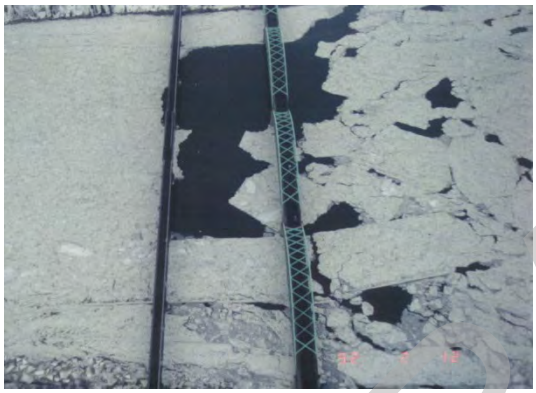

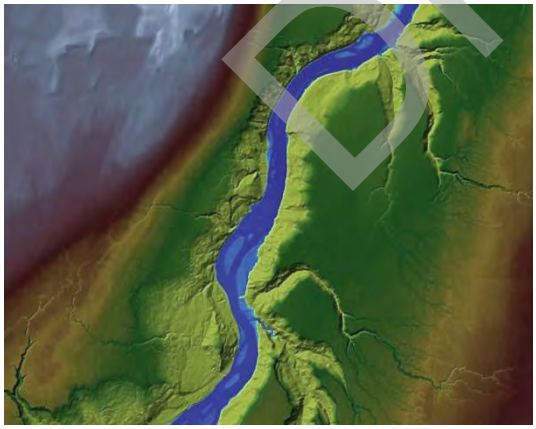

PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT AND INVENTORY

FINAL REPORT

Prepared for:

Alberta Environment and Parks

25 October 2022

NHC Ref. No. 1001119

nhc
northwest hydraulic consultants
water resource specialists

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APEGA Permit to Practice – P654

Prepared by:

Dan Healy, PhD, PEng
Principal

Reviewed by:

Robyn Andrishak, MSc, PEng
Principal

DISCLAIMER

This report has been prepared by Northwest Hydraulic Consultants Ltd. in accordance with generally accepted engineering practices, for the benefit of Alberta Environment and Parks for specific application to the Peace River Hazard Study in Alberta. The information and data contained herein represent Northwest Hydraulic Consultants Ltd.'s best professional judgment based on the knowledge and information available to Northwest Hydraulic Consultants Ltd. at the time of preparation.

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CREDITS AND ACKNOWLEDGEMENTS

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Thanks are also expressed to the Town of Peace River for providing inventory data for this study.

The following NHC personnel provided the key contributions to the flood risk assessment and inventory component of the Peace River Hazard Study. Dan Healy, PhD, PEng (Project Manager) ensured the overall direction of the project. Sarah North, GISP (GIS Specialist) developed the mapping and database creation. Ilana Klinghoffer (Geomorphologist) helped with review, interpretation, and the summary of the inventory results.

EXECUTIVE SUMMARY

Northwest Hydraulic Consultants Ltd. was retained in September 2015 by Alberta Environment and Parks to conduct a River Hazard Study for the Peace River through the Town of Peace River. The objectives of this River Hazard Study are to identify and assess river and flood-related hazards along 54 km of the Peace River, from about 6 km upstream of Shaftesbury Ferry to about 5 km downstream of the Highway 986 bridge, and along 1.2 km of the Heart River upstream of its confluence with the Peace River.

This report summarizes the work of the flood risk assessment and inventory component of the study. A summary of the work supporting the infrastructure inventory and categorization and flood risk statistic assessment is provided. Flood risks in the study area are identified by combining open water and ice jam flood inundation extents, as well as the governing flood hazard area information with basic spatial inventory information on land parcels, infrastructure, and population under various flood scenarios. Statistics are presented for open water flood inundation areas, ice jam flood inundation areas, and a governing design flood hazard area, which is divided into floodway and flood fringe zones using the FHIP Guidelines (Alberta Environment, 2011), incorporating technical changes implemented in 2021 regarding how floodways are mapped in Alberta.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Study Objectives

The overall objectives of the Peace River Hazard Study are to identify and assess river and flood hazards along the Peace and Heart rivers through the Town of Peace River (TPR). The study is being completed under the provincial Flood Hazard Identification Program (FHIP), the goals of which include enhancement of public safety and reduction of future flood damages through the identification of river and flood hazards. The intent is to reduce potential future flood damage 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 Peace River Hazard Study has been structured into the following major project components.

1) Survey and Base Data Collection
2) Open Water Hydrology Assessment
3) Hydraulic Model Creation and Calibration
4) Open Water Flood Inundation Map Production
5) Open Water Flood Hazard Identification
6) Ice Jam Modelling Assessment & Flood Hazard Identification
7) Governing Design Flood Hazard Map Production
8) Flood Risk Assessment and Inventory
9) Channel Stability Investigation

This report summarizes the work of the flood risk assessment and inventory component of the study. A summary of the work supporting the infrastructure inventory and categorization and flood risk statistic assessment is provided. Flood risks in the study area are identified by combining open water and ice jam flood inundation extents as well as governing flood hazard area information with basic spatial inventory information on land parcels, infrastructure, and population under various flood scenarios. Statistics are presented for open water flood inundation areas, ice jam inundation areas, and a governing design flood hazard area, which is divided into floodway and flood fringe zones using the FHIP Guidelines (Alberta Environment, 2011), incorporating technical changes implemented in 2021 regarding how floodways are mapped in Alberta.

1.2 Study Area and Reach

The Peace River flows into northwestern Alberta from British Columbia, passing through TPR, which is located about 380 km northwest of Edmonton. The extent of the contributing basin for the study reach

is shown in **Figure 1**. Peace River flows are regulated by BC Hydro for hydropower production at Bennett Dam and Peace Canyon (PCN) Dam. The primary storage unit that enables regulation is Williston Lake, the reservoir created by Bennett Dam, which has sufficient capacity to provide multi-year storage of inflows.

The study reach consists of a 54 km segment of the Peace River beginning at the west boundary of 1-82-24-W5M about 6 km upstream of the Shaftesbury Ferry crossing (Highway 740) to the north boundary of 24-85-21-W5M about 5 km downstream of the Highway 986 bridge. The location of the study reach is shown in **Figure 1.** TPR is the most developed and populated area along this reach of the Peace River. Also included in the study area is a 1.2 km reach of the Heart River upstream of its confluence with the Peace River and a limited reach of the Smoky River near its confluence with the Peace River. Study limits are shown in **Figure 2**.

2 AVAILABLE SPATIAL DATA

2.1 Cadastral

Cadastral information was provided by AEP as polyline and polygon shapefiles. The cadastral information provided legal delineation of land ownership properties. The dataset included cadastral blocks and lots, cadastral hydrography, cadastral plans, cadastral rights-of-way, and land parcels with unique land parcel identifiers. Land parcels are specified areas of land, including untitled and titled parcels with registered Certificates of Title at Alberta Land Titles. TPR also supplied cadastral information, but this was not used as it overlapped with data from AEP. The AEP data provided more complete coverage of the study area.

2.2 Infrastructure

There were several possible sources for the road and railway networks, including municipal, provincial, and national datasets. The National Road Network (NRN) and National Railway Network (NRWN) from Natural Resources Canada were selected for the flood risk assessment, as they provided the most complete and consistent coverage of the study area. The NRN and NRWN datasets were developed through collaboration with data providers from the federal, provincial, and municipal governments, and the private sector.

Bridges were mapped by NHC based on field surveys and other reference data. Within the study area there are three bridges that cross the Peace River:

- CN Rail Bridge,
- Highway 2 Bridge, and
- Highway 986 Bridge.

Within the study reach there are four bridges that cross the Heart River:

- CN Rail Bridge,
- Pedestrian Bridge 1 (Twelve Foot Davis Ball Park),
- 101 Street Bridge, and
- Pedestrian Bridge 2 (100 Street).

Within the study area there is also a ferry crossing located upstream of TPR at Highway 740. It is not likely that the Shaftesbury Ferry would operate during open water or ice jam floods; however, it is plausible that the ferry would be in the water or very near the water edge under all flood scenarios. It was not possible to quantify the degree of risk to the ferry based on the analysis of spatial data and approach used in this assessment.

2.3 Census

The 2016 census boundaries and population values were downloaded from Statistics Canada (Statistics Canada, 2016). The smallest geographic area for which population and dwelling counts are disseminated are termed as census dissemination blocks. The census dissemination blocks are "bounded on all sides by roads and/or boundaries of standard geographic areas" (Statistics Canada, 2016). These blocks were used to identify the total population at risk under different flood scenarios. If the total population within a block is under 15, Statistics Canada rounds the population count to a base of 5, resulting in a count that always end in 0 or 5. A random rounding algorithm is used to either round upwards or downwards in count value.

3 INTERPRETED SPATIAL DATA

3.1 Aerial Photography

ORTHOSHOP Geomatics Ltd. (OGL) completed acquisition of new aerial imagery on 3 May 2016 and used this imagery to generate colour-balanced ortho-rectified mosaics. A complete description of the aerial imagery acquisition and data processing procedures are provided in the ***Survey and Base Data Collection*** report provided under a separate cover. These 2016 orthophotos were used to interpret spatial data for the flood risk assessment.

3.2 Residential Structures

Centroids for residential structures were digitized based on inspection of the 2016 orthophotos and cadastral data – sheds and garages were excluded from the count. Google StreetView was referenced to help identify the type of structure when it was not apparent from the orthophotography. Structures were identified and digitized within the 1000-year flood inundation extents.

Residential structures were classified according to the scheme listed in **Table 1**.

Table 1 Classification Scheme for Residential Structures.

Category	Sub-Category
Buildings	Single Family
	Multi Family
	Retirement Home
	Mobile Home

3.3 Non-Residential Structures

The identification of non-residential structures was based on cadastral data and inspection of the 2016 orthophotos. Areas within the 1000-year inundation extent were examined. Google Maps and Google StreetView were referenced to assist in identifying the building category and sub-category. The adopted non-residential structure classification scheme is listed in **Table 2**.

Table 2 Classification Scheme for Non-Residential Structures

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

4 FLOOD RISK ASSESSMENT & INVENTORY

4.1 Methodology

All flood risk assessment data were assembled into a geodatabase, according to: bridges; census dissemination blocks; municipality boundaries; railways; roadways; land parcels; and buildings. A description of these data, their spatial attributes, and relevant digital file information is detailed in **Appendix A**. The extent of the spatial data is depicted on the map sheets provided in **Appendix B**.

Statistics are presented for open water flood inundation areas (2-, 5-, 10-, 20-, 35-, 50-, 75-, 100-, 200-, 350-, 500-, 750-, and 1000-year open water floods), ice jam flood inundation areas (50-, 100-, and 200-year ice jam floods), and the governing flood hazard area, which is divided into floodway and flood fringe zones (including high hazard flood fringe areas). For the open water and ice jam inundation scenarios,

the inundation extents were assessed according to the following three inundation subcategories: direct inundation, potential inundation due to flood control structure failure, and potential inundation of isolated areas. The inundation extents for these scenarios were developed under the following study components: Open Water Flood Inundation Map Production; Open Water Flood Hazard Identification; Ice Jam Modelling Assessment and Flood Hazard Identification; and Governing Design Flood Hazard Map Production.

Direct inundation: Direct inundation areas correspond to areas that are part of the actively-flowing river channel or flooded overbank areas connected to the actively-flowing river channel.

Potential inundation due to flood control structure failure: Potential inundation areas due to flood control structure (FCS) failure correspond to areas that would flood if the flood control structure protecting the area failed. When the water surface elevations did not indicate overtopping of a FCS, the area behind the FCS was shown as potential inundation due to FCS failure. When the water surface elevations indicated that all or portions of the FCS were overtopped, then areas behind the FCS were mapped as direct inundation areas.

Potential inundation of isolated areas: Isolated areas correspond to low lying areas with ground elevations below the water surface elevation in the main channel that are not directly connected to the actively flowing river channel. However, they could potentially be inundated by a subsurface hydraulic connection to the actively flowing river channel or by ponding of water in low lying areas. 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 a flood control structure, such as roads and berms, were assessed as isolated areas.

For each flood inundation scenario, the extent of inundation was overlain atop of the flood risk assessment data to determine the following statistics for each of the three inundation subcategories described above:

- Number of land parcels at risk;
- Number of residential buildings at risk – single family, multi-unit, retirement homes, and mobile homes;
- Number of non-residential buildings at risk – hospitals, schools, commercial, industrial, government buildings, water and wastewater treatment facilities, and other major non-residential buildings;
- Number of bridges at risk;
- Kilometres of roadway and railway at risk; and
- Estimated population at risk.

All parcels that intersected a given flood inundation scenario extent were deemed to be at risk of inundation for that flood inundation scenario. The total number of land parcels at risk for a particular

inundation scenario were further subdivided according to the three inundation subcategories. Individual land parcels were found to span over more than one inundation subcategory. Thus, in some instances, the sum of land parcels at risk under the three subcategories exceeded the number of land parcels intersecting the total inundated area.

The method for grouping land parcels at risk according to municipality was based on the intersection of land parcel polygon centroids within municipality polygon boundaries. This approach was used to ensure that each land parcel was associated with a single municipality. Intersection of land parcel polygons with municipality polygons would have resulted in some of the land parcels being associated with more than one municipality and accounted for more than once.

Buildings were categorized as either residential buildings or non-residential buildings. Residential buildings were subcategorized as single family (SF), multi-family (MF), retirement home (RH), or mobile home (MH). Garages and other secondary buildings on properties with a primary building were not included in the analysis. Non-residential buildings were subcategorized as hospital (H), school (SCH), water treatment plant (WTP), wastewater treatment plant (WWTP), industrial (IND), government (GOV), or commercial (COM). All building centroids that fell within the flood extent were deemed to be at risk. Buildings at risk were further subdivided according to the three inundation subcategories.

All bridges lie with the inundation extents for all scenarios. To provide context on the relative risk for the various flood scenarios, the potential risk was assessed according to bridge clearance above flood levels. Bridge clearance was defined as the height of the low chord elevation above the water surface elevation for each flood inundation scenario. Roadway and railway at risk were calculated by determining the total cumulative length, in kilometres, within the extent of inundation for each flood scenario.

The population at risk was based on the intersection of census dissemination blocks with the inundation extents for each flood inundation scenario. The population at risk for dissemination blocks that partially intersected an inundation area were approximated by the percentage area of the dissemination block intersecting the flood extent, multiplied by the dissemination block's total population. Statistics were calculated separately for each of the three inundation subcategories.

All results were also summarized according to municipality, as this provided more meaningful information to stakeholders. The municipal stakeholders for this study are:

- Municipal District of Peace No. 135,
- Northern Sunrise County,
- Birch Hills County,
- County of Northern Lights, and
- Town of Peace River.

The overlay analysis was automated in ArcGIS using a Python geoprocessing script. Results were summarized and tallied in a spreadsheet (Excel).

4.2 Open Water, Ice Jam, and Governing Design Flood Inundation Areas

The results of the flood risk assessment were summarized into statistics based on the number of land parcels, number of buildings and bridges, length of roadway and railway, and estimated population. The results are presented below for all of the various open water, ice-affected, and governing design flood scenarios investigated under this study.

The statistics for the governing design flood hazard area reflect the sum of statistics from the floodway and flood fringe zones (including high hazard flood fringe areas). Statistics reported for the flood fringe include high hazard flood fringe areas. Statistics for the high hazard flood fringe are a subset of the flood fringe area.

4.2.1 Land Parcels

Statistics for the number of land parcels at risk due to flooding are summarized in **Tables 3** through **6**. A land parcel at risk was attributed to the municipality within which the centroid of the land parcel polygon was found.

Table 3 summarizes statistics for the total extent of inundation for the open water and ice jam flood scenarios (including direct inundation and indirect inundation through potential flood control structure failure). **Table 4** provides summary statistics for direct inundation. Statistics for the number of land parcels at risk due to potential flood control structure failure are summarized in **Table 5**. **Table 6** summarizes the statistics for the number of land parcels at risk for the governing design flood scenario according to the floodway, flood fringe, and high hazard flood fringe. The statistics are grouped according to municipality. **Figure 3** provides a chart of land parcels at risk in the Town of Peace River according to the total extent of inundation (refer to **Table 3**) and by direct inundation (refer to **Table 4**). The relative number of land parcels at risk by direct inundation closely matches the total extent of inundation for open water floods larger than the 100-year open water flood scenario because the dikes are overtopped and the areas behind the dike are then classed as direct inundation. Statistics for land parcels at risk according to total extent of inundation for the remaining four municipalities are charted in **Figure 4**. A land parcel was classified at risk when any portion of the parcel intersected the inundation extent. Thus, some land parcels adjacent to the river were identified as at risk even when the flood levels remained within the river banks. The number of land parcels for each flood scenario are stacked atop of each other to provide a visual representation of the total combined and relative apportioning by municipality.

The Town of Peace River has the highest number of land parcels at risk of direct inundation at the 200- to 1000-year return periods for open water flood floods, and at the 50-, 100-, and 200-year return periods for ice jam floods. The Town of Peace River has land parcels at risk of direct inundation at all return periods; however, for return periods of 100-years and lower, the at-risk land parcels do not contain at-risk residential buildings - there are no building centroids within the inundation extents. At the 200-year and higher open water flood return periods, residential and non-residential areas located

east of the Peace River are at risk of direct inundation due to overtopping of the Peace River East Dike and Heart River Dikes; and, residential areas west of the Peace River are at risk of direct inundation due to overtopping of the Peace River West Dike. At the 10- to 100-year open water return periods, land parcels in residential and non-residential areas are at risk due to potential flood control structure failure including potential failure of the Peace River East Dike, Peace River West Dike, Heart River Left Dike, Heart River Right Dike, and 12 Foot Davis Park Dike. The land parcels that are at risk due to the potential failure of these flood control structures and due to the potential overtopping of these flood control structures vary in size, but have a median area of 675 m^2. The land parcels in the TPR are generally smaller than those in the other municipalities. The Town of Peace River is the only municipality that has land parcels at risk of inundation due to potential flood control structure failure. The Town of Peace River has the highest number of land parcels at risk in the floodway, high hazard flood fringe, and flood fringe for the governing design flood scenario. Many of these land parcels contain at-risk residential and non-residential buildings.

The Municipal District of Peace No. 135 (includes Shaftesbury Settlement) has the highest number of land parcels at risk of direct inundation at the 2- to 100-year open water flood extents, with 99 to 109 land parcels at risk, respectively. The majority of these at-risk land parcels do not contain residential buildings. For example, of the 109 land parcels at risk of direct inundation at the 100-year return period, only two of these land parcels contain a total of three residential buildings at risk of direct inundation. The majority of land parcels at risk of direct inundation at all return periods in the M.D. of Peace No. 135 are located on agricultural land and on crown land.

There are land parcels at risk of direct inundation at all return periods for open water flood extents in Northern Sunrise County, Birch Hills County, and the County of Northern Lights; however, none of these land parcels contain residential buildings at risk of direct inundation. The majority of at-risk land parcels in Northern Sunrise County are on land classified as Environmental/Park Reserve District and agricultural land. The majority of at-risk land parcels in Birch Hills County are located in Peace River Wildland Provincial Park. In the County of Northern Lights, the majority of at-risk land parcels are located on crown land and in industrial districts.

Table 3 Land Parcels at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Number of Parcels by Municipality – Total Extent of Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	99	44	47	61	58	309
5-YR Open Water	102	46	49	65	105	367
10-YR Open Water	106	47	53	66	216	488
20-YR Open Water	108	50	53	67	395	673
35-YR Open Water	111	50	55	69	740	1025
50-YR Open Water	112	50	55	70	954	1241
75-YR Open Water	113	50	55	71	1255	1544
100-YR Open Water	114	50	56	73	1396	1689
200-YR Open Water	119	51	57	74	1623	1924
350-YR Open Water	125	51	58	82	1671	1987
500-YR Open Water	128	51	58	85	1698	2020
750-YR Open Water	132	51	59	87	1725	2054
1000-YR Open Water	136	51	59	88	1759	2093
50-YR Ice Jam	125	50	58	70	1526	1829
100-YR Ice Jam	132	50	60	74	1614	1930
200-YR Ice Jam	143	51	61	74	1669	1998

Table 4 Land Parcels at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Number of Parcels by Municipality – Direct Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	99	44	47	61	56	307
5-YR Open Water	102	44	49	63	63	321
10-YR Open Water	104	46	49	63	66	328
20-YR Open Water	104	49	50	66	70	339
35-YR Open Water	106	49	52	68	75	350
50-YR Open Water	106	50	54	68	78	356
75-YR Open Water	106	50	55	68	81	360
100-YR Open Water	106	50	56	70	83	365
200-YR Open Water	110	51	57	70	1615	1903
350-YR Open Water	117	51	58	79	1669	1974
500-YR Open Water	120	51	58	79	1695	2003
750-YR Open Water	122	51	59	80	1724	2036
1000-YR Open Water	128	51	59	80	1759	2077
50-YR Ice Jam	113	50	58	68	1336	1625
100-YR Ice Jam	124	50	60	70	1607	1911
200-YR Ice Jam	136	51	61	70	1667	1985

Table 5 Land Parcels at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Number of Parcels by Municipality – Potential FCS Failure					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	No data – there are no FCS protected areas.					
5-YR Open Water						
10-YR Open Water	0	0	0	0	148	148
20-YR Open Water	0	0	0	0	256	256
35-YR Open Water	0	0	0	0	383	383
50-YR Open Water	0	0	0	0	413	413
75-YR Open Water	0	0	0	0	1149	1149
100-YR Open Water	0	0	0	0	1345	1345
200-YR Open Water	No data – FCS is overtopped and areas behind are under direct inundation.					
350-YR Open Water						
500-YR Open Water						
750-YR Open Water						
1000-YR Open Water						
50-YR Ice Jam	0	0	0	0	192	192
100-YR Ice Jam	No data – FCS is overtopped and areas behind are under direct inundation.					
200-YR Ice Jam						

Table 6 Land Parcels at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Number of Parcels by Municipality – Governing Design Flood					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
Governing Design Flood	124	50	60	70	1607	1911
Floodway	113	50	58	68	84	373
Flood Fringe	87	44	50	48	1599	1828
High Hazard Flood Fringe	*18*	*7*	*7*	*5*	*1277*	*1314*

4.2.2 Buildings and Infrastructure

Statistics for buildings and infrastructure were categorized into: residential buildings, non-residential buildings, bridges, railway, and, roadway.

Residential Buildings: Statistics for residential buildings at risk due to flooding are summarized in **Tables 7** through **10**. **Appendix C** provides more detailed summary of residential buildings according to the following subcategories – single family (SF), multi-family (MF), retirement home (RH), and mobile home (MH).

Table 7 summarizes statistics for the total extent of inundation for the open water and ice jam flood scenarios. **Table 8** provides a summary of statistics for direct inundation. Statistics for the number of

residential buildings at risk due to potential flood control structure failure are summarized in **Table 9**. Statistics for the governing design floodway, flood fringe, and high hazard flood fringe scenarios and summarized in **Table 10**. The statistics are grouped according to municipality.

Figure 5 provides a chart of residential buildings at risk in the Town of Peace River according to the total extent of inundation (refer to **Table 7**) and by direct inundation (refer to **Table 8**). The relative number of residential buildings at risk by direct inundation closely matches the total extent of inundation for open water floods larger than the 100-year flood scenario because the dikes are overtopped and the areas behind the dike are then classed as direct inundation.

Figure 6 provides summary statistics for residential buildings at risk in the M.D. of Peace No. 135 (which includes Shaftesbury Settlement). The other remaining municipalities do not have any residential buildings at risk of inundation.

The Town of Peace River and the M.D. of Peace No. 135 are the only municipalities with residential buildings at risk of inundation. The Town of Peace River has residential buildings at risk of direct inundation at the 200- to 1000-year open water flood extents and at the 50-, 100-, and 200-year ice jam flood extents. At the 200-year return period and higher open water flood return periods, residential buildings located east of the Peace River are at risk of direct inundation due to overtopping of the Peace River East Dike and Heart River Dikes; and, residential areas west of the Peace River are at risk of direct inundation due to overtopping of the Peace River West Dike. At the 20- to 100-year return periods, residential buildings are at risk due to potential flood control structure failure including potential failure of the Peace River East Dike, Peace River West Dike, Heart River Left Dike, Heart River Right Dike and 12 Foot Davis Park Dike. There are also residential buildings at risk of potential isolated inundation in the Town of Peace River at the 20-, 35-, and 50-year return periods. The Town of Peace River is the only municipality with residential buildings at risk due to potential flood control structure failure and potential isolated inundation. The Town of Peace River has the highest number of residential buildings at risk for the governing design flood scenarios. There are single family homes, multi-family homes, and mobile homes at risk in the Town of Peace River for the floodway, flood fringe, and high hazard flood fringe governing design flood scenarios. There are no retirement homes at risk in the Town of Peace River for the governing design flood scenarios.

In the M.D. of Peace No. 135 the number of residential buildings at risk of direction inundation reaches 9 for the 1000-year open water flood extents and 10 for the 100-year ice jam flood extents. For the governing design flood, a total of 10 residential buildings are at risk – 4 single family homes are in the floodway and 6 single family homes are in the flood fringe.

Table 7 Residential Buildings at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Number of Residential Buildings by Municipality – Total Extent of Inundation[1]					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	8	8
10-YR Open Water	0	0	0	0	53	53
20-YR Open Water	0	0	0	0	117	117
35-YR Open Water	1	0	0	0	187	188
50-YR Open Water	2	0	0	0	259	261
75-YR Open Water	3	0	0	0	427	430
100-YR Open Water	3	0	0	0	553	556
200-YR Open Water	4	0	0	0	817	821
350-YR Open Water	7	0	0	0	856	863
500-YR Open Water	7	0	0	0	871	878
750-YR Open Water	8	0	0	0	893	901
1000-YR Open Water	9	0	0	0	897	906
50-YR Ice Jam	7	0	0	0	644	651
100-YR Ice Jam	10	0	0	0	786	796
200-YR Ice Jam	10	0	0	0	855	865

1. The total extent of inundation includes direct inundation, potential FCS failure, and potential isolated areas. For example, the 8 residential buildings indicated to be at risk in TPR for the 5-YR Open Water flood scenario are located within potential isolated areas behind the dike in Lower West Peace.

Table 8 Residential Buildings at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Number of Residential Buildings by Municipality – Direct Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
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	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0
50-YR Open Water	2	0	0	0	0	2
75-YR Open Water	3	0	0	0	0	3
100-YR Open Water	3	0	0	0	0	3
200-YR Open Water	4	0	0	0	816	820
350-YR Open Water	7	0	0	0	856	863
500-YR Open Water	7	0	0	0	871	878
750-YR Open Water	8	0	0	0	893	901
1000-YR Open Water	9	0	0	0	897	906
50-YR Ice Jam	7	0	0	0	501	508
100-YR Ice Jam	10	0	0	0	786	796
200-YR Ice Jam	10	0	0	0	855	865

Table 9 Residential Buildings at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Number of Residential Buildings by Municipality – FCS Failure					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	No data – there are no FCS protected areas.					
5-YR Open Water						
10-YR Open Water	0	0	0	0	53	53
20-YR Open Water	0	0	0	0	116	116
35-YR Open Water	0	0	0	0	155	155
50-YR Open Water	0	0	0	0	160	160
75-YR Open Water	0	0	0	0	420	426
100-YR Open Water	0	0	0	0	553	553
200-YR Open Water	No data – FCS is overtopped and areas behind are under direct inundation.					
350-YR Open Water						
500-YR Open Water						
750-YR Open Water						
1000-YR Open Water						
50-YR Ice Jam	0	0	0	0	142	142
100-YR Ice Jam	No data – FCS is overtopped and areas behind are under direct inundation.					
200-YR Ice Jam						

Table 10 Residential Buildings at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Number of Residential Buildings by Municipality – Governing Design Flood					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
Governing Design Flood	10	0	0	0	786	796
Floodway	4	0	0	0	0	4
Flood Fringe	6	0	0	0	786	792
High Hazard Flood Fringe	*0*	*0*	*0*	*0*	*427*	*427*

Non-residential Buildings: Statistics for non-residential buildings at risk due to flooding are summarized in **Tables 11** through **14**. **Appendix D** provides a more detailed summary of non-residential buildings according to the following subcategories – hospital (H), school (SCH), water treatment plant (WTP), wastewater treatment plant (WWTP), industrial (IND), government (GOV), and, commercial (COM).

Table 11 summarizes statistics for the total extent of inundation for the open water and ice jam flood scenarios. **Table 12** provides summary statistics for direct inundation. Statistics for the number of non-residential buildings at risk due to potential flood control structure failure are summarized in **Table 13**. Statistics for the governing design floodway and flood fringe scenarios and summarized in **Table 14**. The statistics are grouped according to municipality.

Figure 7 provides a chart of non-residential buildings at risk in the Town of Peace River according to the total extent of inundation (refer to **Table 11**) and by direct inundation (refer to **Table 12**). Statistics for land parcels at risk according to the total extent of inundation for the remaining four municipalities are charted in **Figure 8.** The number of non-residential buildings for each flood scenario are stacked atop of each other to provide a visual representation of the total combined and relative apportioning by municipality.

Table 11 Non-residential Buildings at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Number of Non-residential Buildings by Municipality – Total Extent of Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
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	0	0	1	0	1
20-YR Open Water	0	0	0	1	16	17
35-YR Open Water	0	1	0	1	25	27
50-YR Open Water	0	1	0	1	36	38
75-YR Open Water	0	1	0	1	57	59
100-YR Open Water	0	1	0	2	79	82
200-YR Open Water	0	2	0	2	128	132
350-YR Open Water	1	2	0	2	129	136
500-YR Open Water	1	2	0	2	138	143
750-YR Open Water	2	2	0	2	151	157
1000-YR Open Water	3	3	0	3	159	168
50-YR Ice Jam	2	1	0	1	105	109
100-YR Ice Jam	3	1	0	2	126	132
200-YR Ice Jam	3	2	0	2	131	138

Table 12 Non-residential Buildings at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Number of Non-residential Buildings by Municipality – Direct Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
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	0	0	1	0	1
20-YR Open Water	0	0	0	1	0	1
35-YR Open Water	0	1	0	1	0	2
50-YR Open Water	0	1	0	1	0	2
75-YR Open Water	0	1	0	1	0	2
100-YR Open Water	0	1	0	2	0	3
200-YR Open Water	0	2	0	2	128	132
350-YR Open Water	1	2	0	2	129	136
500-YR Open Water	1	2	0	2	138	143
750-YR Open Water	2	2	0	2	151	157
1000-YR Open Water	3	3	0	3	159	168
50-YR Ice Jam	2	1	0	1	105	109
100-YR Ice Jam	3	1	0	2	126	132
200-YR Ice Jam	3	2	0	2	131	138

Table 13 Non-residential Buildings at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Number of Non-residential Buildings by Municipality – FCS Failure					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	No data – there are no FCS protected areas.					
5-YR Open Water						
10-YR Open Water	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	15	15
35-YR Open Water	0	0	0	0	22	22
50-YR Open Water	0	0	0	0	29	29
75-YR Open Water	0	0	0	0	51	51
100-YR Open Water	0	0	0	0	79	79
200-YR Open Water	No data – FCS is overtopped and areas behind are under direct inundation.					
350-YR Open Water						
500-YR Open Water						
750-YR Open Water						
1000-YR Open Water						
50-YR Ice Jam	0	0	0	0	0	0
100-YR Ice Jam	No data – FCS is overtopped and areas behind are under direct inundation.					
200-YR Ice Jam						

Table 14 Non-residential Buildings at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Number of Non-residential Buildings by Municipality – Governing Design Flood					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
Governing Design Flood	3	1	0	2	126	132
Floodway	1	1	0	1	0	3
Flood Fringe	2	0	0	1	126	129
High Hazard Flood Fringe	*0*	*0*	*0*	*0*	*76*	*76*

Bridges: Statistics for bridges at risk due to flooding are summarized in **Table 15 and Table 16.** Statistics for bridges on the Peace River are provided in **Table 15** and statistics for bridges on the Heart River are provided in **Table 16**. For this study, all bridges that lie within the inundated area for each flood scenario were identified and bridge clearance levels were computed by comparing the bridge low chord to the water levels at the bridge location.

There are a maximum of seven bridges in the potential inundated area. Six of these bridges are located in the Town of Peace River and one of these bridges is located in the County of Northern Lights.

In the Town of Peace River, there are four bridges at risk of inundation. The CNR bridge over the Peace River is at risk of inundation at the 750- and 1000-year return periods for open water flood extents. The 101 St. Bridge over the Heart River is at risk of inundation at the 20-year return period and higher return periods for open water flood extents, and at the 50-, 100-, and 200-year return periods for ice jam flood extents. Both pedestrian bridges over the Heart River (Ped. Bridge 1 and 2) are at risk of inundation at the 200-year return period and higher return periods for open water flood extents, and at the 100-year and 200-year return periods for ice jam flood extents.

Railway: Statistics for railway at risk due to flooding are summarized in **Tables 17** through **20.**

Table 17 summarizes statistics for the total extent of inundation for the open water and ice jam flood scenarios. **Table 18** provides statistics for direct inundation. Statistics for the number of kilometres of railway at risk due to potential flood control structure failure are summarized in **Table 19**. Statistics for the governing design floodway and flood fringe scenarios and summarized in **Table 20**. The statistics are grouped according to municipality.

In the Town of Peace River, the CNR Bridge over the Peace River is at risk of inundation at the 750- and 1000-year return periods, as reported in **Table 17**. With the exception of bridge crossings, there are no segments of railway intersecting the flood limits of any flood scenario. There is railway at risk of inundation in the County of Northern Lights for the open water flood scenario at the 10-year return period and higher; for the ice jam flood scenario at the 50-, 100-, and 200-year return periods; and for the governing design flood. There is no railway at risk of inundation in the remaining municipalities for open water, ice jam flood, or governing design flood scenarios

Table 15 Bridges at Risk for Various Flood Scenarios – Peace River

Upstream XS	Low Chord Elevation	Bridge Name	Open Water Flood Level Clearance (m)													Ice Jam Flood Level Clearance (m)				Governing Design Flood Level Clearance (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	1000-year	OW Design Flood	50-year	100-year	200-year	Ice Jam Design Flood	Floodway	Flood Fringe	High Hazard Flood Fringe	Governing Design Flood
XS #7	325.9	HWY 986 Bridge	15.1	13.9	13.1	12.3	11.7	11.2	10.8	10.5	9.6	9.0	8.5	8.0	7.6	10.5	11.3	10.6	9.8	10.6	10.6	na[1]	na[1]	10.6
XS #25	327.4	HWY 2 Bridge	12.1	11.1	10.5	9.7	9.0	8.6	8.2	7.9	6.9	6.3	5.9	5.4	5.1	7.9	7.2	6.7	6.1	6.7	6.7	na[1]	na[1]	6.7
XS #28	322.2	CNR Bridge	6.6	5.7	5.0	4.2	3.6	3.2	2.7	2.4	1.4	0.8	0.4	-0.1	-0.4	2.4	2.0	1.5	0.8	1.5	1.5	na[1]	na[1]	1.5

1. The bridge opening does not extend into the flood fringe.

Table 16 Bridges at Risk for Various Flood Scenarios – Heart River

Upstream XS	Low Chord Elevation	Bridge Name	Open Water Flood Level Clearance (m)													Ice Jam Flood Level Clearance (m)				Governing Design Flood Level Clearance (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	1000-year	OW Design Flood	50-year	100-year	200-year	Ice Jam Design Flood	Floodway	Flood Fringe	High Hazard Flood Fringe	Governing Design Flood
XS #74	355.4	CN Rail Bridge	38.3	37.6	37.0	36.4	35.8	35.5	35.1	34.8	33.9	33.3	32.9	32.4	32.1	34.7	34.6	34.0	33.3	34.0	34.0	na[1]	na[1]	34.0
XS #66	321.2	Ped. Bridge 1	5.0	4.0	3.3	2.5	1.9	1.5	1.0	0.7	-0.3	-0.8	-1.3	-1.8	-2.1	0.6	0.5	-0.1	-0.7	-0.1	-0.1	na[1]	na[1]	-0.1
XS #60	317.9	101 St. Bridge	1.9	0.9	0.2	-0.6	-1.2	-1.7	-2.1	-2.5	-3.4	-4.0	-4.4	-5.0	-5.3	-2.6	-2.8	-3.3	-4.0	-3.3	-3.3	na[1]	na[1]	-3.3
XS #56	320.8	Ped. Bridge 2	4.9	3.9	3.2	2.4	1.8	1.3	0.9	0.5	-0.5	-1.1	-1.5	-2.1	-2.4	0.3	0.1	-0.4	-1.1	-0.4	-0.4	na[1]	na[1]	-0.4

1. The bridge opening does not extend into the flood fringe.

Table 17 Railway at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Kilometres of Railway by Municipality (km) - Total Extent of Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
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	0	0	0.01	0	0.01
20-YR Open Water	0	0	0	0.01	0	0.01
35-YR Open Water	0	0	0	0.01	0	0.01
50-YR Open Water	0	0	0	0.02	0	0.02
75-YR Open Water	0	0	0	0.02	0	0.02
100-YR Open Water	0	0	0	0.02	0	0.02
200-YR Open Water	0	0	0	0.02	0	0.02
350-YR Open Water	0	0	0	0.35	0	0.35
500-YR Open Water	0	0	0	0.52	0	0.52
750-YR Open Water	0	0	0	0.83	0.49	1.32
1000-YR Open Water	0	0	0	0.96	0.49	1.45
50-YR Ice Jam	0	0	0	0.02	0	0.02
100-YR Ice Jam	0	0	0	0.02	0	0.02
200-YR Ice Jam	0	0	0	0.03	0	0.03

Table 18 Railway at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Kilometres of Railway by Municipality (km) - Direct Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
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	0	0	0.01	0	0.01
20-YR Open Water	0	0	0	0.01	0	0.01
35-YR Open Water	0	0	0	0.01	0	0.01
50-YR Open Water	0	0	0	0.02	0	0.02
75-YR Open Water	0	0	0	0.02	0	0.02
100-YR Open Water	0	0	0	0.02	0	0.02
200-YR Open Water	0	0	0	0.02	0	0.02
350-YR Open Water	0	0	0	0.35	0	0.35
500-YR Open Water	0	0	0	0.52	0	0.52
750-YR Open Water	0	0	0	0.83	0.49	1.32
1000-YR Open Water	0	0	0	0.96	0.49	1.45
50-YR Ice Jam	0	0	0	0.02	0	0.02
100-YR Ice Jam	0	0	0	0.02	0	0.02
200-YR Ice Jam	0	0	0	0.03	0	0.03

Table 19 Railway at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Kilometres of Railway by Municipality (km) - FCS Failure					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	No data – there are no FCS protected areas.					
5-YR Open Water						
10-YR Open Water	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0
50-YR Open Water	0	0	0	0	0	0
75-YR Open Water	0	0	0	0	0	0
100-YR Open Water	0	0	0	0	0	0
200-YR Open Water	No data – FCS is overtopped and areas behind are under direct inundation.					
350-YR Open Water						
500-YR Open Water						
750-YR Open Water						
1000-YR Open Water						
50-YR Ice Jam	0	0	0	0	0	0
100-YR Ice Jam	No data – FCS is overtopped and areas behind are under direct inundation.					
200-YR Ice Jam						

Table 20 Railway at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Kilometres of Railway by Municipality (km) – Governing Design Flood					By Total Inundated Area
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	
Governing Design Flood	0	0	0	0.03	0	0.03
Floodway	0	0	0	0.02	0	0.02
Flood Fringe	0	0	0	0.01	0	0.01
High Hazard Flood Fringe	*0*	*0*	*0*	*0*	*0*	*0*

Roadway: Statistics for roadway at risk due to flooding are summarized in **Tables 21** through **24. Tables 21** and **22** summarize statistics on open water and ice jam flood scenarios for total extent and direct inundation, respectively. Statistics for the number of kilometres of roadway at risk due to potential flood control structure failure are summarized in **Table 23**. Statistics for the governing design flood are summarized in **Table 24**. The statistics are grouped according to municipality. At low return periods, small segments of roadway at risk were identified for the Town of Peace River on an unnamed road along the eastern edge of Riverfront Park and Peace Boulevard near 93 St. The small segments at risk within Municipal District of Peace No. 135 and Birch Hills County were mostly attributed to the approaches to the Shaftesbury Ferry Crossing. The length of roadway at risk increases for larger return periods. The Town of Peace River has the longest length of roadway at risk of inundation for total extent

of inundation at all return periods. There were no roadways at risk identified for the County of Northern Lights.

Table 21 Roadway at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Kilometres of Roadway by Municipality (km) - Total Extent of Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	0.02	0	0.02	0	0.07	0.11
5-YR Open Water	0.04	0	0.03	0	0.64	0.71
10-YR Open Water	0.06	0	0.04	0	1.86	1.95
20-YR Open Water	0.07	0.54	0.08	0	5.85	6.54
35-YR Open Water	0.08	0.56	0.35	0	9.19	10.18
50-YR Open Water	0.09	0.56	0.55	0	12.24	13.44
75-YR Open Water	0.11	0.57	0.62	0	16.34	17.64
100-YR Open Water	0.19	0.58	0.67	0	18.43	19.87
200-YR Open Water	0.58	0.59	0.78	0	23.69	25.65
350-YR Open Water	0.78	0.6	0.87	0	24.87	27.12
500-YR Open Water	0.99	0.61	0.91	0	25.27	27.78
750-YR Open Water	1.41	0.79	1.01	0	26.32	29.53
1000-YR Open Water	2.37	0.96	1.17	0	26.83	31.34
50-YR Ice Jam	0.94	0.56	0.89	0	21.42	23.81
100-YR Ice Jam	1.51	0.58	0.96	0	23.36	26.41
200-YR Ice Jam	3.47	0.59	1.28	0	24.71	30.05

Table 22 Roadway at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Kilometres of Roadway by Municipality (km) - Direct Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	0.02	0	0.02	0	0.07	0.11
5-YR Open Water	0.04	0	0.03	0	0.16	0.23
10-YR Open Water	0.06	0	0.04	0	0.19	0.29
20-YR Open Water	0.07	0.54	0.08	0	0.21	0.9
35-YR Open Water	0.08	0.56	0.35	0	0.23	1.21
50-YR Open Water	0.09	0.56	0.55	0	0.24	1.44
75-YR Open Water	0.11	0.57	0.62	0	0.32	1.62
100-YR Open Water	0.19	0.58	0.67	0	0.35	1.78
200-YR Open Water	0.58	0.59	0.78	0	23.69	25.65
350-YR Open Water	0.78	0.6	0.87	0	24.87	27.12
500-YR Open Water	0.99	0.61	0.91	0	25.27	27.78
750-YR Open Water	1.41	0.79	1.01	0	26.26	29.47
1000-YR Open Water	2.37	0.96	1.17	0	26.83	31.34
50-YR Ice Jam	0.94	0.56	0.89	0	18.28	20.67
100-YR Ice Jam	1.51	0.58	0.96	0	23.28	26.33
200-YR Ice Jam	3.47	0.59	1.28	0	24.71	30.05

Table 23 Roadway at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Kilometres of Roadway by Municipality (km) - FCS Failure					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	No data – there are no FCS protected areas.					
5-YR Open Water						
10-YR Open Water	0	0	0	0	1.65	1.65
20-YR Open Water	0	0	0	0	4.31	4.31
35-YR Open Water	0	0	0	0	5.4	5.4
50-YR Open Water	0	0	0	0	6.48	6.48
75-YR Open Water	0	0	0	0	15.39	15.39
100-YR Open Water	0	0	0	0	18.08	18.08
200-YR Open Water	No data – FCS is overtopped and areas behind are under direct inundation.					
350-YR Open Water						
500-YR Open Water						
750-YR Open Water						
1000-YR Open Water						
50-YR Ice Jam	0	0	0	0	3.14	3.14
100-YR Ice Jam	No data – FCS is overtopped and areas behind are under direct inundation.					
200-YR Ice Jam						

Table 24 Roadway at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Kilometres of Roadway by Municipality (km) – Governing Design Flood					By Total Inundated Area
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	
Governing Design Flood	2.22	0.58	0.97	0	22.9	26.67
Floodway	1.86	0.56	0.85	0	0.30	3.57
Flood Fringe	0.36	0.02	0.12	0	22.60	23.10
High Hazard Flood Fringe	*0*	*0*	*0*	*0*	*17.32*	*17.32*

4.2.3 Population

Statistics for estimated population at risk due to flooding are summarized in **Tables 25** through **28**. 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. Census blocks adjacent to the river were adjusted by masking out the river channel portion from that census block. This was done to prevent counting population at risk for areas inside the main river channel.

Table 25 summarizes statistics for the total extent of inundation for the open water and ice jam flood scenarios. **Tables 26** provides statistics for direct inundation. Statistics for population at risk due to potential flood control structure failure are summarized in **Table 27** and **Table 28** summarizes the statistics for the estimated population at risk for the governing design flood. The statistics are grouped according to municipality. **Figure 9** provides a chart of estimated population at risk in the Town of Peace River according to the total extent of inundation (refer to **Table 25**) and by direct inundation (refer to **Table 26**). Statistics for estimated population at risk according to total extent of inundation for the remaining four municipalities are charted in **Figure 10**. The estimated population at risk for each flood scenario are stacked atop of each other to provide a visual representation of the total combined and relative apportioning by municipality.

The Town of Peace River has the highest number of people at risk of direct inundation and was the only municipality with people at risk due to potential flood control structure failure and isolated inundation. The Town of Peace River has 31 to 2849 people at risk of inundation at the 2- to 1000-year return periods, respectively. The Town of Peace River has the highest number of people at risk due to the governing design flood scenarios. The M.D. of Peace No. 135 has a maximum of 15 people at risk of inundation at the 200-year ice jam flood scenario. Northern Sunrise County has a maximum of 13 people at risk of inundation at the 1000-year return period. Birch Hills County has a maximum of five people at risk at the 1000-year return period and the County of Northern Lights has a maximum of four people at risk at the 1000-year return period. In Northern Sunrise County, M.D. of Peace No. 135, and the Town of Peace River there is population at risk in the floodway, flood fringe, and high hazard flood fringe for the governing design flood scenario. In Birch Hills County and the County of Northern Lights there is population at risk in the floodway for the governing design flood scenario.

Table 25 Estimated Population at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Estimated Population by Municipality - Total Extent of Inundation					
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	Total
2-YR Open Water	4	1	1	1	31	38
5-YR Open Water	5	2	1	2	80	90
10-YR Open Water	6	3	2	2	205	219
20-YR Open Water	6	5	2	2	439	454
35-YR Open Water	7	6	2	3	789	807
50-YR Open Water	8	6	3	3	1102	1124
75-YR Open Water	8	7	4	3	1594	1617
100-YR Open Water	9	7	4	3	1942	1966
200-YR Open Water	10	9	5	3	2593	2622
350-YR Open Water	12	10	5	4	2684	2716
500-YR Open Water	14	11	5	4	2729	2762
750-YR Open Water	15	12	5	4	2779	2815
1000-YR Open Water	17	13	5	4	2809	2849
50-YR Ice Jam	11	7	5	3	2205	2231
100-YR Ice Jam	14	8	5	3	2529	2560
200-YR Ice Jam	15	9	5	3	2672	2705

Table 26 Estimated Population at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Estimated Population by Municipality - Direct Inundation					Total
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	
2-YR Open Water	4	1	1	1	31	38
5-YR Open Water	5	2	1	2	44	54
10-YR Open Water	6	3	2	2	49	63
20-YR Open Water	6	5	2	2	63	78
35-YR Open Water	7	6	2	3	88	106
50-YR Open Water	8	6	3	3	97	119
75-YR Open Water	8	7	4	3	104	127
100-YR Open Water	9	7	4	3	109	133
200-YR Open Water	10	9	5	3	2590	2619
350-YR Open Water	12	10	5	4	2682	2714
500-YR Open Water	14	11	5	4	2726	2759
750-YR Open Water	15	12	5	4	2775	2811
1000-YR Open Water	17	13	5	4	2809	2849
50-YR Ice Jam	11	7	5	3	1907	1933
100-YR Ice Jam	14	8	5	3	2507	2538
200-YR Ice Jam	15	9	5	3	2670	2703

Table 27 Estimated Population at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Estimated Population by Municipality - FCS Failure					Total
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	
2-YR Open Water	No data – there are no FCS protected areas.					
5-YR Open Water						
10-YR Open Water	0	0	0	0	153	153
20-YR Open Water	0	0	0	0	292	292
35-YR Open Water	0	0	0	0	378	378
50-YR Open Water	0	0	0	0	422	422
75-YR Open Water	0	0	0	0	1468	1468
100-YR Open Water	0	0	0	0	1816	1816
200-YR Open Water	No data – FCS is overtopped and areas behind are under direct inundation.					
350-YR Open Water						
500-YR Open Water						
750-YR Open Water						
1000-YR Open Water						
50-YR Ice Jam	0	0	0	0	279	279
100-YR Ice Jam	No data – FCS is overtopped and areas behind are under direct inundation.					
200-YR Ice Jam						

Table 28 Estimated Population at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Estimated Population by Municipality – Governing Design Flood					By Total Inundated Area
	MD #135	Northern Sunrise	Birch Hills	Northern Lights	TPR	
Governing Design Flood	12	8	5	3	2503	2531
Floodway	10	7	5	3	111	136
Flood Fringe	2	1	0	0	2392	2395
High Hazard Flood Fringe	*0*	*0*	*0*	*0*	*1535*	*1535*

5 CONCLUSIONS

The objectives of this study were to assess river flood-related hazards along a 54 km long reach of the Peace River. The Peace River Hazard Study was divided into eight major project components. This report summarizes the Flood Risk Assessment and Inventory component, for which land parcels, infrastructure, and population at risk have been summarized and described in this report.

The following is a summary of land parcels, infrastructure, and population at risk by municipality. Of note, for all areas, no hospitals are at risk of flooding under all scenarios.

Town of Peace River

The Town of Peace River has land parcels at risk of direct inundation at all return periods; however, for open water flood return periods of 100-years and lower, the at-risk land parcels do not contain at-risk residential buildings. At the 50-, 100-, and 200-year ice jam flood scenarios and at the governing design flood scenarios, there are land parcels at risk of direct inundation, and some of these parcels contain at-risk residential buildings. The land parcels containing at-risk residential buildings for the ice jam floods and governing design floods are located in the residential areas west of the Peace River West Dike and east of the Peace River East Dike. At the 200-year and higher open water flood return periods and at the 50-, 100-, and 200-year ice jam floods, residential and non-residential areas located east of the Peace River are at risk of direct inundation due to overtopping of the Peace River East Dike and Heart River Dikes; and, residential areas west of the Peace River are at risk of direct inundation due to overtopping of the Peace River West Dike. At the 10- to 100-year open water return periods, residential buildings are at risk due to potential flood control structure failure including potential failure of the Peace River East Dike, Peace River West Dike, Heart River Left Dike, Heart River Right Dike and 12 Foot Davis Park Dike. There are four bridges at risk of inundation in the Town of Peace River: the CNR bridge over the Peace River at the 750- and 1000-year open water flood extents; the 101 St. Bridge over the Heart River at the 20-year return period and higher return periods for open water flood extents, at the 50-, 100-, and 200-year return periods for ice jam flood extents, and in the floodway zone of the governing design flood scenario; and, both pedestrian bridges over the Heart River (Ped. Bridge 1 and Ped. Bridge 2) at the 200-year return period and higher return periods for open water flood extents, at the 100- and 200-year ice jam flood scenarios, and in the floodway zone of the governing design flood scenario. There is less than 1 km of railway at risk of inundation in the Town of Peace River for the largest open water or ice jam

floods (including the governing design flood). The Town of Peace River has the longest length of roadway at risk of inundation at all the return periods for open water, ice jam flood, and governing flood scenarios, ranging from 0.07 km to 26.83 km of at-risk roadway. The Town of Peace River has 31 to 2809 people at risk of inundation at the 2- to 1000-year open water flood return periods, respectively. The Town of Peace River has 2205 to 2672 people at risk of inundation at the 50- to 200-year ice jam flood scenarios, respectively, and 2531 people at risk of inundation for the governing design flood scenario.

Municipal District of Peace No. 135

The Municipal District of Peace No. 135 has 99 to 128 land parcels at risk of direct inundation at the 2- to 1000-year return periods for open water flood extents, 113 to 136 land parcels at risk at the ice jam flood extents, and 124 land parcels at risk for the governing design flood; however, the majority of these land parcels are located on agricultural or crown land and do not contain residential buildings. In the M.D. of Peace No. 135 there are a maximum of nine residential buildings at risk of direction inundation for open water flood extents and a maximum of 10 residential buildings at risk of direct inundation for ice jam flood extents and for the governing design flood. There are no bridges and no railway at risk of inundation in the M.D. of Peace No. 135 for the open water, ice jam flood, and governing design flood scenarios. The M.D. of Peace No. 135 has less than 1 km of roadway at risk of inundation at most open water return periods, less than 3.5 km of roadway at risk for all ice jam scenarios, and less than 2.5 km of roadway at risk for the governing design flood. The M.D. of Peace No. 135 has between 4 and 17 people at risk of direct inundation at all return periods for open water, ice jam, and governing design flood scenarios.

Northern Sunrise County

There are land parcels at risk of direct inundation in Northern Sunrise County at all return periods; however, none of these land parcels contain residential buildings at risk of direct inundation. The majority of at-risk land parcels in Northern Sunrise County are on land classified as Environmental/Park Reserve District and agricultural land. There are no bridges and no railway at risk of inundation in Northern Sunrise County for the open water, ice jam flood, and governing design flood scenarios. Northern Sunrise County has less than 1 km of roadway at risk of inundation at all return periods for open water, ice jam flood, and governing design flood scenarios. There are one to 13 people at risk of direct inundation at all return periods for open water, ice jam, and governing design flood scenarios.

Birch Hills County

There are land parcels at risk of direct inundation in Birch Hills County at all return periods; however, none of these land parcels contain residential buildings at risk of direct inundation. The majority of at-risk land parcels in Birch Hills County are located in Peace River Wildland Provincial Park. There are no bridges and no railway at risk of inundation in Birch Hills County for the open water, ice jam flood, and governing design flood scenarios. Birch Hills County has 1 km of roadway or less at risk of inundation at most return periods. There is a maximum of five people at risk of direct inundation at the 200-year return period and higher for open water flood scenarios, at the 50-, 100-, and 200-year ice jam flood scenarios, and at the governing design flood scenario.

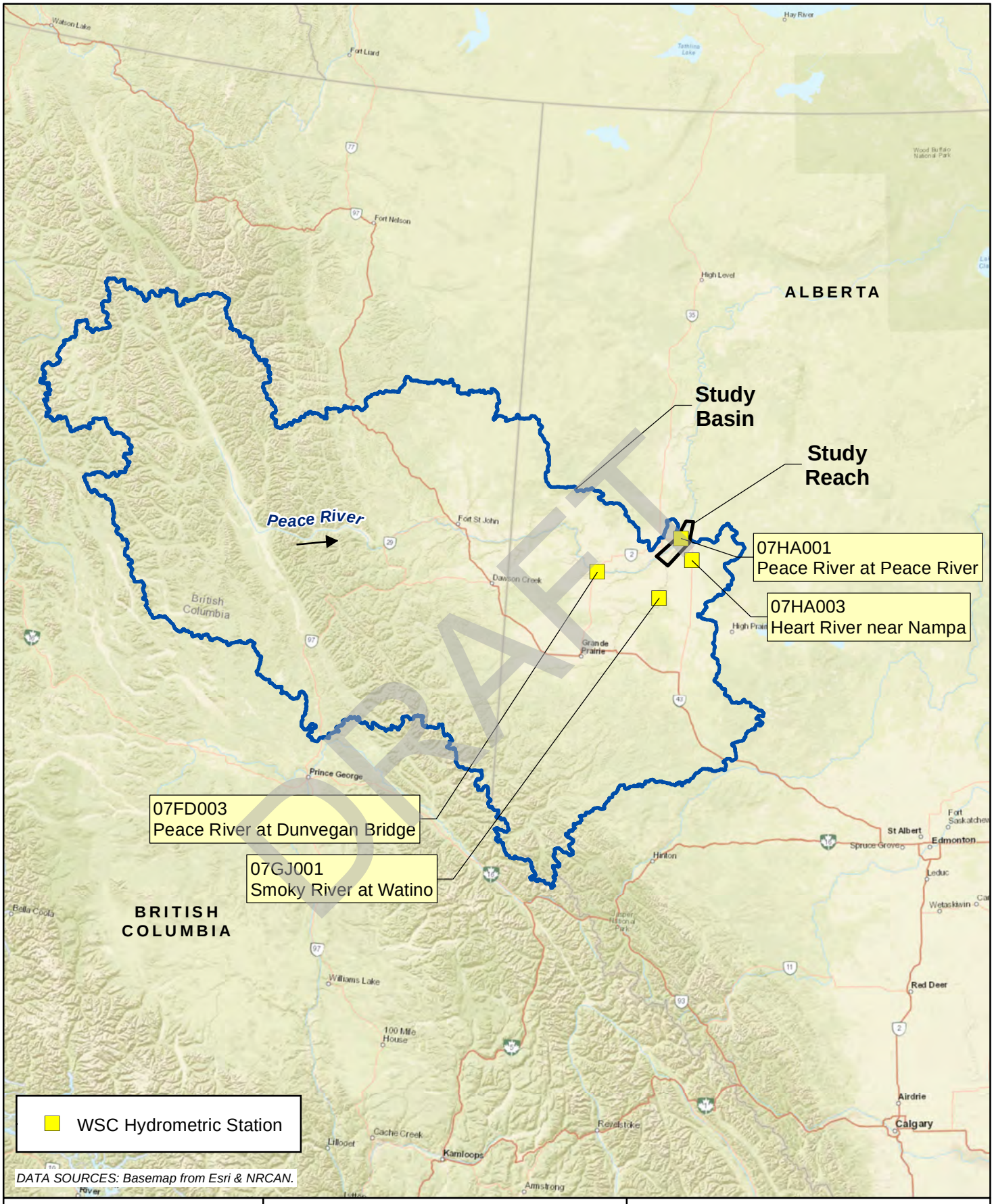
County of Northern Lights

There are land parcels at risk of direct inundation in the County of Northern Lights at all return periods; however, none of these land parcels contain residential buildings at risk of direct inundation. In the County of Northern Lights, the majority of at-risk land parcels are located on crown land and in industrial districts. There are no bridges at risk of inundation in the County of Northern Lights. There is less than 1 km of railway at risk of inundation in the County of Northern Lights for the open water flood scenario at the 10-year return period and higher, for the ice jam flood scenario at the 50-, 100-, and 200-year return periods, and for the governing design flood scenario. There are one to four people at risk of direct inundation at all return periods for open water, ice jam, and governing design flood scenarios.

6 REFERENCES

Statistics Canada (2016). 2016 Census – Boundary files. Statistics Canada. Data set accessed 12-Dec-2017 at http://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2016-eng.cfm

Figures



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Coordinate System: NAD 1983 CSRS 10TM AEP FOREST
Units: METRES

Job: 1001119

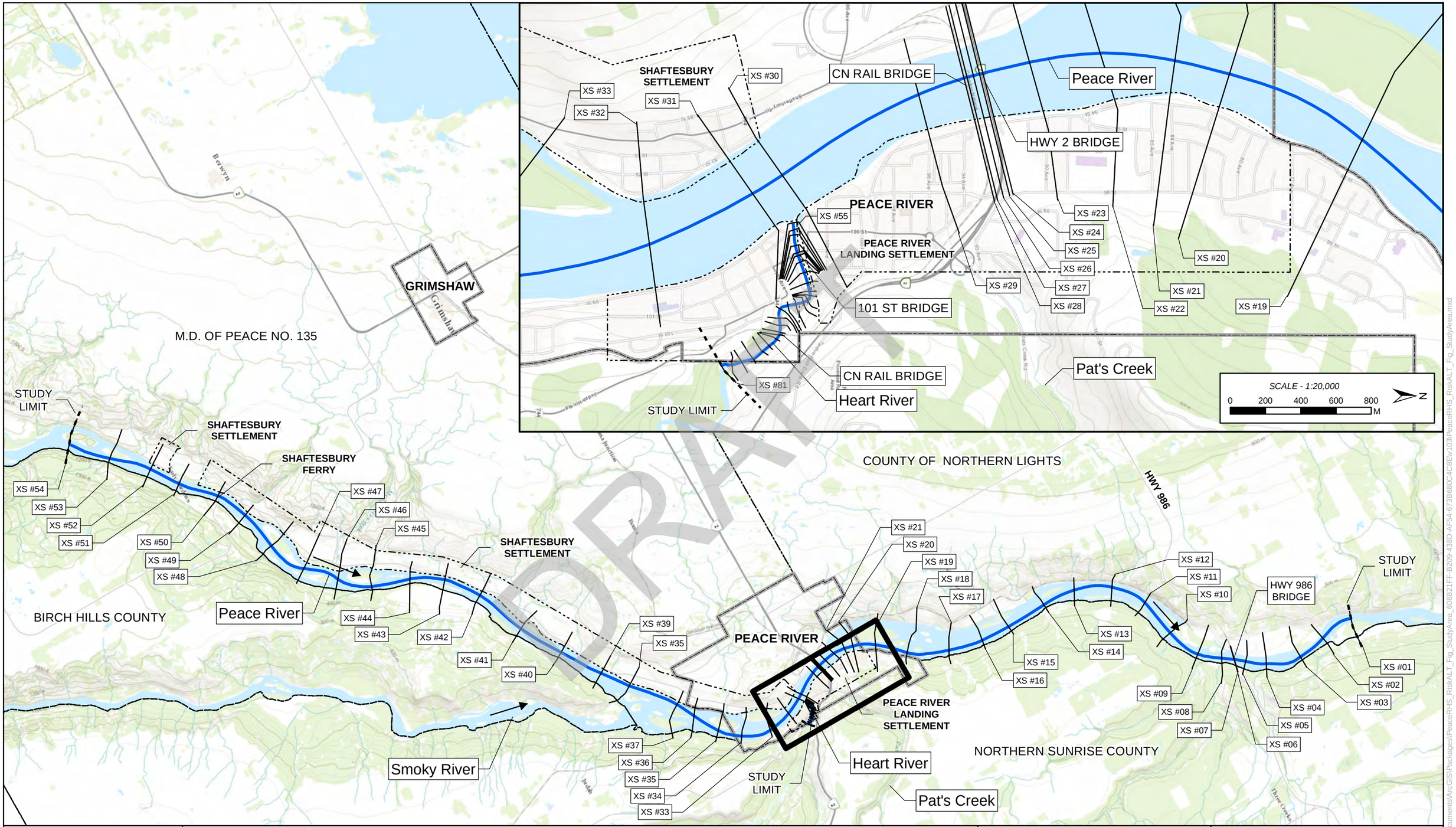
Date: 31-MAR-2021

PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT & INVENTORY

LOCATION MAP

FIGURE 1



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Model Stream Network
Model Cross Section
Settlement
Town
County or Municipal District

DATA SOURCES: Basemap from Esri & NRCAN.

SCALE - 1:130,000
0 1 2 3 4 5 KM
N

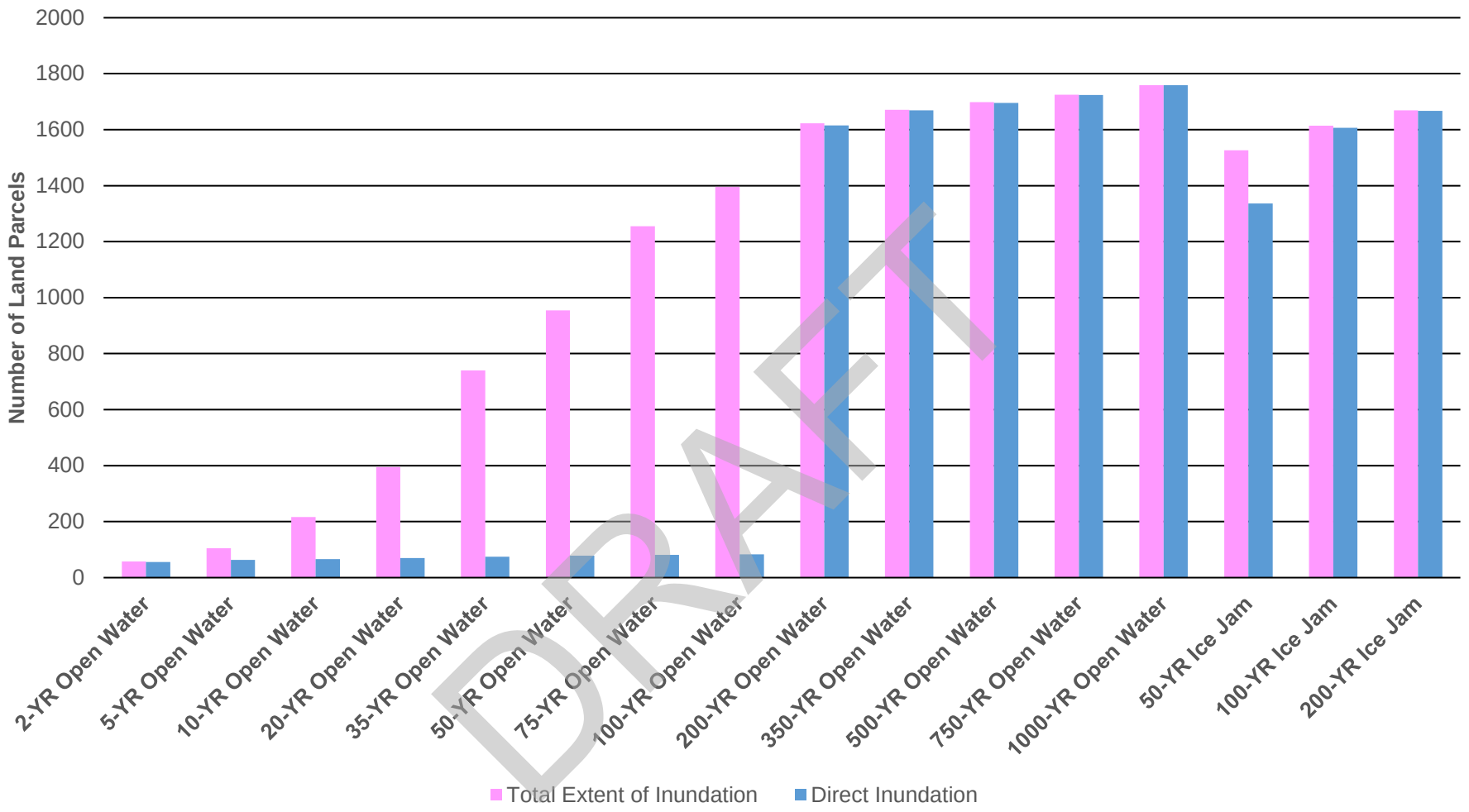
Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119 | Date: 31-MAR-2021

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY
STUDY AREA

FIGURE 2

MSN, C:\Users\MBachynsky\Documents\ArcGIS\Packages\PeaceRHS_RiskALT_Fig_StudyArea_606B21FF-B209-438D-AF54-673B68DC4C8E\v103\PeaceRHS_RiskALT_Fig_StudyArea.mxd



Notes: 1. A land parcel was deemed to be at risk if the land parcel polygon intersected the flood extent. The land parcel at risk was attributed to the municipality within which the centroid of the land parcel polygon was found.

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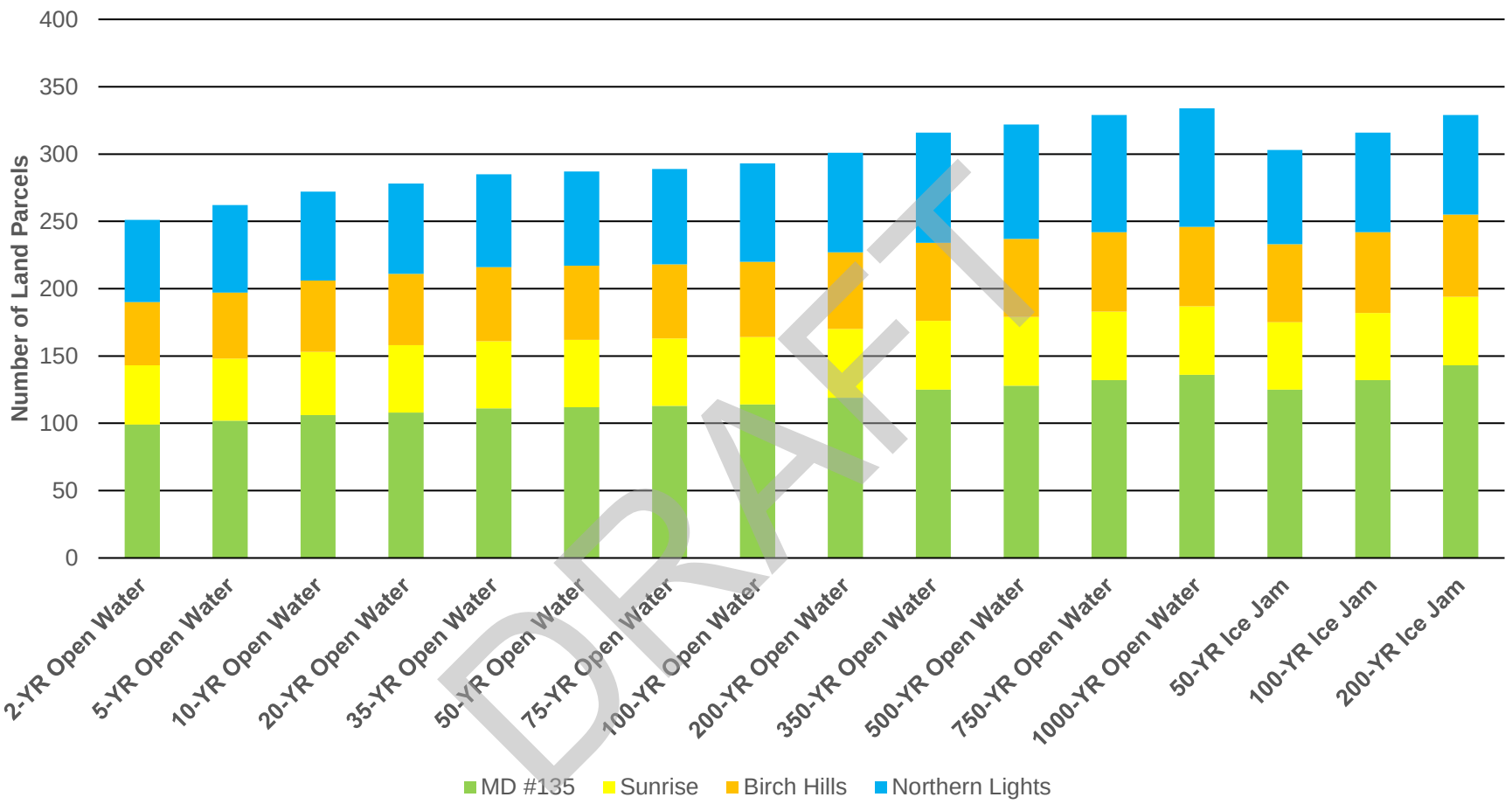
ALBERTA ENVIRONMENT AND PARKS

PEACE RIVER HAZARD STUDY
FLOOD RISK INVENTORY AND ASSESSMENT

LAND PARCELS AT RISK TOWN OF PEACE RIVER FOR TOTAL EXTENT AND DIRECT INUNDATION

1001119	31 MAY 2021	**FIGURE 3**



Notes:
1. A land parcel was deemed to be at risk if the land parcel polygon intersected the flood extent. The land parcel at risk was attributed to the municipality within which the centroid of the land parcel polygon was found.
2. Values are stacked by municipality.

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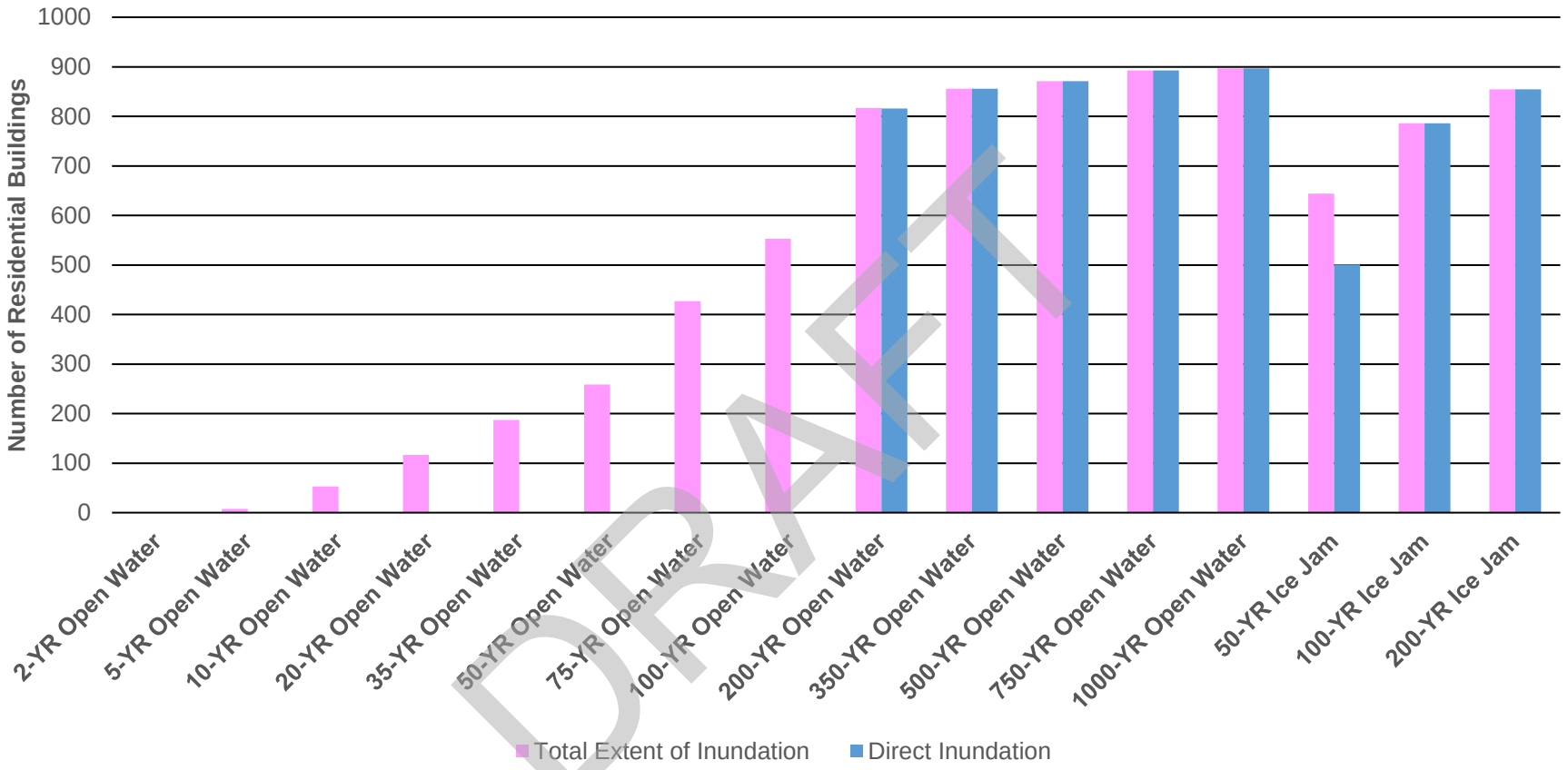
ALBERTA ENVIRONMENT AND PARKS

PEACE RIVER HAZARD STUDY
FLOOD RISK INVENTORY AND ASSESSMENT

LAND PARCELS AT RISK BY MUNICIPALITY FOR TOTAL EXTENT OF INUNDATION

1001119	31 MAY 2021	**FIGURE 4**



Notes:

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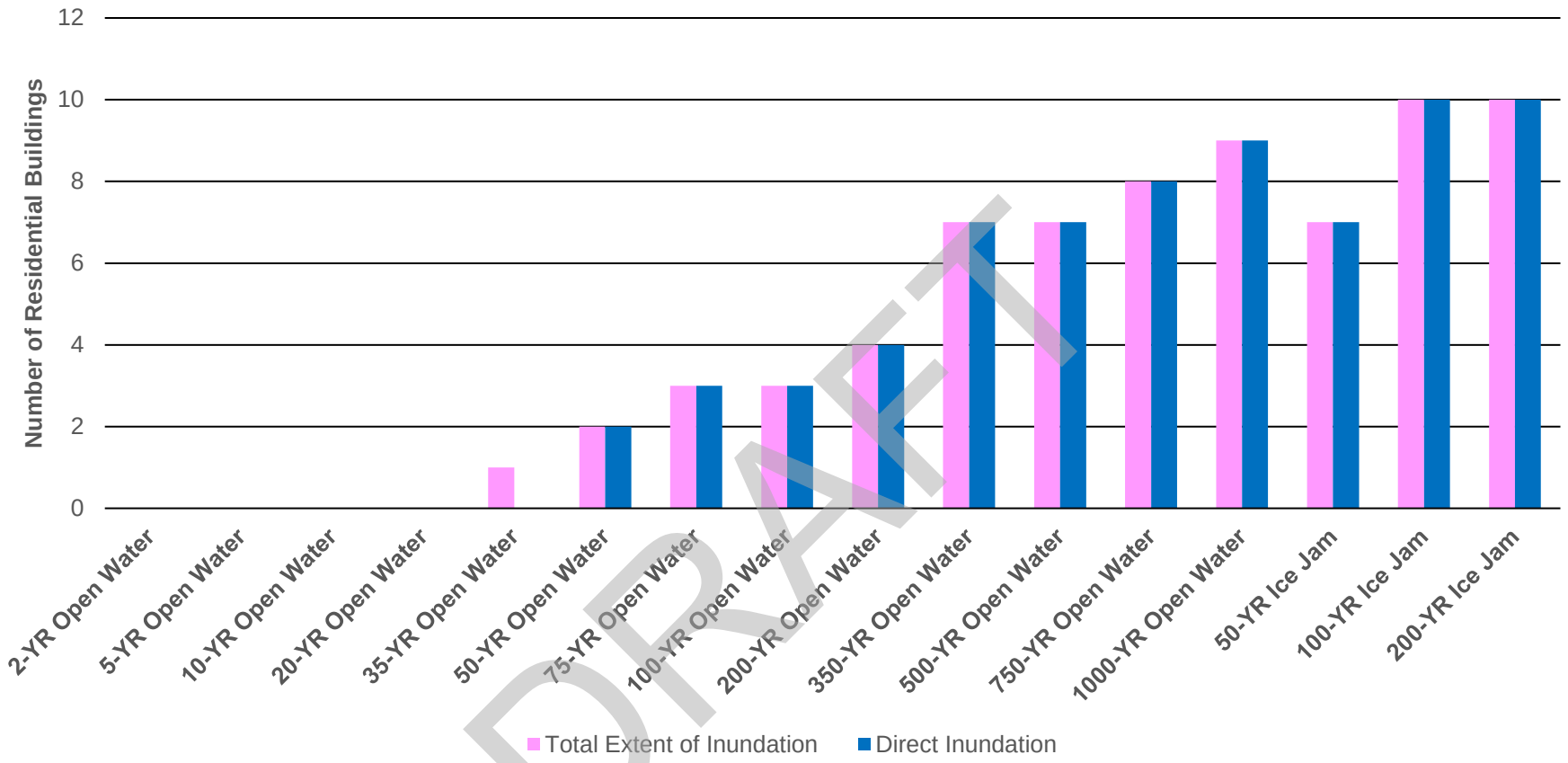
ALBERTA ENVIRONMENT AND PARKS		
PEACE RIVER HAZARD STUDY FLOOD RISK INVENTORY AND ASSESSMENT **RESIDENTIAL BUILDINGS AT RISK TOWN OF PEACE RIVER FOR TOTAL EXTENT AND DIRECT INUNDATION**		
1001119	31 MAY 2021	**FIGURE 5**



Notes: 1. MD135 includes Shaftesbury Settlement.

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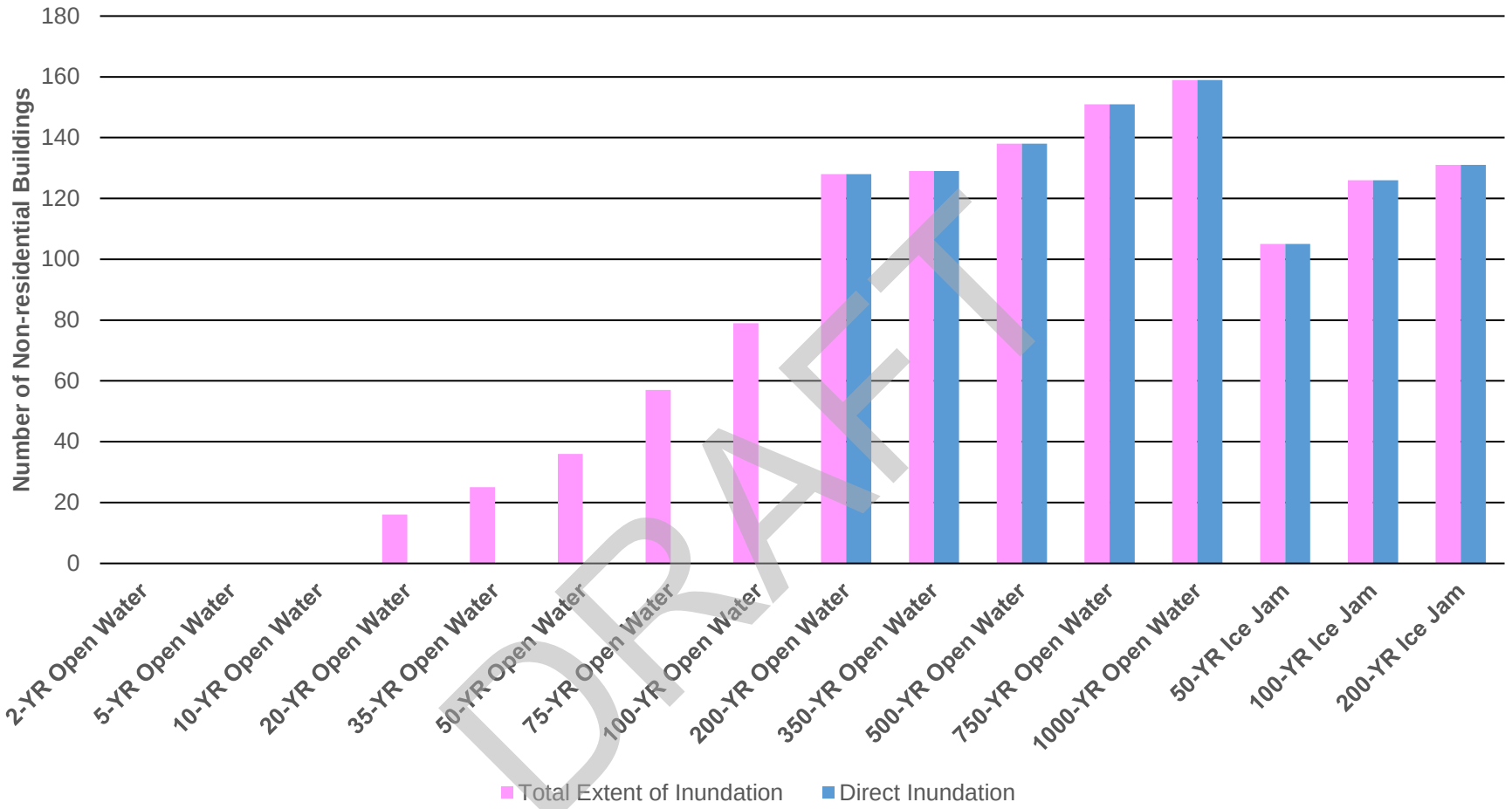
ALBERTA ENVIRONMENT AND PARKS		
PEACE RIVER HAZARD STUDY FLOOD RISK INVENTORY AND ASSESSMENT **RESIDENTIAL BUILDINGS AT RISK MD #135 FOR TOTAL EXTENT AND DIRECT INUNDATION**		
1001119	31 MAY 2021	**FIGURE 6**



Notes:

ALBERTA ENVIRONMENT AND PARKS		
PEACE RIVER HAZARD STUDY FLOOD RISK INVENTORY AND ASSESSMENT **NON-RESIDENTIAL BUILDINGS AT RISK TOWN OF PEACE RIVER FOR TOTAL EXTENT AND DIRECT INUNDATION**		
1001119	31 MAY 2021	**FIGURE 7**

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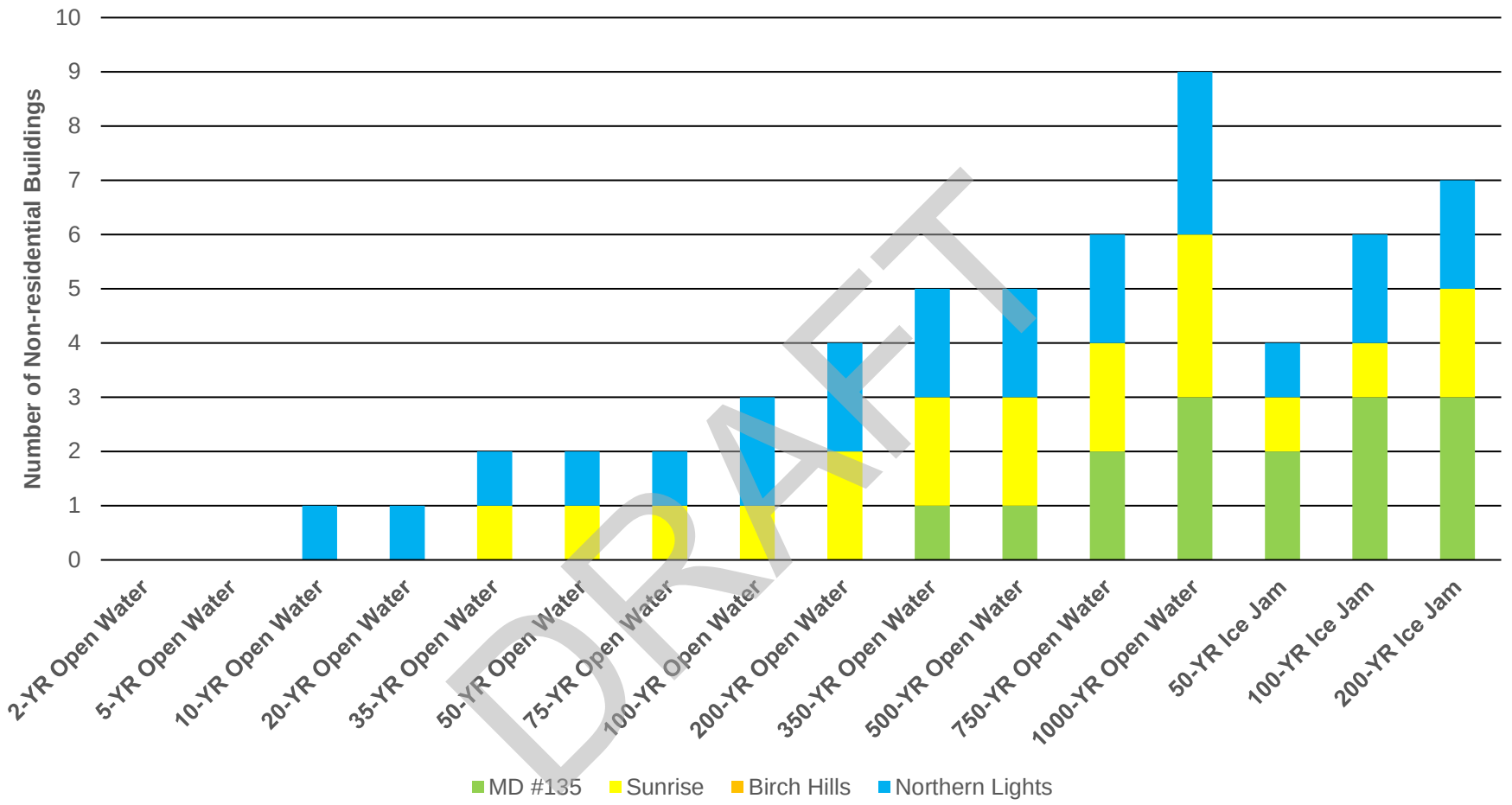

Notes: 1. Values are stacked by municipality.

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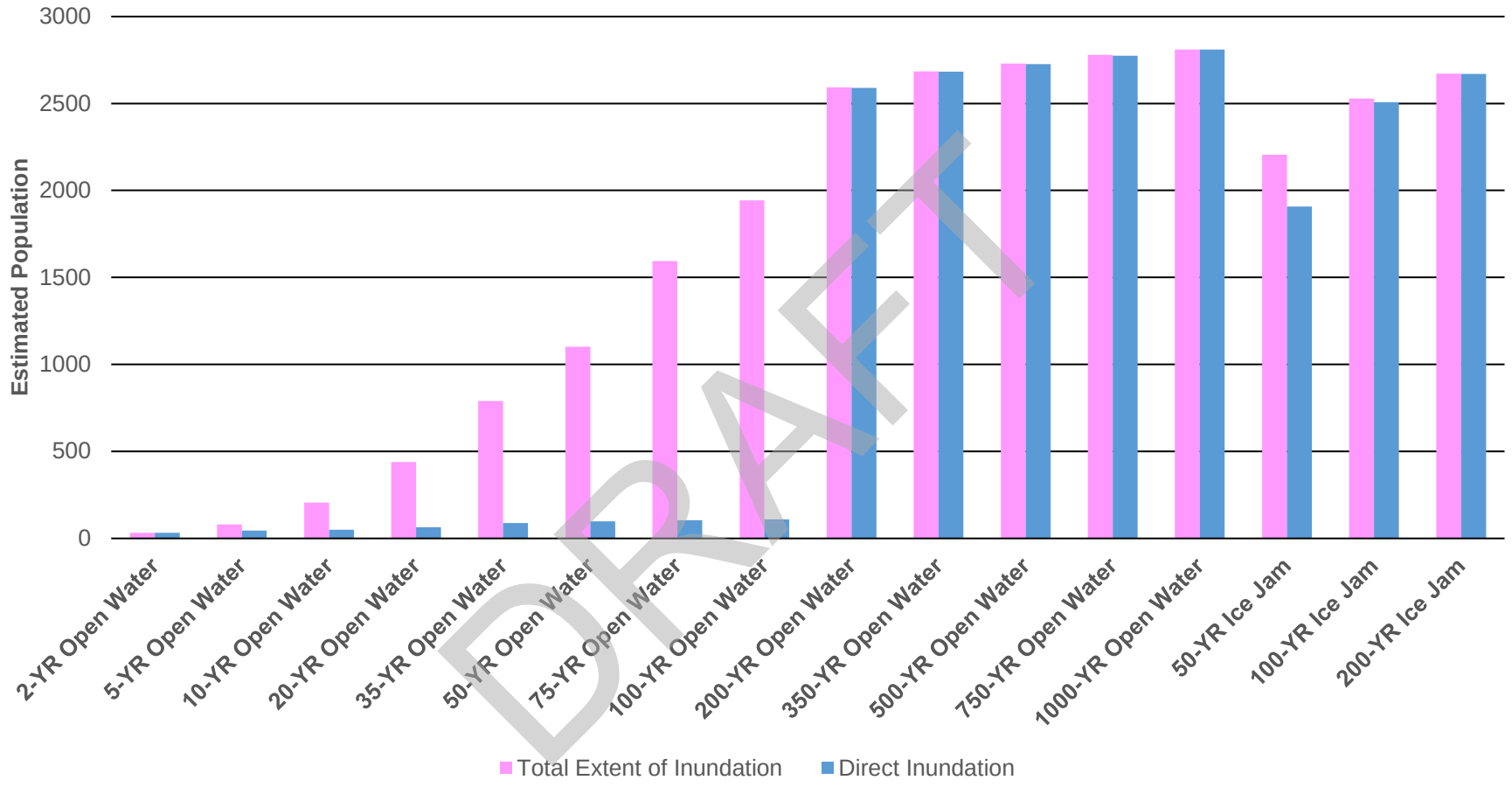
ALBERTA ENVIRONMENT AND PARKS

PEACE RIVER HAZARD STUDY
FLOOD RISK INVENTORY AND ASSESSMENT

NON-RESIDENTIAL BUILDINGS AT RISK BY MUNICIPALITY FOR TOTAL EXTENT OF INUNDATION

1001119	31 MAY 2021	**FIGURE 8**



Notes: 1. Population values were estimated based on the percentage of each census dissemination block that intersected the flood extent, multiplied by the total population within each dissemination block..

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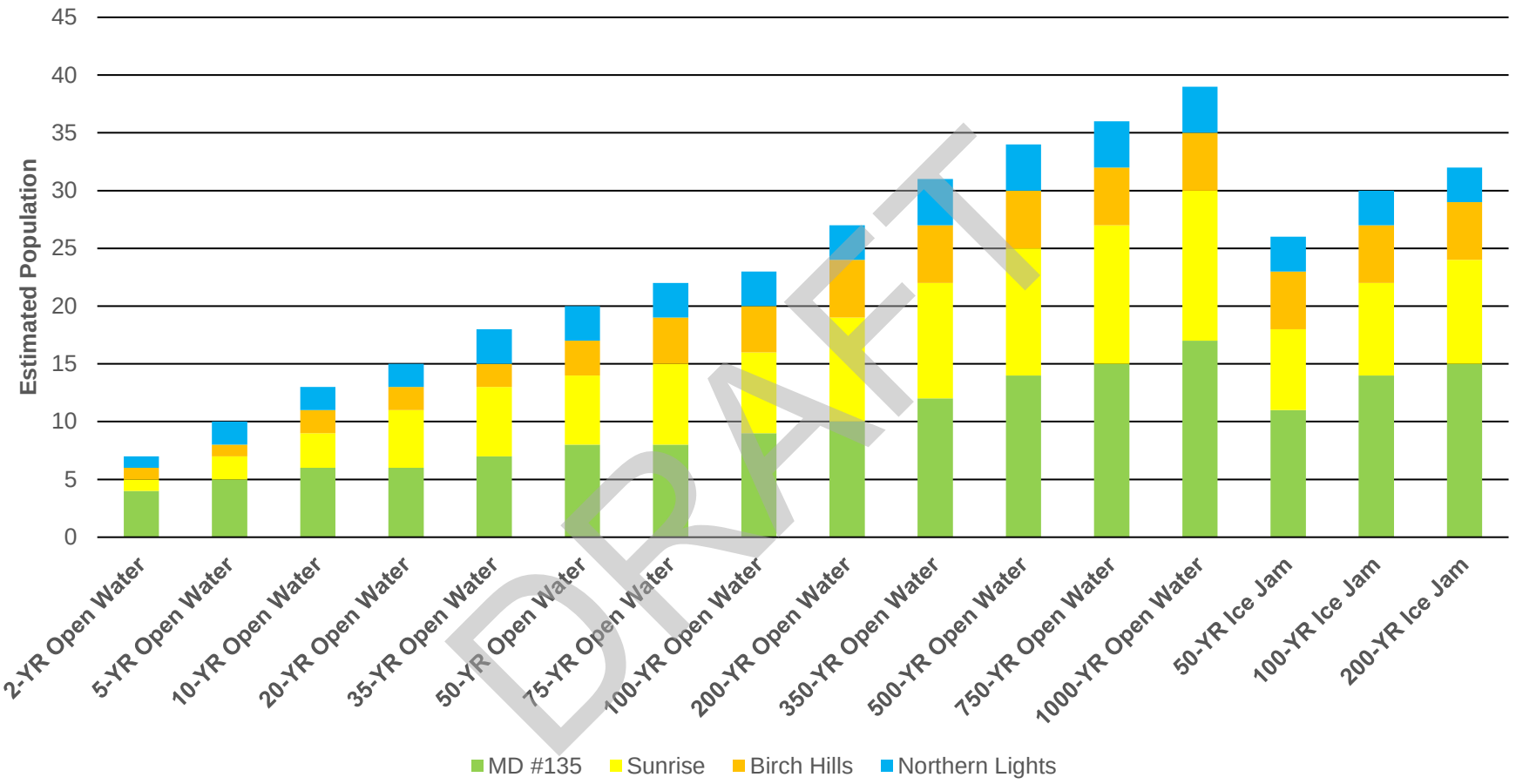
ALBERTA ENVIRONMENT AND PARKS

PEACE RIVER HAZARD STUDY
FLOOD RISK INVENTORY AND ASSESSMENT

ESTIMATED POPULATION AT RISK TOWN OF PEACE RIVER FOR TOTAL EXTENT AND DIRECT INUNDATION

1001119	31 MAY 2021	**FIGURE 9**



Notes:
1. Population values were estimated based on the percentage of each census dissemination block that intersected the flood extent, multiplied by the total population within each dissemination block.
2. Values are stacked by municipality.

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ALBERTA ENVIRONMENT AND PARKS

PEACE RIVER HAZARD STUDY
FLOOD RISK INVENTORY AND ASSESSMENT

ESTIMATED POPULATION AT RISK BY MUNICIPALITY FOR TOTAL EXTENT OF INUNDATION

1001119	31 MAY 2021	**FIGURE 10**

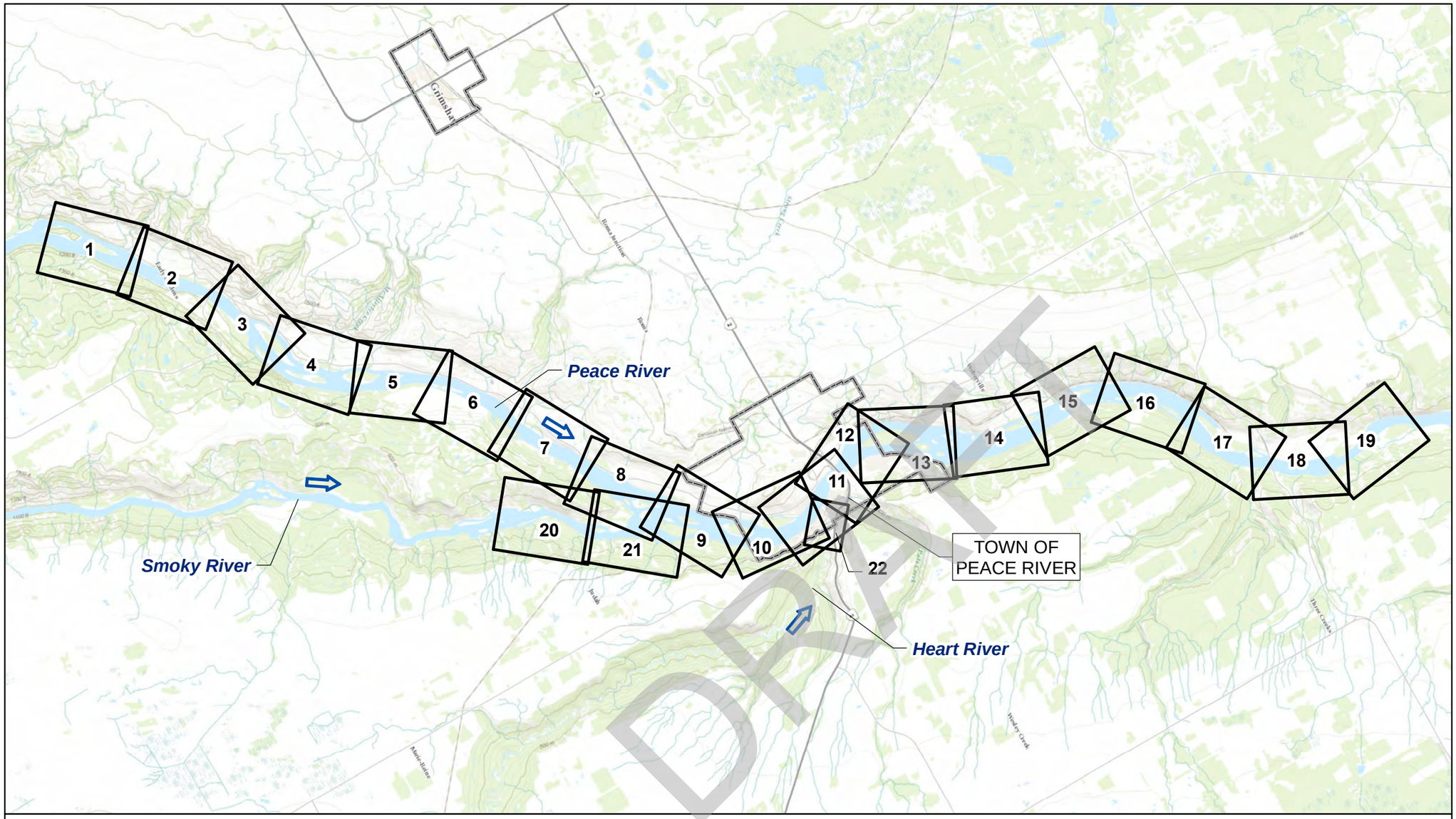
Appendix A
Spatial Data Description

Spatial Data Summary - Risk Assessment

CATEGORY	TITLE	DESCRIPTION	KEY ATTRIBUTE DESCRIPTION	FOLDER or GDB	FILE
RISK ASSESSMENT DATA					
	Bridges	Point locations of bridges within the study area. Esri file geodatabase point feature class.	HydroID = unique id created by NHC ; RiverCode = name of river; ReachCode = name of river reach; NodeName = name of bridge.	PeaceRHS_RiskAssessment.gdb\	Bridges
	Census Dissemination Blocks	Census dissemination blocks that intersect the study area. 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.	PeaceRHS_RiskAssessment.gdb\	CensusPopulation
	Water Bodies	Water bodies used to clip census data, in order to ensure census areas over water were not counted. Extracted from Alberta Base Features Hydrography. Esri file geodatabase polygon feature class.	FEATURE_TY = feature type.	PeaceRHS_RiskAssessment.gdb\	WaterBodies
	Community Boundaries	Communities intersecting the study area. These boundaries include: Municipal District of Peace No. 135, Northern Sunrise County, Birch Hills County, County of Northern Lights, and Town of Peace River. Esri file geodatabase polygon feature class.	Type = type of boundary; Name = name of community.	PeaceRHS_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. Bridges were removed by NHC so that bridge decks are not included in calculation of railway at risk. Bridge segements were determined based on examination of underlying topography. Esri file geodatabase line feature class.	TRACKNAME = name of track; TRACKCLASS = track classification; USETYPE = use of railway line; OPERATOENA = name of operator; OWNERENA = name of owner.	PeaceRHS_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. Bridges were removed by NHC so that bridge decks are not included in calculation of roadway at risk. Bridge segements were determined based on examination of underlying topography. 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; L_STNAME_C, R_STNAME_C = name of road.	PeaceRHS_RiskAssessment.gdb\	Roads

CATEGORY	TITLE	DESCRIPTION	KEY ATTRIBUTE DESCRIPTION	FOLDER or GDB	FILE
	Land Parcel	Cadastral boundaries within the study area. Data supplied by AEP. Esri file geodatabase polygon feature class.	PID = parcel ID; SOURCE = source of data.	PeaceRHS_RiskAssessment.gdb\	CadastralBoundaries
	Buildings	Point locations of residential and non-residential buildings within the study area. Features digitized and classified by NHC, based on 2016 orthophoto, cadastral data, Google Maps, and Google Street View. Esri file geodatabase point feature class.	CATEGORY = building category (RESIDENTIAL, NON-RESIDENTIAL); SUB_CATEGORY = building sub-category (SINGLE FAMILY, MULTI FAMILY, MOBILE HOME, RETIREMENT HOME; COMMERCIAL, GOVERNMENT, INDUSTRIAL, SCHOOL, WATER TREATMENT FACILITY, WASTEWATER TREATMENT FACILITY, OTHER); STATUS = building to be included in statistics or not (Include, Exclude).	PeaceRHS_RiskAssessment.gdb\	BuildingPts

Appendix B
Flood Risk Assessment and Inventory Spatial Data



Notes to Users:

1. Please refer to the accompanying **Peace River Hazard Study – Flood Risk Inventory and Assessment Report** (issued on 31 May 2021) for important information concerning these maps.

Data Sources and References:

1. Cadastral land parcel boundaries provided by Alberta Environment and Parks.
2. National Road Network and National Railway Network data acquired from NRCan.
3. 2016 census boundaries acquired from Statistics Canada.
4. Residential and non-residential structures digitized by NHC based on 2016 orthophoto.
5. Orthophoto imagery acquired by ORTHOSHOP Geomatics Ltd. (3 May 2016) for Alberta Environment and Parks.
6. Base data from Town of Peace River, Alberta Environment and Parks, AltaLIS, and NRCan.
7. Additional base mapping from Esri.

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SCALE - 1:150,000

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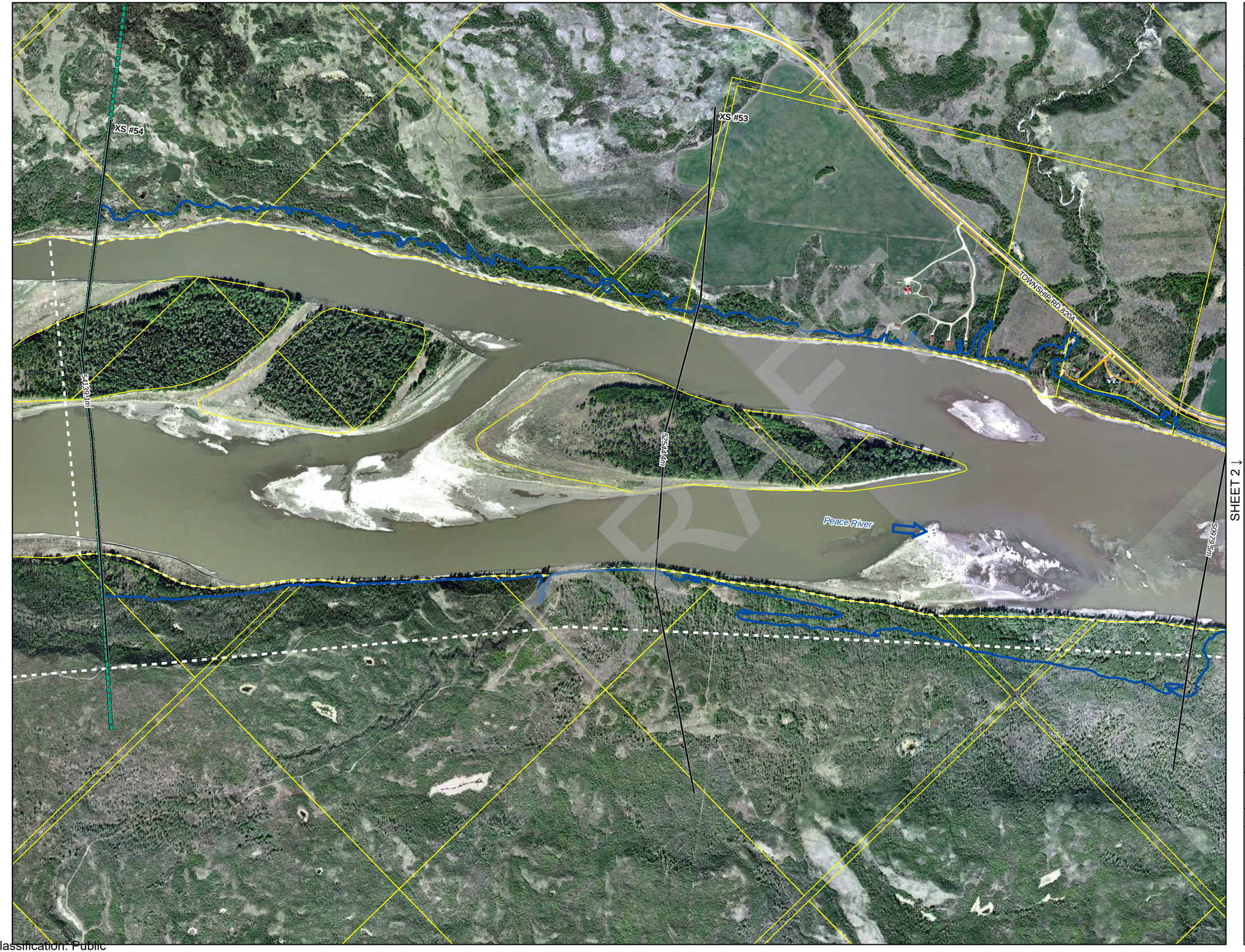
Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119 | *Date: 31-MAY-2021*

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA INDEX MAP

INDEX MAP

MSN, \\mainfile-van\Projects\Active\1001119 Peace River Flood Hazard Study\GIS\1001119_MSN_Map_T800_2021_RiskAssessmentMapIndex_R0A.mxd



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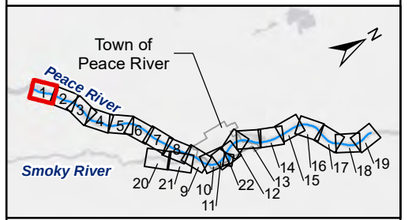


- FLOW DIRECTION
- CROSS SECTION
- STUDY LIMIT
- 1000-YEAR FLOOD INUNDATION EXTENT

INFRASTRUCTURE
- BRIDGE
- RAILWAY
- MAJOR ROAD
- LOCAL ROAD
- FERRY ROUTE
- LAND PARCEL
- CENSUS BOUNDARY
- PEACE RIVER TOWN BOUNDARY
- SETTLEMENT BOUNDARY

STRUCTURES
- RESIDENTIAL
- NON-RESIDENTIAL

SCALE - 1:10,000

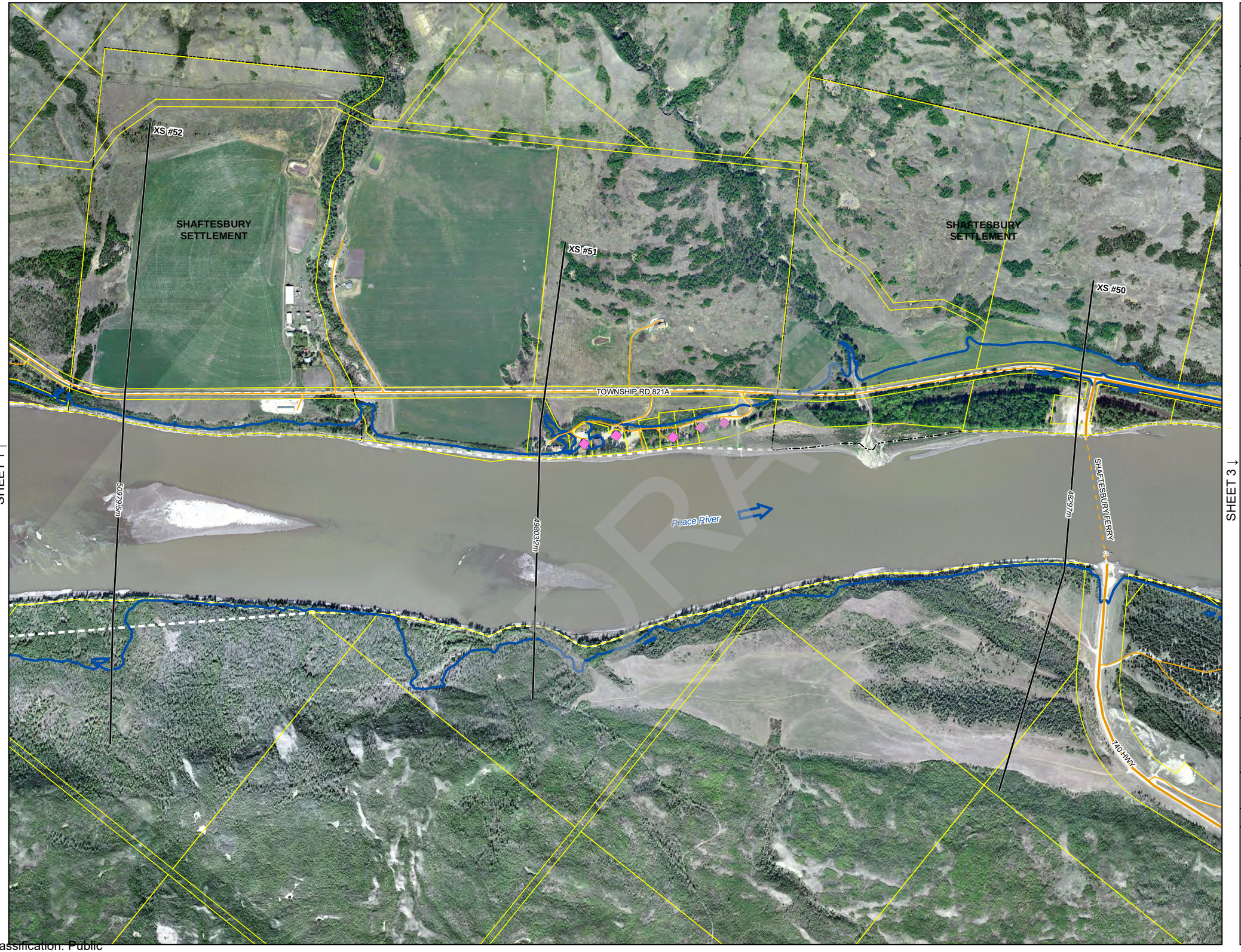
0 200 400 M

Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119	Date: 31-MAY-2021

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 1 OF 22



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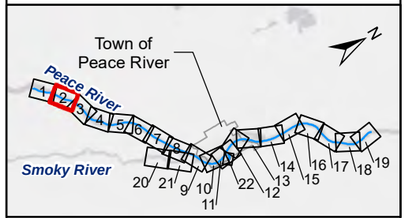


- FLOW DIRECTION
- CROSS SECTION
- STUDY LIMIT
- 1000-YEAR FLOOD INUNDATION EXTENT

INFRASTRUCTURE
- BRIDGE
- RAILWAY
- MAJOR ROAD
- LOCAL ROAD
- FERRY ROUTE
- LAND PARCEL
- CENSUS BOUNDARY
- PEACE RIVER TOWN BOUNDARY
- SETTLEMENT BOUNDARY

STRUCTURES
- RESIDENTIAL
- NON-RESIDENTIAL

SCALE - 1:10,000

0 200 400 M

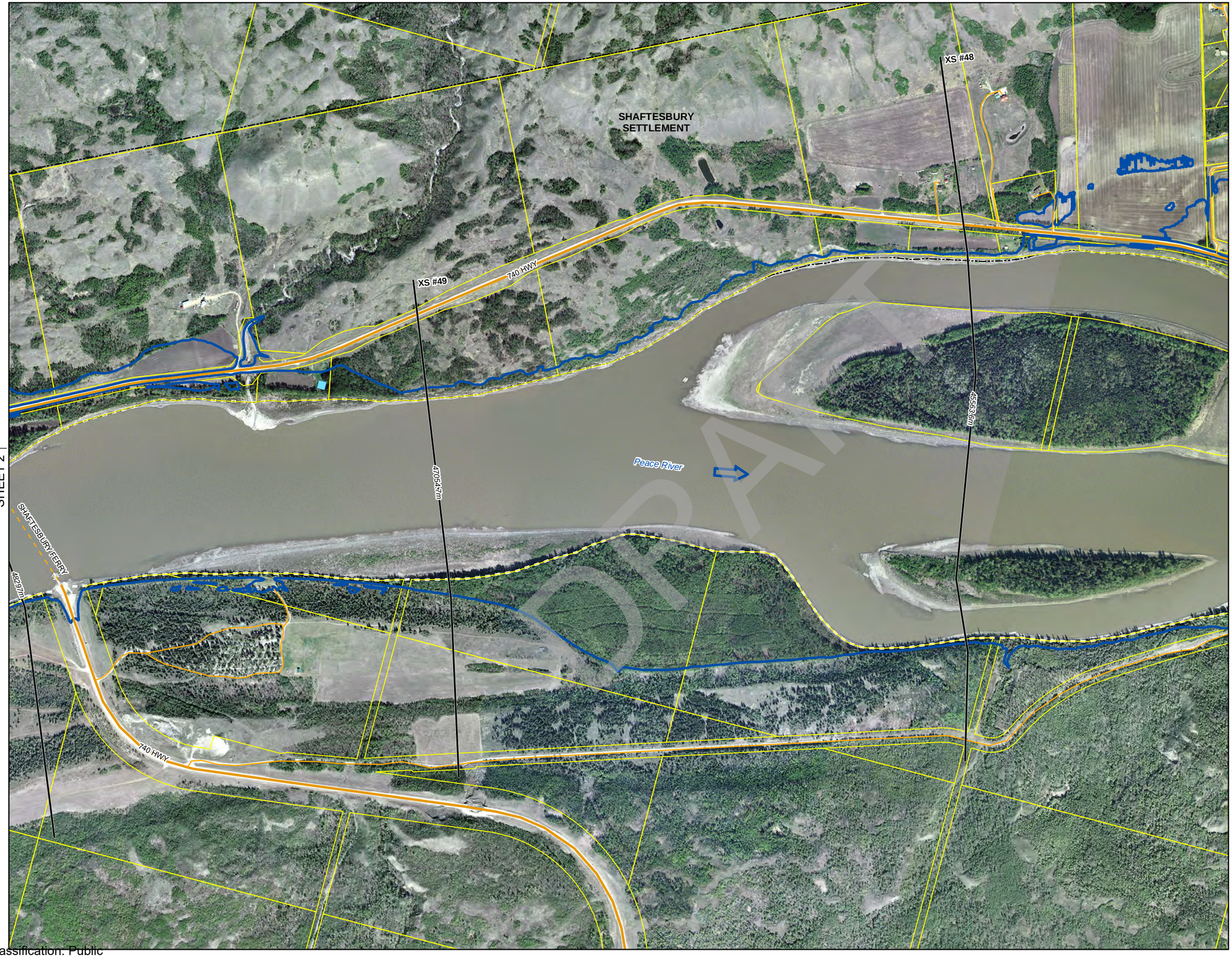
Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119 | Date: 31-MAY-2021

PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 2 OF 22



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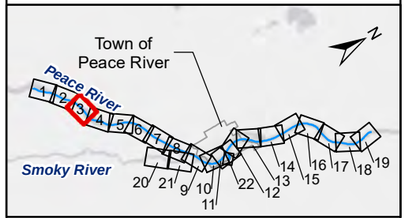


- FLOW DIRECTION
- CROSS SECTION
- STUDY LIMIT
- 1000-YEAR FLOOD INUNDATION EXTENT

INFRASTRUCTURE
- BRIDGE
- RAILWAY
- MAJOR ROAD
- LOCAL ROAD
- FERRY ROUTE
- LAND PARCEL
- CENSUS BOUNDARY
- PEACE RIVER TOWN BOUNDARY
- SETTLEMENT BOUNDARY

STRUCTURES
- RESIDENTIAL
- NON-RESIDENTIAL

SCALE - 1:10,000

0 200 400 M

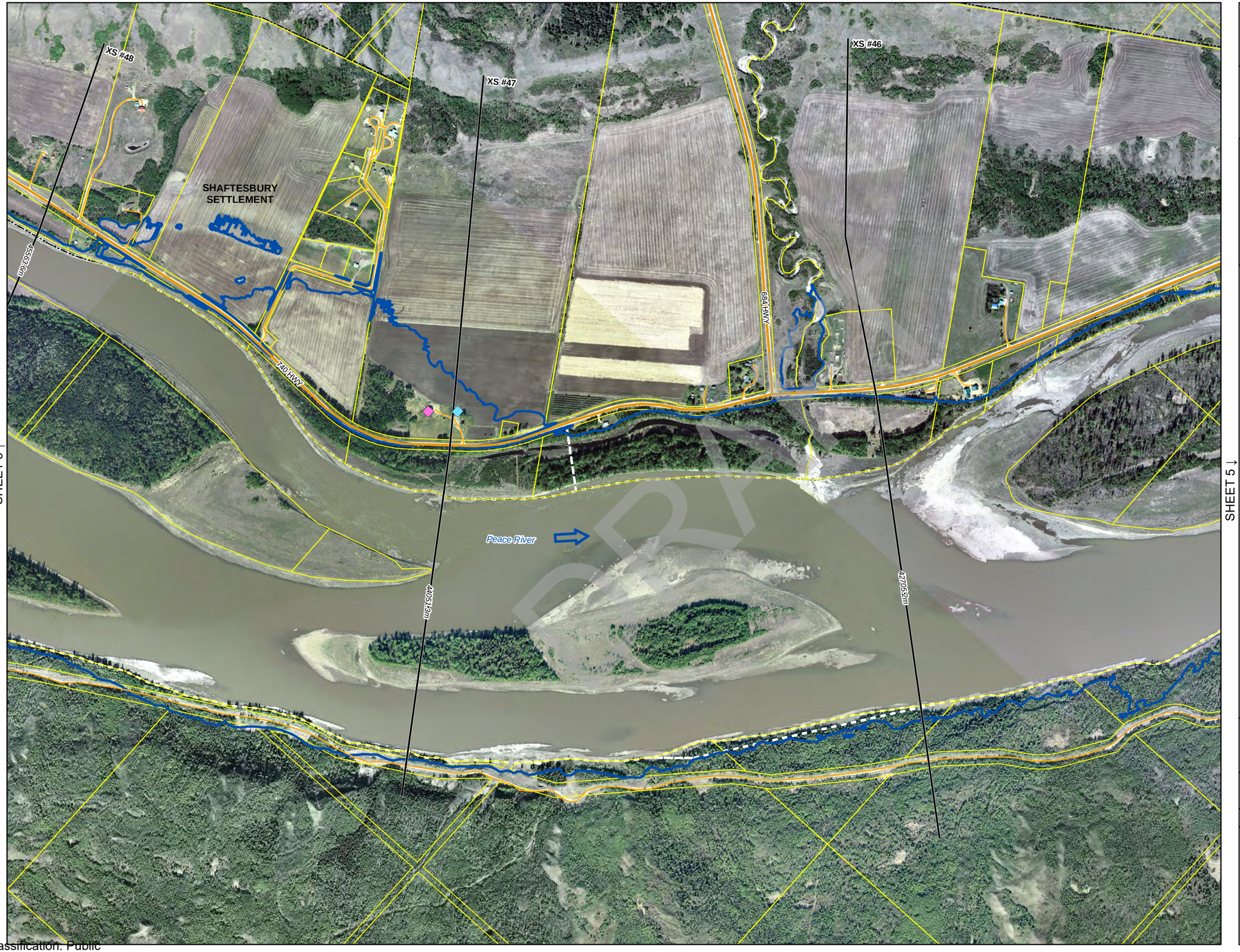
N

Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119 | Date: 31-MAY-2021

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 3 OF 22



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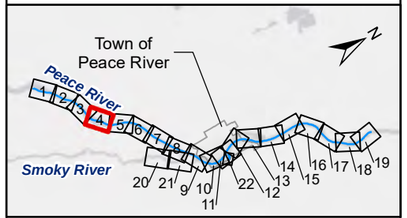


- FLOW DIRECTION
- CROSS SECTION
- STUDY LIMIT
- 1000-YEAR FLOOD INUNDATION EXTENT

INFRASTRUCTURE

- BRIDGE
- RAILWAY
- MAJOR ROAD
- LOCAL ROAD
- FERRY ROUTE
- LAND PARCEL
- CENSUS BOUNDARY
- PEACE RIVER TOWN BOUNDARY
- SETTLEMENT BOUNDARY

STRUCTURES

- RESIDENTIAL
- NON-RESIDENTIAL

SCALE - 1:10,000

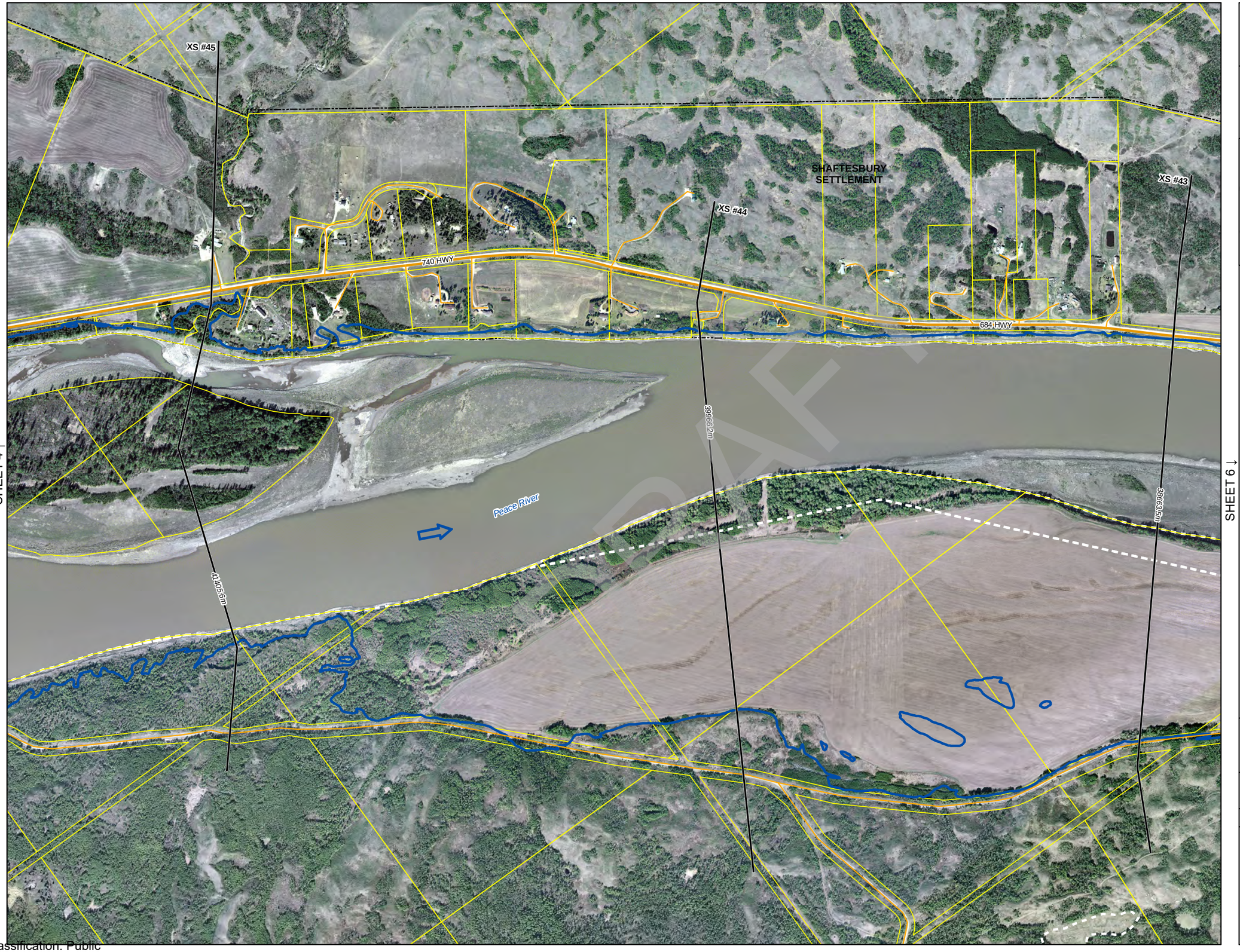
0 200 400 M

Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119	Date: 31-MAY-2021

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 4 OF 22



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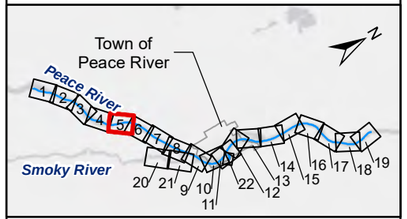

- FLOW DIRECTION
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- STUDY LIMIT
- 1000-YEAR FLOOD INUNDATION EXTENT

INFRASTRUCTURE
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Job: 1001119 | *Date: 31-MAY-2021*

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 5 OF 22

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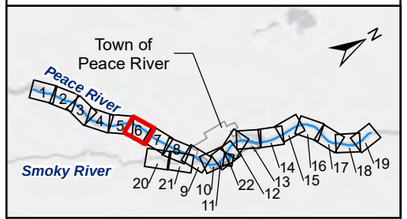

- FLOW DIRECTION
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N

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Job: 1001119 | Date: 31-MAY-2021

PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 6 OF 22

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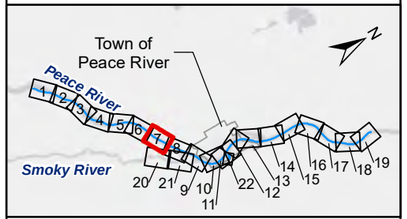

- FLOW DIRECTION
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INFRASTRUCTURE
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Job: 1001119 | Date: 31-MAY-2021

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 7 OF 22

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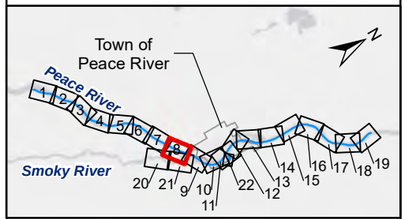

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INFRASTRUCTURE
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PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 8 OF 22

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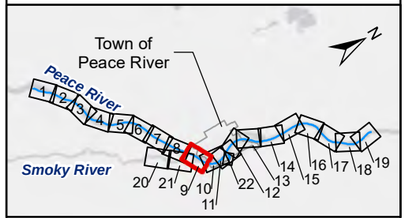

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PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 9 OF 22

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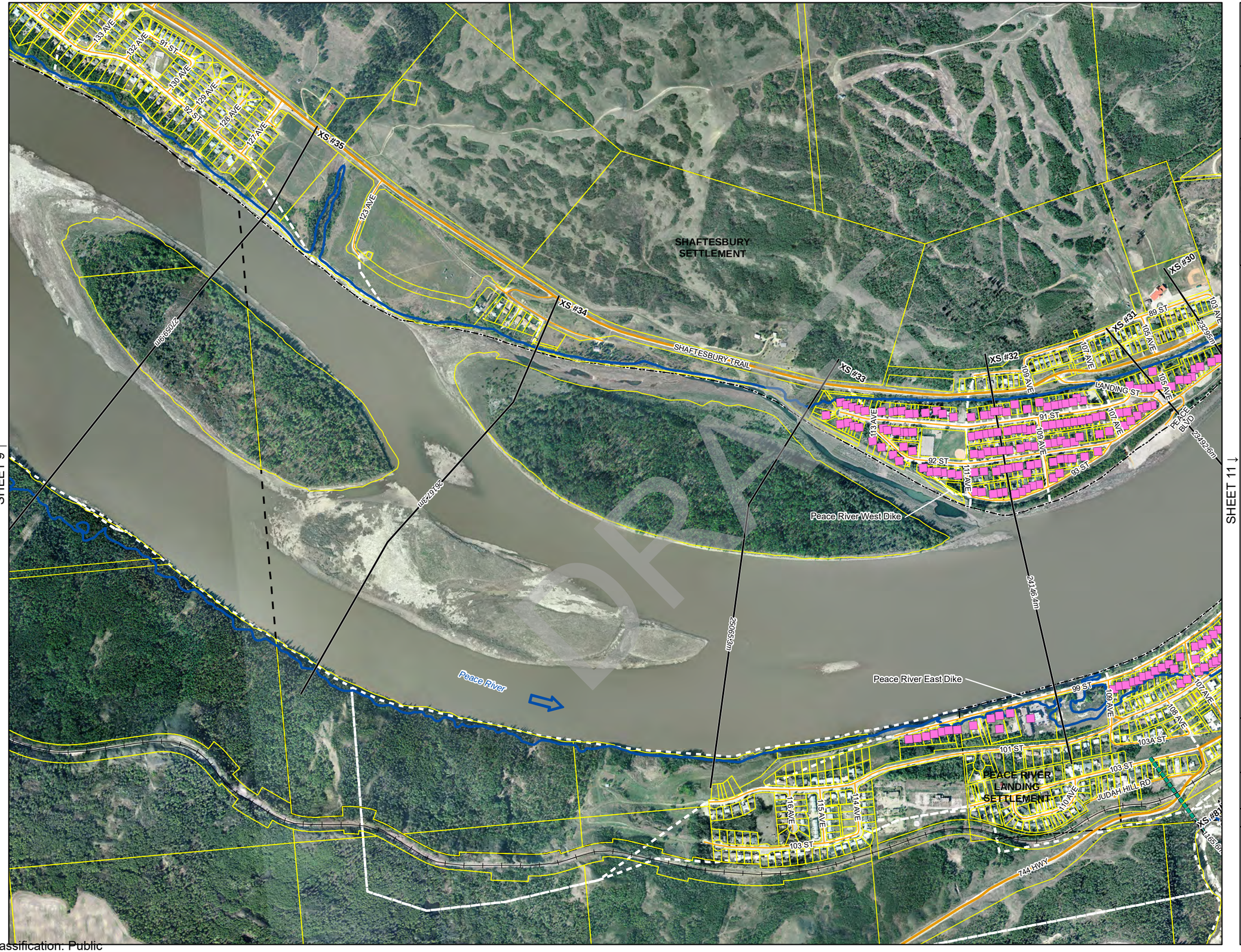

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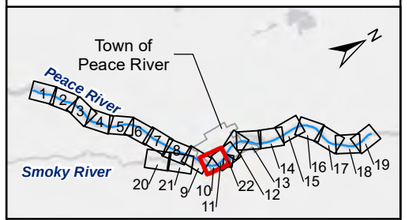

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PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 10 OF 22

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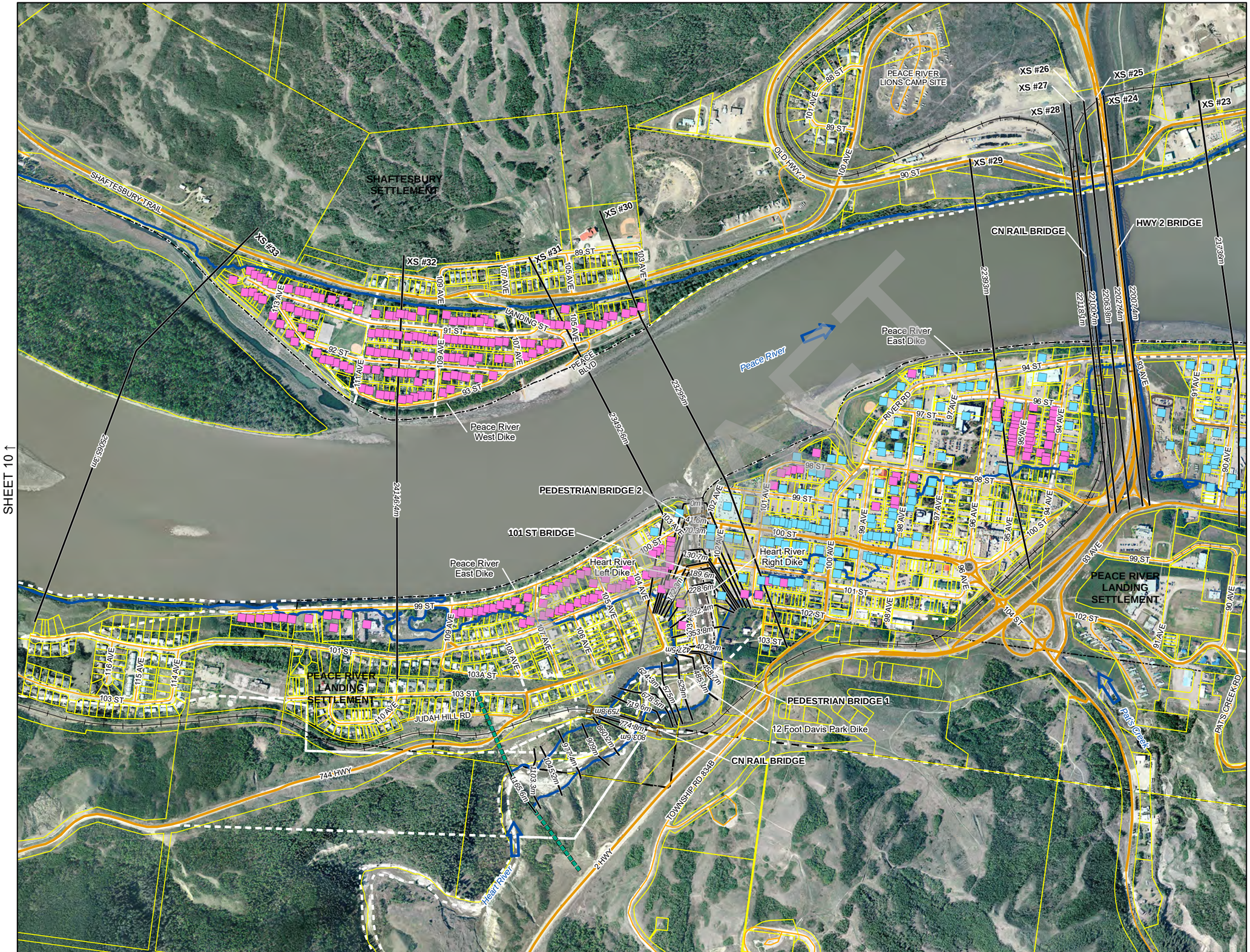

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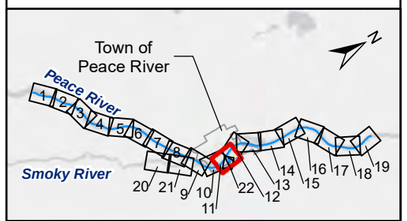

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PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 11 OF 22

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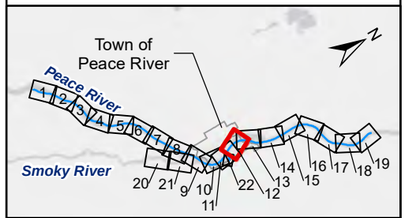

FLOW DIRECTION
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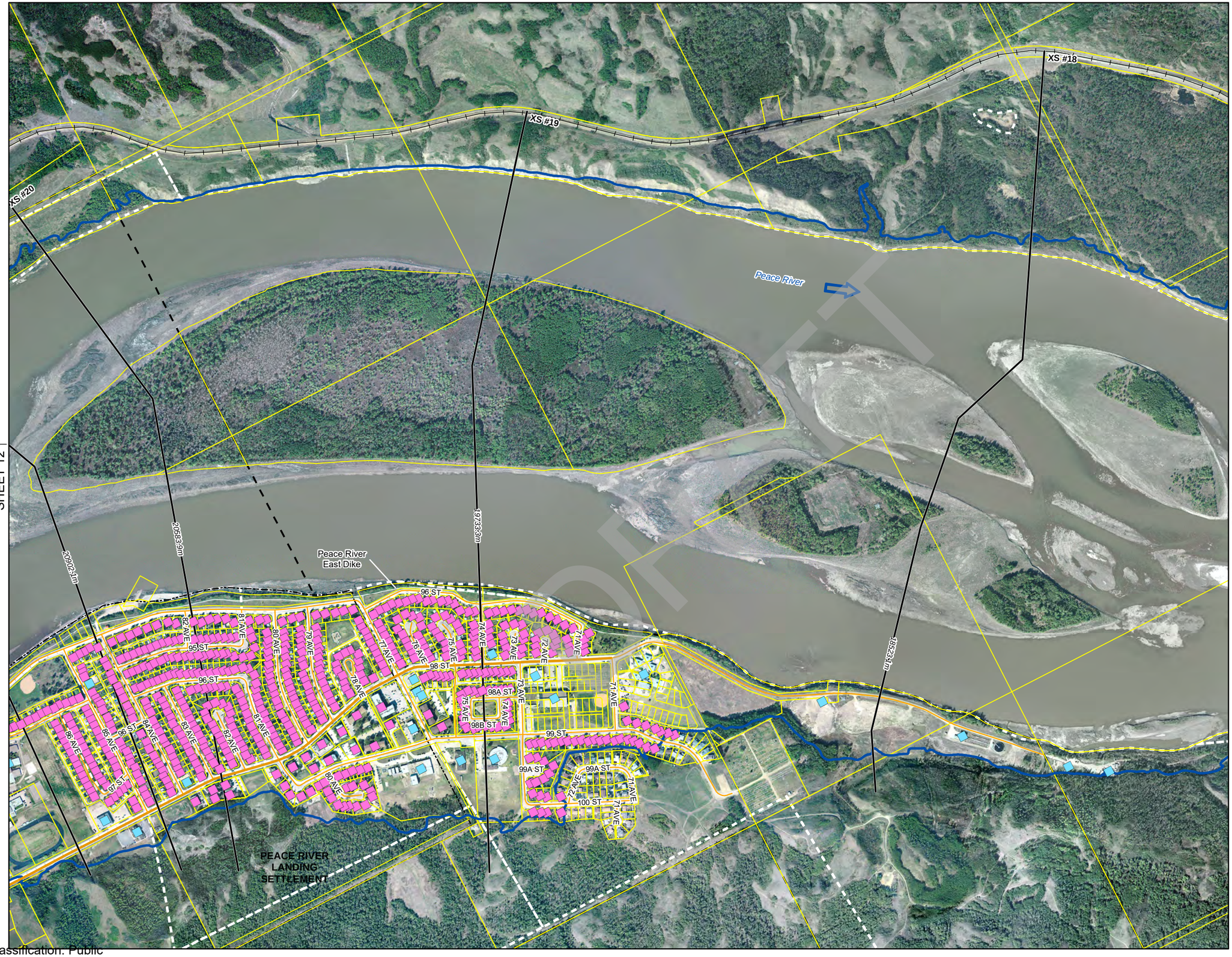
PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 12 OF 22



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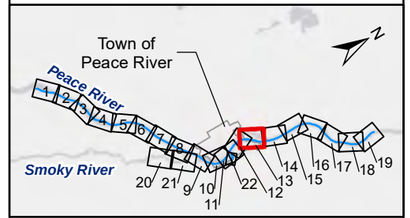

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PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 13 OF 22

SHEET 13 ↑

SHEET 15 ↓

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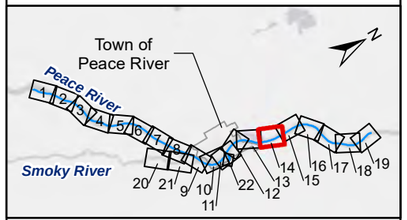

- FLOW DIRECTION
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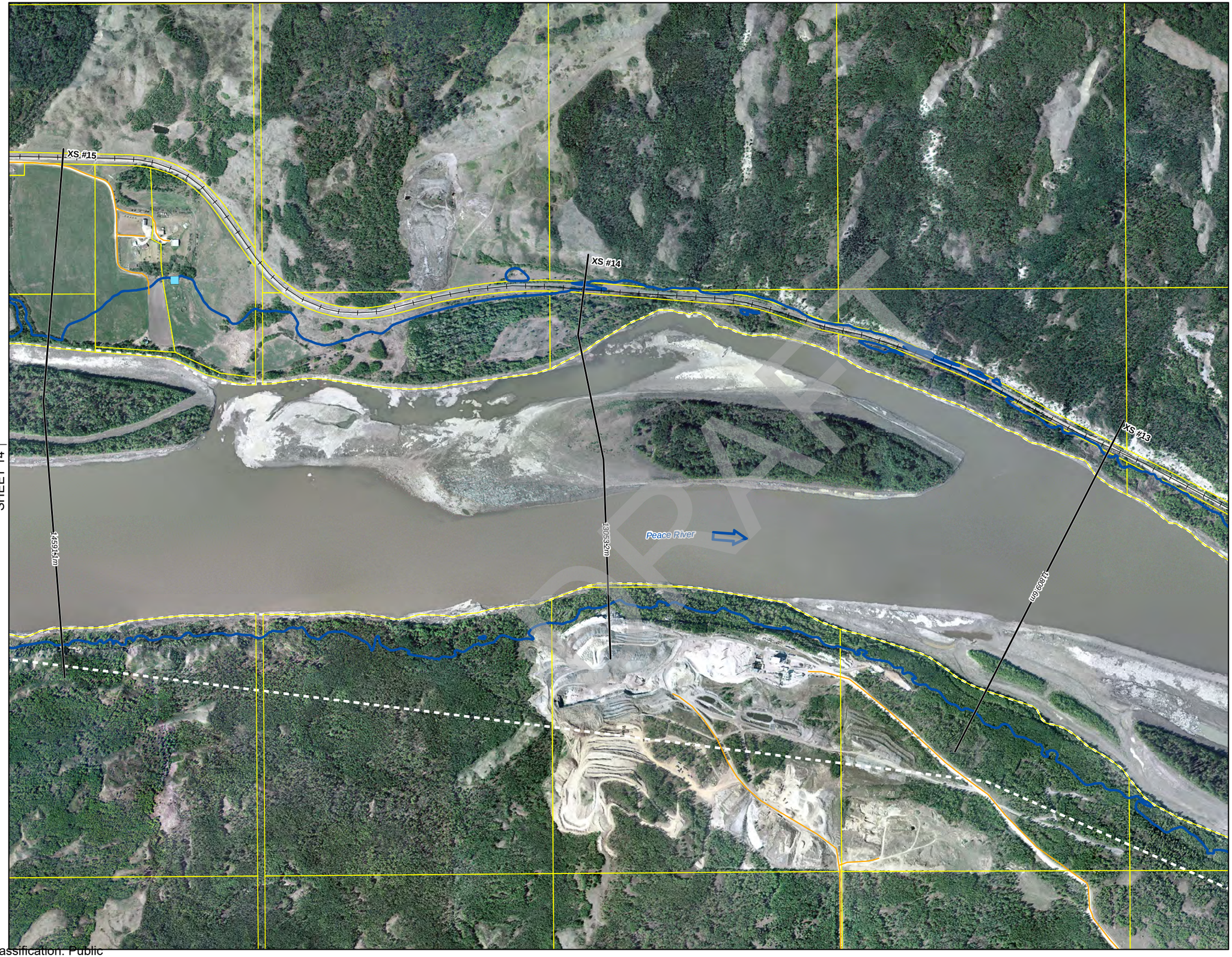
Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119	*Date: 31-MAY-2021*

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 14 OF 22



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SHEET 16 ↓

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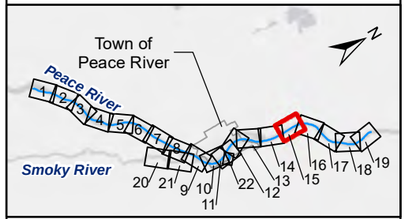

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PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 15 OF 22

SHEET 15 ↑

SHEET 17 ↓

XS #12

XS #11

Peace River

10385.1m

9024.8m

11899.6m

RANGE RD 213

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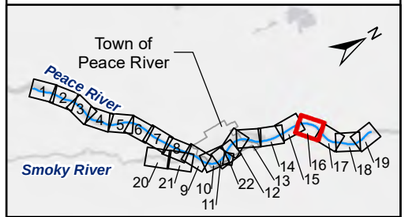

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PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY
SPATIAL DATA

SHEET 16 OF 22

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SHEET 16 ↑

SHEET 18 ↓

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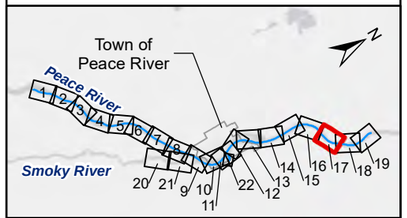

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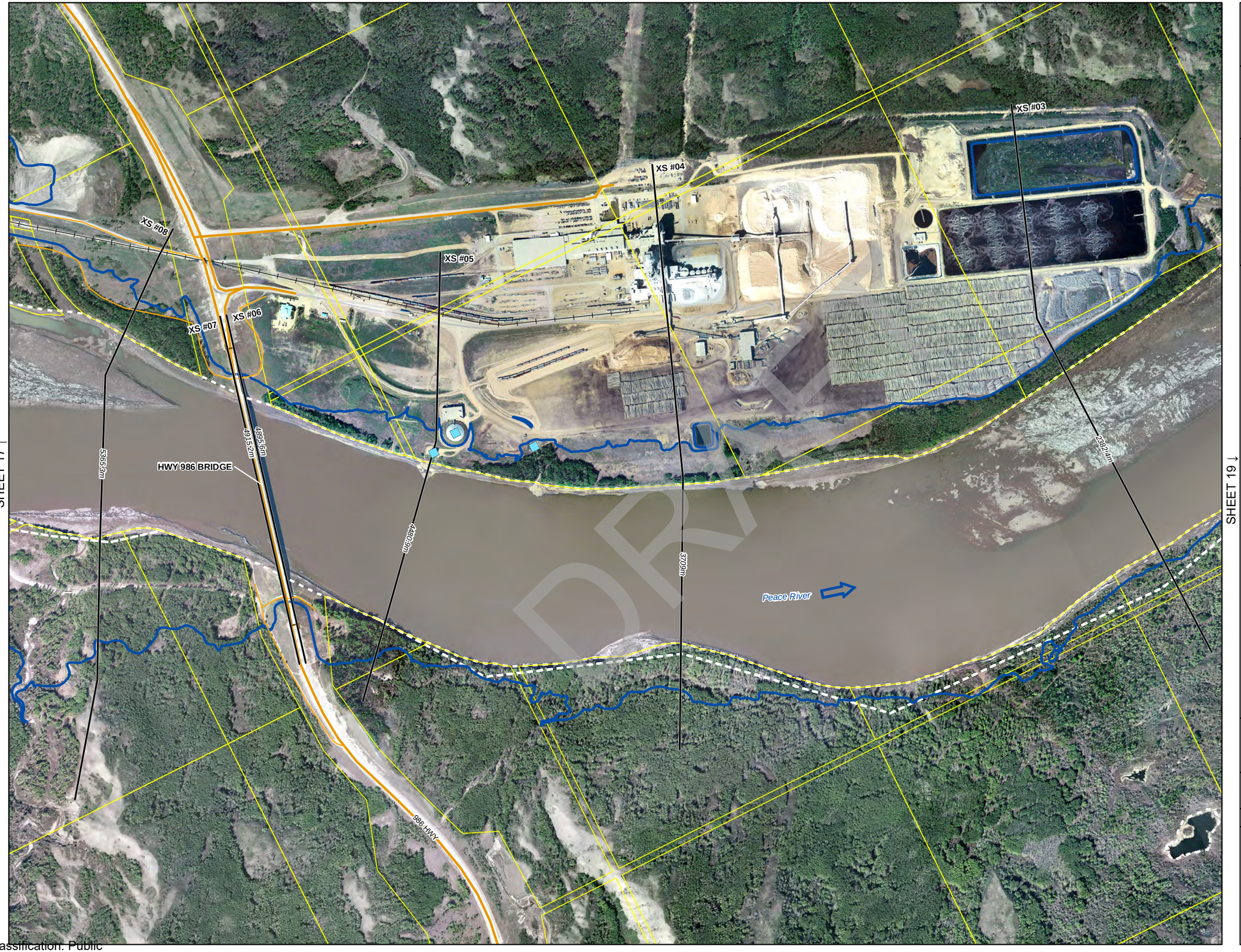
PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 17 OF 22



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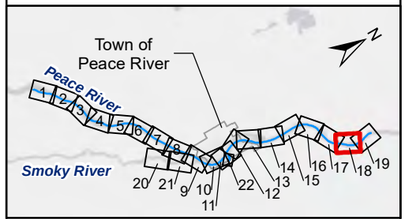

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PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 18 OF 22

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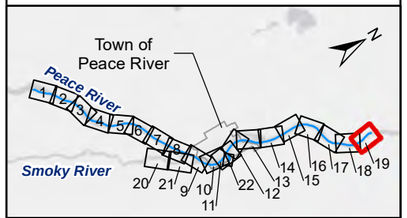

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PEACE RIVER HAZARD STUDY

FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 19 OF 22

SHEET 21 →

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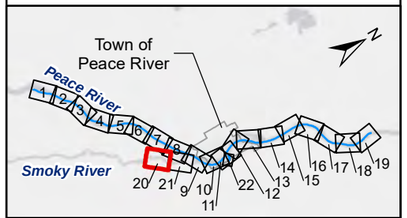

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PEACE RIVER HAZARD STUDY

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SHEET 20 OF 22

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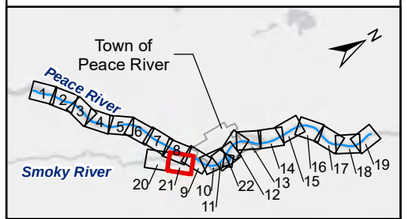

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PEACE RIVER HAZARD STUDY

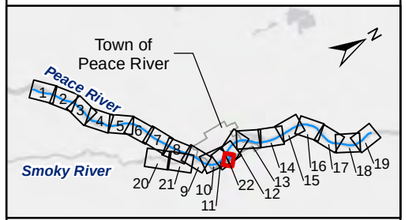
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 21 OF 22

MSN: \\mainfile-van\Projects\Active\1001119 Peace River Flood Hazard Study\GIS\1001119_MSN_Map_T800_2021_RiskAssessmentMap_R0A.mxd

Alberta Government

nhc
northwest hydraulic consultants



- FLOW DIRECTION
- CROSS SECTION
- STUDY LIMIT
- 1000-YEAR FLOOD INUNDATION EXTENT

INFRASTRUCTURE
- BRIDGE
- RAILWAY
- MAJOR ROAD
- LOCAL ROAD
- FERRY ROUTE
- LAND PARCEL
- CENSUS BOUNDARY
- PEACE RIVER TOWN BOUNDARY
- SETTLEMENT BOUNDARY

STRUCTURES
- RESIDENTIAL
- NON-RESIDENTIAL

SCALE - 1:5,000

0 100 200 M

Coordinate System: NAD 1983 CSRS 3TM 117
Units: METRES

Job: 1001119	*Date: 31-MAY-2021*

PEACE RIVER HAZARD STUDY
FLOOD RISK ASSESSMENT & INVENTORY SPATIAL DATA

SHEET 22 OF 22

MSN, \\mainfile-van\Projects\Active\1001119 Peace River Flood Hazard Study\GIS\1001119_MSN_Map_T800_2021_RiskAssessment_R0A.mxd

Appendix C
Residential Buildings at Risk Detailed

Table C.1 Detailed Statistics for Residential Buildings at Risk for Various Flood Scenarios – Total Extent of Inundation

Flood Scenario	Number of Residential Buildings by Municipality - Total Extent of Inundation																									Total				
	MD #135					Northern Sunrise					Birch Hills					Northern Lights					TPR									
2-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**
5-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 8	MF 0	RH 0	MH 0	**Σ 8**	SF 8	MF 0	RH 0	MH 0	**Σ 8**
10-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 45	MF 8	RH 0	MH 0	**Σ 53**	SF 45	MF 8	RH 0	MH 0	**Σ 53**
20-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 97	MF 20	RH 0	MH 0	**Σ 117**	SF 97	MF 20	RH 0	MH 0	**Σ 117**
35-YR Open Water	SF 1	MF 0	RH 0	MH 0	**Σ 1**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 158	MF 29	RH 0	MH 0	**Σ 187**	SF 159	MF 29	RH 0	MH 0	**Σ 188**
50-YR Open Water	SF 2	MF 0	RH 0	MH 0	**Σ 2**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 228	MF 31	RH 0	MH 0	**Σ 259**	SF 230	MF 31	RH 0	MH 0	**Σ 261**
75-YR Open Water	SF 3	MF 0	RH 0	MH 0	**Σ 3**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 372	MF 49	RH 0	MH 6	**Σ 427**	SF 375	MF 49	RH 0	MH 6	**Σ 430**
100-YR Open Water	SF 3	MF 0	RH 0	MH 0	**Σ 3**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 476	MF 65	RH 0	MH 12	**Σ 553**	SF 479	MF 65	RH 0	MH 12	**Σ 556**
200-YR Open Water	SF 4	MF 0	RH 0	MH 0	**Σ 4**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 714	MF 91	RH 0	MH 12	**Σ 817**	SF 718	MF 91	RH 0	MH 12	**Σ 821**
350-YR Open Water	SF 7	MF 0	RH 0	MH 0	**Σ 7**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 751	MF 93	RH 0	MH 12	**Σ 856**	SF 758	MF 93	RH 0	MH 12	**Σ 863**
500-YR Open Water	SF 7	MF 0	RH 0	MH 0	**Σ 7**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 764	MF 95	RH 0	MH 12	**Σ 871**	SF 771	MF 95	RH 0	MH 12	**Σ 878**
750-YR Open Water	SF 8	MF 0	RH 0	MH 0	**Σ 8**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 784	MF 97	RH 0	MH 12	**Σ 893**	SF 792	MF 97	RH 0	MH 12	**Σ 901**
1000-YR Open Water	SF 9	MF 0	RH 0	MH 0	**Σ 9**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 787	MF 98	RH 0	MH 12	**Σ 897**	SF 796	MF 98	RH 0	MH 12	**Σ 906**
50-YR Ice Jam	SF 7	MF 0	RH 0	MH 0	**Σ 7**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 555	MF 77	RH 0	MH 12	**Σ 644**	SF 562	MF 77	RH 0	MH 12	**Σ 651**
100-YR Ice Jam	SF 10	MF 0	RH 0	MH 0	**Σ 10**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 683	MF 91	RH 0	MH 12	**Σ 786**	SF 693	MF 91	RH 0	MH 12	**Σ 796**
200-YR Ice Jam	SF 10	MF 0	RH 0	MH 0	**Σ 10**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 750	MF 93	RH 0	MH 12	**Σ 855**	SF 760	MF 93	RH 0	MH 12	**Σ 865**

Table C.2 Detailed Statistics for Residential Buildings at Risk for Various Flood Scenarios – Direct Inundation

Flood Scenario	Number of Residential Buildings by Municipality - Direct Inundation																											Total				
	MD #135					Northern Sunrise					Birch Hills					Northern Lights					TPR										
2-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**
5-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**
10-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**
20-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**
35-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**
50-YR Open Water	SF 2	MF 0	RH 0	MH 0	**Σ 2**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 2	MF 0	RH 0	MH 0	**Σ 2**
75-YR Open Water	SF 3	MF 0	RH 0	MH 0	**Σ 3**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 3	MF 0	RH 0	MH 0	**Σ 3**
100-YR Open Water	SF 3	MF 0	RH 0	MH 0	**Σ 3**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 3	MF 0	RH 0	MH 0	**Σ 3**
200-YR Open Water	SF 4	MF 0	RH 0	MH 0	**Σ 4**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 713	MF 91	RH 0	MH 12	**Σ 816**	SF 717	MF 91	RH 0	MH 12	**Σ 820**
350-YR Open Water	SF 7	MF 0	RH 0	MH 0	**Σ 7**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 751	MF 93	RH 0	MH 12	**Σ 856**	SF 758	MF 93	RH 0	MH 12	**Σ 863**
500-YR Open Water	SF 7	MF 0	RH 0	MH 0	**Σ 7**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 764	MF 95	RH 0	MH 12	**Σ 871**	SF 771	MF 95	RH 0	MH 12	**Σ 878**
750-YR Open Water	SF 8	MF 0	RH 0	MH 0	**Σ 8**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 784	MF 97	RH 0	MH 12	**Σ 893**	SF 792	MF 97	RH 0	MH 12	**Σ 901**
1000-YR Open Water	SF 9	MF 0	RH 0	MH 0	**Σ 9**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 787	MF 98	RH 0	MH 12	**Σ 897**	SF 796	MF 98	RH 0	MH 12	**Σ 906**
50-YR Ice Jam	SF 7	MF 0	RH 0	MH 0	**Σ 7**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 432	MF 57	RH 0	MH 12	**Σ 501**	SF 439	MF 57	RH 0	MH 12	**Σ 508**
100-YR Ice Jam	SF 10	MF 0	RH 0	MH 0	**Σ 10**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 683	MF 91	RH 0	MH 12	**Σ 786**	SF 693	MF 91	RH 0	MH 12	**Σ 796**
200-YR Ice Jam	SF 10	MF 0	RH 0	MH 0	**Σ 10**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 750	MF 93	RH 0	MH 12	**Σ 855**	SF 760	MF 93	RH 0	MH 12	**Σ 865**

Table C.3 Detailed Statistics for Residential Buildings at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Number of Residential Buildings by Municipality - FCS Failure																															
	MD #135					Northern Sunrise					Birch Hills					Northern Lights					TPR					Total				
2-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
5-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
10-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 45	MF 8	RH 0	MH 0	**Σ 53**	SF 45	MF 8	RH 0	MH 0	**Σ 53**
20-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 96	MF 20	RH 0	MH 0	**Σ 116**	SF 96	MF 20	RH 0	MH 0	**Σ 116**
35-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 132	MF 23	RH 0	MH 0	**Σ 155**	SF 132	MF 23	RH 0	MH 0	**Σ 155**
50-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 137	MF 23	RH 0	MH 0	**Σ 160**	SF 137	MF 23	RH 0	MH 0	**Σ 160**
75-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 372	MF 48	RH 0	MH 0	**Σ 420**	SF 372	MF 48	RH 0	MH 6	**Σ 426**
100-YR Open Water	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 476	MF 65	RH 0	MH 12	**Σ 553**	SF 476	MF 65	RH 0	MH 12	**Σ 553**
200-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
350-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
500-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
750-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
1000-YR Open Water	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
50-YR Ice Jam	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 0	MF 0	RH 0	MH 0	**Σ 0**	SF 122	MF 20	RH 0	MH 0	**Σ 142**	SF 122	MF 20	RH 0	MH 0	**Σ 142**
100-YR Ice Jam	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**
200-YR Ice Jam	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**	SF NULL	MF NULL	RH NULL	MH NULL	**Σ NULL**

*NULL: No inundation areas due to potential flood control structure failure were identified for the 2-, 5-, 10-, 200-, 350-, 500-, 750-, and 1000-year open water flood extents and for the 100- and 200-year ice jam flood extents.

Table C.4 Detailed Statistics for Residential Buildings at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Number of Residential Buildings by Municipality - Governing Design Flood																										
	MD #135					Northern Sunrise					Birch Hills					Northern Lights					TPR					Total				
Governing Design Flood	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
	10	0	0	0	**10**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	683	91	0	12	**786**	693	91	0	12	**796**
Floodway	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
	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**	4	0	0	0	**4**
Flood Fringe	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
	6	0	0	0	**6**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	683	91	0	12	**786**	689	91	0	12	**792**
High Hazard Flood Fringe	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
	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	370	51	0	6	**427**	370	51	0	6	**427**

Appendix D
Non-residential Buildings at Risk Detailed

Table D. 1 Detailed Statistics for Non-residential Buildings at Risk for Various Flood Scenarios – Total Extent of Inundation

Number of Non-residential Buildings by Municipality - Total Extent of Inundation

Flood Scenario	MD #135							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0	0	0
50-YR Open Water	0	0	0	0	0	0	0	0
75-YR Open Water	0	0	0	0	0	0	0	0
100-YR Open Water	0	0	0	0	0	0	0	0
200-YR Open Water	0	0	0	0	0	0	0	0
350-YR Open Water	0	0	0	0	0	1	0	1

Flood Scenario	Northern Sunrise							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	1	0	0	0	0	1
50-YR Open Water	0	0	1	0	0	0	0	1
75-YR Open Water	0	0	1	0	0	0	0	1
100-YR Open Water	0	0	1	0	0	0	0	1
200-YR Open Water	0	0	2	0	0	0	0	2
350-YR Open Water	0	0	2	0	0	0	0	2

Flood Scenario	Birch Hills							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0	0	0
50-YR Open Water	0	0	0	0	0	0	0	0
75-YR Open Water	0	0	0	0	0	0	0	0
100-YR Open Water	0	0	0	0	0	0	0	0
200-YR Open Water	0	0	0	0	0	0	0	0
350-YR Open Water	0	0	0	0	0	0	0	0

Flood Scenario	Northern Lights							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	1	0	0	0	0	1
20-YR Open Water	0	0	1	0	0	0	0	1
35-YR Open Water	0	0	1	0	0	0	0	1
50-YR Open Water	0	0	1	0	0	0	0	1
75-YR Open Water	0	0	1	0	0	0	0	1
100-YR Open Water	0	0	2	0	0	0	0	2
200-YR Open Water	0	0	2	0	0	0	0	2
350-YR Open Water	0	0	2	0	0	0	0	2

Flood Scenario	TPR							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	11	0	0	0	0	5	16
35-YR Open Water	0	18	1	0	0	0	6	25
50-YR Open Water	0	28	1	1	0	0	6	36
75-YR Open Water	0	39	4	1	0	0	13	57
100-YR Open Water	3	50	10	2	0	0	14	79
200-YR Open Water	7	72	23	3	0	1	22	128
350-YR Open Water	7	72	27	4	1	1	23	129

Flood Scenario	By Total Inundated Area							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	1	0	0	0	0	1
20-YR Open Water	0	11	1	0	0	0	5	17
35-YR Open Water	0	18	3	0	0	0	6	27
50-YR Open Water	0	28	3	1	0	0	6	38
75-YR Open Water	0	39	6	1	0	0	13	59
100-YR Open Water	3	50	13	2	0	0	14	82
200-YR Open Water	7	72	27	3	0	1	22	132
350-YR Open Water	7	72	27	4	1	2	23	136

Flood Scenario	Number of Non-residential Buildings by Municipality - Total Extent of Inundation																																				By Total Inundated Area							
	MD #135								Northern Sunrise								Birch Hills								Northern Lights								TPR												
500-YR Open Water	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	1	OTH	0	Σ	1	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	76	IND	23	GOV	5	WT	1	WWT	1	OTH	25	Σ	138	SCH	7	COM	76	IND	27	GOV	5	WT	1	WWT	2	OTH	25	Σ	143
750-YR Open Water	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	2	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	87	IND	23	GOV	5	WT	1	WWT	1	OTH	27	Σ	151	SCH	7	COM	87	IND	28	GOV	5	WT	1	WWT	2	OTH	27	Σ	157
1000-YR Open Water	SCH	0	COM	1	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	3	SCH	0	COM	0	IND	3	GOV	0	WT	0	WWT	0	OTH	0	Σ	3	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	3	GOV	0	WT	0	WWT	0	OTH	0	Σ	3	SCH	7	COM	93	IND	24	GOV	6	WT	1	WWT	1	OTH	27	Σ	159	SCH	7	COM	94	IND	31	GOV	6	WT	1	WWT	2	OTH	27	Σ	168
50-YR Ice Jam	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	2	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	0	OTH	0	Σ	1	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	0	OTH	0	Σ	1	SCH	5	COM	62	IND	17	GOV	3	WT	0	WWT	0	OTH	18	Σ	105	SCH	5	COM	62	IND	20	GOV	3	WT	0	WWT	1	OTH	18	Σ	109
100-YR Ice Jam	SCH	0	COM	1	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	3	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	0	OTH	0	Σ	1	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	72	IND	23	GOV	3	WT	0	WWT	0	OTH	21	Σ	126	SCH	7	COM	73	IND	27	GOV	3	WT	0	WWT	1	OTH	21	Σ	132
200-YR Ice Jam	SCH	0	COM	1	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	3	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	72	IND	23	GOV	4	WT	1	WWT	0	OTH	24	Σ	131	SCH	7	COM	73	IND	28	GOV	4	WT	1	WWT	1	OTH	24	Σ	138

Table D. 2 Detailed Statistics for Non-residential Buildings at Risk for Various Flood Scenarios – Direct Inundation

Number of Non-residential Buildings by Municipality - Direct Inundation

MD #135

Flood Scenario	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0	0	0
50-YR Open Water	0	0	0	0	0	0	0	0
75-YR Open Water	0	0	0	0	0	0	0	0
100-YR Open Water	0	0	0	0	0	0	0	0
200-YR Open Water	0	0	0	0	0	0	0	0
350-YR Open Water	0	0	0	0	0	1	0	1

Northern Sunrise

Flood Scenario	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	1	0	0	0	0	1
50-YR Open Water	0	0	1	0	0	0	0	1
75-YR Open Water	0	0	1	0	0	0	0	1
100-YR Open Water	0	0	1	0	0	0	0	1
200-YR Open Water	0	0	2	0	0	0	0	2
350-YR Open Water	0	0	2	0	0	0	0	2

Birch Hills

Flood Scenario	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0	0	0
50-YR Open Water	0	0	0	0	0	0	0	0
75-YR Open Water	0	0	0	0	0	0	0	0
100-YR Open Water	0	0	0	0	0	0	0	0
200-YR Open Water	0	0	0	0	0	0	0	0
350-YR Open Water	0	0	0	0	0	0	0	0

Northern Lights

Flood Scenario	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	1	0	0	0	0	1
20-YR Open Water	0	0	1	0	0	0	0	1
35-YR Open Water	0	0	1	0	0	0	0	1
50-YR Open Water	0	0	1	0	0	0	0	1
75-YR Open Water	0	0	1	0	0	0	0	1
100-YR Open Water	0	0	2	0	0	0	0	2
200-YR Open Water	0	0	2	0	0	0	0	2
350-YR Open Water	0	0	2	0	0	0	0	2

TPR

Flood Scenario	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	0	0	0	0	0	0
20-YR Open Water	0	0	0	0	0	0	0	0
35-YR Open Water	0	0	0	0	0	0	0	0
50-YR Open Water	0	0	0	0	0	0	0	0
75-YR Open Water	0	0	0	0	0	0	0	0
100-YR Open Water	0	0	0	0	0	0	0	0
200-YR Open Water	7	72	23	3	1	0	22	128
350-YR Open Water	7	72	23	4	1	1	23	129

By Total Inundated Area

Flood Scenario	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	0	0	0	0	0	0	0	0
5-YR Open Water	0	0	0	0	0	0	0	0
10-YR Open Water	0	0	1	0	0	0	0	1
20-YR Open Water	0	0	1	0	0	0	0	1
35-YR Open Water	0	0	2	0	0	0	0	2
50-YR Open Water	0	0	2	0	0	0	0	2
75-YR Open Water	0	0	2	0	0	0	0	2
100-YR Open Water	0	0	3	0	0	0	0	3
200-YR Open Water	7	72	27	3	1	0	22	132
350-YR Open Water	7	72	27	4	1	2	23	136

Flood Scenario	Number of Non-residential Buildings by Municipality - Direct Inundation																																				By Total Inundated Area							
	MD #135								Northern Sunrise								Birch Hills								Northern Lights								TPR												
500-YR Open Water	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	1	OTH	0	Σ	1	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	76	IND	23	GOV	5	WT	1	WWT	1	OTH	25	Σ	138	SCH	7	COM	76	IND	27	GOV	5	WT	1	WWT	2	OTH	25	Σ	143
750-YR Open Water	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	2	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	87	IND	23	GOV	5	WT	1	WWT	1	OTH	27	Σ	151	SCH	7	COM	87	IND	28	GOV	5	WT	1	WWT	2	OTH	27	Σ	157
1000-YR Open Water	SCH	0	COM	1	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	3	SCH	0	COM	0	IND	3	GOV	0	WT	0	WWT	0	OTH	0	Σ	3	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	3	GOV	0	WT	0	WWT	0	OTH	0	Σ	3	SCH	7	COM	93	IND	24	GOV	6	WT	1	WWT	1	OTH	27	Σ	159	SCH	7	COM	94	IND	31	GOV	6	WT	1	WWT	2	OTH	27	Σ	168
50-YR Ice Jam	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	2	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	0	OTH	0	Σ	1	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	0	OTH	0	Σ	1	SCH	5	COM	62	IND	17	GOV	3	WT	0	WWT	0	OTH	18	Σ	105	SCH	5	COM	62	IND	20	GOV	3	WT	0	WWT	1	OTH	18	Σ	109
100-YR Ice Jam	SCH	0	COM	1	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	3	SCH	0	COM	0	IND	1	GOV	0	WT	0	WWT	0	OTH	0	Σ	1	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	72	IND	23	GOV	3	WT	0	WWT	0	OTH	21	Σ	126	SCH	7	COM	73	IND	27	GOV	3	WT	0	WWT	1	OTH	21	Σ	132
200-YR Ice Jam	SCH	0	COM	1	IND	1	GOV	0	WT	0	WWT	1	OTH	0	Σ	3	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	0	COM	0	IND	0	GOV	0	WT	0	WWT	0	OTH	0	Σ	0	SCH	0	COM	0	IND	2	GOV	0	WT	0	WWT	0	OTH	0	Σ	2	SCH	7	COM	72	IND	23	GOV	4	WT	1	WWT	0	OTH	24	Σ	131	SCH	7	COM	73	IND	28	GOV	4	WT	1	WWT	1	OTH	24	Σ	138

Table D. 3 Detailed Statistics for Residential Buildings at Risk for Various Flood Scenarios – Potential Flood Control Structure Failure

Flood Scenario	Number of Non-residential Buildings by Municipality - FCS Failure																																															
	MD #135								Northern Sunrise								Birch Hills								Northern Lights								TPR								By Total Inundated Area							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
2-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
5-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
10-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
20-YR Open Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	4	15	0	11	0	0	0	0	4	15
35-YR Open Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	4	22	0	18	0	0	0	0	4	22
50-YR Open Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	4	29	0	25	0	0	0	0	4	29
75-YR Open Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0	0	0	12	51	0	39	0	0	0	0	12	51
100-YR Open Water	0	0	0	0	0	0	0	0	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	50	10	2	0	0	14	79	3	50	10	2	0	0	14	79
200-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
350-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Flood Scenario	Number of Non-residential Buildings by Municipality - FCS Failure																																															
	MD #135								Northern Sunrise								Birch Hills								Northern Lights								TPR								By Total Inundated Area							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
500-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
750-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
1000-YR Open Water	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
50-YR Ice Jam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
100-YR Ice Jam	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
200-YR Ice Jam	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ

*NULL: No inundation areas due to potential flood control structure failure were identified for the 2-, 5-, 10-, 200-, 350-, 500-, 750-, and 1000-year open water flood extents and for the 100- and 200-year ice jam flood extents.

Table D. 4 Detailed Statistics for Non-residential Buildings at Risk for Various Flood Scenarios – Governing Design Flood

Flood Scenario	Number of Non-residential Buildings by Municipality – Governing Design Flood																																																
	MD #135								Northern Sunrise								Birch Hills								Northern Lights								TPR								By Total Inundated Area							
	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ	SCH	COM	IND	GOV	WT	WWT	OTH	Σ
Floodway	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	5	51	16	3	0	0	16	91	5	51	19	3	0	0	16	94
Flood Fringe	0	1	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	21	7	0	0	0	5	35	2	22	8	0	0	1	5	38
Governing Design Flood	0	1	1	0	0	1	0	3	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	7	72	23	3	0	0	21	126	7	73	27	3	0	1	21	132

nhc
northwest hydraulic consultants
water resource specialists