016 to conduct the Fort McMurray River Hazard Study. The primary purpose of the study is to assess and identify river and flood hazards along the Athabasca River, the Clearwater River (including the Snye), and the Hangingstone River through Fort McMurray, AB in the Regional Municipality of Wood Buffalo (RMWB).

The study is being completed under the provincial Flood Hazard Identification Program (FHIP). The goals of this program include the enhancement of public safety and reduction of future flood damages through the identification of river and flood hazards. Project stakeholders include the Government of Alberta, the RMWB, and the public.

The study includes multiple components and deliverables. This report documents the methodology and results of the flood risk assessment and inventory component. The assessment compares open water flood inundation, ice jam flood inundation, and design flood hazard mapping with collected and interpreted spatial data that contain an inventory of land parcels, buildings, major transportation infrastructure, and population. Flood risk statistics are calculated to quantify flood vulnerabilities for each of the 13 open-water flood scenarios, each of the three ice jam flood scenarios, and the design flood scenario. The statistics pertain to the number of affected parcels, buildings, and population, as well as the length of affected road infrastructure, including bridges.

The statistics for the open and ice jam inundation are based on the conditions before 2022. Any flood control structures constructed since 2022 are only included in the governing design flood scenario (floodway and flood fringe delineation).

The main results of the flood risk assessment for the open water flood scenarios are summarized below:

- The number of affected residential buildings and affected population remains zero until the 20-year flood. It then slowly increases up to the 1000-year flood.
- The number of affected non-residential buildings remains zero until the 75-year flood. It then increases up the 1000-year flood with a significant increase between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated
- No critical, non-residential buildings (i.e., government buildings, hospitals, schools, or water treatment facilities) are affected up to the 100-year open water flood. The only critical, non-residential buildings affected by any open water flood scenarios are schools, including Keyano College starting at the 200-year flood.
- The length of roads affected by direct inundation remains zero until the 10-year flood. A significant increase occurs between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated. Some of the major roads that would be affected include:
  - Franklin Avenue between Prairie Loop Boulevard and Queen Street starting at the 350-year flood.
  - King Street southwest of the intersection with Franklin Avenue starting at the 350-year flood.

The main results of the flood risk assessment for the ice jam flood scenarios are summarized below:

- Residential buildings around Selby Avenue in the Lower Townsite and in Waterways are affected by direct inundation at the 50-year flood. The number of residential buildings affected by direct inundation then increases steadily between the 50-year and 200-year floods, as additional areas in the Lower Townsite experience direct inundation.
- Non-residential buildings between Franklin Avenue and Gordon Avenue are affected by potential flood control structure failure and non-residential buildings in and around TaigaNova Industrial Park are affected by direct inundation at the 50-year flood. The number of non-residential buildings affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. It then further increases between the 100-year and 200-year floods.
- One school is affected by potential flood control structure failure at the 50-year ice jam flood. Keyano College and the RMWB Water Treatment plant are affected by direct inundation starting at the 100-year flood. The recreational facilities on McDonald Island and two government buildings are affected at the 200-year flood. No hospitals are affected by any of the ice jam flood inundation scenarios.
- Roads between Franklin Avenue and Gordon Avenue are affected by potential flood control structure failure and roads in TaigaNova Industrial Park are affected by direct inundation at the 50-year flood. The length of roads affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. Some of the major roads that would be affected include:
  - Selby Avenue, Clearwater Drive, Bulyea Avenue and large parts of Draper Road starting at the 50-year flood.
  - Most major roads in the Lower Townsite, including Franklin Avenue, starting at the 100-year flood.
  - Highway 63 / Memorial Drive for approximately 1.4 km north of the intersection with Confederation Way starting at the 100-year flood.

The main results of the flood risk assessment for the design flood scenario are summarized below:

- 47 residential buildings and 13 non-residential buildings are located in the floodway. A total of 437 residential and 184 non-residential buildings are located in the flood fringe. Of this flood fringe total, 100 residential and 116 non-residential buildings are located in the high-hazard flood fringe and 19 residential buildings are located in the protected flood fringe.
- A total estimated population of 119 is located in the floodway, and a total estimated population of 2,585 is in the flood fringe. Of this flood fringe total, 492 are in the high-hazard flood fringe and 288 are in the protected flood fringe.
- No government buildings or hospitals would be affected by the design flood. RMWB Wastewater Treatment Plant would be located in the high-hazard flood fringe.

Some of the major roads that would be affected are Selby Avenue, Clearwater Drive, Gordon Avenue Prairie Loop Boulevard, Franklin Avenue, Saline Creek Drive, large parts of Draper Road, and Highway 63 / Memorial Drive for approximately 1.2 km north of the intersection with Confederation Way.

Acknowledgements

This component of the Fort McMurray River Hazard Study was led by Dr. Wolf Ploeger and executed by Peter Thiede. Overall project management was provided by Dr. Wolf Ploeger.

The authors express their special thanks to Abdullah Mamun, Patricia Stevenson, and Jim Choles, Project Managers for Alberta Environment and Parks, who provided overall study management, background data, and technical guidance.

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1.0 INTRODUCTION

1.1 Study Objectives

Alberta Environment and Parks (AEP) retained Golder Associates Ltd. (Golder), in collaboration with SG1 Water Consulting Ltd. (SG1) and Hatch Ltd. (Hatch), in September 2016 to conduct the Fort McMurray River Hazard Study. The primary purpose of the study is to assess and identify river and flood hazards along the Athabasca River, the Clearwater River (including the Snye), and the Hangingstone River through Fort McMurray, AB in the Regional Municipality of Wood Buffalo (RMWB).

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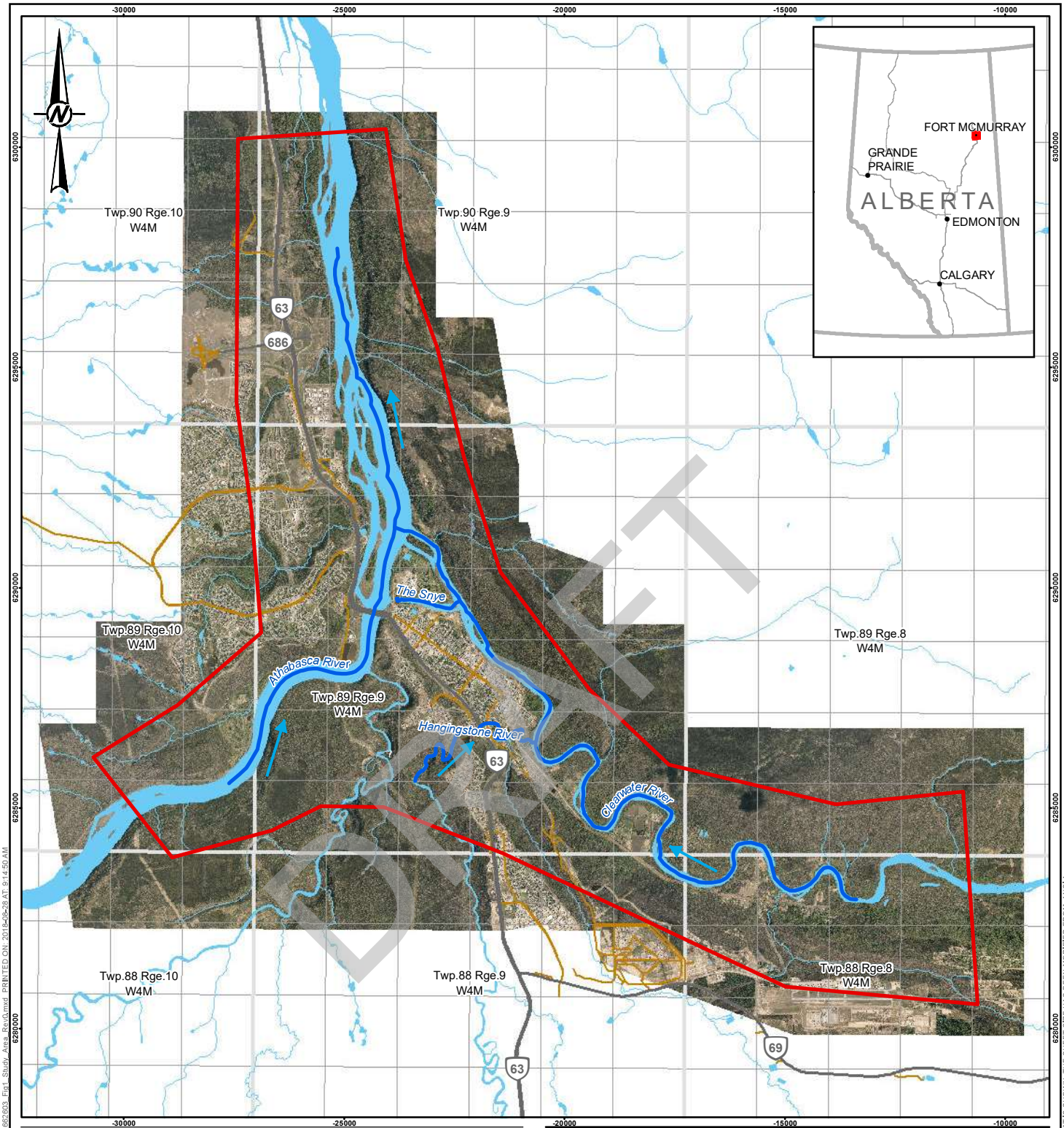
The study includes multiple components and deliverables. This report documents the methodology and results of the flood risk assessment and inventory component. The assessment compares open water flood inundation, ice jam flood inundation and design flood hazard mapping with collected and interpreted spatial data that contain an inventory of land parcels, buildings, major transportation infrastructure, and population. Flood risk statistics are calculated to quantify flood vulnerabilities for each of the 13 open water flood scenarios, each of the three ice jam flood scenarios and the design flood scenario. The statistics pertain to the number of affected parcels, buildings, and population, as well as the length of affected road infrastructure, including bridges.

1.2 Study Area and Reaches

The study area consists of an approximately 15 km stretch of the Athabasca River, a 20 km reach of the Clearwater River, and a 5 km reach of the Hangingstone River (see Figure 1). This domain also includes the Snye and all high-water connected sub-channels in the study area.

The study area includes one local authority: the Regional Municipality of Wood Buffalo (RMWB).



LEGEND

- STUDY REACH
- STUDY AREA
- FLOW DIRECTION
- WATERCOURSE
- WATERBODY

TRANSPORTATION FEATURES

- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- LOCAL ROAD

0 2 4

1:125,000 KILOMETRES

REFERENCE(S)

IMAGERY CAPTURED MAY 2017 BY GEODESY GROUP INC. FOR THE GOVERNMENT OF ALBERTA.
ALBERTA DIGITAL BASE DATA OBTAINED FROM ALTALIS LTD. © GOVERNMENT OF ALBERTA 2014. ALL RIGHTS RESERVED, CANVEC, GEOGRATIS, IHS ENERGY INC.
PROJECTION: 3TM 111° DATUM: NAD 83 CSRS

CLIENT

Alberta Government

PROJECT

FORT MCMURRAY RIVER HAZARD STUDY

TITLE

STUDY AREA

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-05-30
DESIGNED	WP
PREPARED	SK
REVIEWED	WP
APPROVED	DL

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	8000	0	1

2.0 AVAILABLE SPATIAL DATA

2.1 Data Sources

Readily available spatial data for the flood risk inventory included road data obtained from the National Road Network (published by Statistics Canada). The RMWB provided additional cadastral data and building footprints.

2.2 Cadastral Data

Cadastral data (i.e., boundaries of registered land parcels) was provided by the RMWB in April 2018.

2.3 Building Footprints

Two sets of building footprints were provided by the RMWB in April 2018. The most recent dataset was generated in 2016 and fully covers the study area. It does not classify the utilization of the buildings. The other dataset provided is limited to the lower townsite area. It does include classification information for the buildings (e.g., commercial, industrial, residential, secondary residential or multifamily). No information about the vintage of the data was provided but based on a comparison of the building footprints and Google Earth historical images, it is judged that this dataset represents a period around 2008.

Building locations and classifications were reviewed against available aerial imagery (see Section 3.2).

2.4 Roads and Railroads

Road data was obtained from the National Road Network. The data was current as of 2012. There are no railroads in the study area.

Roads were reviewed against available aerial imagery (see Section 3.2).

2.5 Critical Infrastructure Data

2.5.1 Data Sources

The RMWB provided classified building footprints for the lower townsite in April 2018, including critical infrastructure such as:

- government buildings
- hospitals
- schools

No information on critical infrastructure was provided for areas outside of the lower townsite, and the data for these areas was interpreted from aerial imagery (see Section 0). Government buildings, hospitals, and water treatment facilities included in the flood risk inventory are detailed in the following sections.

2.5.2 Government Buildings and Recreational Buildings

The flood risk inventory includes the Provincial Courts building on Franklin Avenue and the RMWB building also located on Franklin Avenue. This building also contains Provincial Government offices.

The inventory also includes the Suncor Community Leisure Centre, a multi-use recreation centre, and Shell Place, a multi-use sports facility, both which are located on McDonald Island. These facilities are classified as “other non-residential”, but are individually addressed in the flood risk assessment (see Section 4.3.4).

2.5.3 Hospitals

The flood risk inventory includes the Northern Lights Regional Health Care Centre.

2.5.4 Schools

The flood risk inventory includes three schools located in the study area and Keyano Collage.

2.5.5 Water Treatment Facilities

The flood risk inventory includes the RMWB Water Treatment Plant and the RMWB Wastewater Treatment Plant.

2.6 Census Data

Population statistics were obtained from Statistics Canada 2016 census dissemination blocks (Statistics Canada 2017). The census tallies the number of people whose usual place of residence is in the area. Dissemination blocks are the smallest geographic area for which population counts are disseminated in Canada.

3.0 INTERPRETED SPATIAL DATA

3.1 Interpretation Method

Additional data for roads, buildings, and other infrastructure was created by interpreting aerial imagery as required.

Cadastral data and building footprints were converted from polygons to points (centroids), large infrastructure features (e.g., hospitals) were reduced to single points, and census data was assigned to building points to allow for more efficient tallying of affected features.

The interpretation method is further described in the following sections.

3.2 Aerial Imagery Interpretation

Aerial imagery collected in May 2021 was available for the study area. The imagery has a 0.30 m Ground Sampling Distance (GSD) resolution.

The imagery was used to review, update, and add, where required, building, critical infrastructure and road locations as well as building classifications throughout the study area.

3.3 Cadastral Data

The polygon datasets representing the land parcels were converted to points (centroids) for further analysis.

3.4 Building Footprints

The polygon datasets representing the building footprints within the RMWB were converted to points (centroids) for further analysis.

3.5 Other Infrastructure Data

Large infrastructure features within the study area were often represented by multiple features in the building footprint dataset provided by the RMWB. All government buildings, hospital, and water treatment facilities in the study area as well as Keyano College, the Suncor Community Leisure Centre, and Shell Place were reduced to single points for the flood risk assessment.

Considering the size and importance of these features, manual checks were performed to determine whether they are affected by flood scenarios, instead of relying on a point-based overlay analysis (see Section 4.2).

3.6 Census Data

To more accurately estimate the population affected by each flood scenario, the population count for each dissemination block was evenly distributed between all residential buildings that fall into the block. Where multifamily buildings existed, it was assumed that their average number of residents would be ten times that of the single family homes within the block. Retirement homes were treated as multifamily buildings. Spot checks showed reasonable estimates of residents per building.

Distributing the population numbers to the residential buildings ensures that residents are only counted as affected when their building falls within the inundation extent.

4.0 FLOOD RISK ASSESSMENT AND INVENTORY

4.1 Approach

After the spatial data was compiled, flood-affected features were identified by overlaying flood polygon datasets with the parcel, building, or infrastructure datasets. Features falling within a flood extent were flagged as being affected or potentially affected by the flood scenario.

Flood statistics were then generated by tallying all affected features for the following categories:

- land parcels
- residential buildings
- non-residential buildings
- major transportation infrastructure
- population (based on residential buildings)

The following sections provide further information on the analysis methodology and the results of the assessment.

4.2 Method

Using the inventory datasets developed and described in Sections 2 and 3, flood statistics were generated for the various flood scenarios and flood scenarios considered in this study. The method to generate these flood statistics consisted of the following four steps:

- Flood polygons for the 2-, 5-, 10-, 20-, 35-, 50-, 75-, 100-, 200-, 350-, 500-, 750-, and 1,000-year open water flood scenarios, the 50-, 100-, and 200-year ice jam flood scenarios and the design flood scenario (floodway and flood fringe) were generated as part of open water flood inundation, ice jam flood inundation and flood hazard mapping work undertaken for this study (Golder 2022a and 2022b).
- For each mapped flood scenario, the flood polygons were compared to the inventory dataset in GIS. Land parcels, buildings, and infrastructure were classified as being “affected” if they were located within a mapped flood extent (centroid for parcels). Road lengths affected by a flooding were also calculated.

- The estimated population affected for each flood scenario was calculated by tallying the number of residents assigned to each affected residential building (see Section 3.6).
- The flood statistics for each category were summarized in a series of tables.

A manual check using aerial imagery was performed for non-residential buildings classified as government buildings, hospital, and water treatment facilities, as well as for Keyano College, Suncor Community Leisure Centre and Shell Place. As these large facilities are represented by single points in the flood risk inventory dataset, the result of the GIS-based overlay analysis may show the structure as not affected, even though some of the actual building footprint is located within the flood extent. The flood statistics were changed accordingly, to include buildings which footprints are affected.

Flood statistics were calculated separately for two areas of flooding based on flood inundation mapping (open water (Golder, 2018) and ice jam (Hatch 2022), and for the flood hazard zones based on the governing flood hazard mapping (Golder 2023), as summarized below:

Flood Inundation Mapping (Open Water and Ice Jam):

- Direct flood inundation areas: Areas expected to be inundated for various flood scenarios and which have a direct overland or other hydraulic connection to main river channels.
- Flood control structure failure inundation areas: Areas of residual risk behind flood control structures, which are protected for various flood scenarios but could be flooded if the structures fail or do not perform as expected.

Flood Hazard Mapping:

Both the open water and ice jam flood events were considered in the development of the governing flood hazard maps. The highest water levels, and therefore the highest river hazard, for all areas on the Athabasca and Clearwater Rivers are governed by ice jam flooding. On the Hangingstone River, open water flood levels exceed the ice jam water levels upstream of Heritage Park Bridge and are therefore governing. Ice jam flooding is governing for the Hangingstone River below Heritage Park Drive (Golder 2023).

- Floodway: The floodway typically represents the area of highest hazard for the 100-year design flood, where flows are deepest, fastest, and most destructive, but it can also be based on previously-defined floodways. The floodway always includes the main river channel and typically includes portions of adjacent floodplain.
- Flood Fringe: The flood fringe is the portion of the 100-year design flood area outside the floodway. The flood fringe can be divided into three sub-zones, with the following characteristics:
  - Flood Fringe: Areas of shallower or slower-moving water outside of the floodway.
  - High Hazard Flood Fringe: Areas of deeper or faster-moving water outside of the floodway.
  - Protected Flood Fringe: Areas of residual risk behind flood control structures, which are protected for the 100-year design flood but could be flooded if the structures fail or do not perform as expected.

Unless otherwise noted, results for the design flood scenario assessment in Section 4.4 report statistics for each of the three flood fringe sub-zones separately.

Only one local authority, the RMWB, is located in the study area. All results are therefore reported as the aggregate total.

4.3 Open Water and Ice Jam Flood Inundation Scenarios

4.3.1 General

Flood inundation extents were delineated for 13 open water and 3 ice jam flood scenarios (Golder 2018 and Hatch 2022). Flood statistics for direct and flood control structure failure inundation areas were calculated for each mapped flood scenario, and the results are presented in the following sections.

4.3.2 Land Parcels

A summary of land parcels affected by the open water and ice jam floods is presented in Table 1, including total number, as well as a breakdown of parcels affected by direct inundation and flood control structure failure. Figure 2 shows the parcels affected by direct inundation and flood control structure failure per flood scenario.

Table 1: Affected Land Parcels – Open Water and Ice Jam Flood Inundation Scenarios

Flood Scenario	Direct Inundation	Flood Control Structure Failure	Total
2-Year Open Water	10	0	**10**
5-Year Open Water	13	0	**13**
10-Year Open Water	23	0	**23**
20-Year Open Water	37	0	**37**
35-Year Open Water	48	0	**48**
50-Year Open Water	55	0	**55**
75-Year Open Water	61	0	**61**
100-Year Open Water	68	0	**68**
200-Year Open Water	108	1	**109**
350-Year Open Water	124	2	**126**
500-Year Open Water	146	2	**148**
750-Year Open Water	187	3	**190**
1,000-Year Open Water	217	3	**220**
50-Year Ice Jam	431	158	**589**
100-Year Ice Jam	1,149	29 (1)	**1,178**
200-Year Ice Jam	1,571	0 (1)	**1,571**

Note 1) For higher return periods, flood control structures are being overtopped and affected parcels are then counted under "Direct Inundation".

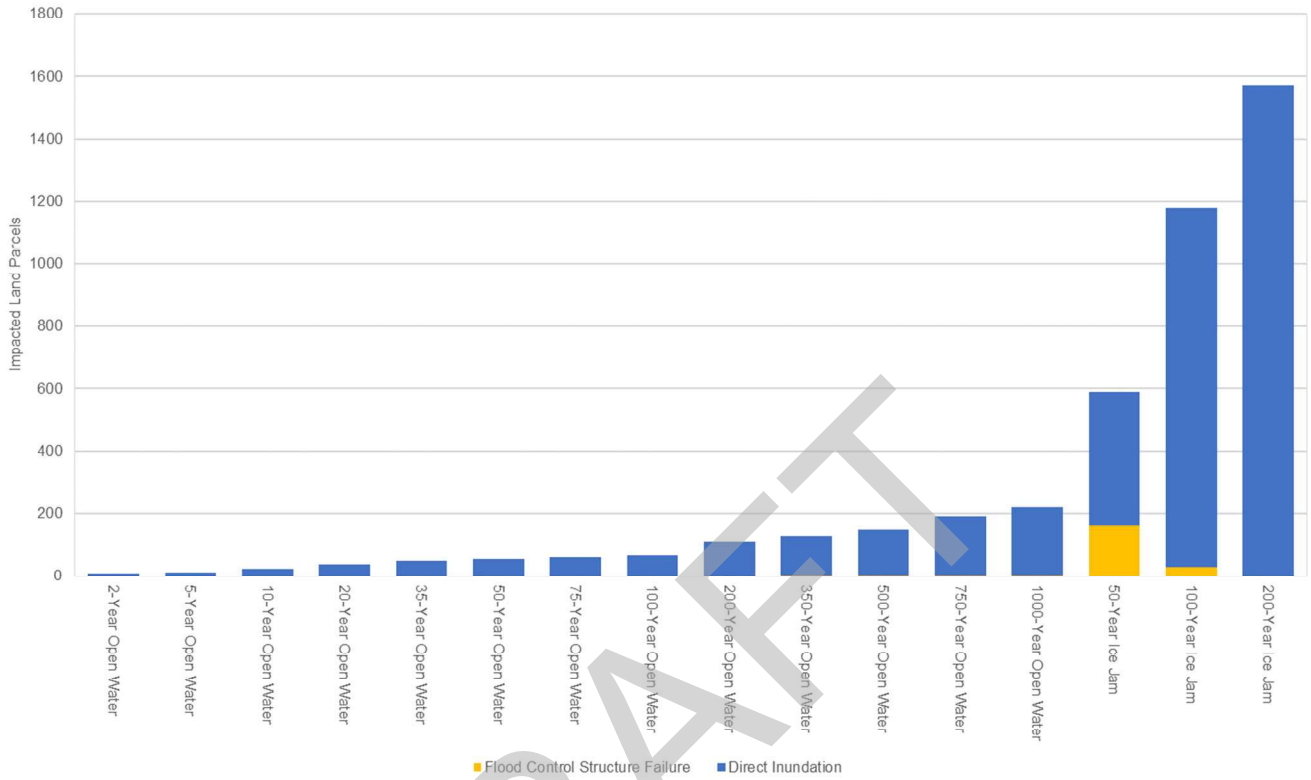


Figure 2: Affected Land Parcels for the Open Water and Ice Jam Flood Inundation Scenarios

For the open water flood scenarios, the number of parcels affected by direct inundation slowly increases between the 2-year and 100-year floods. A significant increase occurs between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated. It then further increases slowly up to the 1000-year flood. The number of parcels affected by potential flood control structure failure remains very low for all open water flood scenarios.

For the ice jam flood scenarios, parcels between Franklin Avenue and Gordon Avenue in the Lower Townsite are affected by potential flood control structure failure at the 50-year flood. Parcels in and around TaigaNova Industrial Park, around Selby Avenue in the Lower Townsite and in Waterways are affected by direct inundation at the 50-year flood. The number of parcels affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. It then further increases between the 100-year and 200-year floods. The number of parcels affected by potential flood control structure failure decreases between the 50-year and 100-year floods and reaches zero at the 200-year flood as flood control structures start being overtopped and these parcels are then counted as directly inundated.

For the 100-year open water flood, 68 land parcels would be directly inundated and none would be potentially inundated in the case of flood control structure failure. In comparison, 217 land parcels would be directly inundated for the 1,000-year open water flood. For the 100-year ice jam flood, 1,149 land parcels would be directly inundated and 29 would be potentially inundated in the case of flood control structure failure.

4.3.3 Residential Buildings

A summary of residential buildings affected by the open water and ice jam floods is presented in Table 2, including total number, as well as a breakdown of residential buildings affected by direct inundation and flood control structure failure. Figure 3 shows the residential and non-residential buildings affected by direct inundation and flood control structure failure per open water flood scenario and Figure 4 shows the residential and non-residential buildings affected by direct inundation and flood control structure failure per ice jam flood scenario (see Section 4.3.4 for non-residential buildings).

Table 2: Affected Residential Buildings – Open Water and Ice Jam Flood Inundation Scenarios

Flood Scenario	2-Year Open Water	5-Year Open Water	10-Year Open Water	20-Year Open Water	35-Year Open Water	50-Year Open Water	75-Year Open Water	100-Year Open Water	200-Year Open Water	350-Year Open Water	500-Year Open Water	750-Year Open Water	1,000-Year Open Water	50-Year Ice Jam	100-Year Ice Jam	200-Year Ice Jam
Total	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**5**	**9**	**25**	**41**	**123**	**483**	**747**
Single Family	0	0	0	0	1	1	1	1	2	2	5	19	35	117	426	645
Multifamily	0	0	0	0	0	0	0	0	0	3	4	6	6	5	56	99
Retirement Home	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
Direct Inundation	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**5**	**9**	**25**	**41**	**108**	**464**	**747**
Single Family	0	0	0	0	1	1	1	1	2	2	5	19	35	103	407	645
Multifamily	0	0	0	0	0	0	0	0	0	3	4	6	6	5	56	99
Retirement Home	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
Flood Control Structure Failure	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15**	**19**	**0**
Single Family	0	0	0	0	0	0	0	0	0	0	0	0	0	14	19	0
Multifamily	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retirement Home	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

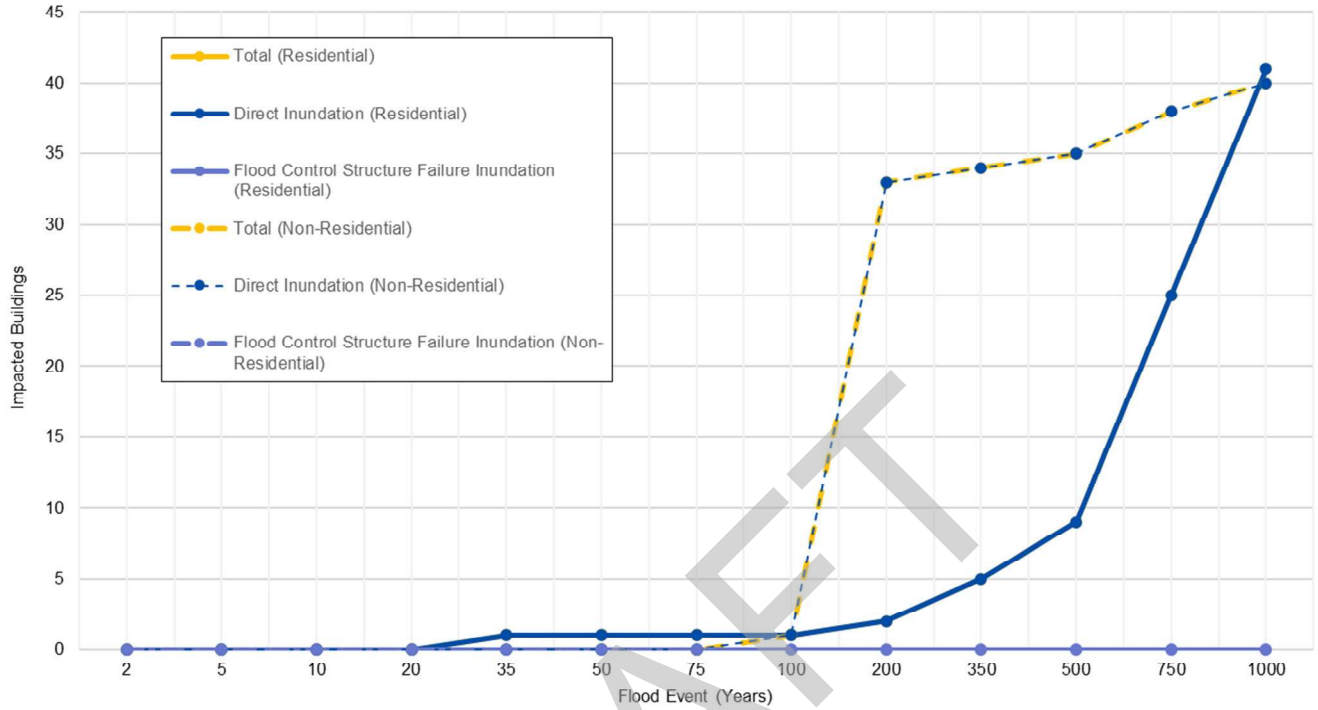


Figure 3: Affected Buildings - Open Water Flood Inundation Scenarios

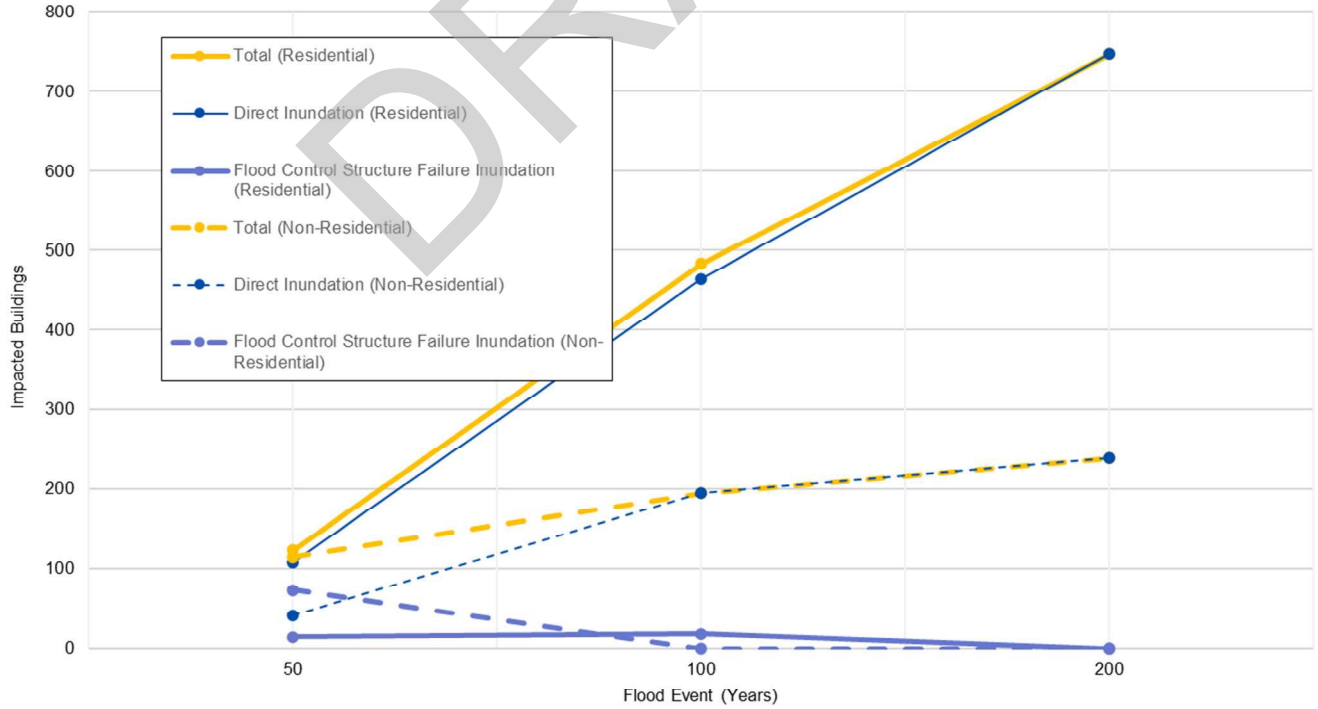


Figure 4: Affected Buildings – Ice Jam Flood Inundation Scenarios

For the open water flood scenarios, the number of residential buildings affected by direct inundation remains zero until the 20-year flood. It then slowly increases between the 2-year and 1000-year floods. The number of residential buildings affected by potential flood control structure failure remains zero for all open water flood scenarios.

For the ice jam flood scenarios, residential buildings around Selby Avenue in the Lower Townsite and in Waterways are affected by direct inundation at the 50-year flood. The number of residential buildings affected by direct inundation then increases steadily between the 50-year and 200-year floods, as additional areas in the Lower Townsite experience direct inundation. The number of residential buildings affected by potential flood control structure failure remains low at the 50-year and 100-year floods and reaches zero at the 200-year flood.

For the 100-year open water flood, 1 residential building would be directly inundated, and none would be potentially inundated in the case of flood control structure failure. In comparison, 41 residential buildings would be directly inundated for the 1,000-year open water flood. For the 100-year ice jam flood, 464 residential buildings would be directly inundated and 19 would be potentially inundated in the case of flood control structure failure.

4.3.4 Non-Residential Buildings

A summary of non-residential buildings affected by the open water and ice jam floods is presented in Table 3, including total number, as well as a breakdown of non-residential buildings affected by direct inundation and flood control structure failure. Figure 3 shows the residential and non-residential buildings affected by direct inundation and flood control structure failure per open water flood scenario and Figure 4 shows the residential and non-residential buildings affected by direct inundation and flood control structure failure per ice jam flood scenario.

For the open water flood scenarios, the number of non-residential buildings affected by direct inundation remains zero until the 75-year flood and very low at the 100-year flood. A significant increase occurs between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated. It then further increases slowly up to the 1000-year flood. The number of non-residential buildings affected by potential flood control structure failure remains zero for all open water flood scenarios.

For the ice jam flood scenarios, non-residential buildings between Franklin Avenue and Gordon Avenue in the Lower Townsite are affected by potential flood control structure failure at the 50-year flood. Non-residential buildings in and around TaigaNova Industrial Park are affected by direct inundation at the 50-year flood. The number of non-residential buildings affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. It then further increases between the 100-year and 200-year floods. The number of non-residential buildings affected by potential flood control structure failure reaches zero at the 100-year flood.

For the 100-year open water flood, 1 non-residential building would be directly inundated, and none would be potentially inundated in the case of flood control structure failure. In comparison, 40 residential buildings would be directly inundated by the 1,000-year open-water flood. For the 100-year ice jam flood, 195 non-residential buildings would be directly inundated, and none would be potentially inundated in the case of flood control structure failure.

No critical, non-residential buildings (i.e., government buildings, hospitals, schools, or water treatment facilities) are affected up to the 100-year open water flood. Only one school was affected by potential flood control structure failure at the 50-year ice jam flood. The following sections provide additional information on some of the other more critical non-residential building infrastructure.

Table 3: Affected Non-Residential Buildings – Open Water and Ice Jam Flood Inundation Scenarios

Flood Scenario	2-Year Open Water	5-Year Open Water	10-Year Open Water	20-Year Open Water	35-Year Open Water	50-Year Open Water	75-Year Open Water	100-Year Open Water	200-Year Open Water	350-Year Open Water	500-Year Open Water	750-Year Open Water	1,000-Year Open Water	50-Year Ice Jam	100-Year Ice Jam	200-Year Ice Jam
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**33**	**34**	**35**	**38**	**40**	**115**	**195**	**239**
Commercial	0	0	0	0	0	0	0	0	12	13	14	16	17	101	146	180
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0	7	12	14
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School	0	0	0	0	0	0	0	0	1	1	1	2	2	1	3	4
Water Treatment Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Other Non-Residential	0	0	0	0	0	0	0	1	20	20	20	20	21	6	33	38
Direct Inundation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**33**	**34**	**35**	**38**	**40**	**42**	**195**	**239**
Commercial	0	0	0	0	0	0	0	0	12	13	14	16	17	33	146	180
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0	7	12	14
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School	0	0	0	0	0	0	0	0	1	1	1	2	2	0	3	4
Water Treatment Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Other Non-Residential	0	0	0	0	0	0	0	1	20	20	20	20	21	2	33	38
Flood Control Structure Failure	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**73**	**0**	**0**
Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0	68	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Water Treatment Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Non-Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0

Government Buildings and Recreational Buildings

No government buildings would be affected by any of the open water flood scenarios. The Provincial Courts building on Franklin Avenue and the RMWB building would be affected by direct inundation at the 200-year ice jam flood.

The Suncor Community Leisure Centre and Shell Place, both which are located on McDonald Island, would be affected by direct inundation starting at the 100-year ice jam flood.

Hospitals

No hospitals in the study area would be affected by any of the open water or ice jam flood scenarios.

Schools

Keyano College would be affected by direct inundation starting at the 200-year open water flood and starting at the 100-year ice jam flood.

Water Treatment Facilities

No water treatment facilities in the study area would be affected by any of the open water flood scenarios.

The RMWB Water Treatment Plant would be cut off by flooding starting at the 50-year ice jam flood and be directly inundated starting at the 100-year ice jam flood.

Roads

A summary of roads affected by the open water and ice jam floods is presented in Table 4, including total length, as well as a breakdown of length of roads affected by direct inundation and flood control structure failure. Figure 5 shows the length of roads affected by direct inundation and flood control structure failure per flood scenario.

Table 4: Lengths of Affected Roads – Open Water and Ice Jam Flood Inundation Scenarios

Flood Scenario	Length (km)		
	Direct Inundation	Flood Control Structure Failure	Total
2-Year Open Water	0.0	0.0	**0.0**
5-Year Open Water	0.0	0.0	**0.0**
10-Year Open Water	0.0	0.0	**0.0**
20-Year Open Water	0.5	0.0	**0.5**
35-Year Open Water	1.1	0.0	**1.1**
50-Year Open Water	1.4	0.0	**1.4**
75-Year Open Water	2.0	0.0	**2.0**
100-Year Open Water	2.1	0.0	**2.1**
200-Year Open Water	6.8	0.0	**6.8**
350-Year Open Water	7.9	0.0	**7.9**
500-Year Open Water	8.9	0.0	**8.9**
750-Year Open Water	10.1	0.1	**10.2**
1,000-Year Open Water	11.8	0.1	**11.8**
50-Year Ice Jam	17.0	12.5	**29.5**
100-Year Ice Jam	47.7	0.1 (1)	**47.8**
200-Year Ice Jam	62.4	0.0 (1)	**62.4**

Notes: 1) For higher return periods, flood control structures are being overtopped and the lengths of affected roads are then counted under "Direct Inundation".

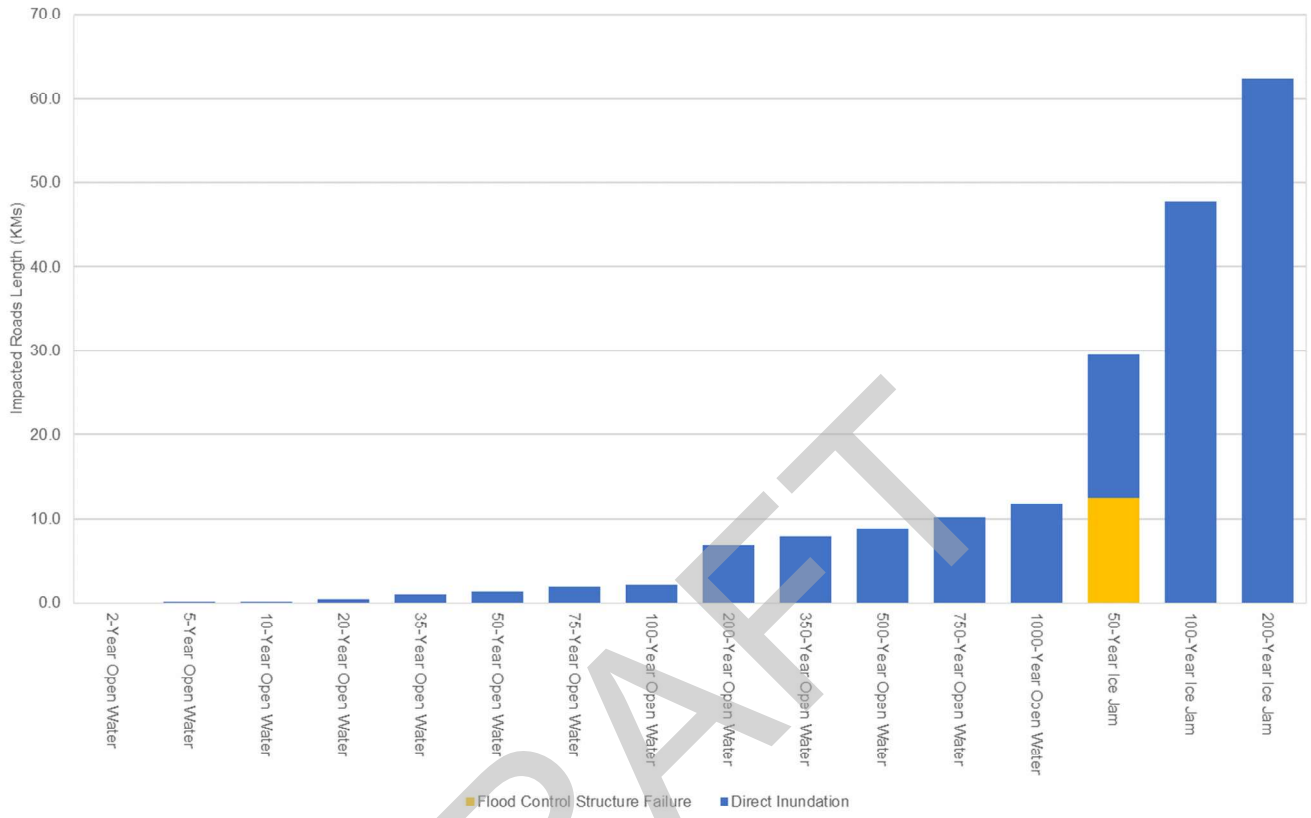


Figure 5: Lengths of Affected Roads – Open Water and Ice Jam Flood Inundation Scenarios

For the open water flood scenarios, the length of roads affected by direct inundation remains zero until the 10-year flood. It increases slowly between the 20-year and 100-year floods. A significant increase occurs between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated. It then further increases slowly up to the 1000-year flood. The length of roads affected by potential flood control structure failure remains very low for all open water flood scenarios.

For the ice jam flood scenarios, roads between Franklin Avenue and Gordon Avenue in the Lower Townsite are affected by potential flood control structure failure at the 50-year flood. Roads in TaigaNova Industrial Park, roads around Selby Avenue in the Lower Townsite and Draper Road are affected by direct inundation at the 50-year flood. The length of roads affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. It then further increases between the 100-year and 200-year floods.

The following list provides details on direct inundation impacts on major roads for the open water flood inundation scenarios:

- Franklin Avenue between Prairie Loop Boulevard and Queen Street starting at the 350-year flood.
- King Street southwest of the intersection with Franklin Avenue starting at the 350-year flood.
- Prairie Loop Boulevard at the intersection with Mills Avenue starting at the 500-year flood.

The following list provides details on direct inundation impacts on major roads for the ice jam flood inundation scenarios:

- Bulyea Avenue and large parts of Draper Road starting at the 50-year flood.
- Selby Avenue, Clearwater Drive and Hardin Street between Clearwater Drive and Fraser Avenue starting at the 50-year flood.
- Prairie Loop Boulevard, Gordon Avenue, King Street, Hospital Street between Gordon Avenue and Franklin Avenue, Franklin Avenue between Prairie Loop Boulevard and Father Mercredi Street and Morrison Street between Selby Avenue and Fraser Avenue starting at the 100-year flood.
- Highway 63 / Memorial Drive for approximately 1.4 km north of the intersection with Confederation Way starting at the 100-year flood.
- Tolen Drive, all of Franklin Avenue, Hardin Street between Franklin Avenue and Highway 63 / Memorial Drive and Morrison Street between Franklin Avenue and Highway 63 / Memorial Drive starting at the 200-year flood.
- Highway 63 / Memorial Drive north of the intersection with Thickwood Boulevard starting at the 200-year flood.

At the 100-year open water flood, 2.1 km of roads would be directly inundated, and none would be potentially inundated in the case of flood control structure failure. In comparison, 11.8 km of roads would be directly inundated by the 1,000-year open water flood. For the 100-year ice jam flood, 47.7 km of roads would be directly inundated, and 0.1 km would be potentially inundated in the case of flood control structure failure.

Bridges and Culverts

A summary of bridge and culvert clearances during floods is presented in Tables 5 to 8.

Table 5: Bridge Clearances Athabasca River – Open Water Flood Inundation Scenarios

Bridge Station (m)	Name	Minimum Low Chord (m)	2-Year		5-Year		10-Year		20-Year		35-Year		50-Year		75-Year		100-Year		200-Year		350-Year		500-Year		750-Year		1,000-Year	
			Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)
10675	Three Athabasca River Bridges	253.0	242.5	10.5	243.0	10.0	243.5	9.5	243.8	9.2	244.1	8.9	244.3	8.7	244.5	8.5	244.6	8.4	245.0	8.0	245.3	7.7	245.5	7.5	245.7	7.3	245.9	7.1

Note: Clearances are the elevation differences between bridge low chord and simulated water levels. A negative value indicates the water depth above the low chord.

Table 6: Bridge Clearances Athabasca River – Ice Jam Flood Inundation Scenarios

Bridge Station (m)	Name	Minimum Low Chord (m)	50-Year		100-Year		200-Year	
			Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)
10675	Three Athabasca River Bridges	253.0	248.6	4.4	249.6	3.4	250.6	2.4

Note: Clearances are the elevation differences between bridge low chord and simulated water levels. A negative value indicates the water depth above the low chord.

Table 7: Bridge Clearances Hangingstone River – Open Water Flood Inundation Scenarios

Bridge Station (m)	Name	Minimum Low Chord (m)	2-Year		5-Year		10-Year		20-Year		35-Year		50-Year		75-Year		100-Year		200-Year		350-Year		500-Year		750-Year		1,000-Year	
			Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)
2,459	Memorial Drive Bridge - Southbound	253.4	248.4	5.1	248.9	4.5	249.2	4.2	249.6	3.8	249.9	3.5	250.1	3.3	250.3	3.1	250.4	3.0	250.9	2.5	251.2	2.2	251.4	2.0	251.7	1.7	251.9	1.5
2,435	Memorial Drive Bridge - Northbound	253.8	248.3	5.5	248.8	5.0	249.2	4.6	249.5	4.3	249.8	4.0	250.0	3.8	250.2	3.6	250.3	3.5	250.8	3.0	251.1	2.7	251.3	2.5	251.5	2.3	251.7	2.1
2,284	Tolen Drive Bridge	250.6	247.9	2.7	248.3	2.3	248.6	2.0	248.9	1.7	249.1	1.5	249.2	1.4	249.3	1.3	249.4	1.2	249.7	0.9	249.9	0.7	250.0	0.6	250.2	0.4	250.4	0.2
2,227	Heritage Park Footbridge	250.3	247.7	2.6	248.1	2.2	248.4	1.9	248.7	1.6	248.9	1.4	249.0	1.3	249.1	1.2	249.2	1.2	249.3	1.0	249.6	0.7	249.9	0.4	250.3	0.0	250.5	-0.2
1,791	Prairie Loop Boulevard Bridge	255.7	246.3	9.4	246.9	8.8	247.2	8.5	247.5	8.2	247.7	8.0	247.9	7.8	248.1	7.6	248.2	7.5	248.5	7.2	248.8	6.9	248.9	6.8	249.2	6.5	249.3	6.4
1,399	Ptarmigan Court Footbridge	247.0	244.4	2.6	244.8	2.2	245.1	1.9	245.4	1.6	245.6	1.4	245.8	1.2	246.0	1.0	246.1	0.9	246.5	0.6	246.7	0.3	247.0	0.1	247.2	-0.2	247.4	-0.4
1,181	Saline Creek Footbridge	249.0	243.9	5.2	244.4	4.7	244.7	4.3	245.0	4.0	245.3	3.7	245.4	3.6	245.6	3.4	245.7	3.3	246.1	2.9	246.3	2.7	246.5	2.5	246.7	2.3	246.9	2.1
1,149	Saline Creek Drive Bridge	247.5	243.8	3.7	244.3	3.2	244.6	2.9	244.9	2.6	245.2	2.3	245.3	2.2	245.5	2.0	245.6	1.9	245.9	1.6	246.2	1.3	246.4	1.1	246.6	0.9	246.7	0.8

Note: Clearances are the elevation differences between bridge low chord and simulated water levels. A negative value indicates the water depth above the low chord.

Table 8: Bridge Clearances Hangingstone River – Ice Jam Flood Inundation Scenarios

Bridge Station (m)	Name	Minimum Low Chord (m)	50-Year		100-Year		200-Year	
			Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)	Water Level (m)	Clearance (m)
2,459	Memorial Drive Bridge - Southbound	253.4	248.7	4.7	249.5	3.9	250.5	3.0
2,435	Memorial Drive Bridge - Northbound	253.8	248.7	5.1	249.5	4.3	250.5	3.4
2,284	Tolen Drive Bridge	250.6	248.6	2.0	249.5	1.1	250.4	0.2
2,227	Heritage Park Footbridge	250.3	248.5	1.8	249.5	0.8	250.4	-0.1
1,791	Prairie Loop Boulevard Bridge	255.7	248.5	7.3	249.5	6.3	250.4	5.3
1,399	Ptarmigan Court Footbridge	247.0	248.4	-1.4	249.5	-2.4	250.4	-3.4
1,181	Saline Creek Footbridge	249.0	248.4	0.6	249.5	-0.4	250.4	-1.4
1,149	Saline Creek Drive Bridge	247.5	248.4	-0.9	249.5	-1.9	250.4	-2.9

Note: Clearances are the elevation differences between bridge low chord and simulated water levels. A negative value indicates the water depth above the low chord.

4.3.5 Population

Each residential building in the study area (including single family, multifamily, and retirement homes) was assigned a number of residents based on the population count of the census block they are located in (see Section 3.6). The population affected by each flood scenario was estimated based on a tally of the residents of all affected residential buildings.

A summary of the population affected by the open water and ice jam floods is presented in Table 9, including total number, as well as a breakdown of the population affected by direct inundation and flood control structure failure. Figure 6 shows the population affected by direct inundation and flood control structure failure per flood scenario.

Table 9: Affected Population – Open Water and Ice Jam Flood Inundation Scenarios

Flood Scenario	Direct Inundation	Flood Control Structure Failure	Total
2-Year Open Water	0	0	**0**
5-Year Open Water	0	0	**0**
10-Year Open Water	0	0	**0**
20-Year Open Water	0	0	**0**
35-Year Open Water	3	0	**3**
50-Year Open Water	3	0	**3**
75-Year Open Water	3	0	**3**
100-Year Open Water	3	0	**3**
200-Year Open Water	7	0	**7**
350-Year Open Water	29	0	**29**
500-Year Open Water	46	0	**46**
750-Year Open Water	108	0	**108**
1,000-Year Open Water	166	0	**166**
50-Year Ice Jam	438	110	**548**
100-Year Ice Jam	2,414	288 (1)	**2,701**
200-Year Ice Jam	4,896	0 (1)	**4,896**

Note 1) For higher return periods, flood control structures are being overtopped and affected population is then counted under "Direct Inundation".

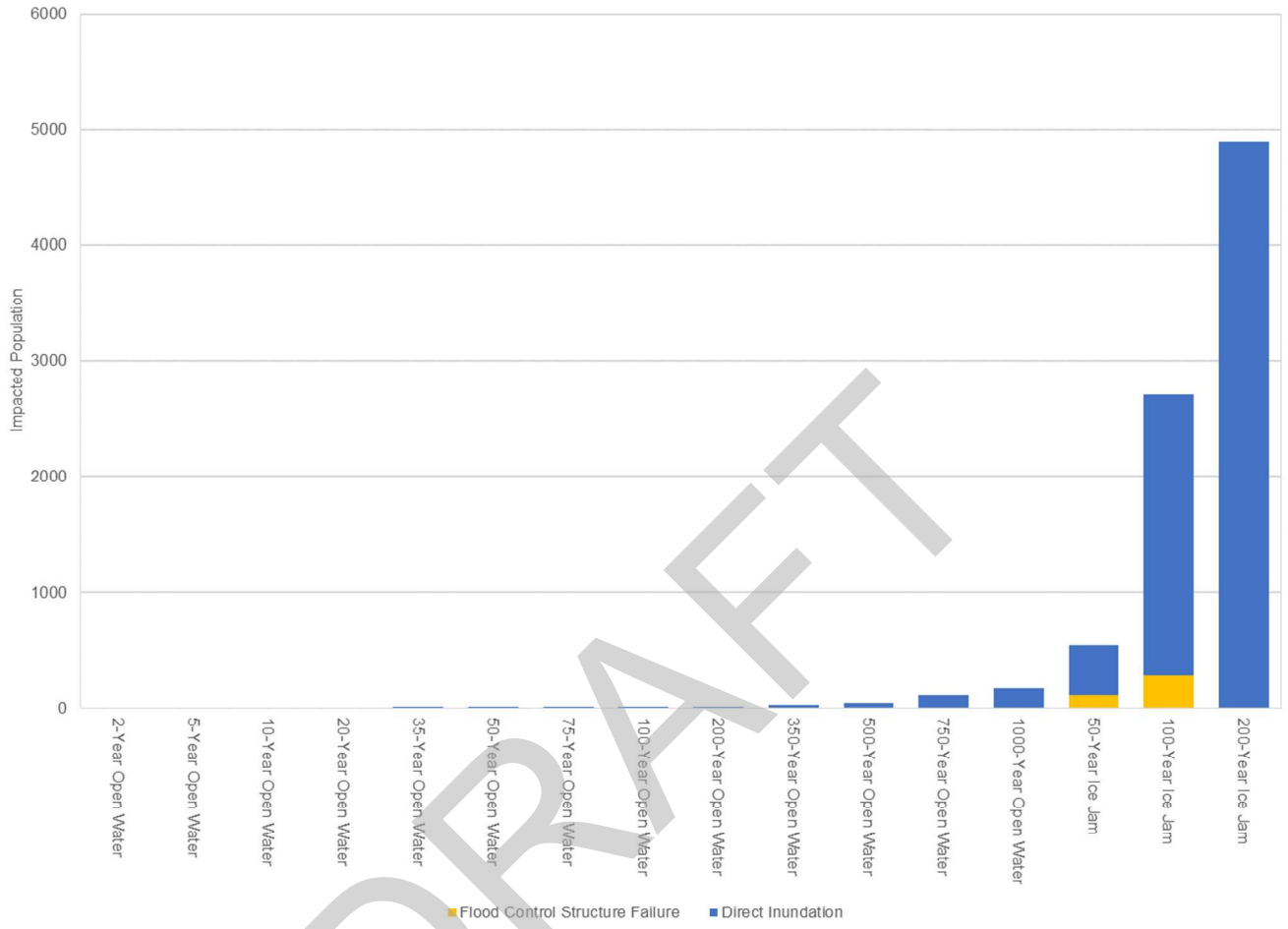


Figure 6: Affected Population – Open Water and Ice Jam Flood Inundation Scenarios

For the open water flood scenarios, the population affected by direct inundation remains zero until the 20-year flood. It then slowly increases between the 2-year and 1000-year floods. The population affected by potential flood control structure failure remains zero for all open water flood scenarios.

For the ice jam flood scenarios, population residing around Selby Avenue in the Lower Townsite and in Waterways would be affected by direct inundation at the 50-year flood. The population affected by direct inundation then increases steadily between the 50-year and 200-year floods, as additional areas in the Lower Townsite experience direct inundation. The population affected by potential flood control structure failure remains low at the 50-year and 100-year floods and reaches zero at the 200-year flood.

For the 100-year open water flood, a population of 3 would be affected by direct inundation and none would be potentially affected in the case of flood control structure failure. In comparison, a population of 166 would be affected by direction inundation for the 1,000-year flood. For the 100-year ice jam flood, a population of 2,414 would be affected by direct inundation and a population of 288 would be potentially affected in the case of flood control structure failure.

4.4 Design Flood Scenario

4.4.1 General

Flood statistics were generated for the design flood scenario (Golder 2022b), and the results are presented in the following sections.

4.4.2 Land Parcels

A summary of affected land parcels for the design flood scenario is presented in Table 10, including total number, as well as a breakdown of parcels located in the floodway, flood fringe (neither high hazard nor protected flood fringe), high hazard flood fringe, and protected flood fringe.

Table 10: Affected Land Parcels – Design Flood Scenario

Floodway	Flood Fringe	High Hazard Flood Fringe	Protected Flood Fringe	Total
257	511	387	29	**1,211**

For the design flood, 257 land parcels would be located in the floodway, 511 in the flood fringe, 387 in the high hazard flood fringe, and 29 in the protected flood fringe zone.

4.4.3 Residential Buildings

A summary of affected residential buildings for the design flood scenario is presented in Table 11, including total numbers, as well as a breakdown of residential buildings located in the floodway, flood fringe (neither high hazard nor protected flood fringe), high hazard flood fringe, and protected flood fringe.

Table 11: Affected Residential Buildings – Design Flood Scenario

Residential Category	Floodway	Flood Fringe	High Hazard Flood Fringe	Protected Flood Fringe
Multifamily	0	46	10	19
Single Family	47	272	89	0
Retirement Home	0	0	1	0
Total	**47**	**318**	**100**	**19**

For the design flood, 47 residential buildings would be located in the floodway, 318 in the flood fringe, 100 in the high hazard flood fringe, and 19 in the protected flood fringe.

4.4.4 Non-Residential Buildings

A summary of affected non-residential buildings for the design flood scenario is presented in Table 12, including total numbers, as well as a breakdown of non-residential buildings located in the floodway, flood fringe (neither high hazard nor protected flood fringe), high hazard flood fringe, and protected flood fringe.

Table 12: Affected Non-Residential Buildings – Design Flood Scenario

Non-Residential Category	Floodway	Flood Fringe	High Hazard Flood Fringe	Protected Flood Fringe
Commercial	6	43	98	0
Industrial	5	1	6	0
Government Building	0	0	0	0
Hospital	0	0	0	0
School	0	3	1	0
Water Treatment Facility	0	0	1	0
Other Non-Residential	2	21	10	0
Total	**13**	**67**	**116**	**0**

For the design flood, 13 non-residential buildings would be located in the floodway, 66 in the flood fringe, 116 in the high-hazard flood fringe, and none in the protected flood fringe.
The following sections provide additional information on some of the other more critical non-residential building infrastructure.

Government Buildings and Recreational Buildings

No government buildings would be affected by the design flood. Suncor Community Leisure Centre would be located in the flood fringe and Shell Place would be located in the high hazard flood fringe.

Hospitals

None of the hospitals in the study area would be affected by the design flood.

Schools

Four schools would be affected by the design flood, with three (including Keyano College) located in the flood fringe and one located in the high hazard flood fringe.

Water Treatment Facilities

The RMWB Wastewater Treatment Plant would be located in the high hazard flood fringe.

4.4.5 Major Transportation Infrastructure

Roads

A summary of affected roads for the design flood scenario is presented in Table 13, including total lengths, as well as a breakdown of affected roads located in the floodway, flood fringe (neither high hazard nor protected flood fringe), high hazard flood fringe, and protected flood fringe.

Table 13: Lengths of Affected Roads – Design Flood Scenario

Length (km)				
Floodway	Flood Fringe	High Hazard Flood Fringe	Protected Flood Fringe	Total
10.7	14.6	22.6	0.1	**48.1**

Details on direct inundation impacts on major roads for the design flood are provided below:

- Selby Avenue, Clearwater Drive, Gordon Avenue and Prairie Loop Boulevard would be located in the floodway.
- Franklin Avenue between Prairie Loop Boulevard and McLeod Street would be located in the high hazard flood fringe. Franklin Avenue between McLeod Street and Father Mercredi Street would be located in the flood fringe.
- Hardin Street between Fraser Avenue and Selby Avenue, Hospital Street between Franklin Avenue and Gordon Avenue and King Street northeast of the intersection with Franklin Avenue would be located in the high hazard flood fringe
- Saline Creek Drive and large parts of Draper Road would be located in the floodway.
- Highway 63 / Memorial Drive for approximately 1.2 km north of the intersection with Confederation Way would be located in the high hazard floodway.

For the design flood, about 11 km of roads would be located in the floodway, about 15 km in the flood fringe, 23 km in the high hazard flood fringe, and 0.1 km would be located in the protected flood fringe.

Bridges and Culverts

A summary of bridge clearances for the design flood scenario is presented in Table 14.

Table 14: Bridge Clearances – Design Flood Scenario

River	Bridge Station (m)	Name	Minimum Low Chord (m)	Design Flood Level (m)	Clearance (m)	Governing Scenario
Athabasca River	10675	Three Athabasca River Bridges	253.0	249.6	3.4	Ice Jam
Hangingstone River	2459	Memorial Drive Bridge - Southbound	253.4	250.4	3.0	Open Water
Hangingstone River	2435	Memorial Drive Bridge - Northbound	253.8	250.3	3.5	Open Water
Hangingstone River	2284	Tolen Drive Bridge	250.6	249.4	1.2	Open Water
Hangingstone River	2227	Heritage Park Footbridge	250.3	249.5	0.8	Ice Jam
Hangingstone River	1791	Prairie Loop Boulevard Bridge	255.7	249.5	6.3	Ice Jam
Hangingstone River	1399	Ptarmigan Court Footbridge	247.0	249.5	-2.4	Ice Jam
Hangingstone River	1181	Saline Creek Footbridge	249.0	249.5	-0.4	Ice Jam
Hangingstone River	1149	Saline Creek Drive Bridge	247.5	249.5	-1.9	Ice Jam

Note: The clearances for the design flood scenario are the elevation differences between bridge low chord or culvert road surface elevations and simulated water levels. A negative value indicates the water depth above the low chord for a bridge or above the road surface for a culvert.

4.4.6 Population

A summary of the affected population for the design flood scenario is presented in Table 15, including total numbers, as well as a breakdown of the population located in the floodway, flood fringe (neither high hazard nor protected flood fringe), high hazard flood fringe, and protected flood fringe.

Table 15: Affected Population – Design Flood Scenario

Floodway	Flood Fringe	High Hazard Flood Fringe	Protected Flood Fringe	Total
119	1,805	492	288	**2,705**

For the design flood, a population of 119 would be located in the floodway, 1,805 in the flood fringe, 492 in the high-hazard flood fringe, and 288 in the protected flood fringe zone.

5.0 CONCLUSIONS

The main results of the flood risk assessment for the open water flood scenarios are summarized below:

- The number of affected residential buildings and affected population remains zero until the 20-year flood. It then slowly increases up to the 1000-year flood.
- The number of affected non-residential buildings remains zero until the 75-year flood. It then increases up the 1000-year flood with a significant increase between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated
- No critical, non-residential buildings (i.e., government buildings, hospitals, schools, or water treatment facilities) are affected up to the 100-year open water flood. The only critical, non-residential buildings affected by any open water flood scenarios are schools, including Keyano College starting at the 200-year flood.
- The length of roads affected by direct inundation remains zero until the 10-year flood. A significant increase occurs between the 100-year and 200-year floods when parts of the Lower Townsite southeast of Queen Street are inundated. Some of the major roads that would be affected include:
  - Franklin Avenue between Prairie Loop Boulevard and Queen Street starting at the 350-year flood.
  - King Street southwest of the intersection with Franklin Avenue starting at the 350-year flood.

The main results of the flood risk assessment for the ice jam flood scenarios are summarized below:

- Residential buildings around Selby Avenue in the Lower Townsite and in Waterways are affected by direct inundation at the 50-year flood. The number of residential buildings affected by direct inundation then increases steadily between the 50-year and 200-year floods, as additional areas in the Lower Townsite experience direct inundation.
- Non-residential buildings between Franklin Avenue and Gordon Avenue are affected by potential flood control structure failure and non-residential buildings in and around TaigaNova Industrial Park are affected by direct inundation at the 50-year flood. The number of non-residential buildings affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. It then further increases between the 100-year and 200-year floods.

- One school is affected by potential flood control structure failure at the 50-year ice jam flood. Keyano College and the RMWB Water Treatment plant are affected by direct inundation starting at the 100-year flood. The recreational facilities on McDonald Island and two government buildings are affected at the 200-year flood. No hospitals are affected by any of the ice jam flood inundation scenarios.
- Roads between Franklin Avenue and Gordon Avenue are affected by potential flood control structure failure and roads in TaigaNova Industrial Park are affected by direct inundation at the 50-year flood. The length of roads affected by direct inundation increases significantly between the 50-year and 100-year floods, as additional areas in the Lower Townsite and areas previously affected by potential flood control structure failure experience direct inundation. Some of the major roads that would be affected include:
  - Selby Avenue, Clearwater Drive, Bulyea Avenue, and large parts of Draper Road starting at the 50-year flood.
  - Most major roads in the Lower Townsite, including Franklin Avenue, starting at the 100-year flood.
  - Highway 63 / Memorial Drive for approximately 1.4 km north of the intersection with Confederation Way starting at the 100-year flood.

The main results of the flood risk assessment for the design flood scenario are summarized below:

- 47 residential buildings and 13 non-residential buildings are located in the floodway. A total of 437 residential and 184 non-residential buildings are located in the flood fringe. Of this flood fringe total, 100 residential and 116 non-residential buildings are located in the high-hazard flood fringe, and 19 residential buildings are located in the protected flood fringe
- A total estimated population of 119 is located in the floodway, and a total estimated population of 2,585 is in the flood fringe. Of this flood fringe total, 492 are in the high-hazard flood fringe and 288 are in the protected flood fringe.
- No government buildings or hospitals would be affected by the design flood. RMWB Wastewater Treatment Plant would be located in the high-hazard flood fringe.
- Some of the major roads that would be affected are Selby Avenue, Clearwater Drive, Gordon Avenue Prairie Loop Boulevard, Franklin Avenue, Saline Creek Drive, large parts of Draper Road, and Highway 63 / Memorial Drive for approximately 1.2 km north of the intersection with Confederation Way.

Report Signature Page

GOLDER ASSOCIATES LTD.

Prepared by:

Original Signed by:

Peter Thiede, Dipl.-Ing.
GIS Specialist

Reviewed by:

Original Signed by:

Wolf Ploeger, Dr.-Ing.
Associate, Senior River Specialist

PT/WP/crm

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For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
2800, 700 - 2nd Street SW,
Calgary, Alberta, T2P 2W2,
Canada
T: +1 403 299 5600

Golder Associates