

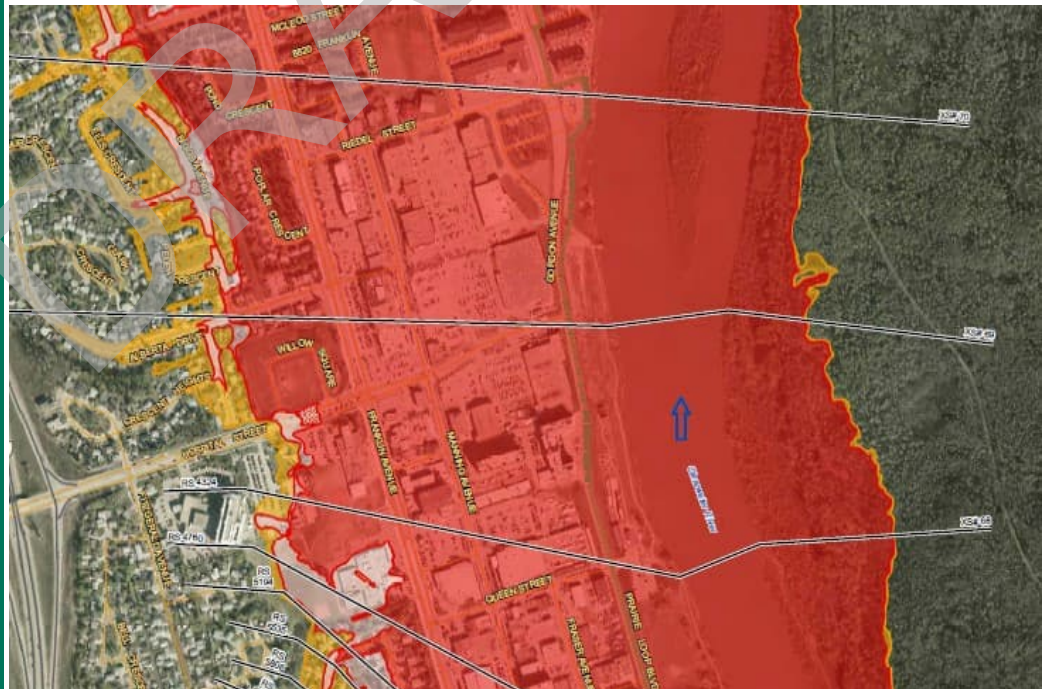


August 2023

## FORT MCMURRAY RIVER HAZARD STUDY

# Governing Design Flood Hazard Mapping Report

**Submitted to:**  
Alberta Environment and Parks  
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Report Number: 1662603\_R0007\_Rev0

REPORT





## Executive Summary

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

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

The Fort McMurray River Hazard study includes multiple components and deliverables. This report summarizes the governing design flood hazard mapping component of the study. The main tasks associated with this work involves producing the governing design flood profile and the design flood hazard maps.

The study area includes the river reaches listed in Table i.

**Table i: River Reaches in the Study Area**

River	Reach Description	Length
Athabasca River	From a location 6 km upstream of Highway 63 bridges to a location 8 km downstream of the Clearwater River confluence	15 km
Clearwater River	20 km river reach upstream of the confluence with Athabasca River	20 km
Hangingstone River	From a location 3 km upstream of Memorial Drive (Highway 63) Bridges to the confluence with Clearwater River	5 km
The Snye	Full length from Snye Dike to the confluence with Clearwater River	1.5 km

Floodways defined by previous flood studies in the study area were considered as part of the floodway delineation for this flood study, and were not made larger by default in most circumstances unless required for technical reasons or if deemed necessary or appropriate.

Open water floods along the Athabasca River and Clearwater River typically result in lower water levels than ice jam floods. However, open water flood levels along the Hangingstone River can be higher than ice jam floods, especially in the reach upstream of Saline Creek Drive.

The governing design flood for the study area is a combination scenario of ice jam and open water flooding that reflects the most severe flood hazard in each reach. Governing water surface profiles have been prepared, and a single set of governing flood hazard maps has been developed, reflecting open water or ice jam design flood levels (which ever is most severe).

The study results show that ice jam flooding governs along the Athabasca River, the Clearwater River, the Snye and the Hangingstone River reach from its confluence with the Clearwater River up to the Heritage Park Foot Bridge. Open water flooding governs above the Heritage Park Foot Bridge on the Hangingstone River.



## **Acknowledgements**

This component of the Fort McMurray River Hazard Study was led by Dr. Wolf Ploeger. Overall project management was provided by Dr. Wolf Ploeger and direction was provided by Dr. Dejiang Long. The governing flood inundation mapping was prepared by Nancy Guo and reviewed by Peter Thiede, Sean Kurash and Dr. Wolf Ploeger.

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

The authors also express their gratitude to Patricia Stevenson, Nadia Kovachis, and Peter Onyshko of AEP for their additional support and guidance.

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#### APPENDIX A

Governing Design Flood Hazard Maps



## 1.0 INTRODUCTION

### 1.1 Study Objectives

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

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

The Fort McMurray River Hazard study includes multiple components and deliverables. This report summarizes the governing design flood hazard mapping component of the study. The main tasks associated with this work involves producing the governing design flood profile and the design flood hazard maps by combining the results of the open water and ice jam flood hazard identification tasks.

There is one previous FHIP study:

- Review of Flood Stage Frequency Estimates for the City of Fort McMurray (AEP, 1993, mapping updated in 1995 and 2003).

Existing floodways defined by the above-listed previous studies were considered as part of the floodway delineation for this flood study and were not made larger by default in most circumstances unless required for technical reasons or if deemed necessary or appropriate.

Dedicated flood control structures are assumed to be effective, and protected areas are not mapped as flooded unless they are overtopped. Areas of residual risk behind dedicated flood control structures that could be flooded if a flood control structure fails or does not perform as expected are identified as protected flood fringe.

### 1.2 Study Area and Reaches

Fort McMurray is located at the confluence of the Athabasca and Clearwater Rivers, and has a history of ice jam flooding. In the spring, the ice cover on the Athabasca River can break up dynamically, and large ice runs are not uncommon. When an ice jam forms on the Athabasca River at or downstream of the Clearwater River confluence, it can cause significant flooding in downtown Fort McMurray. Additionally, the presence of a competent ice cover on the Athabasca River when the Clearwater River is undergoing breakup can also lead to ice jams and significant flooding.

Open water floods along the Athabasca River and Clearwater River typically result in lower water levels than ice jam floods. However, open water flood levels along the Hangingstone River can be higher than ice jam flood levels, especially along the reach upstream of Saline Creek Drive.

The study area includes approximately 15 km of the Athabasca River, approximately 20 km of the Clearwater River (including 1.5 km of the Snye), and approximately 5 km of Hangingstone River through Fort McMurray (see Figure 1). The study area is within the RMWB. The study reaches are summarized in Table 1.

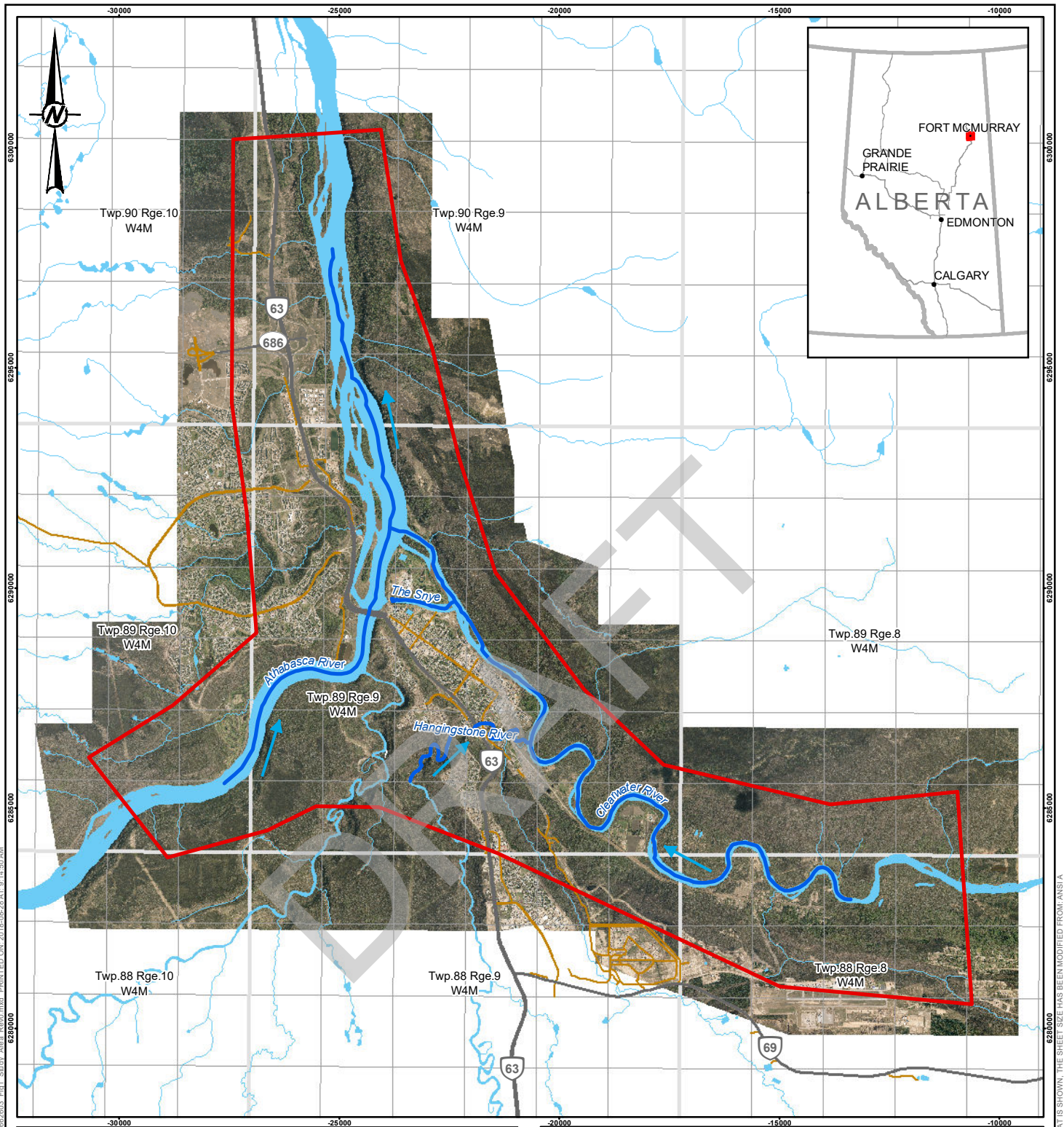


## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 1: River Reaches in the Study Area**

River	Reach Description	Length
Athabasca River	From the location 6 km upstream of Highway 63 bridges to the location 8 km downstream of the Clearwater River confluence	15 km
Clearwater River	20 km river reach upstream of confluence with Athabasca River	20 km
Hangingstone River	From the location 3 km upstream of Memorial Drive (Highway 63) Bridges to the confluence between Hangingstone and Clearwater Rivers	5 km
The Snye	Full length from Snye Dyke to confluence with Clearwater River	1.5 km

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**LEGEND**

- STUDY REACH
  - STUDY AREA
  - ➔ FLOW DIRECTION
  - WATERCOURSE
  - WATERBODY
- TRANSPORTATION FEATURES**
- PRIMARY HIGHWAY
  - SECONDARY HIGHWAY
  - LOCAL ROAD

**REFERENCE(S)**

IMAGERY CAPTURED MAY 2017 BY GEODESY GROUP INC. FOR THE GOVERNMENT OF ALBERTA.  
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 PROJECTION: 3TM 111° DATUM: NAD 83 CSRS

CLIENT



PROJECT

FORT MCMURRAY RIVER HAZARD STUDY

TITLE

**STUDY AREA**

CONSULTANT



YYYY-MM-DD 2018-05-30

DESIGNED WP

PREPARED SK

REVIEWED WP

APPROVED DL

PROJECT NO.

1662603

CONTROL

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FIGURE

1



## 2.0 GOVERNING DESIGN FLOOD HAZARD DETERMINATION

### 2.1 Open Water and Ice Jam Design Flood Details

Both the open water and ice jam flood events were considered in the development of the governing map flood hazard series. The development of open water flood profiles is summarized in detail in the Open Water Flood Hazard Identification report (Golder, 2022). Development of ice related flood profiles is summarized in the Ice Jam Modelling and Flood Hazard Identification Report (Hatch, 2022).

Both open water and ice jam flood events were simulated based on a one-dimensional HEC-RAS model that has been set up specifically for this study. Both models utilize the same cross-sectional dataset. Before simulating open water profiles, the model was first calibrated to match observed water level data on the river reach(es) under low and high flow conditions. The design flood for the open water hazard mapping series was then selected as the 100-year flood event. The 100-year open water design flood flow estimates at key locations in the study area are summarized in Table 2.

Following the calibration of the model, it was used to develop the 100-year open water flood profile.

**Table 2: Design Flood Frequency Estimates – 100-Year Open Water Flood**

Location	100-Year Flood Peak Discharges (m <sup>3</sup> /s)
Athabasca River above Clearwater River Confluence	5,480
Athabasca River below Clearwater River Confluence	5,920
Clearwater River at Draper (upstream of Hangingstone River Confluence)	900
Clearwater River below Hangingstone River Confluence	949
Hangingstone River above Saline Creek Confluence	206
Hangingstone River below Saline Creek Confluence	206

The ice jam flood hazard mapping series was completed based on the passage of the 100-year spring ice jam flood. Frequency-based assessments of ice-affected spring water levels on the Athabasca River were completed, based on a review of the long-term record available in this location. The analysis indicated that the 100-year event would result in a water level of elevation 249.4 m at the confluence of the Athabasca and Clearwater Rivers. A frequency-based assessment was also performed on estimated river flows at the time of breakup on the Athabasca River. Next, the open water HEC-RAS model was enhanced to simulate ice conditions within the study reach, and subsequently calibrated to three recent ice events for which suitable historical data exists (1986, 1987, and 1996), and validated against three additional ice events in 1978, 1979 and 2020. Following calibration of the numerical model, and the completion of a water level frequency assessment, additional analyses were undertaken to predict levels along each river reach associated with the 100-year ice jam flood events. The calibrated model was used in conjunction with the frequency-based water level estimates to simulate a corresponding ice-related water surface profile throughout the study reach for the 100-year ice jam flood event. The final discharges associated with the 100-year ice jam event are summarized in Table 3.

**Table 3: Design Flood Flow Estimates – 100-Year Ice Jam Flood**

Location	100-Year Flood Peak Discharges (m <sup>3</sup> /s)
Athabasca River above Clearwater River Confluence	1,600
Athabasca River below Clearwater River Confluence	1,700
Clearwater River at Draper (upstream of Hangingstone River Confluence)	480
Clearwater River below Hangingstone River Confluence	524
Hangingstone River Upstream of Saline Creek Confluence	44
Hangingstone River Downstream of Saline Creek Confluence	44





## 2.2 Governing Design Flood Profile

The highest water levels, and therefore the highest river hazard, for all areas on the Athabasca and Clearwater Rivers are governed by ice jam flooding. Levels on the Hangingstone River between the Clearwater River confluence and Heritage Park Foot Bridge are governed by ice jam flooding. Open water flood levels exceed the ice jam water levels on the Hangingstone River upstream of Heritage Park Bridge (River Station 2236) as shown in Table 4.

**Table 4: Governing Design Flood Scenario**

River	Reach	Cross Section	River Station	Open Water Design Flood Level (m)	Ice Jam Design Flood Level (m)	Governing Design Scenario
Athabasca	Upper Reach	1	17519	249.03	250.82	Ice Jam
Athabasca	Upper Reach	2	16535	248.46	250.65	Ice Jam
Athabasca	Upper Reach	3	15716	247.86	250.50	Ice Jam
Athabasca	Upper Reach	4	15048	247.41	250.34	Ice Jam
Athabasca	Upper Reach	5	14346	247.03	250.18	Ice Jam
Athabasca	Upper Reach	6	13706	246.70	250.07	Ice Jam
Athabasca	Upper Reach	7	13071	246.29	249.97	Ice Jam
Athabasca	Upper Reach	8	12237	245.92	249.87	Ice Jam
Athabasca	Upper Reach	9	11791	245.65	249.81	Ice Jam
Athabasca	Upper Reach	10	11309	245.13	249.70	Ice Jam
Athabasca	Upper Reach	11	10747	244.83	249.57	Ice Jam
Athabasca	Upper Reach	12	10564	244.56	249.52	Ice Jam
Athabasca	Upper Reach	13	10306	244.55	249.50	Ice Jam
Athabasca	Upper Reach	14	9779	244.19	249.45	Ice Jam
Athabasca	Upper Reach	15	9174	243.92	249.42	Ice Jam
Athabasca	Lower Reach	16	8559	243.81	249.41	Ice Jam
Athabasca	Lower Reach	17	7895	243.59	249.40	Ice Jam
Athabasca	Lower Reach	18	7144	243.23	249.38	Ice Jam
Athabasca	Lower Reach	19	6438	243.03	249.37	Ice Jam
Athabasca	Lower Reach	20	5675	242.90	249.36	Ice Jam
Athabasca	Lower Reach	21	4899	242.57	249.29	Ice Jam
Athabasca	Lower Reach	22	4246	242.28	249.08	Ice Jam
Athabasca	Lower Reach	23	3083	241.89	248.38	Ice Jam
Athabasca	Lower Reach	24	2347	241.71	248.27	Ice Jam
Athabasca	Lower Reach	25	1420	241.46	247.85	Ice Jam
Athabasca	Lower Reach	26	129	241.01	247.47	Ice Jam
Clearwater	Upper Reach	27	20359	247.30	249.56	Ice Jam
Clearwater	Upper Reach	28	19986	247.24	249.55	Ice Jam
Clearwater	Upper Reach	29	19705	247.16	249.55	Ice Jam
Clearwater	Upper Reach	30	19182	247.08	249.54	Ice Jam
Clearwater	Upper Reach	31	18685	246.96	249.53	Ice Jam
Clearwater	Upper Reach	32	18262	246.88	249.52	Ice Jam
Clearwater	Upper Reach	33	17883	246.75	249.51	Ice Jam
Clearwater	Upper Reach	34	17460	246.70	249.51	Ice Jam



## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 4: Governing Design Flood Scenario**

River	Reach	Cross Section	River Station	Open Water Design Flood Level (m)	Ice Jam Design Flood Level (m)	Governing Design Scenario
Clearwater	Upper Reach	35	16972	246.63	249.50	Ice Jam
Clearwater	Upper Reach	36	16560	246.50	249.49	Ice Jam
Clearwater	Upper Reach	37	16223	246.45	249.49	Ice Jam
Clearwater	Upper Reach	38	15826	246.28	249.48	Ice Jam
Clearwater	Upper Reach	39	15382	246.21	249.48	Ice Jam
Clearwater	Upper Reach	40	14757	246.12	249.48	Ice Jam
Clearwater	Upper Reach	41	14127	246.03	249.47	Ice Jam
Clearwater	Upper Reach	42	13537	245.95	249.47	Ice Jam
Clearwater	Upper Reach	43	13179	245.88	249.47	Ice Jam
Clearwater	Upper Reach	44	12786	245.82	249.47	Ice Jam
Clearwater	Upper Reach	45	12424	245.75	249.47	Ice Jam
Clearwater	Upper Reach	46	11985	245.69	249.47	Ice Jam
Clearwater	Upper Reach	47	11537	245.63	249.46	Ice Jam
Clearwater	Upper Reach	48	11033	245.54	249.46	Ice Jam
Clearwater	Upper Reach	49	10663	245.50	249.46	Ice Jam
Clearwater	Upper Reach	50	10095	245.35	249.46	Ice Jam
Clearwater	Upper Reach	51	9674	245.33	249.46	Ice Jam
Clearwater	Upper Reach	52	9210	245.26	249.46	Ice Jam
Clearwater	Upper Reach	53	8934	245.18	249.45	Ice Jam
Clearwater	Upper Reach	54	8679	245.13	249.45	Ice Jam
Clearwater	Upper Reach	55	8440	245.04	249.45	Ice Jam
Clearwater	Upper Reach	56	8121	245.00	249.45	Ice Jam
Clearwater	Upper Reach	57	7780	244.91	249.45	Ice Jam
Clearwater	Upper Reach	58	7396	244.87	249.45	Ice Jam
Clearwater	Upper Reach	59	7081	244.81	249.45	Ice Jam
Clearwater	Upper Reach	60	6802	244.77	249.45	Ice Jam
Clearwater	Mid Reach	61	6605	244.75	249.45	Ice Jam
Clearwater	Mid Reach	62	6350	244.71	249.44	Ice Jam
Clearwater	Mid Reach	63	6078	244.67	249.44	Ice Jam
Clearwater	Mid Reach	64	5806	244.64	249.44	Ice Jam
Clearwater	Mid Reach	65	5535	244.52	249.44	Ice Jam
Clearwater	Mid Reach	66	5194	244.47	249.43	Ice Jam
Clearwater	Mid Reach	67	4760	244.42	249.43	Ice Jam
Clearwater	Mid Reach	68	4324	244.35	249.43	Ice Jam
Clearwater	Mid Reach	69	3906	244.33	249.43	Ice Jam
Clearwater	Mid Reach	70	3541	244.27	249.42	Ice Jam
Clearwater	Mid Reach	71	3183	244.22	249.42	Ice Jam
Clearwater	Mid Reach	72	2815	244.18	249.42	Ice Jam
Clearwater	Lower Reach	73	2250	244.11	249.42	Ice Jam
Clearwater	Lower Reach	74	1848	244.08	249.42	Ice Jam
Clearwater	Lower Reach	75	1471	244.06	249.41	Ice Jam



## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 4: Governing Design Flood Scenario**

River	Reach	Cross Section	River Station	Open Water Design Flood Level (m)	Ice Jam Design Flood Level (m)	Governing Design Scenario
Clearwater	Lower Reach	76	1043	243.97	249.41	Ice Jam
Clearwater	Lower Reach	77	480	243.95	249.41	Ice Jam
Snye	Snye	78	1332	244.18	249.42	Ice Jam
Snye	Snye	79	932	244.18	249.42	Ice Jam
Snye	Snye	80	456	244.18	249.42	Ice Jam
Snye	Snye	81	172	244.18	249.42	Ice Jam
Hangingstone	Hangingstone	82	5586	266.84	265.36	Open Water
Hangingstone	Hangingstone	83	5507	266.54	265.01	Open Water
Hangingstone	Hangingstone	84	5377	265.24	263.97	Open Water
Hangingstone	Hangingstone	85	5278	264.75	263.47	Open Water
Hangingstone	Hangingstone	86	5162	264.16	262.77	Open Water
Hangingstone	Hangingstone	87	5048	263.24	261.95	Open Water
Hangingstone	Hangingstone	88	4975	262.96	261.55	Open Water
Hangingstone	Hangingstone	89	4942	262.88	261.42	Open Water
Hangingstone	Hangingstone	90	4874	262.41	261.15	Open Water
Hangingstone	Hangingstone	91	4788	261.96	260.70	Open Water
Hangingstone	Hangingstone	92	4694	261.62	260.18	Open Water
Hangingstone	Hangingstone	93	4600	261.30	259.72	Open Water
Hangingstone	Hangingstone	94	4525	261.03	259.36	Open Water
Hangingstone	Hangingstone	95	4506	260.84	259.18	Open Water
Hangingstone	Hangingstone	96	4449	260.63	258.98	Open Water
Hangingstone	Hangingstone	97	4409	260.53	258.80	Open Water
Hangingstone	Hangingstone	98	4314	260.00	258.27	Open Water
Hangingstone	Hangingstone	99	4172	259.12	257.46	Open Water
Hangingstone	Hangingstone	100	4122	258.73	257.21	Open Water
Hangingstone	Hangingstone	101	4051	258.22	256.82	Open Water
Hangingstone	Hangingstone	102	3971	257.86	256.33	Open Water
Hangingstone	Hangingstone	103	3906	257.72	255.94	Open Water
Hangingstone	Hangingstone	104	3803	257.11	255.35	Open Water
Hangingstone	Hangingstone	105	3759	256.82	255.21	Open Water
Hangingstone	Hangingstone	106	3667	255.94	254.73	Open Water
Hangingstone	Hangingstone	107	3544	255.65	254.11	Open Water
Hangingstone	Hangingstone	108	3410	254.51	253.26	Open Water
Hangingstone	Hangingstone	109	3298	253.99	252.56	Open Water
Hangingstone	Hangingstone	110	3204	253.62	252.11	Open Water
Hangingstone	Hangingstone	111	3112	253.14	251.69	Open Water
Hangingstone	Hangingstone	112	3031	252.86	251.44	Open Water
Hangingstone	Hangingstone	113	2953	252.43	250.90	Open Water
Hangingstone	Hangingstone	114	2823	251.75	250.29	Open Water
Hangingstone	Hangingstone	115	2710	251.22	249.97	Open Water
Hangingstone	Hangingstone	116	2612	251.00	249.63	Open Water



## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 4: Governing Design Flood Scenario**

River	Reach	Cross Section	River Station	Open Water Design Flood Level (m)	Ice Jam Design Flood Level (m)	Governing Design Scenario
Hangingsstone	Hangingsstone	117	2557	250.95	249.60	Open Water
Hangingsstone	Hangingsstone	118	2491	250.61	249.55	Open Water
Hangingsstone	Hangingsstone	119	2471	250.50	249.54	Open Water
Hangingsstone	Hangingsstone	120	2448	250.42	249.53	Open Water
Hangingsstone	Hangingsstone	121	2418	250.08	249.50	Open Water
Hangingsstone	Hangingsstone	122	2354	249.90	249.48	Open Water
Hangingsstone	Hangingsstone	123	2294	249.56	249.47	Open Water
Hangingsstone	Hangingsstone	124	2276	249.58	249.47	Open Water
Hangingsstone	Hangingsstone	125	2236	249.37	249.46	Ice Jam
Hangingsstone	Hangingsstone	126	2222	249.35	249.46	Ice Jam
Hangingsstone	Hangingsstone	127	2156	249.18	249.46	Ice Jam
Hangingsstone	Hangingsstone	128	2072	249.15	249.46	Ice Jam
Hangingsstone	Hangingsstone	129	2007	248.66	249.46	Ice Jam
Hangingsstone	Hangingsstone	130	1923	248.57	249.46	Ice Jam
Hangingsstone	Hangingsstone	131	1861	248.44	249.46	Ice Jam
Hangingsstone	Hangingsstone	132	1831	248.21	249.45	Ice Jam
Hangingsstone	Hangingsstone	133	1809	248.22	249.45	Ice Jam
Hangingsstone	Hangingsstone	134	1771	247.87	249.45	Ice Jam
Hangingsstone	Hangingsstone	135	1744	247.74	249.45	Ice Jam
Hangingsstone	Hangingsstone	136	1707	247.53	249.45	Ice Jam
Hangingsstone	Hangingsstone	137	1631	246.97	249.45	Ice Jam
Hangingsstone	Hangingsstone	138	1541	246.67	249.45	Ice Jam
Hangingsstone	Hangingsstone	139	1460	246.31	249.45	Ice Jam
Hangingsstone	Hangingsstone	140	1408	246.18	249.45	Ice Jam
Hangingsstone	Hangingsstone	141	1389	246.02	249.45	Ice Jam
Hangingsstone	Hangingsstone	142	1314	246.10	249.45	Ice Jam
Hangingsstone	Hangingsstone	143	1243	245.95	249.45	Ice Jam
Hangingsstone	Hangingsstone	144	1193	245.80	249.45	Ice Jam
Hangingsstone	Hangingsstone	145	1171	245.69	249.45	Ice Jam
Hangingsstone	Hangingsstone	146	1130	245.56	249.45	Ice Jam
Hangingsstone	Hangingsstone	147	1088	245.53	249.45	Ice Jam
Hangingsstone	Hangingsstone	148	1023	245.40	249.45	Ice Jam
Hangingsstone	Hangingsstone	149	960	245.29	249.45	Ice Jam
Hangingsstone	Hangingsstone	150	882	245.27	249.45	Ice Jam
Hangingsstone	Hangingsstone	151	769	245.23	249.45	Ice Jam
Hangingsstone	Hangingsstone	152	701	245.21	249.45	Ice Jam
Hangingsstone	Hangingsstone	153	648	245.15	249.45	Ice Jam
Hangingsstone	Hangingsstone	154	549	245.00	249.45	Ice Jam
Hangingsstone	Hangingsstone	155	490	244.97	249.45	Ice Jam
Hangingsstone	Hangingsstone	156	435	244.95	249.45	Ice Jam
Hangingsstone	Hangingsstone	157	372	244.92	249.45	Ice Jam



Table 4: Governing Design Flood Scenario

River	Reach	Cross Section	River Station	Open Water Design Flood Level (m)	Ice Jam Design Flood Level (m)	Governing Design Scenario
Hangingsstone	Hangingsstone	158	293	244.87	249.45	Ice Jam
Hangingsstone	Hangingsstone	159	227	244.84	249.45	Ice Jam
Hangingsstone	Hangingsstone	160	134	244.79	249.45	Ice Jam
Hangingsstone	Hangingsstone	161	106	244.79	249.45	Ice Jam
Hangingsstone	Hangingsstone	162	92	244.81	249.45	Ice Jam

### 2.3 Floodway and Flood Fringe Terminology

The design flood hazard area is the area of land that will be flooded during the design flood event. Flood hazard maps divide the flood hazard area into floodway and flood fringe zones, including high hazard flood fringe and protected flood fringe sub-zones where appropriate. Flood hazard maps can also illustrate additional information, including incremental areas at risk for floods larger than the 100-year design flood. Flood hazard maps are typically used for long-term flood risk management and land-use planning.

The floodway and flood fringe zones are defined as follows:

- **Floodway:** When a floodway is first defined on a flood hazard map, it typically represents the area of highest flood hazard where flows are deepest, fastest, and most destructive during the 100-year design flood. The floodway generally includes areas where the water is 1 m deep or greater and where local velocities are 1 m/s or faster. The floodway typically includes the main channel of a stream and a portion of the adjacent overbank area. Previously mapped floodways do not typically become larger when a flood hazard map is updated, even if the flood hazard area gets larger or design flood levels get higher.
- **Flood Fringe:** The flood fringe is the portion of the flood hazard area outside of the floodway that typically has relatively shallow water (less than 1 m deep) and lower velocities (less than 1 m/s velocity) during the 100-year design flood. However, areas with deeper or faster moving water may also be identified as high hazard flood fringe areas within the flood fringe. Areas with residual risk behind dedicated flood control structures may also be mapped as protected flood fringe areas within the flood fringe.

### 2.4 Governing Design Flood Hazard Criteria

In areas being mapped for the first time, the floodway typically represents the area of highest hazard where flows are deepest, fastest, and most destructive during the design flood.

When a flood hazard map is updated, an existing floodway will not change in most circumstances. Exceptions to this can include, but are not limited, to the following circumstances: (1) a floodway could get larger if a main channel shifts outside of a previously-defined floodway or (2) a floodway could get smaller if an area of previously-defined floodway is no longer flooded by the design flood.

Areas of deeper or faster moving water outside of the floodway are identified as high hazard flood fringe. These high hazard flood fringe sub-zones are identified in all areas, whether they are newly-mapped or have a previously-defined or existing floodway. The depth and velocity criteria used to define high hazard flood fringe areas are typically aligned with the 1 m depth and 1 m/s velocity floodway determination criteria for newly-mapped areas.



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All areas protected by dedicated flood control structures (e.g., flood berms) that are not overtopped during the design flood are excluded from the floodway. Areas behind flood berms will still be mapped as flooded if they are overtopped, but areas of residual risk of behind flood berms that are not overtopped are mapped as protected flood fringe sub-zones. There is one area that is currently protected by a flood control berm along the Snye at MacDonald Drive.

Following the completion of the flood hazard criteria maps, one additional flood control structure (Saline Creek Drive to Waterways, to be completed in 2023) was considered during the governing flood hazard mapping.

The draft flood hazard criteria and floodway limit stations have been determined in the Open Water Flood Hazard Identification Report (Golder, 2022) and Ice Jam Modelling and Flood Hazard Identification Report (Hatch, 2022).

The final draft flood hazard map along the Athabasca and Clearwater Rivers differs from the Ice Jam Modelling and Flood Hazard Identification Report criteria map. In consultation with RMWB, and in anticipation of the completion of flood control berms in the downtown area along the Clearwater River and around TaigaNova along the Athabasca River, the floodway follows the path of the existing and proposed berms. Until the berms are complete and functioning, the areas behind them will be shown as flood fringe and high-hazard flood fringe. Once the berms are completed, and supplemental information is provided, the governing flood hazard map can be revised to show the areas behind the berms as protected flood fringe.

The floodway determination criteria for the left and right floodway limits at each cross section are provided together with the governing design flood levels and the governing flood scenario in Table 5.

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**Table 5: Governing Floodway Criteria and Limit Stations**

River	Reach	Cross Section	River Station	Governing Design Flood Level (m)	Governing Design Flood Scenario	Floodway Limit Station		Governing Criteria	
						Left Station (m)	Right Station (m)	Left Station	Right Station
Athabasca	Upper Reach	1	17519	250.82	Ice Jam	193.63	585.23	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	2	16535	250.65	Ice Jam	185.04	613.14	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	3	15716	250.50	Ice Jam	657.45	1025.15	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	4	15048	250.34	Ice Jam	1737.91	2156.79	1 m Depth	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	5	14346	250.18	Ice Jam	706.34	1200.05	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	6	13706	250.07	Ice Jam	453.08	928.05	Inundation Extent <sup>(2)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	7	13071	249.97	Ice Jam	119.71	568.66	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	8	12237	249.87	Ice Jam	579.06	1076.38	1 m Depth	1 m Depth
Athabasca	Upper Reach	9	11791	249.81	Ice Jam	583.16	996.08	Inundation Extent <sup>(2)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	10	11309	249.70	Ice Jam	384.56	816.45	1 m Depth	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	11	10747	249.57	Ice Jam	29.87	777.51	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	12	10564	249.52	Ice Jam	248.53	701.49	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	13	10306	249.50	Ice Jam	71.40	936.62	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	14	9779	249.45	Ice Jam	207.84	960.16	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Upper Reach	15	9174	249.42	Ice Jam	614.12	1393.97	Inundation Extent <sup>(1)</sup>	Previous Floodway
Athabasca	Lower Reach	16	8559	249.41	Ice Jam	658.19	1950.00	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Lower Reach	17	7895	249.40	Ice Jam	750.72	1959.52	1 m Depth	Inundation Extent <sup>(1)</sup>
Athabasca	Lower Reach	18	7144	249.38	Ice Jam	559.88	2045.64	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Athabasca	Lower Reach	19	6438	249.37	Ice Jam	1092.28	2156.14	Main Channel	Inundation Extent <sup>(1)</sup>
Athabasca	Lower Reach	20	5675	249.36	Ice Jam	1125.00	2112.28	Main Channel	Inundation Extent <sup>(1)</sup>
Athabasca	Lower Reach	21	4899	249.29	Ice Jam	587.15	1939.86	1 m Depth	1 m Depth
Athabasca	Lower Reach	22	4246	249.08	Ice Jam	1058.28	2181.17	1 m Depth	1 m Depth
Athabasca	Lower Reach	23	3083	248.38	Ice Jam	886.81	2071.37	1 m Depth	1 m Depth
Athabasca	Lower Reach	24	2347	248.27	Ice Jam	795.66	2073.47	1 m Depth	1 m Depth
Athabasca	Lower Reach	25	1420	247.85	Ice Jam	363.77	1893.92	1 m Depth	1 m Depth
Athabasca	Lower Reach	26	129	247.47	Ice Jam	354.21	1927.04	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	27	20359	249.56	Ice Jam	524.64	1003.76	1 m Depth	1 m Depth
Clearwater	Upper Reach	28	19986	249.55	Ice Jam	460.06	1102.32	1 m Depth	1 m Depth
Clearwater	Upper Reach	29	19705	249.55	Ice Jam	377.38	1243.68	1 m Depth	1 m Depth
Clearwater	Upper Reach	30	19182	249.54	Ice Jam	423.28	1385.72	1 m Depth	1 m Depth
Clearwater	Upper Reach	31	18685	249.53	Ice Jam	353.99	1519.68	1 m Depth	1 m Depth
Clearwater	Upper Reach	32	18262	249.52	Ice Jam	434.40	1718.02	1 m Depth	1 m Depth
Clearwater	Upper Reach	33	17883	249.51	Ice Jam	590.18	1813.84	1 m Depth	1 m Depth
Clearwater	Upper Reach	34	17460	249.51	Ice Jam	965.66	2114.82	1 m Depth	1 m Depth
Clearwater	Upper Reach	35	16972	249.50	Ice Jam	861.72	1984.20	Mixed	1 m Depth
Clearwater	Upper Reach	36	16560	249.49	Ice Jam	769.10	1740.90	1 m Depth	1 m Depth
Clearwater	Upper Reach	37	16223	249.49	Ice Jam	695.86	1886.95	1 m Depth	1 m Depth
Clearwater	Upper Reach	38	15826	249.48	Ice Jam	450.29	2052.52	1 m Depth	1 m Depth
Clearwater	Upper Reach	39	15382	249.48	Ice Jam	438.25	2026.73	1 m Depth	1 m Depth
Clearwater	Upper Reach	40	14757	249.48	Ice Jam	570.22	1905.05	1 m Depth	1 m Depth
Clearwater	Upper Reach	41	14127	249.47	Ice Jam	435.53	1835.00	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	42	13537	249.47	Ice Jam	352.54	1905.40	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	43	13179	249.47	Ice Jam	313.55	2027.79	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	44	12786	249.47	Ice Jam	311.45	2119.69	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	45	12424	249.47	Ice Jam	304.24	1800.77	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	46	11985	249.47	Ice Jam	267.72	1727.00	1 m Depth	1 m Depth



## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 5: Governing Floodway Criteria and Limit Stations**

River	Reach	Cross Section	River Station	Governing Design Flood Level (m)	Governing Design Flood Scenario	Floodway Limit Station		Governing Criteria	
						Left Station (m)	Right Station (m)	Left Station	Right Station
Clearwater	Upper Reach	47	11537	249.46	Ice Jam	276.05	1724.48	1 m Depth	1 m Depth
Clearwater	Upper Reach	48	11033	249.46	Ice Jam	336.06	2033.08	1 m Depth	1 m Depth
Clearwater	Upper Reach	49	10663	249.46	Ice Jam	367.21	1781.01	1 m Depth	1 m Depth
Clearwater	Upper Reach	50	10095	249.46	Ice Jam	346.48	1597.60	1 m Depth	1 m Depth
Clearwater	Upper Reach	51	9674	249.46	Ice Jam	323.30	1680.01	Main Channel	1 m Depth
Clearwater	Upper Reach	52	9210	249.46	Ice Jam	442.80	1735.43	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	53	8934	249.45	Ice Jam	512.31	1841.83	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	54	8679	249.45	Ice Jam	544.16	1736.41	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	55	8440	249.45	Ice Jam	558.15	1588.89	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	56	8121	249.45	Ice Jam	566.51	1711.98	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	57	7780	249.45	Ice Jam	563.47	1835.72	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	58	7396	249.45	Ice Jam	575.97	1806.24	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	59	7081	249.45	Ice Jam	454.78	1675.81	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Upper Reach	60	6802	249.45	Ice Jam	484.49	1677.76	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	61	6605	249.45	Ice Jam	1470.36	2653.07	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	62	6350	249.44	Ice Jam	1487.02	2264.43	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	63	6078	249.44	Ice Jam	1200.89	2042.08	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	64	5806	249.44	Ice Jam	1077.97	1830.67	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	65	5535	249.44	Ice Jam	1126.74	1693.30	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	66	5194	249.43	Ice Jam	1173.23	1552.90	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	67	4760	249.43	Ice Jam	972.22	1398.72	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	68	4324	249.43	Ice Jam	805.69	1318.68	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	69	3906	249.43	Ice Jam	1152.32	1570.28	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	70	3541	249.42	Ice Jam	1268.48	1656.53	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	71	3183	249.42	Ice Jam	1242.96	1691.57	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Mid Reach	72	2815	249.42	Ice Jam	1214.92	1709.53	Main Channel	Inundation Extent <sup>(1)</sup>
Clearwater	Lower Reach	73	2250	249.42	Ice Jam	747.68	1457.64	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Lower Reach	74	1848	249.42	Ice Jam	675.50	1289.54	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Lower Reach	75	1471	249.41	Ice Jam	291.25	1149.15	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Lower Reach	76	1043	249.41	Ice Jam	66.84	1085.08	1 m Depth	Inundation Extent <sup>(1)</sup>
Clearwater	Lower Reach	77	480	249.41	Ice Jam	n/a	688.86	No Floodway Station <sup>(3)</sup>	Inundation Extent <sup>(1)</sup>
Snye	Snye	78	1332	249.42	Ice Jam	30.98	213.46	Main Channel	Main Channel
Snye	Snye	79	932	249.42	Ice Jam	62.65	266.47	Main Channel	Main Channel
Snye	Snye	80	456	249.42	Ice Jam	n/a	343.40	No Floodway Station <sup>(3)</sup>	Main Channel
Snye	Snye	81	172	249.42	Ice Jam	n/a	n/a	No Floodway Station <sup>(3)</sup>	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	82	5586	266.84	Open Water	302.57	334.68	Main Channel	Main Channel
Hangingstone	Hangingstone	83	5507	266.54	Open Water	178.93	217.71	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	84	5377	265.24	Open Water	102.81	132.63	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	85	5278	264.75	Open Water	158.02	191.21	Inundation Extent <sup>(1)</sup>	Main Channel
Hangingstone	Hangingstone	86	5162	264.16	Open Water	272.50	309.35	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingstone	Hangingstone	87	5048	263.24	Open Water	351.82	381.93	Inundation Extent <sup>(2)</sup>	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	88	4975	262.96	Open Water	360.12	393.77	Inundation Extent <sup>(2)</sup>	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	89	4942	262.88	Open Water	374.00	408.53	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	90	4874	262.41	Open Water	491.59	522.15	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingstone	Hangingstone	91	4788	261.96	Open Water	580.73	618.49	Inundation Extent <sup>(1)</sup>	Main Channel
Hangingstone	Hangingstone	92	4694	261.62	Open Water	645.29	687.30	Inundation Extent <sup>(1)</sup>	1 m/s Velocity





## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 5: Governing Floodway Criteria and Limit Stations**

River	Reach	Cross Section	River Station	Governing Design Flood Level (m)	Governing Design Flood Scenario	Floodway Limit Station		Governing Criteria	
						Left Station (m)	Right Station (m)	Left Station	Right Station
Hangingsstone	Hangingsstone	93	4600	261.30	Open Water	615.88	658.51	1 m/s Velocity	Inundation Extent <sup>(2)</sup>
Hangingsstone	Hangingsstone	94	4525	261.03	Open Water	610.48	643.76	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	95	4506	260.84	Open Water	539.50	578.19	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	96	4449	260.63	Open Water	457.54	501.57	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	97	4409	260.53	Open Water	391.46	445.99	1 m/s Velocity	1 m/s Velocity
Hangingsstone	Hangingsstone	98	4314	260.00	Open Water	274.10	305.84	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingsstone	Hangingsstone	99	4172	259.12	Open Water	253.01	280.66	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingsstone	Hangingsstone	100	4122	258.73	Open Water	197.03	233.45	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	101	4051	258.22	Open Water	255.88	287.48	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingsstone	Hangingsstone	102	3971	257.86	Open Water	350.91	382.04	Inundation Extent <sup>(1)</sup>	Main Channel
Hangingsstone	Hangingsstone	103	3906	257.72	Open Water	422.17	459.95	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	104	3803	257.11	Open Water	450.56	481.79	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	105	3759	256.82	Open Water	435.65	470.36	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	106	3667	255.94	Open Water	399.16	430.12	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	107	3544	255.65	Open Water	310.30	349.51	1 m/s Velocity	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	108	3410	254.51	Open Water	212.58	243.73	Inundation Extent <sup>(1)</sup>	1 m Depth
Hangingsstone	Hangingsstone	109	3298	253.99	Open Water	115.96	150.11	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingsstone	Hangingsstone	110	3204	253.62	Open Water	82.26	113.26	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	111	3112	253.14	Open Water	68.09	100.91	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingsstone	Hangingsstone	112	3031	252.86	Open Water	49.52	90.51	Inundation Extent <sup>(1)</sup>	1 m Depth
Hangingsstone	Hangingsstone	113	2953	252.43	Open Water	127.16	165.99	Inundation Extent <sup>(1)</sup>	1 m/s Velocity
Hangingsstone	Hangingsstone	114	2823	251.75	Open Water	276.70	311.41	Inundation Extent <sup>(1)</sup>	1 m Depth
Hangingsstone	Hangingsstone	115	2710	251.22	Open Water	353.46	388.49	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	116	2612	251.00	Open Water	372.99	426.24	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	117	2557	250.95	Open Water	353.73	404.22	Main Channel	Main Channel
Hangingsstone	Hangingsstone	118	2491	250.61	Open Water	362.92	392.23	Main Channel	Main Channel
Hangingsstone	Hangingsstone	119	2471	250.50	Open Water	364.28	390.37	Main Channel	Main Channel
Hangingsstone	Hangingsstone	120	2448	250.42	Open Water	349.53	375.01	Main Channel	Main Channel
Hangingsstone	Hangingsstone	121	2418	250.08	Open Water	346.07	371.31	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	122	2354	249.90	Open Water	354.84	385.92	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	123	2294	249.56	Open Water	410.42	441.86	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	124	2276	249.58	Open Water	438.77	474.48	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	125	2236	249.46	Ice Jam	473.88	529.97	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	126	2222	249.46	Ice Jam	493.71	540.95	Inundation Extent <sup>(1)</sup>	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	127	2156	249.46	Ice Jam	575.52	730.55	Main Channel	Inundation Extent <sup>(2)</sup>
Hangingsstone	Hangingsstone	128	2072	249.46	Ice Jam	700.93	913.19	Main Channel	Inundation Extent <sup>(2)</sup>
Hangingsstone	Hangingsstone	129	2007	249.46	Ice Jam	771.30	1014.81	Main Channel	Inundation Extent <sup>(2)</sup>
Hangingsstone	Hangingsstone	130	1923	249.46	Ice Jam	856.39	1138.37	Main Channel	Inundation Extent <sup>(2)</sup>
Hangingsstone	Hangingsstone	131	1861	249.46	Ice Jam	866.43	1188.00	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	132	1831	249.45	Ice Jam	1085.01	1208.93	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	133	1809	249.45	Ice Jam	1115.83	1223.22	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	134	1771	249.45	Ice Jam	1145.86	1253.41	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	135	1744	249.45	Ice Jam	1145.82	1251.39	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	136	1707	249.45	Ice Jam	1128.17	1257.98	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	137	1631	249.45	Ice Jam	1092.99	1239.58	Main Channel	1 m Depth
Hangingsstone	Hangingsstone	138	1541	249.45	Ice Jam	1062.32	1283.33	Main Channel	1 m Depth



## FORT MCMURRAY RIVER HAZARD STUDY – GOVERNING DESIGN FLOOD HAZARD MAPPING REPORT

**Table 5: Governing Floodway Criteria and Limit Stations**

River	Reach	Cross Section	River Station	Governing Design Flood Level (m)	Governing Design Flood Scenario	Floodway Limit Station		Governing Criteria	
						Left Station (m)	Right Station (m)	Left Station	Right Station
Hangingsstone	Hangingsstone	139	1460	249.45	Ice Jam	998.39	1289.58	Main Channel	1 m Depth
Hangingsstone	Hangingsstone	140	1408	249.45	Ice Jam	991.49	1349.57	Main Channel	1 m Depth
Hangingsstone	Hangingsstone	141	1389	249.45	Ice Jam	990.06	1338.71	Main Channel	1 m Depth
Hangingsstone	Hangingsstone	142	1314	249.45	Ice Jam	974.38	1553.70	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	143	1243	249.45	Ice Jam	979.31	1509.00	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	144	1193	249.45	Ice Jam	1050.87	1599.55	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	145	1171	249.45	Ice Jam	1120.16	1608.58	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	146	1130	249.45	Ice Jam	1061.90	1656.75	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	147	1088	249.45	Ice Jam	1109.26	1705.33	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	148	1023	249.45	Ice Jam	1196.76	1828.06	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	149	960	249.45	Ice Jam	1273.14	1861.34	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	150	882	249.45	Ice Jam	1330.62	2004.09	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	151	769	249.45	Ice Jam	1357.31	2227.53	Main Channel	Inundation Extent <sup>(1)</sup>
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Hangingsstone	Hangingsstone	153	648	249.45	Ice Jam	1367.85	2205.38	Main Channel	Inundation Extent <sup>(1)</sup>
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Hangingsstone	Hangingsstone	156	435	249.45	Ice Jam	1384.95	1947.15	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	157	372	249.45	Ice Jam	1390.62	1923.87	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	158	293	249.45	Ice Jam	1395.86	1969.48	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	159	227	249.45	Ice Jam	1405.36	1924.85	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	160	134	249.45	Ice Jam	1417.93	1928.51	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	161	106	249.45	Ice Jam	1430.83	1955.45	Main Channel	Inundation Extent <sup>(1)</sup>
Hangingsstone	Hangingsstone	162	92	249.45	Ice Jam	1449.78	1983.82	Main Channel	Inundation Extent <sup>(1)</sup>

Notes:

- 1) No viable flood fringe
- 2) Floodway set at interior inundation extent, no viable interior flood fringe
- 3) No floodway station because edge of inundation is outside of cross-section extent



## **3.0 GOVERNING DESIGN FLOOD HAZARD MAP PRODUCTION**

### **3.1 Governing Flood Mapping Methodology**

The design flood hazard extent is a combination of the 100-year ice jam and the 100-year open water inundation extent. For river reaches where the ice jam scenario governs, the hazard area corresponds to the 100-year ice jam flood extent. For river reaches where the open water scenario governs, the hazard area corresponds to the 100-year open water flood extent. The mapping method for the inundation mapping is described in detail in the flood inundation mapping report prepared for this study (Golder 2018c). Exceptions are areas where the floodway crosses small areas of dry land for the purpose of floodway smoothing and consistency with previous mapping.

### **3.2 Governing Flood Hazard Maps**

Flood hazard maps divide the flood hazard area into floodway and flood fringe zones, including high-hazard flood fringe and protected flood fringe sub-zones where appropriate. Flood hazard maps can also illustrate additional information, including incremental areas at risk for floods larger than the governing 100-year design flood. In this study, the incremental risk is shown as the 200-year ice jam flood. These maps have been developed in accordance with applicable provincial standards, and the floodway was delineated based on the open water and ice jam floodway criteria mapping. All areas within the floodway boundary are typically mapped as floodway, even if design flood levels do not indicate a specific location as inundated (i.e., “islands” of dry ground within the floodway) shown in floodway criteria maps are not present in flood hazard maps. The governing flood hazard maps are provided in Appendix A of this report.

### **3.3 Areas in the Floodway**

The following areas are in the governing floodway:

- Main channels of the Athabasca, Clearwater, and Hangingstone Rivers and the Snye.
- Approximately 2.8 km of the downstream end of the main channel of the Horse River
- All islands in the Athabasca River main channel.
- Low-lying parts of the Clearwater River floodplain between Draper and Fort McMurray, including properties off of Draper Road and along Garden Lane.
- Parts of Ptarmigan Court on the Hangingstone River.
- Confluence area of the Hangingstone River.

### **3.4 Areas in the Flood Fringe**

The following areas are in the governing flood fringe:

- Low-lying floodplain areas along the Athabasca River, including the protected areas at the TaigaNova Industrial Park and the RMWB Wastewater Treatment Plant.
- Protected areas along the Clearwater River, including most of Waterways, and low-lying areas of downtown Fort McMurray.
- Parts of the MacDonald Island Park Recreation Centre.



- Limited low-lying floodplain areas along the Hangingstone River upstream of the Memorial Drive Bridges (Highway 63).
- Parts of Ptarmigan Court.
- Protected areas on the Snye at Richard Street.

## **4.0 POTENTIAL CLIMATE CHANGE IMPACTS**

To better understand the possible impacts of climate change on flood levels, the effect of more severe 100-year flood conditions was assessed for both open-water and ice-affected flood scenarios.

The analysis for the open water flood scenario consisted of increasing 100-year flood flows by 10 and 20 percent for the reaches where open water flood governs and comparing the resulting flood levels with the base levels. Open water floods along the Athabasca River and Clearwater River typically result in lower water levels than ice jam floods and hence the impacts of increased flows were not assessed for these reaches. However, open water flood levels along the Hangingstone River can be higher than ice jam floods, especially in the reach upstream of the Heritage Park Foot Bridge. For the Hangingstone River reach where open water flood levels govern, the average increases in flood levels are 0.19 m for a 10 percent increase in flow and 0.28 m for a 20 percent increase in flow.

The analysis for the ice-affected flood scenario consisted of comparing 100-year and 200-year ice-affected flood water levels. The average increase in flood levels along the Athabasca, Clearwater and Hangingstone Rivers is 0.98 m, 0.97 m, and 0.62 m respectively. A rise of 0.97 m is also expected to occur along Snye due to backwater effect from Clearwater River.

It is acknowledged that the above analyses are not based on a regional climate change impacts assessment but are based on a simplified assumption that climate change will result in increased peak flood flows. The presented values can be viewed as a general range of potential climate change “freeboard” that could be considered in addition to computed design flood water levels.

## **5.0 CONCLUSIONS**

This report summarizes the work of the governing design flood hazard mapping component of the Fort McMurray River Hazard Study.

In assessing the governing design flood event for this study reach, it has been determined that ice jam floods are the governing design flood on the Athabasca and Clearwater Rivers, and on a reach of the Hangingstone River from the confluence to upstream of the Heritage Park bridge. For areas on the Hangingstone River that are upstream of this bridge, 100-year open-water flood levels are higher than ice jam flood levels.

The governing floodway and flood fringe areas were delineated for the Athabasca, Clearwater, and Hangingstone Rivers and the Snye using the previously determined floodways for the open water and ice jam scenarios (Golder 2022, Hatch 2022). Following the completion of the flood hazard criteria maps, one additional flood control structure (Saline Creek Drive to waterways, to be completed in 2023) was considered during the governing flood hazard mapping.

The governing floodway and flood fringe include developed areas as described in section 3.3 and section 3.4 respectively.



## Report Signature Page

This report was prepared and reviewed by the undersigned.

Prepared by:

Reviewed by:

**Original Signed By:**

**Original Signed By:**

Nancy Guo, B.Sc., P.Eng.  
River Engineer

Wolf Ploeger, Dr.-Ing., P.Eng.  
Senior River Engineer

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## **REFERENCES**

- Alberta Environmental Protection (AEP). 1993. *Review of Flood Stage Frequency Estimates for the City of Fort McMurray*. November 1993 (mapping updated in 1995 and 2003).
- Golder. 2022. *Fort McMurray River Hazard Study – Open Water Flood Hazard Identification*. July 2022.
- Hatch. 2022. *Fort McMurray River Hazard Study – Ice Jam Modelling and Flood Hazard Identification*. July 2022.

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# **APPENDIX A**

## **Governing Design Flood Hazard Maps**

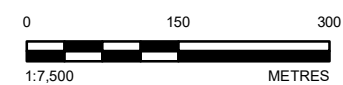
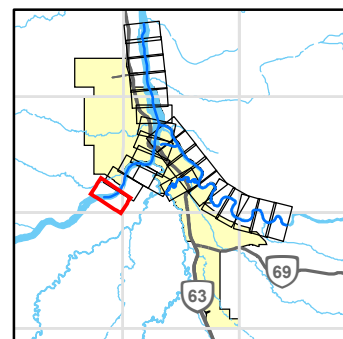
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➡	FLOW DIRECTION
⌈⌋	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY

■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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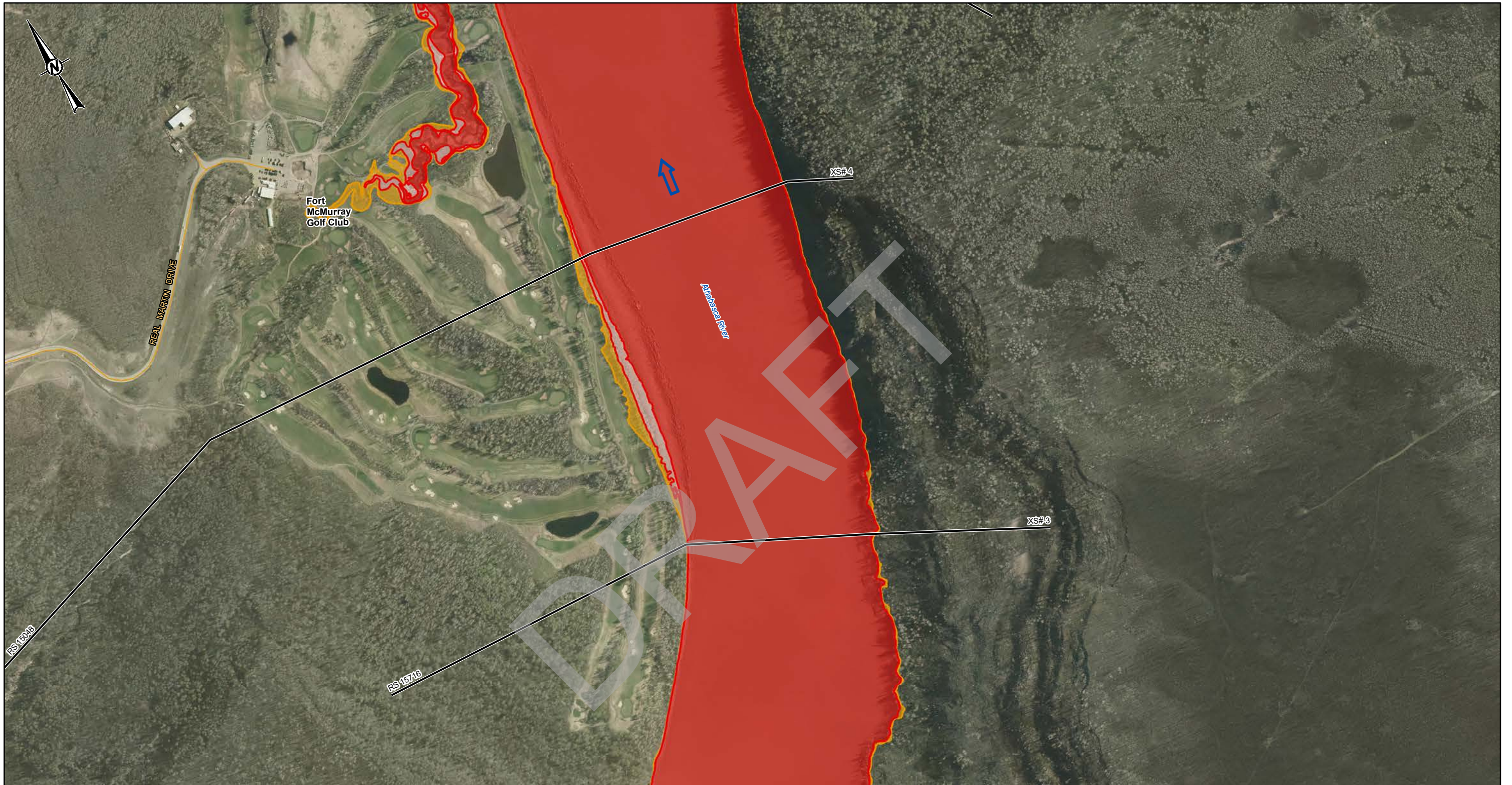
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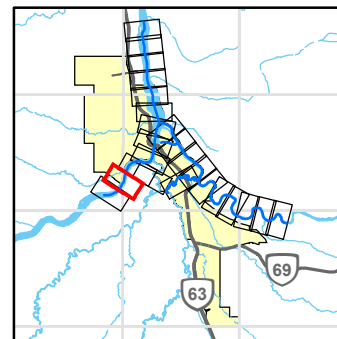
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RIVER STATION	FLOOD FRINGE
FLOW DIRECTION	PROTECTED FLOOD FRINGE
BRIDGE	200-YEAR FLOOD EXTENT
LOCAL ROAD	
PRIMARY HIGHWAY	
FLOOD CONTROL STRUCTURE	
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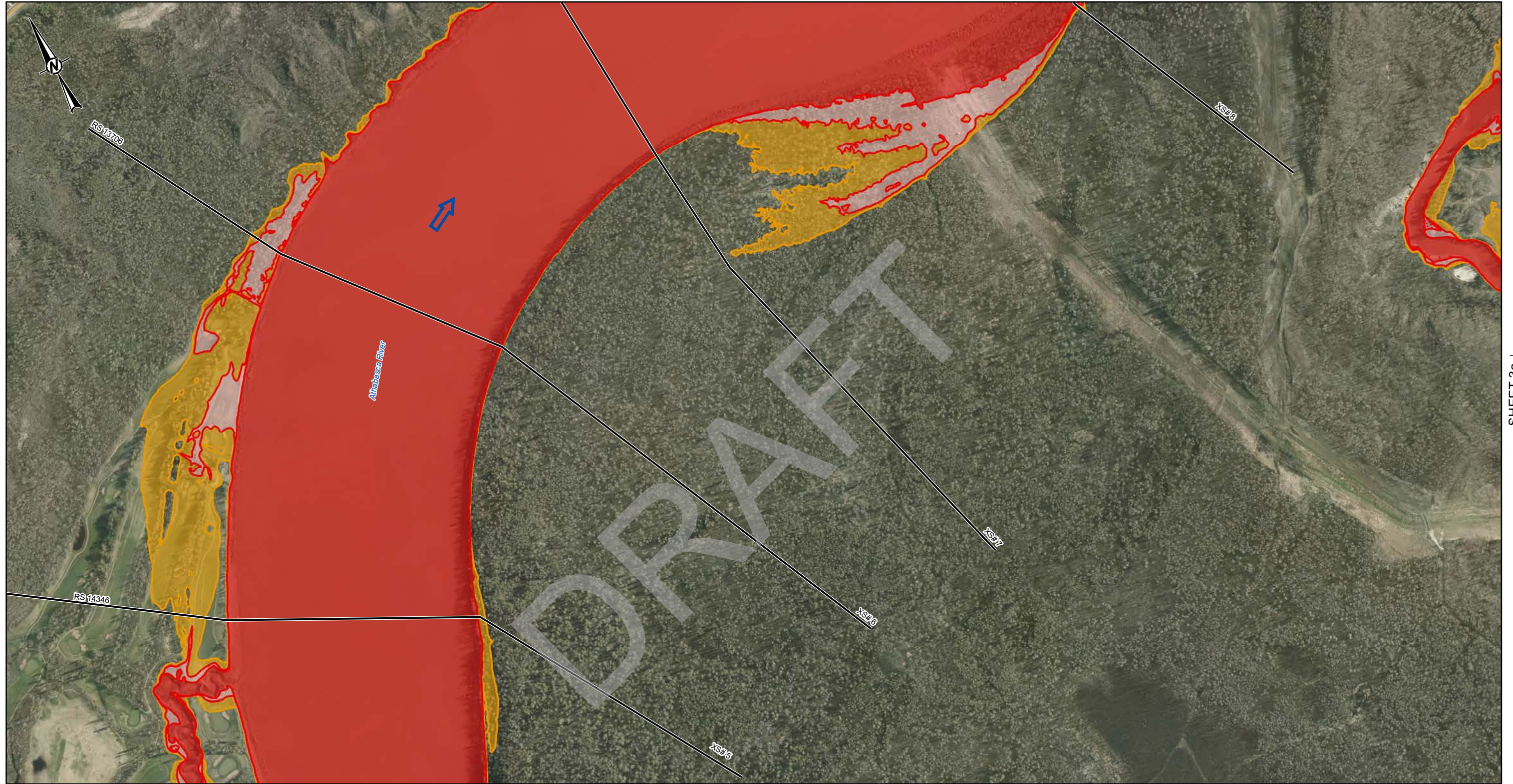
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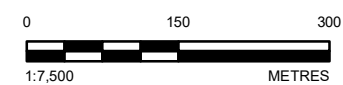
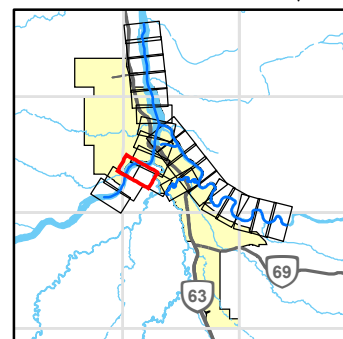
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RIVER STATION	FLOOD FRINGE
FLOW DIRECTION	PROTECTED FLOOD FRINGE
BRIDGE	200-YEAR FLOOD EXTENT
LOCAL ROAD	
PRIMARY HIGHWAY	
FLOOD CONTROL STRUCTURE	
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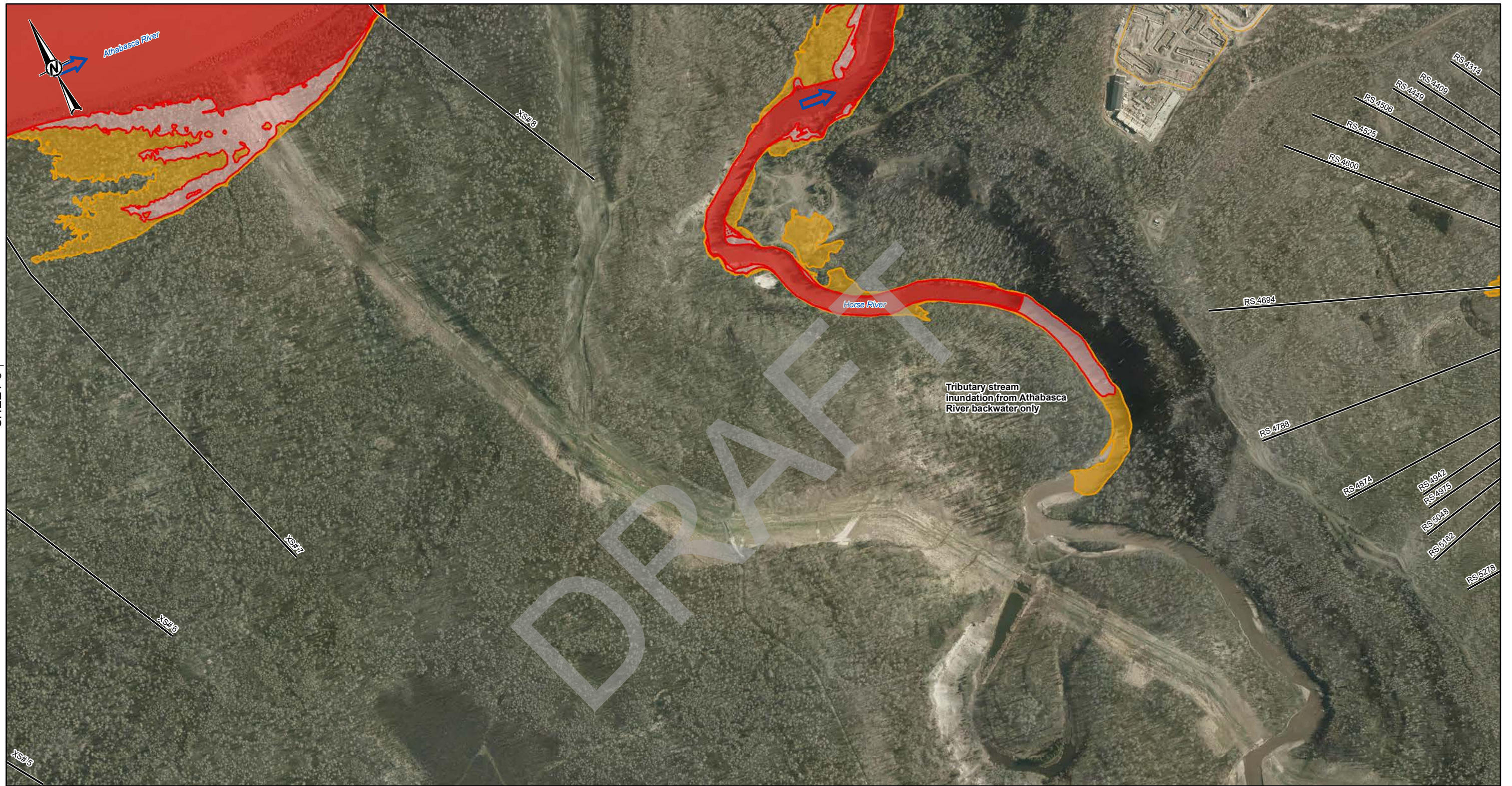
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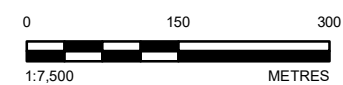
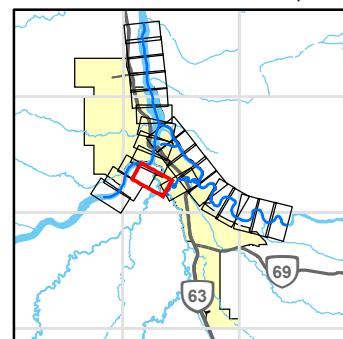


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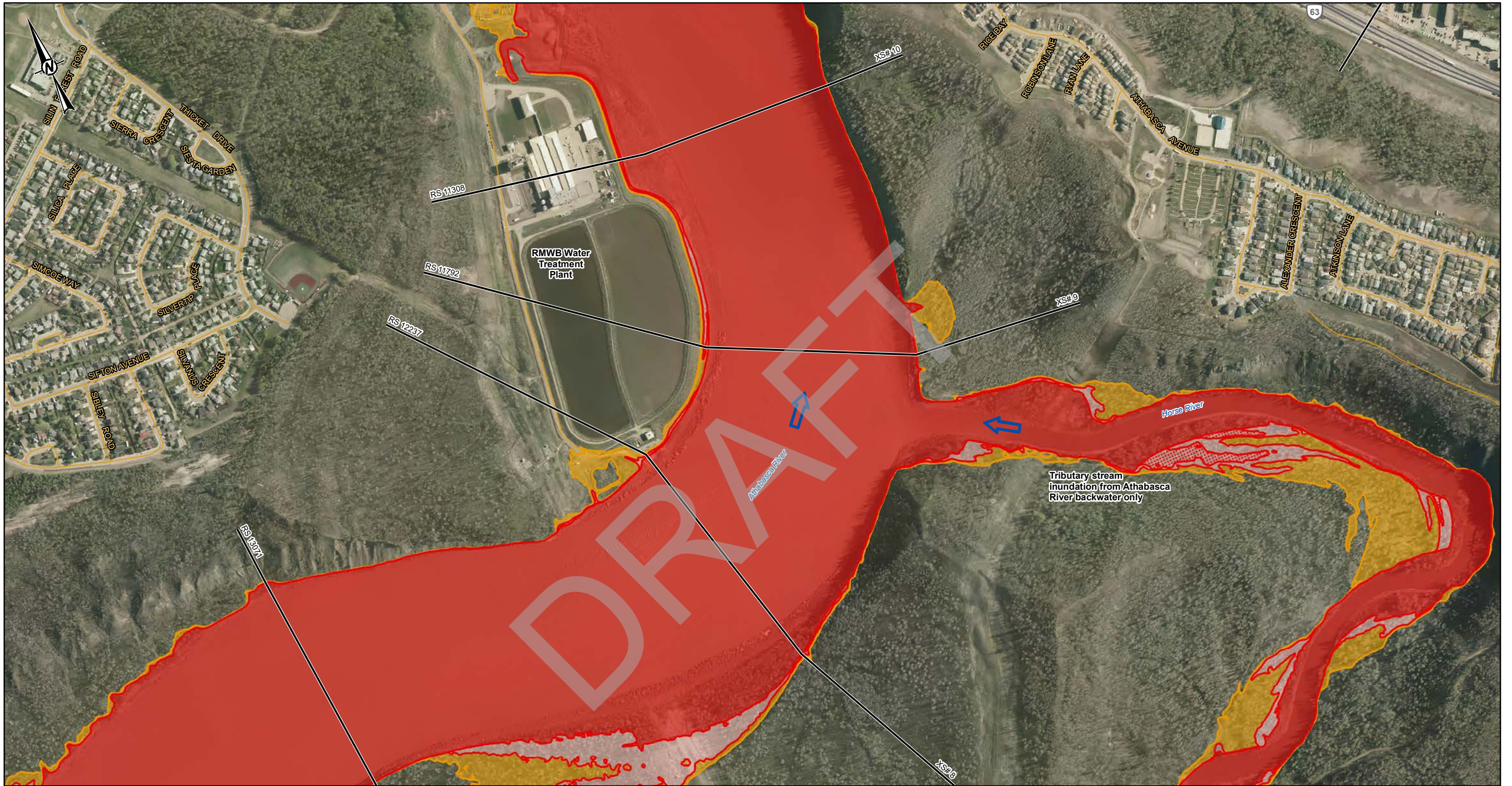
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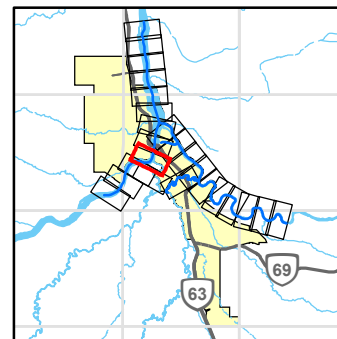
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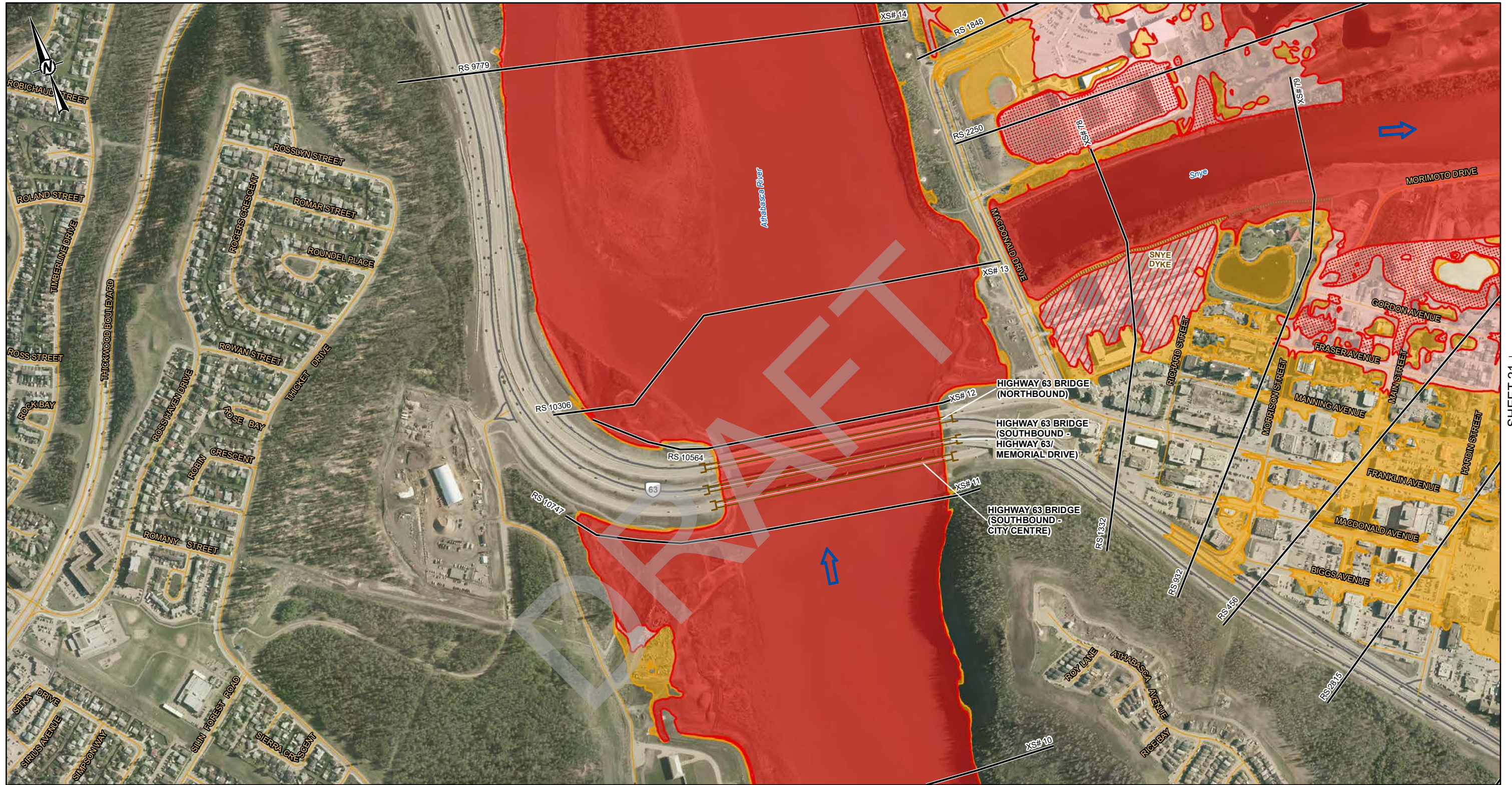
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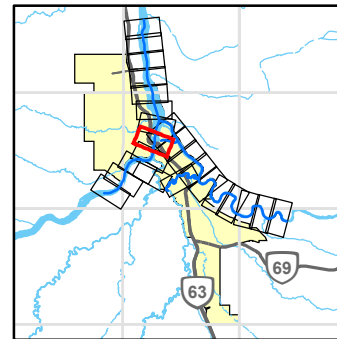
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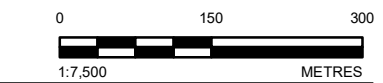


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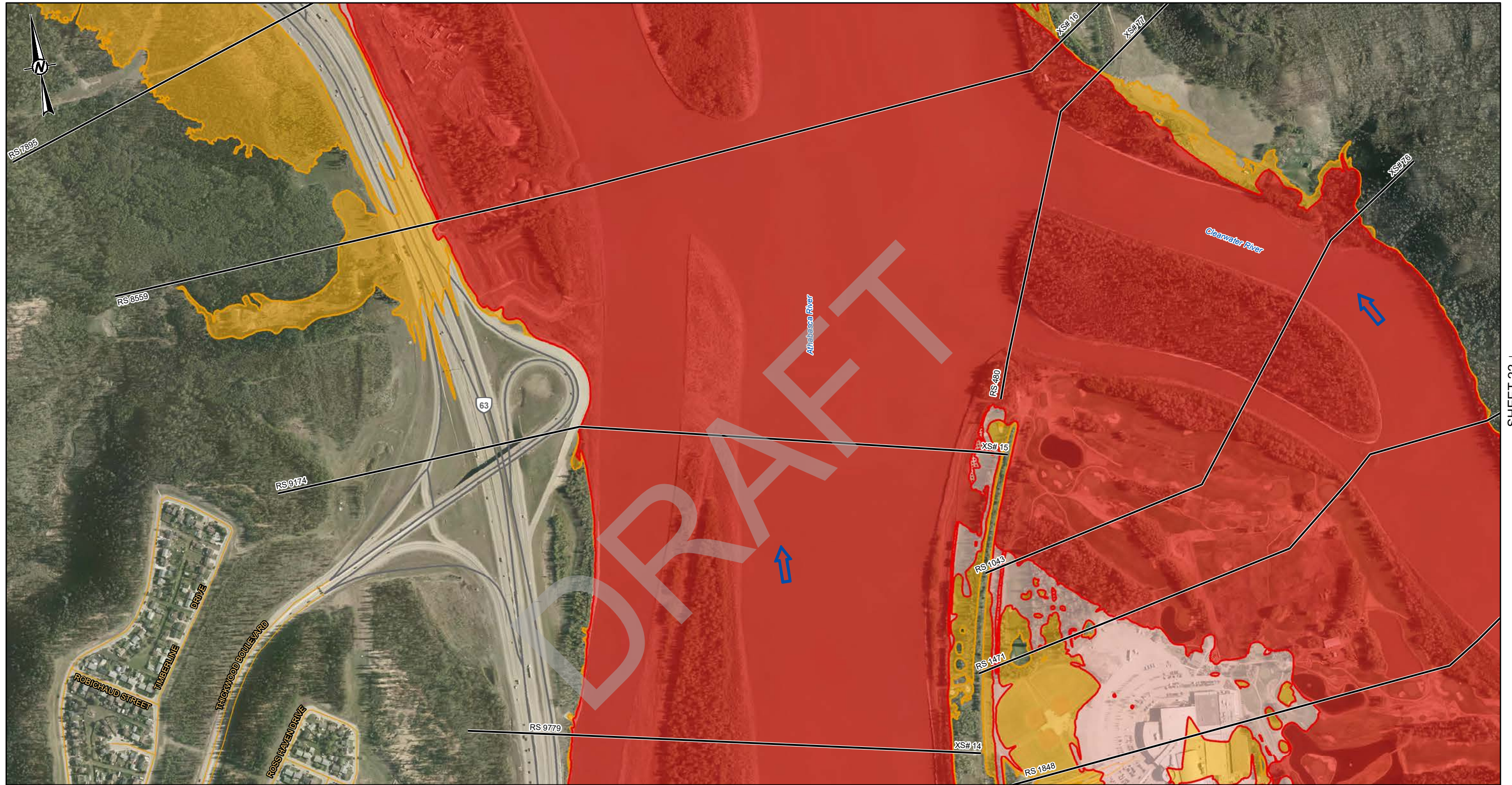
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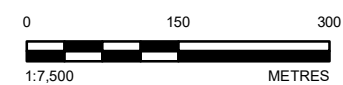
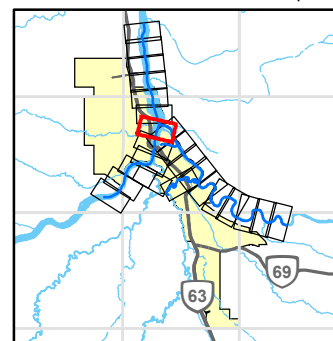
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⌈	BRIDGE
—	LOCAL ROAD
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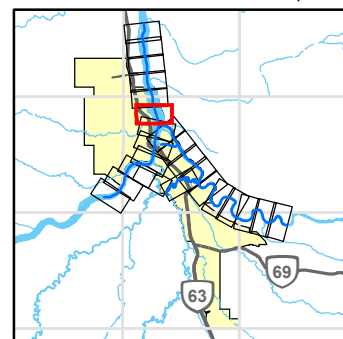
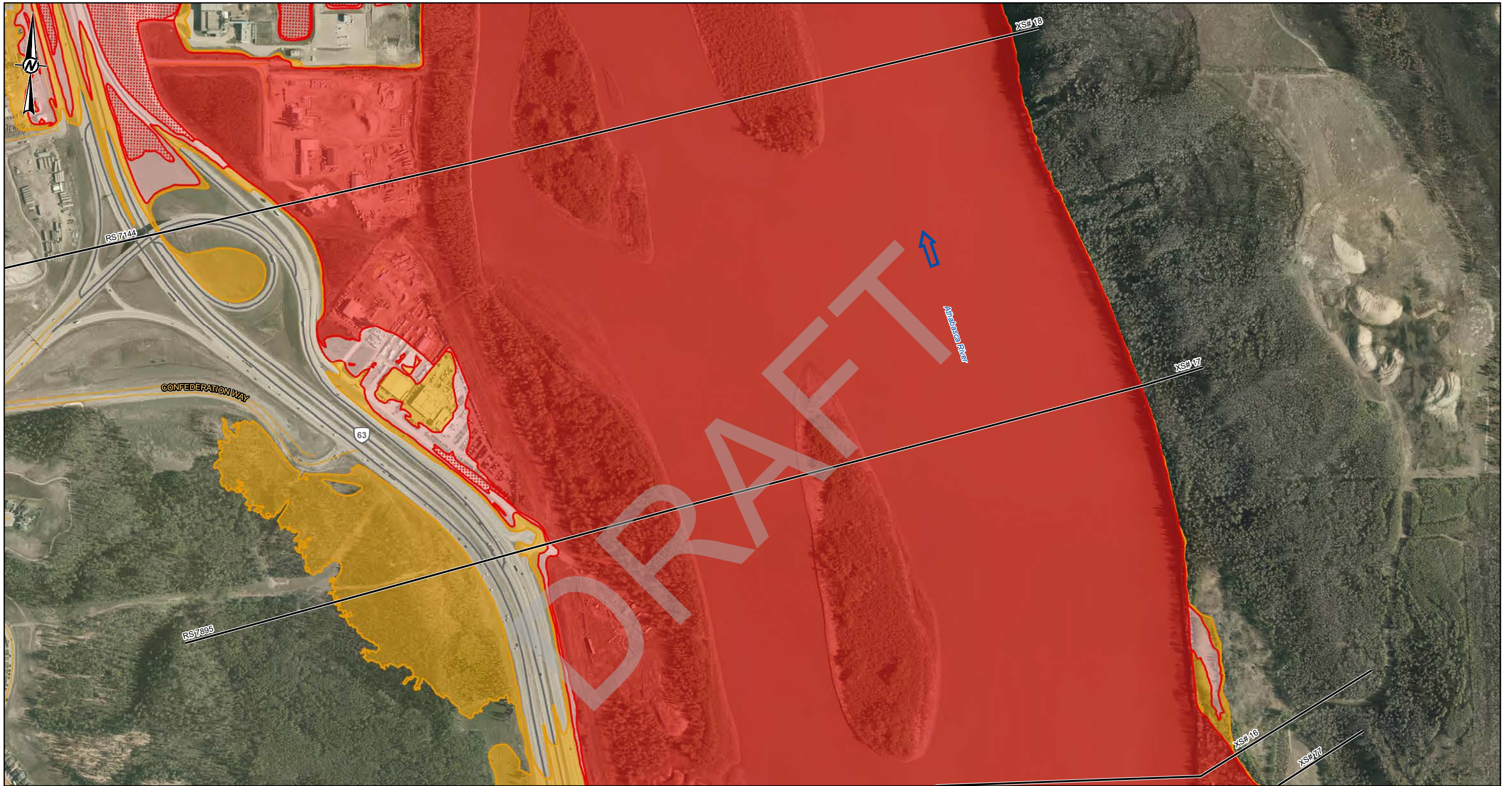
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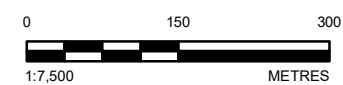
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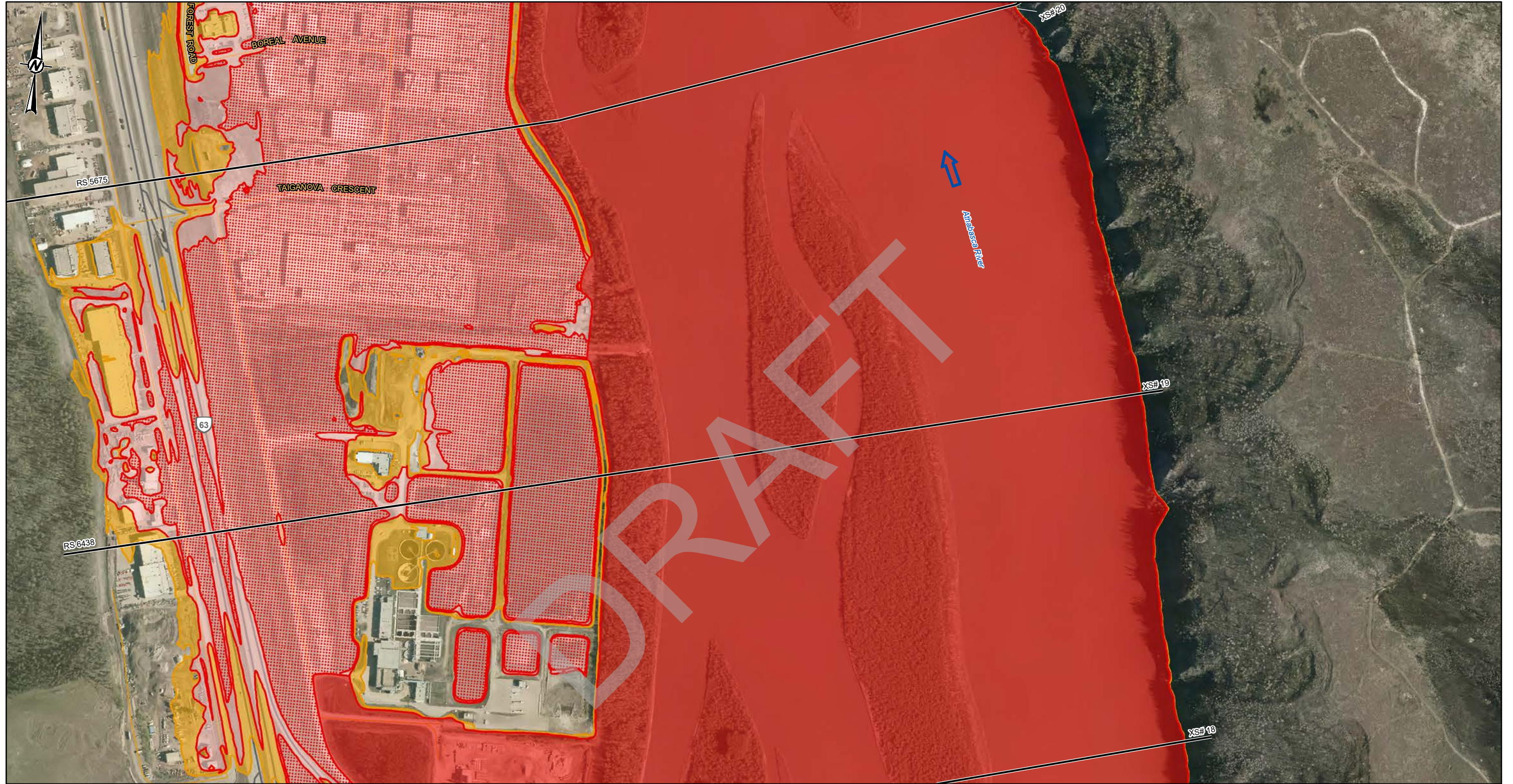
PROJECT  
**FORT McMURRAY RIVER HAZARD STUDY**

TITLE  
**GOVERNING DESIGN FLOOD HAZARD MAP**

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 7 of 23

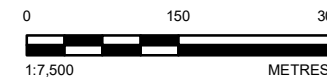
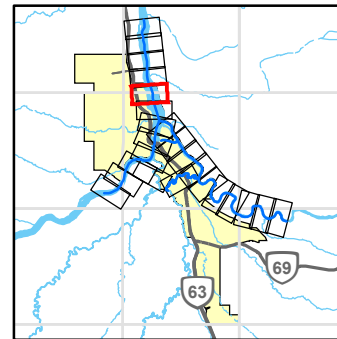
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSIS B



**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
➡	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
⌈	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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AND PARKS



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PREPARED	PT
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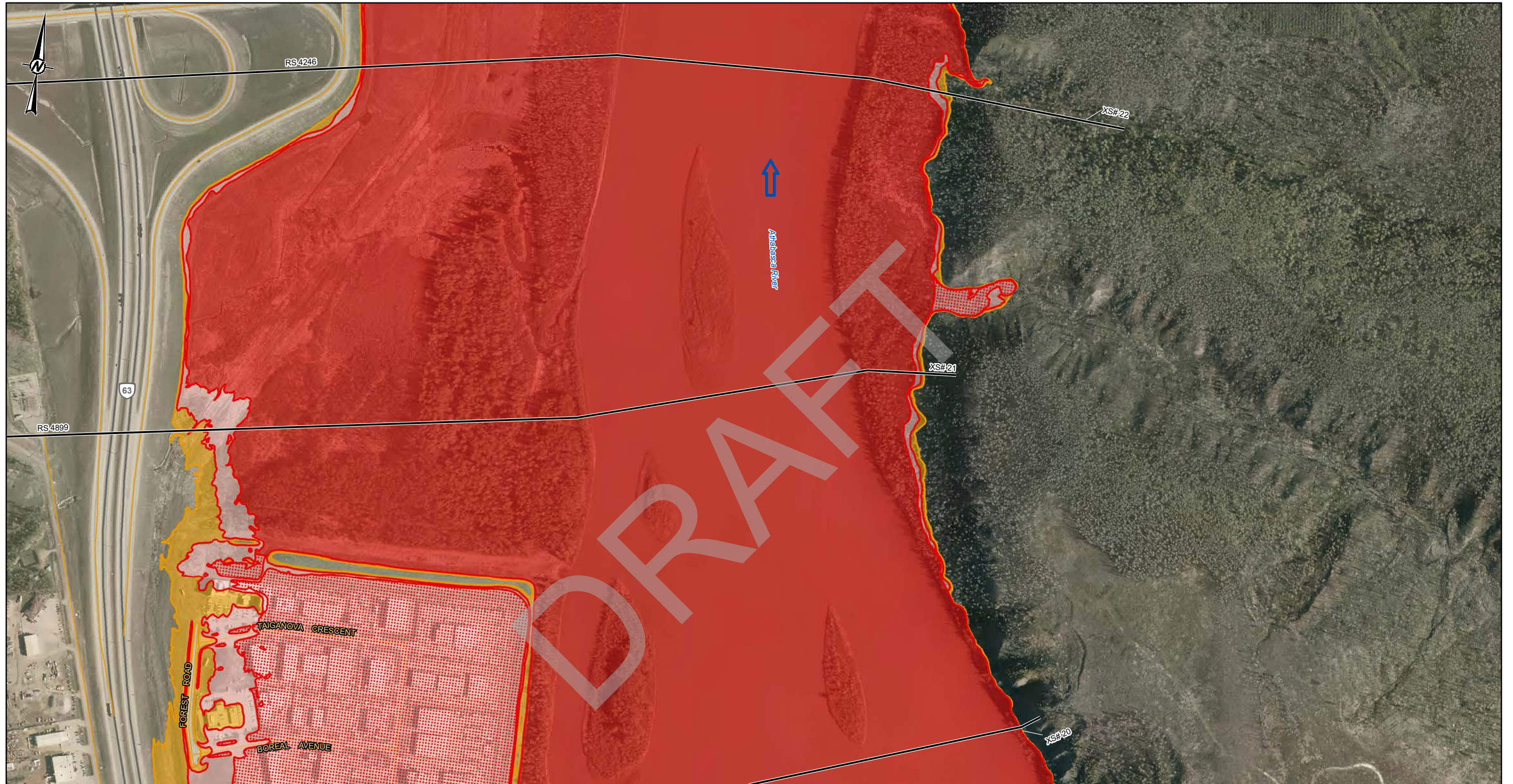
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DATUM: NAD 83 CSRS PROJECTION: 3TM 111

PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

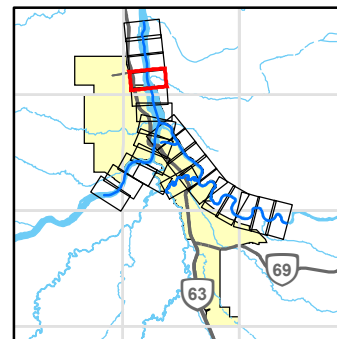
TITLE  
**GOVERNING DESIGN FLOOD HAZARD MAP**

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 8 of 23





LEGEND	
—	CROSS SECTION
XS#110	CROSS SECTION NUMBER
RS57085	RIVER STATION
➡	FLOW DIRECTION
—	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY
■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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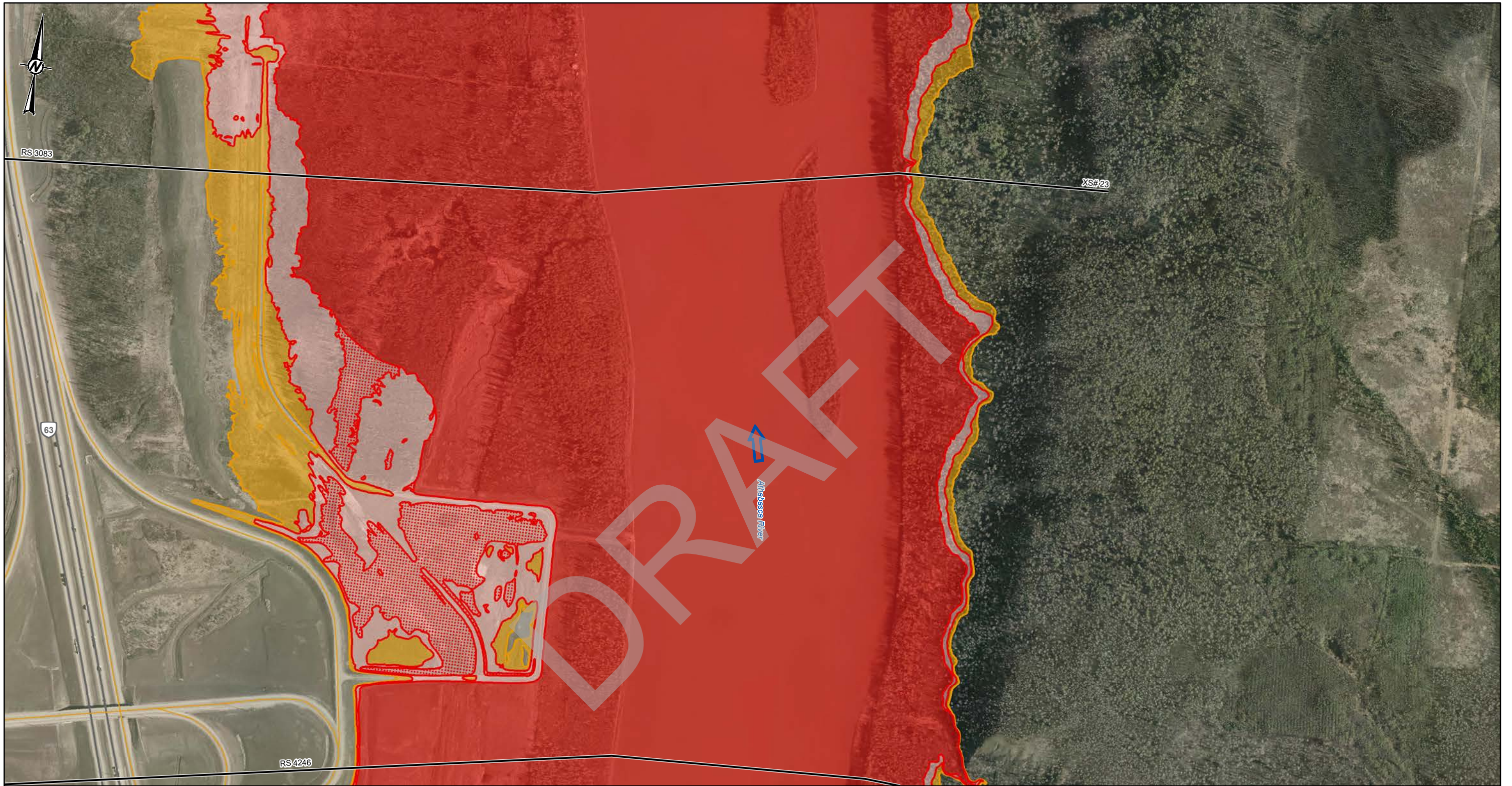
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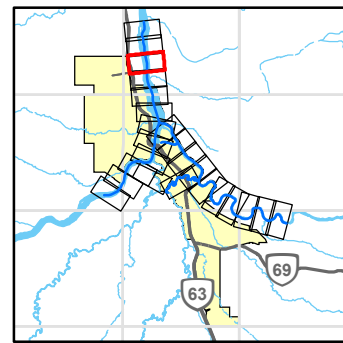
PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

TITLE  
GOVERNING DESIGN FLOOD HAZARD MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 9 of 23



- LEGEND**
- CROSS SECTION
  - XS#110 CROSS SECTION NUMBER
  - RS57085 RIVER STATION
  - ➡ FLOW DIRECTION
  - ⌈⌋ BRIDGE
  - LOCAL ROAD
  - PRIMARY HIGHWAY
  - ▤ FLOOD CONTROL STRUCTURE
  - ▣ STUDY BOUNDARY
  - ▨ GOVERNING FLOOD BOUNDARY
  - ▣ FLOODWAY
  - ▤ HIGH HAZARD FLOOD FRINGE
  - ▣ FLOOD FRINGE
  - ▤ PROTECTED FLOOD FRINGE
  - ▨ 200-YEAR FLOOD EXTENT



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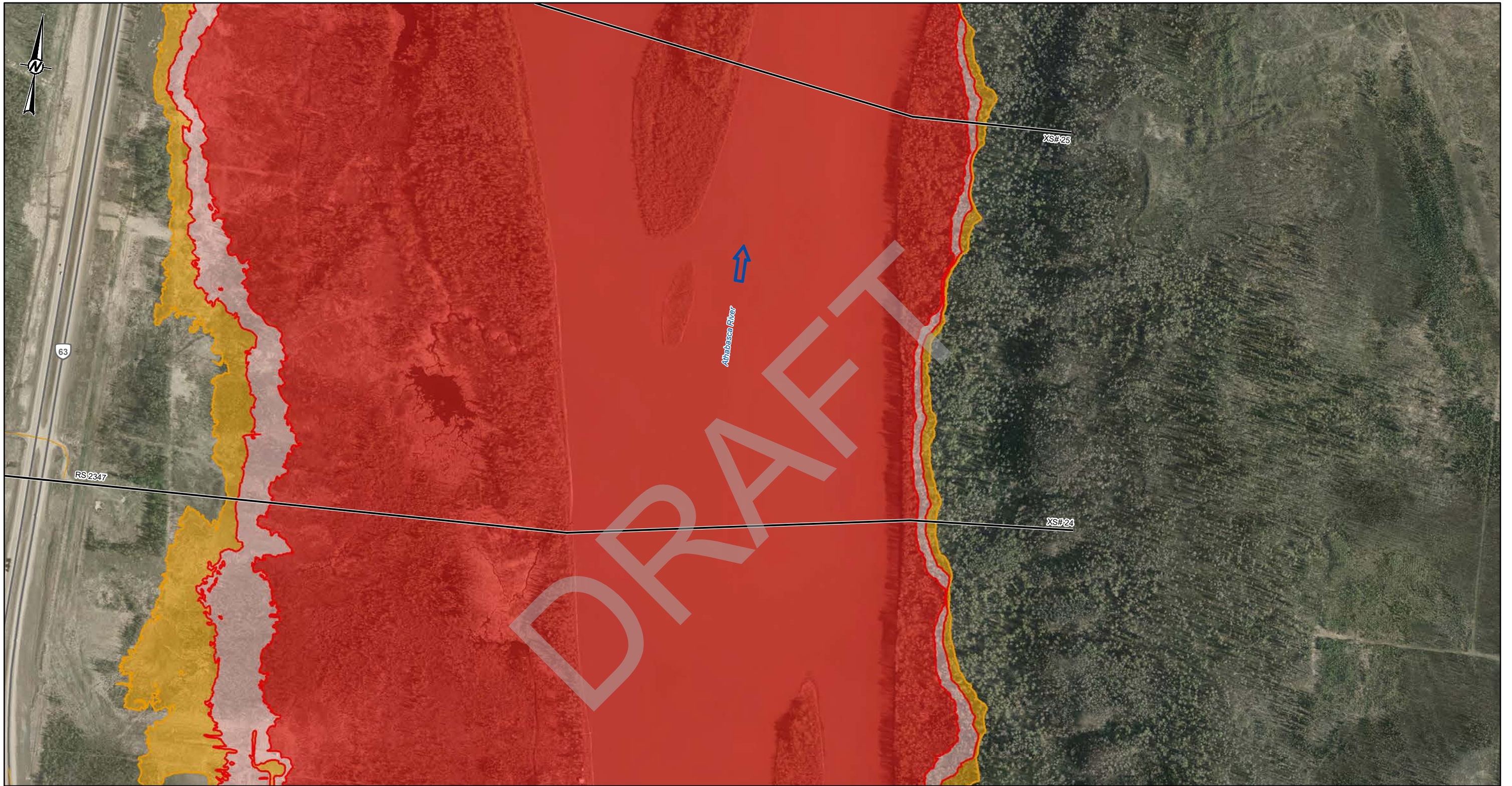
PROJECT  
**FORT McMURRAY RIVER HAZARD STUDY**

TITLE  
**GOVERNING DESIGN FLOOD HAZARD MAP**

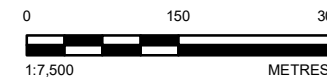
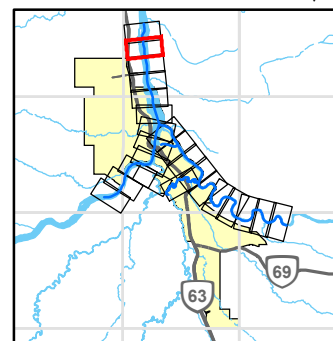
PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 10 of 23

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LEGEND	
—	CROSS SECTION
XS#110	CROSS SECTION NUMBER
RS57085	RIVER STATION
➡	FLOW DIRECTION
⌈	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY
■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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AND PARKS



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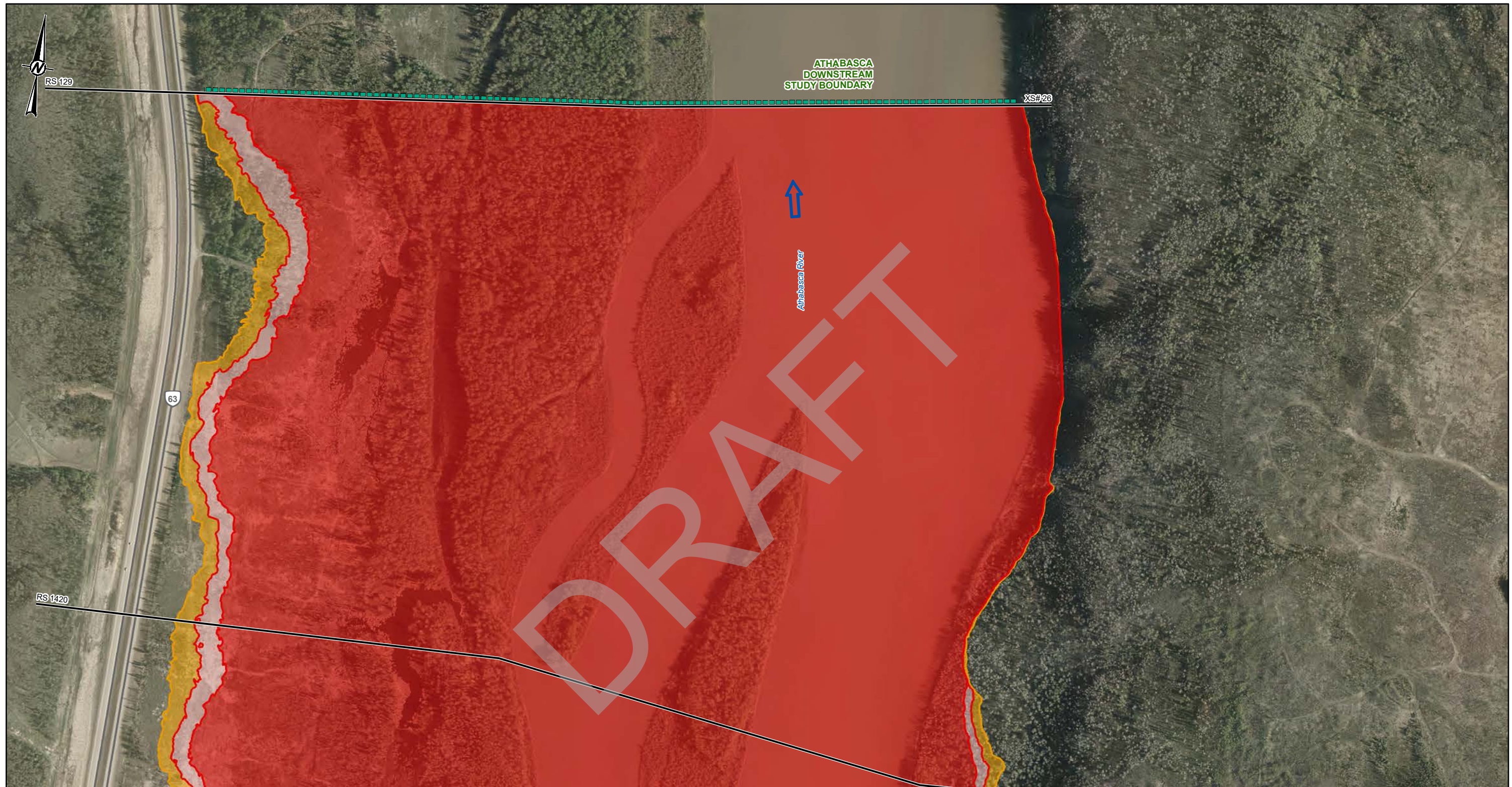
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PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

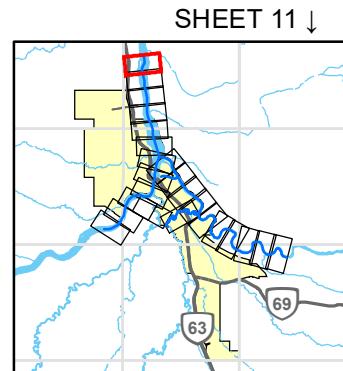
TITLE  
GOVERNING DESIGN FLOOD HAZARD MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 11 of 23

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LEGEND	
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XS#110	CROSS SECTION NUMBER
RS57085	RIVER STATION
➔	FLOW DIRECTION
⌈⌋	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY
■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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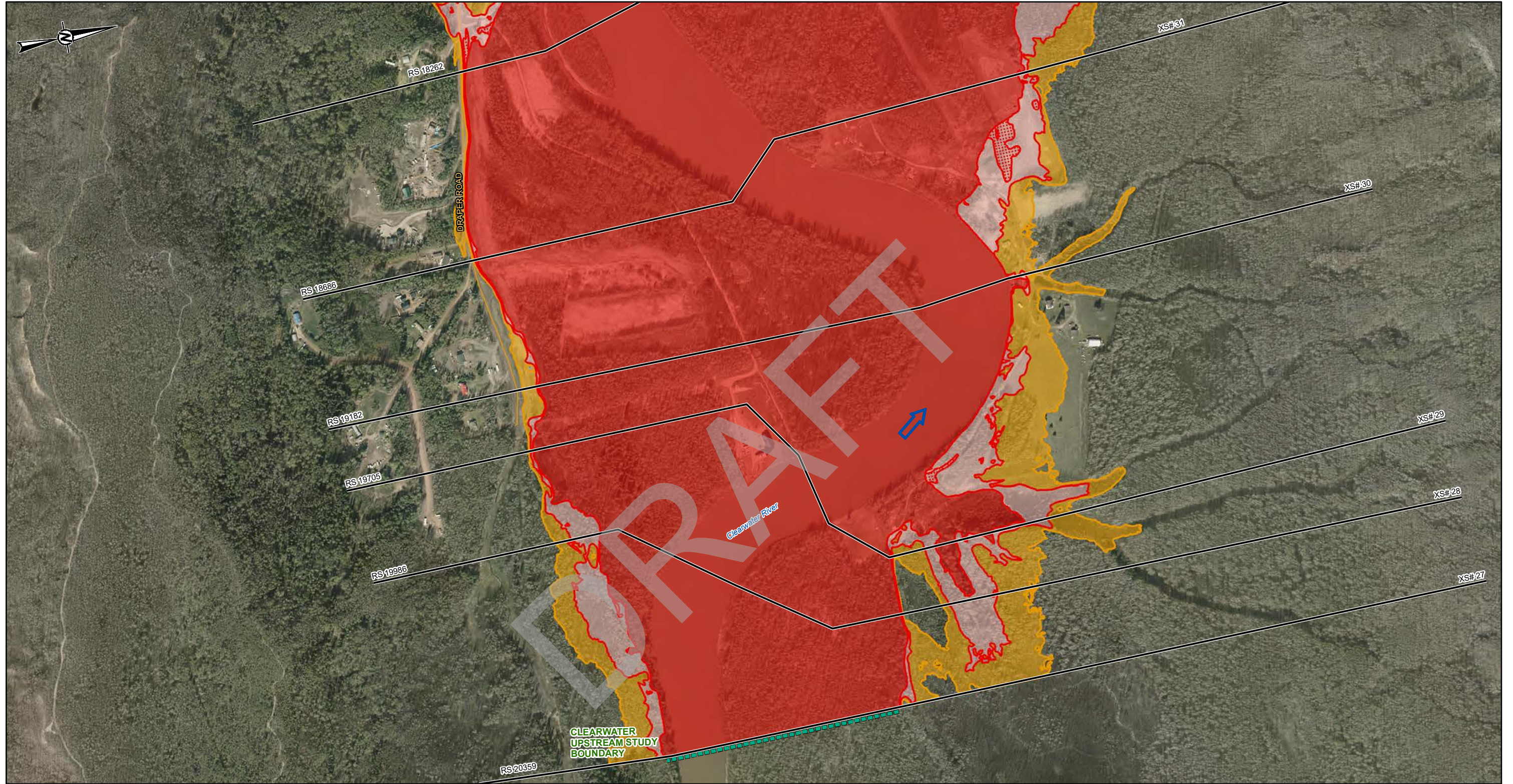


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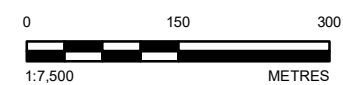
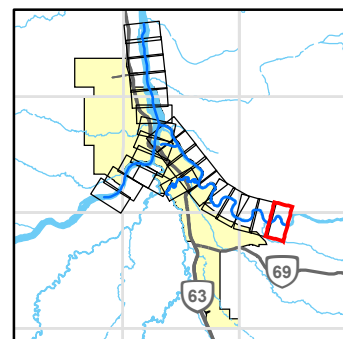
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TITLE		<b>GOVERNING DESIGN FLOOD HAZARD MAP</b>	
PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 12 of 23

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANS I



**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	▨	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	□	FLOOD FRINGE
➡	FLOW DIRECTION	▨	PROTECTED FLOOD FRINGE
⌈	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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**GOLDER**  
MEMBER OF WSP

Alberta Government

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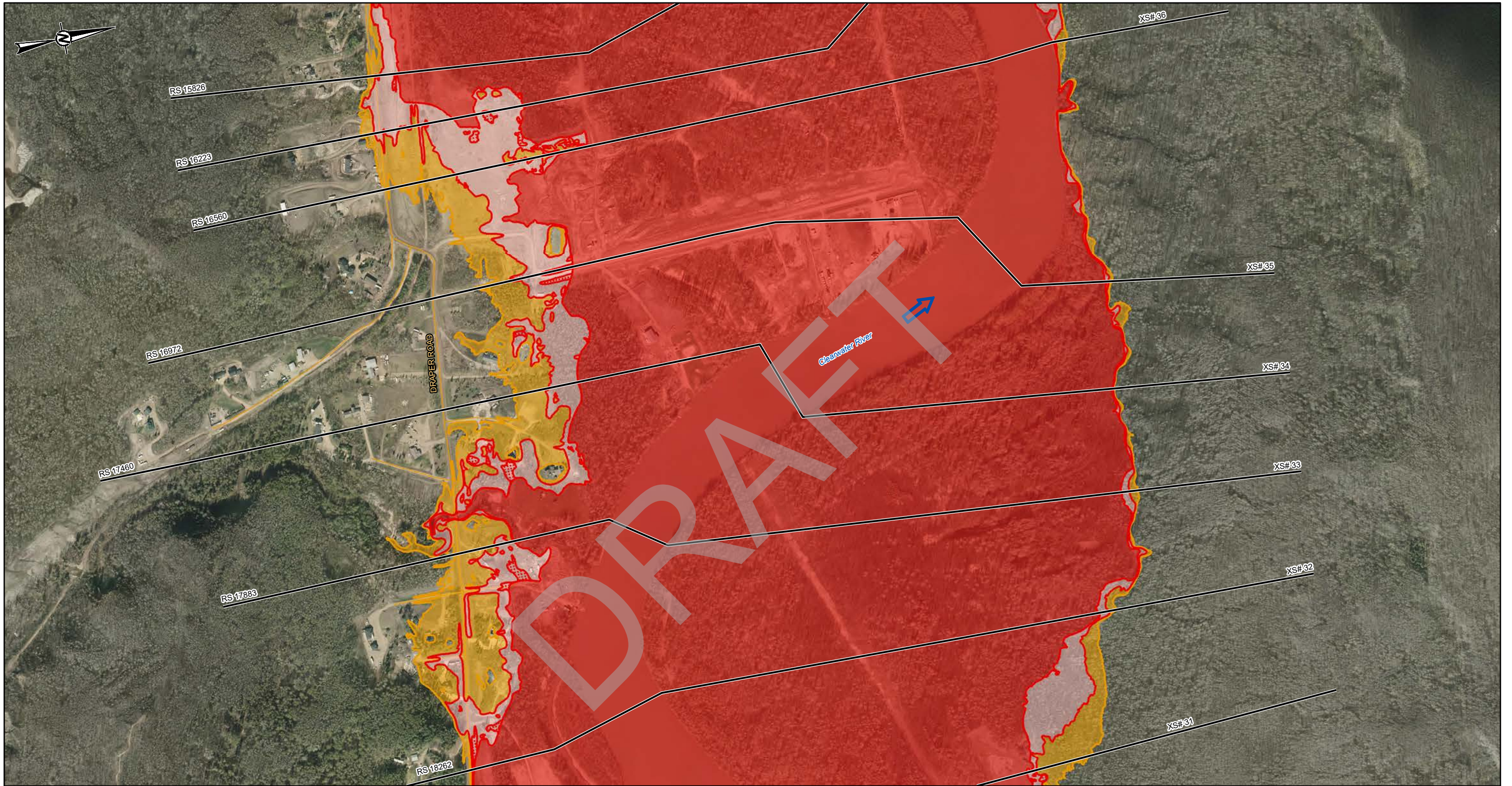
PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

TITLE  
**GOVERNING DESIGN FLOOD HAZARD MAP**

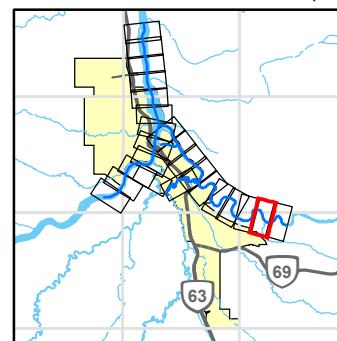
PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 13 of 23

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LEGEND	
—	CROSS SECTION
XS#110	CROSS SECTION NUMBER
RS57085	RIVER STATION
➡	FLOW DIRECTION
⌈⌋	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY
■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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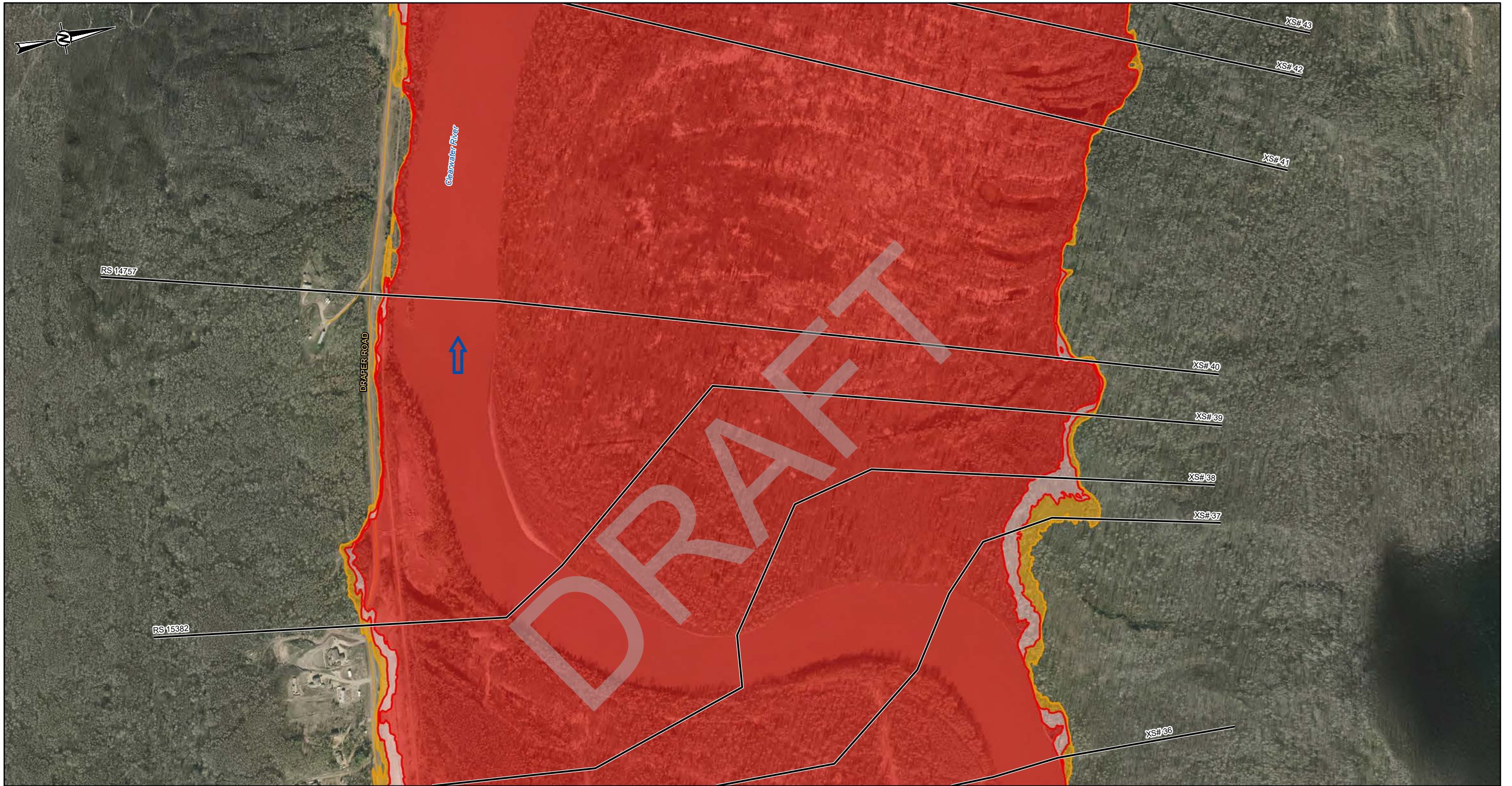
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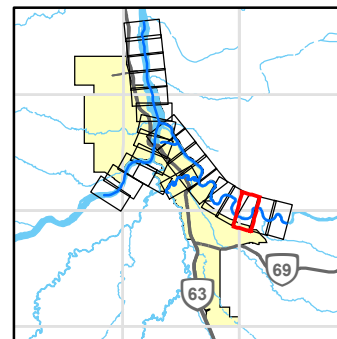
PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

TITLE  
GOVERNING DESIGN FLOOD HAZARD MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 14 of 23



LEGEND	
—	CROSS SECTION
XS#110	CROSS SECTION NUMBER
RS57085	RIVER STATION
➡	FLOW DIRECTION
⌈	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY
■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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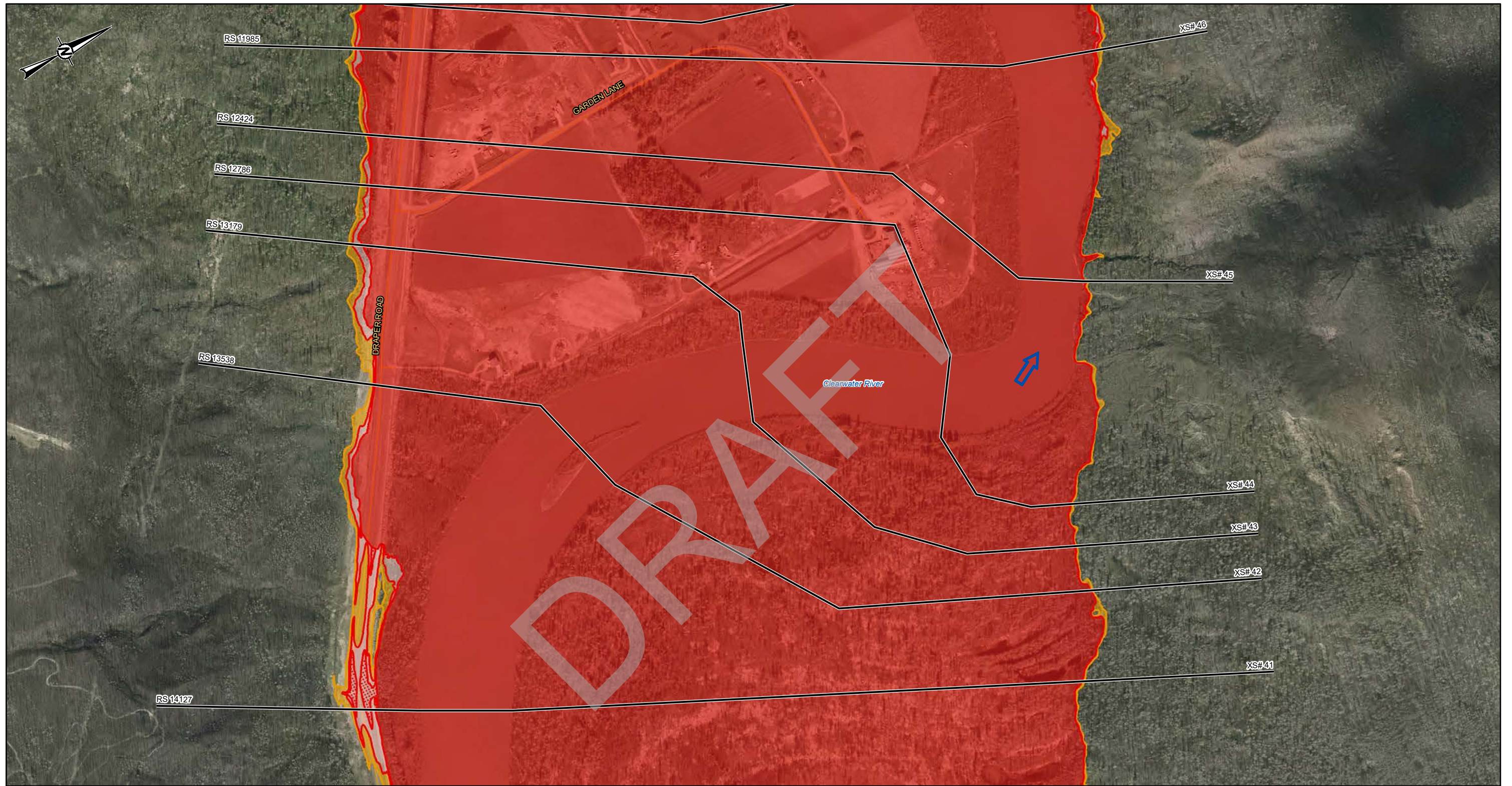
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PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

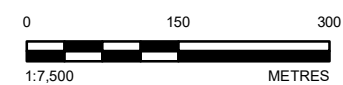
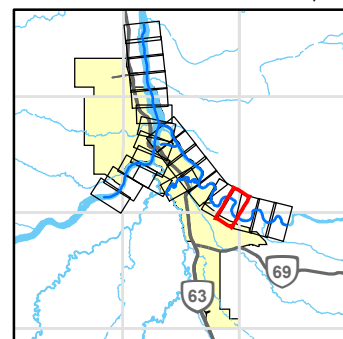
TITLE  
GOVERNING DESIGN FLOOD HAZARD MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 15 of 23



**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
➡	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
⌈	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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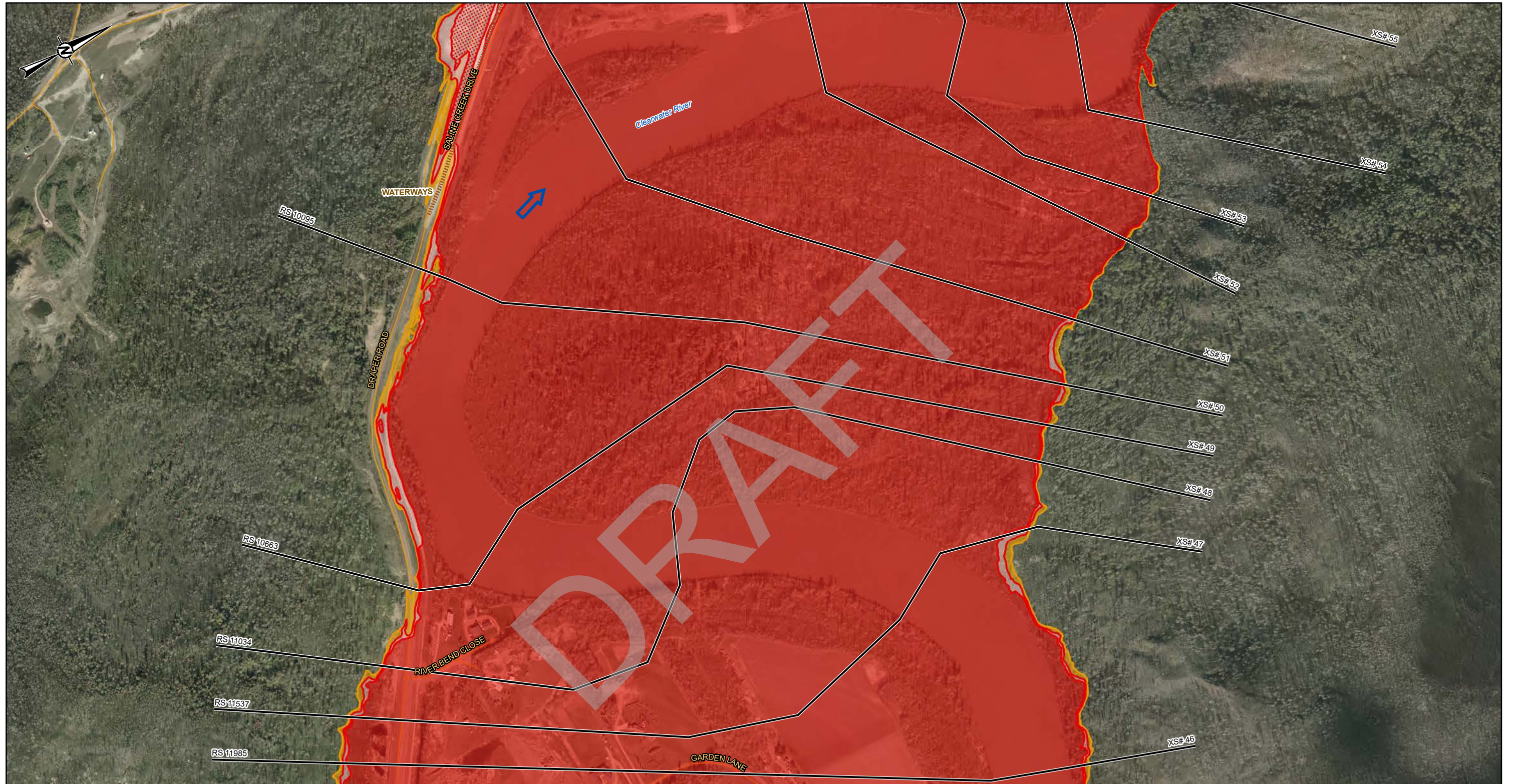
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PROJECT FORT McMURRAY RIVER HAZARD STUDY	
TITLE <b>GOVERNING DESIGN FLOOD HAZARD MAP</b>	
PROJECT NO. 1662603	CONTROL 7000
REV. 0	FIGURE Sheet 16 of 23

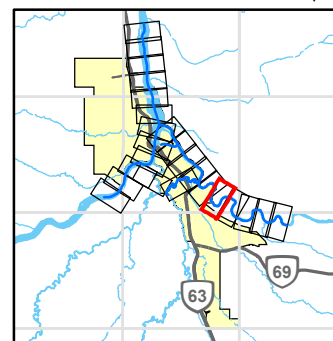
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LEGEND	
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XS#110	CROSS SECTION NUMBER
RS#7085	RIVER STATION
➡	FLOW DIRECTION
⌈⌋	BRIDGE
—	LOCAL ROAD
—	PRIMARY HIGHWAY
—	FLOOD CONTROL STRUCTURE
—	STUDY BOUNDARY
—	GOVERNING FLOOD BOUNDARY
■	FLOODWAY
■	HIGH HAZARD FLOOD FRINGE
■	FLOOD FRINGE
■	PROTECTED FLOOD FRINGE
■	200-YEAR FLOOD EXTENT



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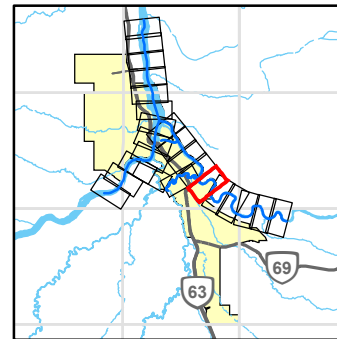
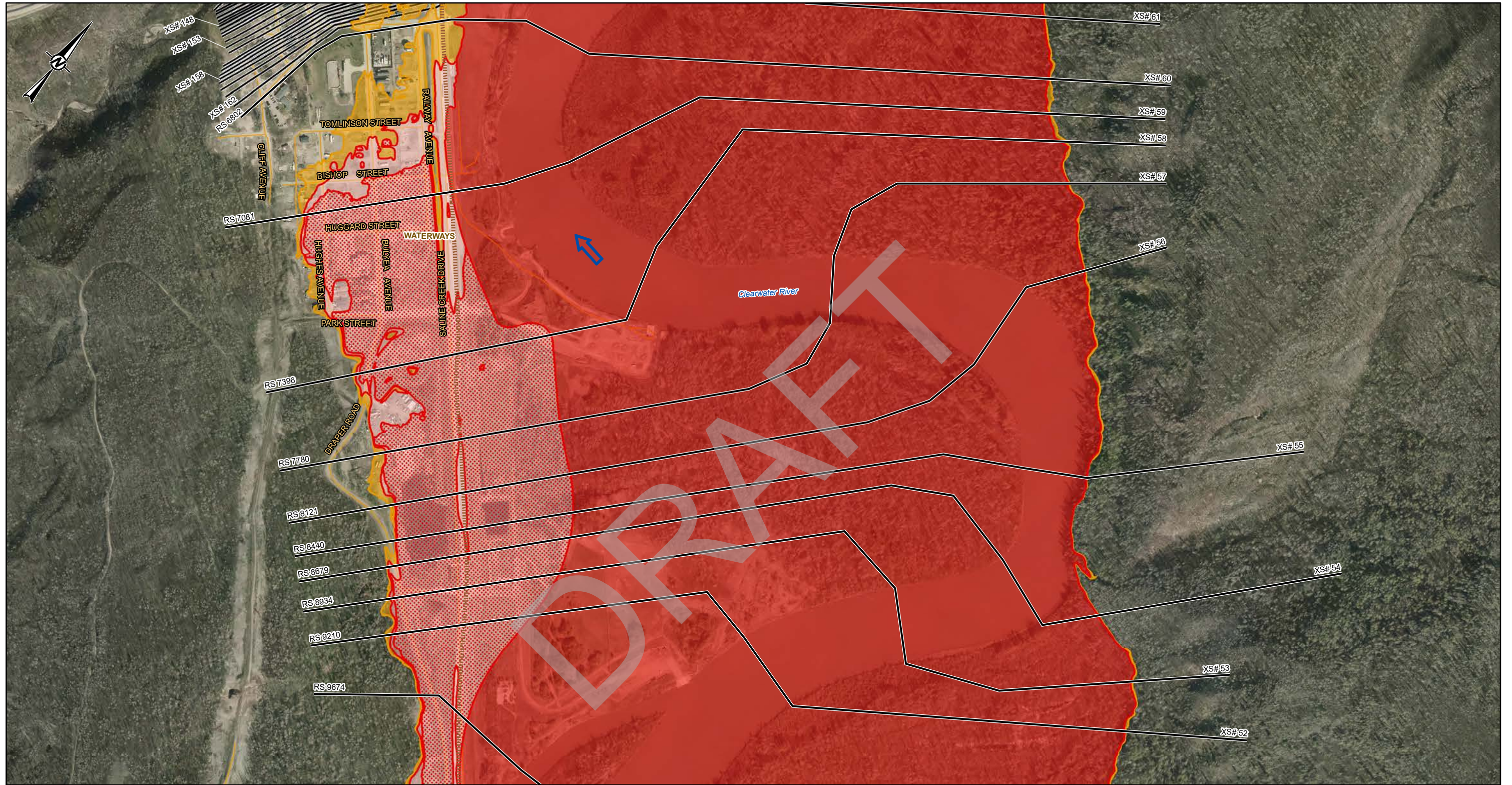
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DATUM: NAD 83 CSRS PROJECTION: 3TM 111

PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

TITLE  
GOVERNING DESIGN FLOOD HAZARD MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 17 of 23



**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
➡	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
—	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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AND PARKS



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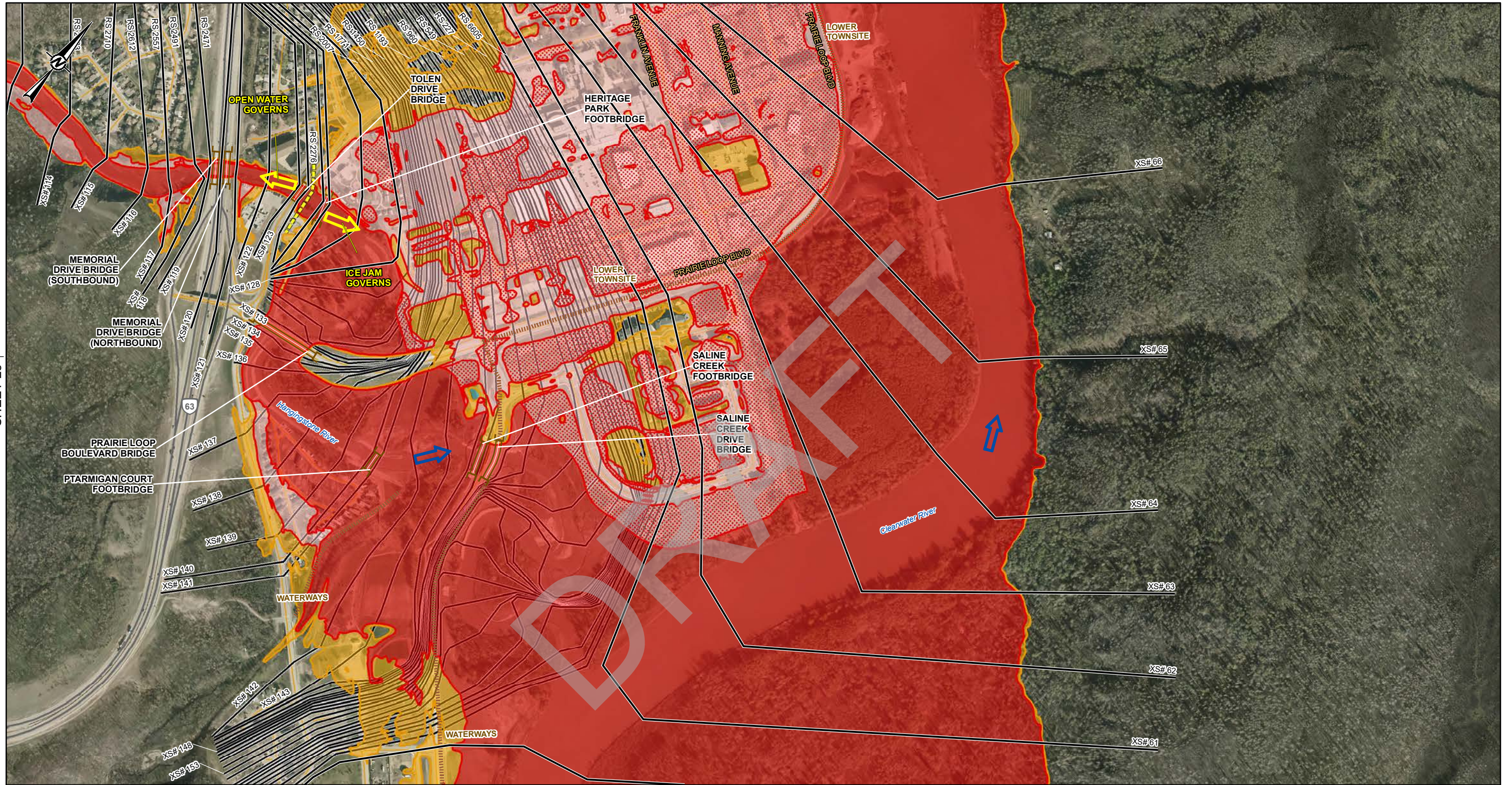
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PREPARED	PT
REVIEWED	WP
APPROVED	WP

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DATUM: NAD 83 CSRS PROJECTION: 3TM 111

PROJECT  
**FORT McMURRAY RIVER HAZARD STUDY**

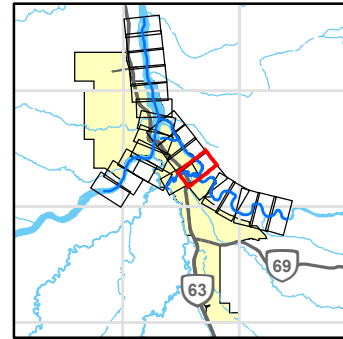
TITLE  
**GOVERNING DESIGN FLOOD HAZARD MAP**

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 18 of 23



**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
➡	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
⌈	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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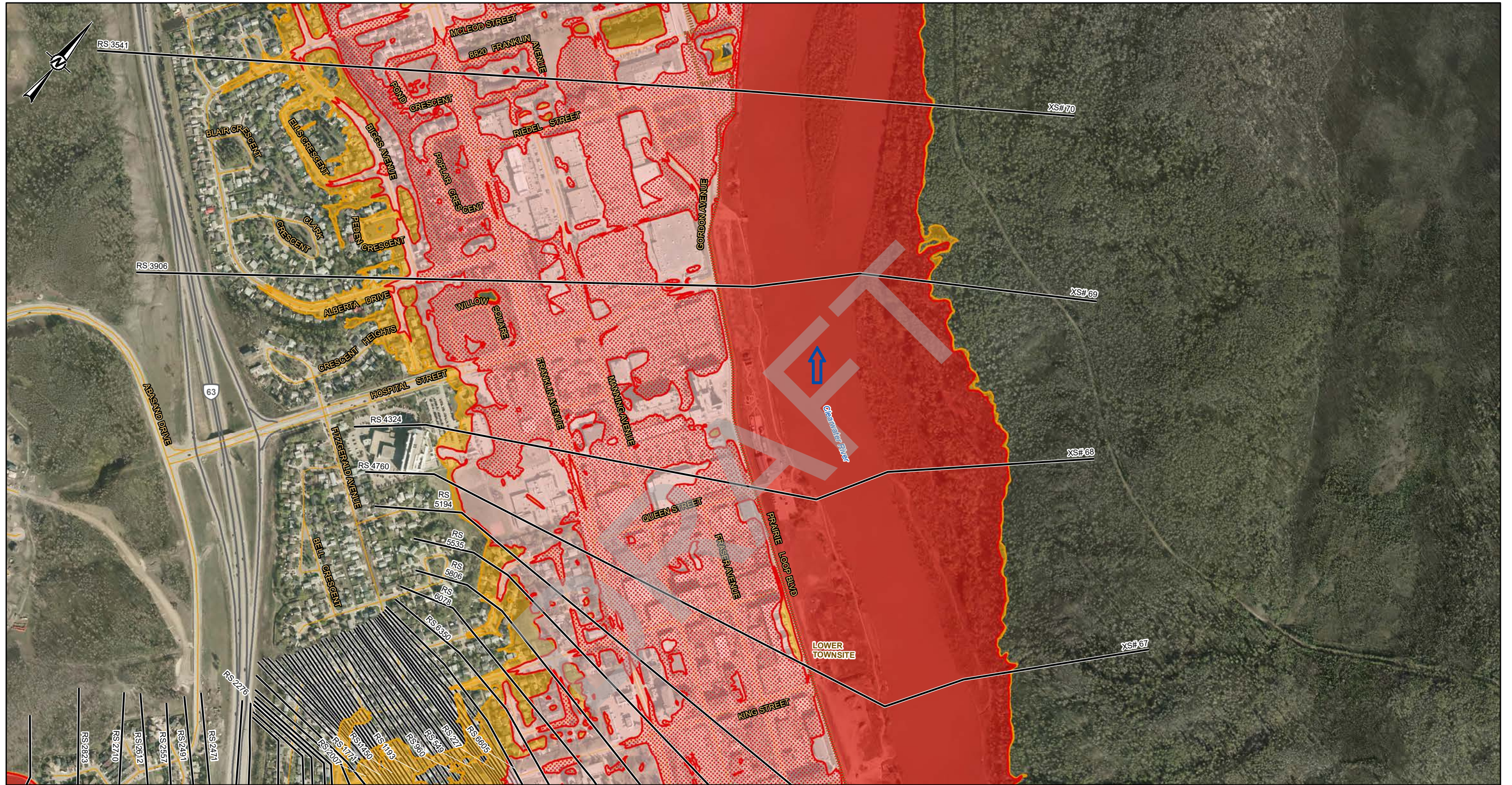
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PREPARED	PT
REVIEWED	WP
APPROVED	WP

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PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

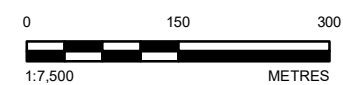
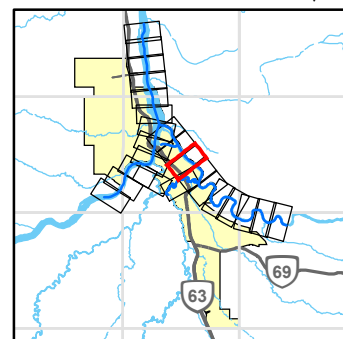
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**GOVERNING DESIGN FLOOD HAZARD MAP**

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 19 of 23



**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
➡	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
⌈	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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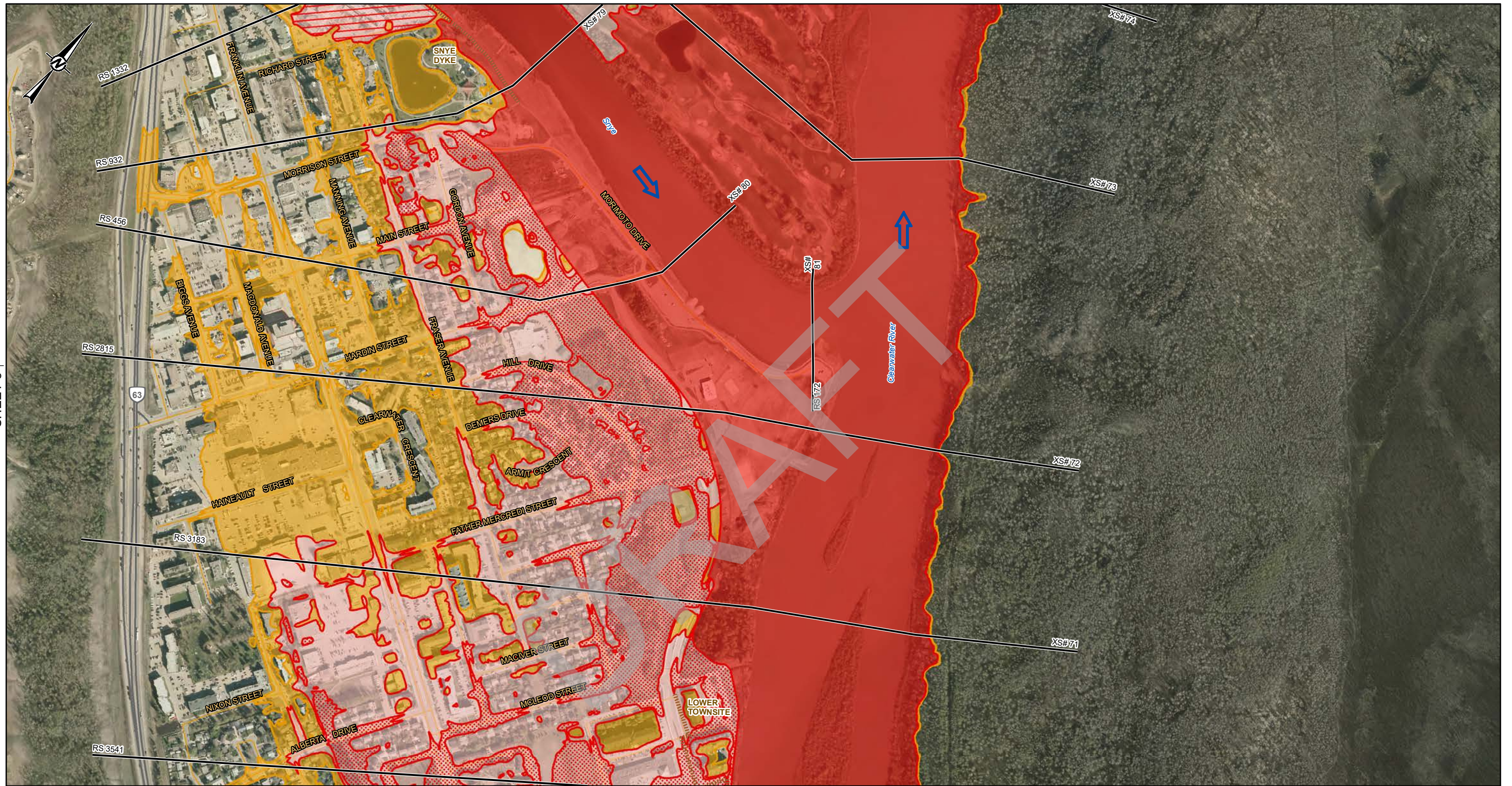
YYYY-MM-DD	2023-05-10
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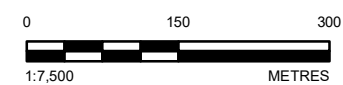
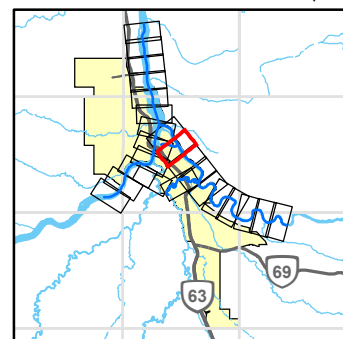
PROJECT  
FORT McMURRAY RIVER HAZARD STUDY

TITLE  
**GOVERNING DESIGN FLOOD HAZARD MAP**

PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 20 of 23



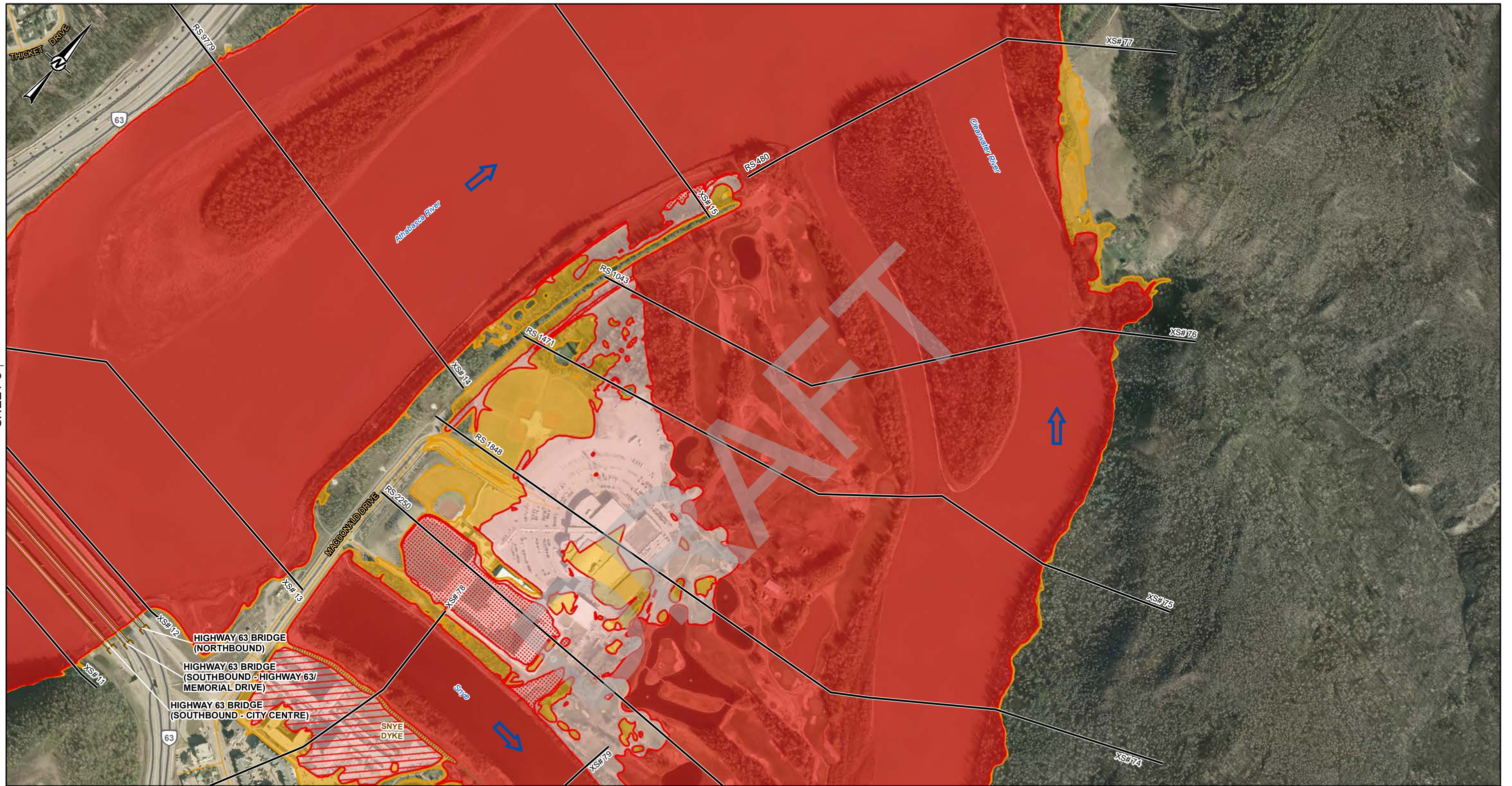
LEGEND	
	CROSS SECTION
	FLOODWAY
	HIGH HAZARD FLOOD FRINGE
	FLOOD FRINGE
	PROTECTED FLOOD FRINGE
	200-YEAR FLOOD EXTENT
	FLOW DIRECTION
	BRIDGE
	LOCAL ROAD
	PRIMARY HIGHWAY
	FLOOD CONTROL STRUCTURE
	STUDY BOUNDARY
	GOVERNING FLOOD BOUNDARY
	CROSS SECTION NUMBER
	RIVER STATION



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PROJECT	FORT McMURRAY RIVER HAZARD STUDY		
TITLE	GOVERNING DESIGN FLOOD HAZARD MAP		
PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 21 of 23

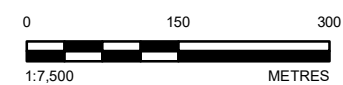
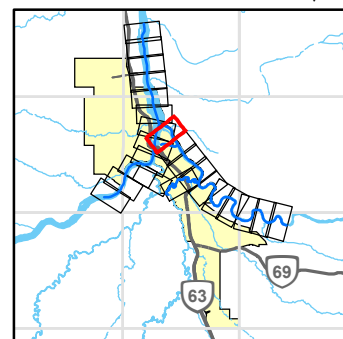


SHEET 5 ↑

SHEET 21 ↓

**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
➡	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
—	BRIDGE	■	200-YEAR FLOOD EXTENT
—	LOCAL ROAD		
—	PRIMARY HIGHWAY		
—	FLOOD CONTROL STRUCTURE		
—	STUDY BOUNDARY		
—	GOVERNING FLOOD BOUNDARY		



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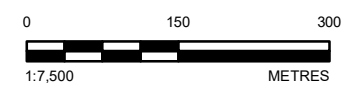
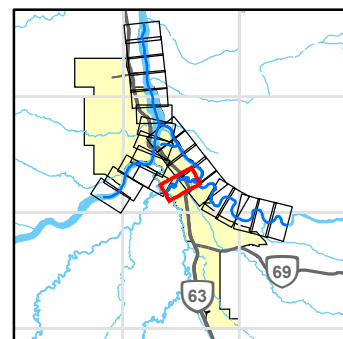
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TITLE <b>GOVERNING DESIGN FLOOD HAZARD MAP</b>	
PROJECT NO. 1662603	CONTROL 7000
REV. 0	FIGURE Sheet 22 of 23



SHEET 19 ↓

**LEGEND**

—	CROSS SECTION	■	FLOODWAY
XS#110	CROSS SECTION NUMBER	■	HIGH HAZARD FLOOD FRINGE
RS57085	RIVER STATION	■	FLOOD FRINGE
→	FLOW DIRECTION	■	PROTECTED FLOOD FRINGE
—	BRIDGE	■	200-YEAR FLOOD EXTENT
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PROJECT	FORT McMURRAY RIVER HAZARD STUDY		
TITLE	GOVERNING DESIGN FLOOD HAZARD MAP		
PROJECT NO.	CONTROL	REV.	FIGURE
1662603	7000	0	Sheet 23 of 23

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