TESLIN FLOOD MAPPING STUDY

FINAL REPORT

WATER RESOURCES BRANCH, DEPARTMENT OF ENVIRONMENT, GOVERNMENT OF YUKON

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EXECUTIVE SUMMARY

The Government of Yukon Water Resources Branch retained WSP E&I Canada Limited (WSP) to conduct the Teslin Flood Mapping Study (the Project), following the guidelines set out in the Federal Flood Mapping Guideline Series (NRCan 2018a; NRCan 2018b; NRCan 2019; NRCan 2022; NRCan 2023). This Project received partial funding from Natural Resources Canada through the Flood Hazard Information and Mapping Program. The Project's final deliverables are flood hazard maps (as defined in NRCan 2018a) for the Teslin Lake and Teslin River areas situated within the Teslin Tlingit Council Traditional Territory.

The purpose of the study is to assess and identify flood levels at the community of Johnson's Crossing adjacent to the Teslin River and four areas along Teslin Lake. The Teslin River study reach extends approximately 8.75 km downstream from the outlet of Teslin Lake. The lake shoreline areas of interest are located upstream of the Teslin Lake outlet, and from north to south are Brooks Brook, Deadman Creek, Village of Teslin, and Morley Bay. The total study area is 75 km^2.

A flood frequency analysis for Teslin Lake levels and Teslin River streamflows was undertaken to estimate annual exceedance probabilities (AEPs) for 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2%, based on the following: (1) Water Survey of Canada (WSC) Station Teslin Lake at Teslin (09AE002), with recorded data from 1944 to the present; and (2) Teslin River flood streamflows based on the discontinued WSC station Teslin River near Teslin (09AE001), with recorded data from 1944 to 1994.

Teslin River streamflows are directly related to Teslin Lake levels. Hence, a graphical relationship was developed between the annual peaks based on the concurrent period of record. This relationship was used to infill missing data at the two stations and develop a complete 78-year dataset of annual maximum water levels and streamflows between 1944 to 2022, excluding 1999 (when data was not available for either station).

Table E-1 below lists the still water flood frequency lake levels that were mapped for the primary AEP/return periods of interest, considering both historic (i.e., existing) conditions and potential climate change impacts (for the AEPs mapped).

Table E-1 Results of Still Water Teslin Lake Flood Frequency

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	FLOOD FREQUENCY ESTIMATE (M, CGVD2013)	
		HISTORIC CONDITIONS	CLIMATE CHANGE
0.5	200	687.13	687.40
1.0	100	686.83	687.11
5.0	20	686.03	686.28
50.0	2	684.31	-

Seasonal variations in still water levels significantly influence both the wind setup and wave runup components. The largest wind setup in the study areas was modelled to be 0.13 m at the northern tip of the lake when the winds were blowing from the southeast, and as such a conservative estimate of 0.13 m was applied across the study area for wind setup, regardless of the flood frequency (i.e., ranging from 50% AEP to 0.5% AEP). This estimate was added directly to the still water lake levels for all flood frequencies.

The joint probability analysis indicated that the highest estimated total water level for the 1% AEP was the sum of the 1% AEP still water levels, wind setup, and 100% AEP wave runup. Similarly, for the 0.5% AEP and 5% AEP events, the highest total water levels were found by combining the still water levels for those events with the wind setup and 100% AEP wave runup. The 100% AEP wave runup is site specific and varies greatly (from 0.17 m to 3.12 m) depending on aspect and lakeshore topography.

Flood hazard maps were developed that show the design levels for the 5%, 1% and 0.5% AEPs for historic conditions and for the 5% and 0.5% AEPs for the climate change impact maps for Teslin Lake and Teslin River. Additionally, the 1% AEP climate change impact lake level was developed for Teslin Lake since it was required for the wind-wave analysis. Teslin Lake flood hazard maps show both the static and wind-wave levels for the above noted AEPs.

Table E-2 below displays the flood frequency flow estimates for the Teslin River, which were used to establish the mapping elevations at Johnson's Crossing for both historic conditions and projected climate change (for the AEPs mapped).

Table E-2 Summary of Teslin River Flood Frequency Analysis

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	HISTORIC FLOOD FREQUENCY ESTIMATE (m^3/s)	FLOOD FREQUENCY ESTIMATE WITH CLIMATE CHANGE (m^3/s)
		VALUE	VALUE
0.5	200	2,120	2434
1.0	100	1,990	-
5.0	20	1,670	1841
50	2	1,020	-

To support hydraulic modelling of the Teslin River, a bathymetric survey was undertaken for an 8.75 km long reach of the Teslin River, downstream of the Teslin Lake outlet. A total of 18 cross-sections were surveyed, including 2 cross-sections at the Johnson's Crossing bridge.

The Teslin River hydraulic modelling was completed using the HEC-RAS software (version 6.3.1). A 1D steady state modelling approach was selected since the floodplain hydraulics are relatively straightforward. The Teslin River has a relatively narrow floodplain that is confined in a deep river valley. A steady state flow simulation is appropriate due to the steady and gentle channel gradient, simple hydraulic structure modelling and a flood hydrograph that maintains a constant flow.

HEC-RAS model calibration was undertaken based on the 2022 flood rating curve estimate at station 09AE001 – Teslin River near Teslin and the 2022 HWM's. The calibrated model showed good agreement with the calibration values as did the model validation at other flood discharges. Flood hazard maps for the Teslin River at Johnson's crossing were developed that show the design levels for the 5%, 1% and 0.5% AEPs for historic (representative of existing) conditions and for the 5% and 0.5% AEPs for the climate change impact maps.

Residential and commercial areas as well as select infrastructure impacted by flooding at the historic 0.5% AEP are described below. The flood inundation maps should be consulted for further details.

- Within the study area, the Alaska Highway is located adjacent to Teslin Lake at numerous locations but is not overtopped by the 0.5% AEP historic total water level.
- Johnson's Crossing
  - Boat launches and associated access roads on both sides of the bridge are inundated.

- Brooks Brook
  - Some residences north of the TTC campground located at the margins of inundation (i.e., just start to get flooded).
  - The TTC campground is mostly inundated with inundation extending back to the outlet of the Brooks Brook culvert crossing of the Alaska Highway.
- Deadman Creek
  - Backwater extends upstream of the Alaska Highway at the bridge crossing.
  - Agricultural land/structures south of the Deadman's Creek confluence are inundated.
- Teslin
  - North of Teslin to the southeast of Teslin Cottage Road, some residences on the east shore of the bay are subject to flooding.
  - North of Teslin, backwater of the Alaska Highway Fox Creek culvert extends to the northeast side of the Alaska Highway. Residences to the north of the confluence of Fox Creek are inundated.
  - The Teslin Lake Lookout platform and parking lot is inundated.
  - Residences west of Smarchville along the shores of Teslin Lake and south of the Alaska Highway across from the airport, are inundated.
  - In Smarchville, residences northeast of Geddes Drive and Smarch Crescent are inundated.
  - Residences to the east of Jackson Avenue and south of Nisutlin Drive are inundated.
  - Nisutlin Drive gets overtopped, and the southeast portion of the Tom Dewhurst Recreation Centre parking lot is flooded, as are portions of the George Johnston Museum building and parking lot. Inundation extends east up to Fox Street.
  - At Village Point
    - The northwest portion of Tlingit Drive gets overtopped and a residence to the north is inundated.
    - Jackson Avenue gets overtopped, and properties on both sides of the road are inundated.
  - Properties to the west of the cemetery and south of Nisutlin Drive and the southern portions of the cemetery are inundated.
  - East of the cemetery, south of Nisutlin Drive and west of the Alaska Highway, buildings, the park and boat launch are inundated.
  - Northeast of the Alaska Highway and just north of the bridge, most of the Yukon Motel and Restaurant property, including the campground and cabins are inundated.
  - North of the motel, Sawmill Road is overtopped, and residences along the bay south of Sawmill Road are inundated.
- Morley Bay
  - There are a few properties just west of the confluence of the Morley River on the north shore that are subject to inundation.
- The Nisutlin Bay Bridge is currently being replaced with a new structure. At the centre bridge spans, the freeboard (with respect to the 0.5% AEP historic total water level) at the existing and new bridge structures, is 0.3 m and 1.74 m, respectively.

- The truss section (i.e., the lowest portion of the bridge superstructure) of the Teslin River Bridge at Johnson's Crossing is located well above the modelled floods. The lowest elevation of the truss is 2.79 m higher than the 0.5 % AEP water level.

Flood probabilities are generally derived from historical data, but future conditions may diverge from past trends. The project assessed potential changes in land cover, such as alterations in vegetation types and the risk of forest fires and determined that these changes are unlikely to lead to increased flood flows. Additionally, the Project examined the possible effects of climate change. A qualitative and detailed quantitative climate change analyses were undertaken to determine flood hazard mapping levels for climate change conditions. As detailed below, these were estimated to be higher than flood hazard mapping levels for historic conditions.

A qualitative assessment of climate change impacts in northern Canada and the Yukon was undertaken based on a literature review and is summarized below.

There is significant uncertainty about future conditions and their impact on flooding. According to global climate models (i.e., CMIP5 and CMIP6) and Yukon-specific research, it is anticipated that there will be more precipitation and higher average temperatures. However, there may be a reduction in snowfall, as warmer temperatures are likely to result in more rain rather than snow.

The anticipated climate change impacts on the Teslin Lake basin are as follows:

- The basin is expected to experience a decrease in total seasonal snowfall on average.
- The average temperature during the melt season (April through June) is projected to more than double by the century's end, accompanied by increases in total rainfall and maximum one-day rainfall. The months with the highest rainfall overlap with the melt season (ECCC, 2024b for 1981-2010), which could lead to heavy rain days during this period.
- The average maximum sustained windspeed for the basin is projected to rise by 3 km/h by the end of the century, with an increase of 2 km/h specifically for Teslin. While this change is minor and aligns with expectations, wind projections are generally less precise than those for temperature and precipitation, resulting in lower confidence for these values.

These complex climate changes make it challenging to accurately estimate impacts on lake levels, though there is a general trend toward higher lake levels and streamflows. This finding was confirmed by a quantitative based assessment undertaken for the Teslin basin, which determined a 4.5% increase in overall precipitation contributing to freshet and the same increase in freshet lake inflow volume. This is based on median climate change values for worst-case scenario – SSP5-8.5. A relationship between lake volume and water levels (referred to as the stage-storage curve) was developed to convert the above noted increases in freshet lake inflow volume to increases in lake levels. The 0.5% AEP static lake level is 687.4 m and is associated with the median long-term climate change scenario. This is 0.27 m higher than the 0.5% AEP historic lake level of 687.13 m. The climate change flows at Teslin River were derived using a relationship developed for Teslin Lake Levels vs Teslin River flows. The percent increase for the 0.5% AEP climate change flow is 14.8%.

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ACRONYMS AND ABBREVIATIONS

AEP	Annual Exceedance Probability
CGVD2013	Canadian Geodetic Vertical Datum of 2013
CMIP	Coupled Model Intercomparison Project
CSRS	Canadian Spatial Reference System
DDC	Deisleen Development Corporation
DEM	Digital Elevation Model
DTM	Digital Terrain Model
ECCC	Environment and Climate Change Canada
GEV	Generalized Extreme Value
GNSS	Global Navigation Satellite System
GPS	Global Position System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HRDEM	High Resolution Digital Elevation Model
HWM	High Water Mark
KM	Kilometre
LiDAR	Light Detection and Ranging
NAD83	North American Datum of 1983
NRCan	Natural Resources Canada
POT	Peak Over Threshold
RCP	Representative Concentration Pathway
RTK	Real Time Kinematic
SPM	Shore Protection Manual
SSP	Shared Socioeconomic Pathway
SWE	Snow Water Equivalent
TBC	Trimble Business Centre
TTC	Teslin Tlingit Council
VoT	Village of Teslin
WRB	Water Resources Branch
WSC	Water Survey of Canada
YG	Government of Yukon

1 INTRODUCTION

1.1 BACKGROUND

The community of Teslin includes the Village of Teslin, Teslin Tlingit Council lands, and the surrounding area. There are areas of cultural importance throughout the region including various locations on Teslin Lake. The village itself as well as other low-lying areas on the lake are subject to periodic flooding. The flood of record on Teslin Lake occurred in 1962. In 2022 the highest level recorded since 1962 occurred and resulted in a widespread active flood response by the Village of Teslin, which was supported by the Government of Yukon. Some minor flooding and an active response also occurred in 2021 but was far less impactful. Due to the minor flooding in 2021, the Village of Teslin had already begun permanent flood mitigation work (e.g., berms and shoreline armouring) prior to the 2022 event. The mitigation work continued during and following the 2022 event. However, more comprehensive flood mapping for the village of Teslin and other areas of interest on Teslin Lake is still required. As climate change continues to drive more extreme seasonal weather, and greater interannual peak snowpack variability, the frequency and severity of flooding on Teslin Lake is likely to change. Flood mapping does not exist for this area; however, the Village or Teslin did have some preliminary work done to inform their flood mitigation efforts. Flood mapping has been increasingly highlighted as a key tool, both in support of emergency preparation and response, and development planning to reduce community vulnerability to flooding in the face of the Yukon's changing climate. The Teslin Lake Flood Mapping Study advances the goals of enhancing public safety and reducing future flood vulnerability through the identification and mapping of flood hazards.

The mandate and funding for mapping of communities at risk of flooding was established as an action in the *Our Clean Future*, the Government of Yukon's climate change, energy and green economy strategy. Natural Resources Canada provided 75% of the funding for this work through the Flood Hazard Identification and Mapping Program.

1.2 OBJECTIVE

The Government of Yukon retained WSP E&I Canada Limited (WSP) to conduct the Teslin Flood Mapping Study. The purpose of the study is to assess and identify flood levels at the community of Johnson's Crossing adjacent to the Teslin River and four areas along Teslin Lake, as shown Figure 1-1. The Teslin River study reach extends approximately 8.75 km downstream from the outlet of Teslin Lake. The lake shoreline areas of interest are located upstream of the Teslin Lake outlet, and from north to south are Brooks Brook, Deadman Creek, Village of Teslin, and Morley Bay. The total study area is 75 km^2.

1.3 TERMINOLOGY FOR SIZE OF FLOOD

The terms 0.5% annual exceedance probability (AEP) flood ,1:200 return period flood, and 200-year flood, are all different ways of describing the same flood. Similar terminology is used to describe floods that have different chances of occurring. Smaller floods are statistically more likely to occur in any given year than larger floods. For example, a 1:100 flood is smaller than a 1:200 flood and has a higher (1%) chance of occurring each year. Similarly, a 1:500 flood is larger than a 1:200 flood and has a lower (0.2%) chance of occurring each year. The AEP terminology is used in this report. Mapping is presented for historic (i.e., existing) and climate change conditions.

460000 470000 480000 490000 500000

670000 660000 650000 640000 630000 620000 610000

Johnson's Crossing

Brooks Brook

Alaska Highway

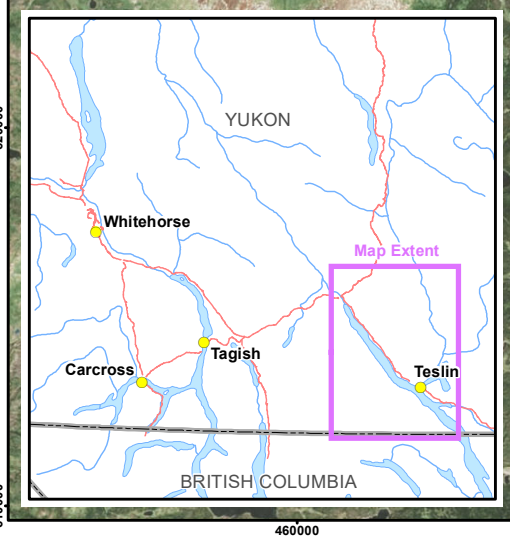
Deadman Creek

Teslin Lake

Teslin

Alaska Highway

Morley Bay



LEGEND

- Study Area
- Highway

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

REV 0 - ISSUED AS FINAL (24/08/30)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY © 2024 MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS SIO

Yukon Canada

Teslin Flood Mapping Study

Project Overview Map

2 0 2
Kilometres
1:200,000

N

August 2024

Figure 1-1

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1.4 STUDY TEAM AND SCHEDULE

Flood mapping in Teslin began in 2023, and the study was completed by WSP on behalf of the Government of Yukon, with input from the Teslin Tlingit Council and the Village of Teslin. Underhill Geomatics Ltd., located in Whitehorse, undertook topographic and bathymetric surveys and associated survey tasks, and the Deisleen Development Corporation (DDC) assisted with community engagement sessions.

The study schedule is listed below:

- May 2023: start of consultant contract and site visit
- Summer/Fall 2023: shoreline and aerial surveying, bathymetric river survey, high water mark surveys, background analysis
- Winter 2023/2024: modelling and mapping
- Spring 2024: engagement on draft maps
- Summer 2024: preparing final maps
- Fall 2024: final maps released, and report shared with public

1.5 SCOPE OF WORK

The scope of work for the study is described below.

- Background data gathering, topographic and bathymetric survey:
  - Included site visit, survey plan, hydraulic structure surveys, High Water Mark survey, land access permission, photographic inventory.
  - Development of a Digital Terrain Model (DTM) based on the LiDAR provided by Government of Yukon (YG) and the above noted survey. The CGVD2013 datum is used herein.
- Hydrologic Assessment:
  - Data series preparation including gathering all available recorded water level, flow, and flood peak data, including data and rating curves from Water Survey of Canada.
  - Flood history documentation.
  - Static lake level and river flow frequency analyses. The assessment included frequency open water levels of 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEPs.
  - Wind and wave analysis, joint probability analysis.
- Climate and land cover change assessment including recommended changes to hazard mapping design levels based on both qualitative and quantitative assessment of potential impacts of both climate and land-cover change on lake and river flooding.
- Hydraulic analysis and modelling to accurately define the flood hazard for the mapped areas on the Teslin River. Modelling tasks included model set-up, calibration and validation, sensitivity analysis and design flow modelling.
- Flood hazard mapping showing the extent of potential floodwater coverage for the 0.5%, 1.0% and 5% annual exceedance probabilities (AEPs), which are equivalent to the 200-yr, 100-yr and 20-yr return period floods. Mapping is presented for historic and climate change conditions.
- Engagement support including meetings with Teslin Tlingit Council knowledge holders and government staff.
- Project management and reporting.

2 WATERSHED CHARACTERISTICS AND HISTORICAL FLOODS

Teslin Lake is a large lake with a surface area of approximately 354 km^2 that is located in both British Columbia and the Yukon, at the southern (upstream) extent of the Yukon River basin. The southern headwaters of Teslin Lake originate in the Stikine Plateau and are bordered by the Cassiar Mountains to the east and the Big Salmon Range to the north. The Nisutlin River is a major tributary of Teslin Lake and flows from north to south into Nisutlin Bay. The village of Teslin is located on the north side of the Nisutlin inlet, where it meets the main body of Teslin Lake. The Alaska Highway crosses the Nisutlin inlet at Teslin (Nisutlin Bay Bridge) and crosses the Teslin River 4.3 km downstream of the outlet of the lake at Johnson's Crossing. The Teslin River drains north from the lake outlet and is a major tributary of the Yukon River. Significant Teslin Lake tributaries, in addition to the Nisutlin River, include the Teslin River at the south end of the lake, Jennings River, Swift River and Morley River. The basin consists of steep mountainous regions with areas of flatter terrain adjacent to Teslin Lake.

Peak Teslin Lake levels typically occur in mid to late-June and are primarily the result of snowmelt and also rain on snow that occurs in the spring/early-summer (i.e., the freshet) and then drains via surface and groundwater flow into the lake. Lake levels typically start increasing in April and decreasing in late-June once the snowpack is depleted. The freshet period can loosely be defined as the period from April through end of June. The 2022 freshet is a good example of Teslin Lake and Teslin River flooding mechanisms. In 2022, a heavy snowpack had developed during the winter. Additionally, cooler spring temperatures delayed snowmelt and sudden warming later in the spring resulted in large inflows and high lake levels. YG produces the Yukon Snow Survey Bulletin and Water Supply Forecasts for each year in March, April and May for numerous locations. YG analysis indicates peak spring snowpack in the Teslin basin has a strong correlation with peak lake levels.

Listed below (Table 2–1) are the two WSC hydrometric stations used for the hydrologic assessment of the Teslin River and Teslin Lake. The six largest annual peak water levels/flows for both stations are shown in Table 2–1. The most recent large flood was in 2022 and photos from the flood are shown in Appendix A.

The discontinued station Teslin River near Teslin (09AE001) has a drainage area of 30,300 km^2, recorded data from 1944 to 1994 and was located at Johnsons Crossing, approximately 4.3 km downstream of the Teslin Lake outlet. The largest recorded flood occurred in June 1962, with a maximum daily discharge of 1,840 m^3/s. Other large floods occurred in June 1964 and June 1992.

The Teslin Lake at Teslin (09AE002) has a drainage area of 30,137 km^2, recorded data from 1944 onwards and is located in Teslin. The largest recorded flood level occurred in July 1962, with a maximum instantaneous water level of 9.638 m. Other high lake levels occurred in June 2022, June 1964, and June 1992.

Table 2–1: Summary of Six Largest Recorded Historical Floods and Water Levels

TESLIN RIVER NEAR TESLIN (09AE001)				TESLIN LAKE AT TESLIN (09AE002)			
Year	Month, Day	Annual Maximum Daily (m^3/s)	Annual Maximum Instantaneous (m^3/s)	Year	Month, Day	Annual Maximum Daily (m)	Annual Maximum Instantaneous (m)
1957	June 13	1,490	-	1957	June 13	8.217 (685.530)	-
1961	June 15	1,660	-	1962	July 3	9.638 (686.951)	-
1962	June 27	1,840	-	1964	June 22	8.827 (686.140)	-
1964	June 18	1,710	-	1992	June 23	8.750 (686.063)	8.778 (686.091)
1972	June 20	1,510	-	2021	June 24	8.674 (685.987)	8.688 (686.001)
1992	June 22	1,730	1,730	2022	June 23	9.388 (686.701)	9.395 (686.708)

Teslin Lake local gauge datum was vertically converted using the CGVD 2013 datum. Geodetic water level values are in brackets (local datum +677.313 m) in Table 2–1.

Engagement with Teslin Tlingit Council staff and community members corroborates the major floods listed above in Table 2–1 (engagement sessions occurred on May 30, 2023 and June 13, 2024 and are documented in Section 10). For example, many of the Elders referred to high water levels from the 1960s whereby they would have to duck their heads when navigating under the Nisutlin Bay bridge; that water was so high the community became an island, that they were canoeing to steps of the school, and that in 2022 the levels rose very quickly. The two recent large floods in 2021 and 2022 are well documented by the community and its local government employees. This includes photos, high water marks and design drawings for flood protection works. Elders in the community remembered large floods in the 1950s (likely the 1957 flood listed in Table 2–1) and in 1962. Anecdotal remembrances include the use of boats to reach houses/buildings that were isolated by flooding.

3 SURVEY AND BASE DATA COLLECTION

Survey and based data collection included the following tasks:

- Initial Site Visit
- Survey Plan
- Topographic and Bathymetric Surveys
- Hydraulic Structure Data Collection and Surveys
- High Water Mark Survey
- Land Access Permission
- Photographic Inventory

An initial site visit was undertaken by WSP and Government of Yukon staff on May 30, 2023, to inspect the lake/river and floodplain sites and support cross-section locations and alignment planning and finalization. Appendix A contains select photos from the site visit. In coordination with the Owner YG and monitoring of high water periods, WSP's aim was an initial visit as early as possible after award and when the ground was bare or only partially covered with snow. This visit and all other site visit/access (e.g., surveys) were done in coordination with YG to ensure appropriate permissions were obtained and representatives of the Village of Teslin and TTC could participate if desired.

Following the initial site visit, WSP presented to YG the proposed survey plan for discussion and finalization with respect to the proposed surveyed river cross section and bathymetric surveys. The cross-sections survey alignments were selected to allow appropriate modelling and mapping. The cross-sections were surveyed along the main channels and to the banks to allow extending each cross-section through the overbanks using the LiDAR elevation data that was provided by YG.

3.1 SURVEY METHODS

The survey information collected supported the hydraulic modelling task and utilized typical ground survey technologies such as RTK GPS and total station equipment. Additionally, the surveyed overbank elevations were compared to the LiDAR elevation data to verify that the elevation data was suitable for overbank cross-section data extraction and flood mapping purposes. If there were discrepancies or issues that arose, WSP informed YG promptly for further investigation and follow-up.

Underhill Geomatics Ltd. collected additional relevant survey information at the bridge locations within the study area. High water mark locations provided by YG, residents and First Nations from the recent 2021 and 2022 floods were confirmed during the surveys.

The surveys took place over a period between June-September 2023 with some follow-up high water mark surveys in the spring of 2024, and surveys also included surveying the WSC benchmarks (at 09AE001 and 09AE002). All land access permissions were coordinated between WSP and YG to ensure that permission was obtained from landowners for all survey tasks. In addition, during both the ground and bathymetric surveys, photos were collected in order to document the physical characteristics of the channel, shoreline and overbank.

Details on the field surveys, bathymetric surveys and equipment are listed below:

Field Surveys

- RTK GNSS were used for LiDAR verification in evenly distributed locations across the Project area.
- RTK GNSS were used to extend river cross-sections where applicable on the shore and banks adjacent to the river.
- Existing Coordinated Control Monument (CCM) were used as survey control.
- Survey control was extended where required using Static GPS methods and verified using NRCan's Precise Point Positioning Service.

Bathymetric Surveys

- Bathymetry was collected using single beam echosounder where water depths were greater than 1 m.
- Bathymetry was collected using RTK GNSS where water depths were less than 1 m.
- The Echo Sounder absolute position was corrected using RTK GNSS.
- Sound speed corrections were verified daily by measuring river temperature and completing a bar check.

Equipment

- Trimble R10 GNSS Receivers.
- Trimble TSC5/TSC7 Data Collectors.
- CEE Hydro Systems CEE-LINE Echo Sounder, single beam, 200 kHz.

The accuracy of equipment is discussed below in Section 3.4.

3.2 SURVEY CONTROL

Underhill Geomatics Ltd. collected flood mapping highwater mark (HWM) data and benchmarks between Johnson Crossing and Teslin. Coordinates (XY) are UTM Zone 8 North, North American Datum 1983 (NAD83) Canadian Spatial Referencing System (CSRS) derived from Real Time Kinematic GPS observations. Elevations are Orthometric and are derived from CGVD2013 Datum using the CGG2013a Geoid Model.

Data collected in Johnson Crossing, Brooks Brook and Deadman Creek were holding UGL Base Control Point "999" fixed in 3D. Data Collected North of Teslin, Teslin and South of Teslin were holding UGL Base Control Point "608" fixed in 3D. Coordinates and elevations of 999 and 608 are derived from NRCan's Precise Point Position Service as listed in Table 3–1.

Table 3–1: Survey Control Points

CONTROL	NORTHING	EASTING	ELEVATION	DESCRIPTION
999	6706474.518	593205.102	700.924	UGL999
608	6672112.414	626248.117	689.073	UGL608

3.3 CHANNEL CROSS SECTIONS AND HYDRAULIC STRUCTURES

The bathymetric survey technologies included acoustic depth sounding equipment used in conjunction with RTK GPS survey equipment. The following bathymetric survey was conducted along the Teslin River:

- River reach was approximately 8.75 km long;
- The average river width was approximately 300 to 400 m;
- Transects were approximately at every 500 m; and
- There were 18 cross-sections surveyed in total, including two cross-sections at the Jonhson's Crossing bridge.

3.4 SURVEY ACCURACY AND DATUM AGREEMENT

All survey data is reported in Yukon Albers referenced horizontally to the North American Datum of 1983 Yukon Albers, Canadian Spatial Reference System, Epoch 2002 (NAD83 Yukon Albers CSRS, Epoch 2002). Vertically, the data is referenced to CGVD2013, in accordance with the Federal Flood Mapping Guidelines and Specifications (NRCan 2019).

Underhill Geomatics Ltd. processed the survey data collected during the detailed site survey using Trimble Business Centre (TBC). After processing, the detailed survey data consistently met acceptable survey tolerances when compared to the LiDAR data provided to WSP by YG. Below are the respective accuracies from the surveys when compared to the LiDAR:

- Survey data from rover pole compared to LiDAR:
  - Horizontal accuracy: within +/- 0.02 m
  - Vertical accuracy: within +/- 0.03 m
- Survey data from single beam echosounder compared to LiDAR:
  - Horizontal accuracy: within +/- 0.06 m
  - Vertical accuracy: within +/- 0.10 m

3.5 BENCHMARK SURVEYS

Table 3–2 below lists the benchmark locations and number of benchmarks from the Underhill Geomatics Ltd. survey report (Appendix B). These values were used in the hydraulic modelling component.

Table 3–2: Benchmark Locations and Number of Benchmarks

BENCHMARK LOCATIONS	NUMBER OF BENCHMARKS
Johnson Crossing	2
Teslin	3

3.6 HIGH WATER MARKS

Table 3–3 below lists the high water mark locations and number of HWMs measurements at each. Detailed information is contained in the Underhill Geomatics Ltd. survey report (Appendix B).

Table 3–3: High Water Mark (HWM) Locations and Number of Measurements

HWM LOCATION	NUMBER OF HWM MEASUREMENTS
Johnson Crossing	11
Brooks Brook	9
Deadman Creek	6
North of Teslin	3
Teslin	34
South of Teslin	4

3.6.1 2022 FLOOD HIGH WATER MARKS

Three primary HWMs, that were documented during the 2022 flood, were used for model calibration. The first two HWMs are located on The Teslin River are described in the sections below. The third HWM was the 2022 peak lake level recorded at the Water Survey of Canada (WSC) Teslin Lake at Teslin (09AE002) gauge, listed in Table 2–1.

3.6.1.1 HIGHWATER MARK 1

HWM 1 is the staff gauge near a Johnson's Crossing resident's cabin located approximately 1 km downstream from Johnson's Crossing and on the right (north) bank of the Teslin River. According to detailed notes provided by some of the residents, the water level started to rise on June 16, 2022 and peaked on June 22, 2022. The staff gauge staining shows that the instantaneous water level on the staff gauge was between the 40 cm to 50 cm mark. This level was corroborated by the resident's notes. The geodetic elevation of the 45 cm HWM is 686.69 m, based on Underhill Geomatics Ltd. survey. HWM 1 was used for hydraulic modelling calibration and verifying the 2022 flow estimate using the discontinued station Teslin River near Teslin (09AE001) rating curve. The staff gauge is shown below in Figure 3-1 and the identification number for the adjacent hydraulic model cross-section with the HWM 1 elevation are shown below in Table 3–4 (overall cross-section plan with naming convention is shown in Figure 7-1 later in the report).

Table 3–4: HWM 1 and Adjacent Hydraulic Model Cross Section

HWM 1 ELEVATION (M)	ADJACENT CROSS SECTION
686.69	CS 3430



Figure 3-1: Staff Gauge near Resident's Cabin

3.6.1.2 HIGHWATER MARK 2

HWM 2 is on the left bank of Teslin River immediately downstream of the Johnson's Crossing bridge and the location of the discontinued station WSC Gauge 09AE001 (Teslin River near Teslin). Two locations were surveyed by Underhill Geomatics Ltd. from the 2022 flood photos provided by local residents (taken on June 19, 2022). The first location was at the Teslin Lake Fish Species sign (just upstream of the bridge), where photos show the water came up to the bottom of the Northern Pike description (Figure 3-2). The second location was at the garbage cans near the outhouse approximately 60 m downstream of the Teslin Lake Fish Species sign where the water came close to the front top edge of the garbage cans (Figure 3-3). The surveyed geodetic elevation of the first location was 686.344 m and the second location was 686.362 m. Since HWM 2 is based on June 19, 2022, photos (3 days before the peak), the lower elevations corroborate HWM 1. Based on the detailed notes from local residents, the water level increased 15 cm from June 19, 2022, to June 22, 2022, at HWM 1, and a similar increase was used to estimate the peaks at HWM 2. The photos taken at the two locations on June 19 are shown below and the identification number for the hydraulic model cross-section with estimated HWM 2 peak elevations are shown in Table 3–5 (overall cross-section plan with naming convention is provided as Figure 7-1).

Table 3–5: HWM 2 and Adjacent Cross Section

HWM 2 LOCATION	JUNE 19, 2022 DOCUMENTED ELEVATION (m)	JUNE 22, 2022 ESTIMATED ELEVATION (m)	ADJACENT CROSS-SECTION
Teslin Lake Fish Species Sign	686.344	686.494	CS 4267.63
Garbage Cans near the Outhouse	686.362	686.512	CS 4267.63



Figure 3-2: Teslin Lake Fish Species sign on June 19, 2022



Figure 3-3: Garbage Cans near the Outhouse on June 19, 2022

4 HYDROLOGY ASSESSMENT

4.1 STATIC LAKE LEVEL FREQUENCY ASSESSMENT

4.1.1 TESLIN LAKE LEVEL DATA

The data from stations 09AE001 (Teslin River near Teslin) and 09AE002 (Teslin Lake at Teslin) were used to determine the flood frequency estimates at Teslin Lake. The two stations have an overlapping period from 1944 to 1994 and similar drainage areas. As discussed below, a relationship was developed between the annual peak flows and lake levels for the common period of record at the two stations. This allows missing annual peak data at one of the stations to be estimated if data is available at the other station.

The Teslin River near Teslin station (09AE001) has a 50-year period of record with available annual maximum daily flows from 1944 to 1994, excluding 1945, 1946 and 1947. Annual maximum instantaneous flows were only available from 1976 to 1992, excluding 1988.

The Teslin Lake station (09AE002) has a 79-year period of record with available annual maximum daily water levels from 1945 onwards. Some recorded annual maximum daily water levels were not published since they were part of an incomplete record year dataset. The daily water level data were reviewed for these years to confirm that values were recorded between May and September and included the annual maximums, where available. The maximum annual daily water levels for these years were added to the overall dataset. The years 1944,1949, 1950 and 1999 were excluded since data was missing for the high water period. The methodology to obtain estimates for missing years of annual maximum water levels is described below. Annual maximum instantaneous lake levels were only available from 1981 to 2022, excluding 1999.

Using the available data, two graphical relationships were derived to determine the annual maximum instantaneous water level dataset for the Teslin Lake water level frequency analysis. The first graphical relationship (Figure 4-1) plots annual maximum daily flows of Station 09AE001 and annual maximum daily water levels of Station 09AE002. Maximum instantaneous data were not used since there is not a good record of overlapping data. The concurrent events plotted in Figure 4-1 are listed in Table 4–1.

Since the two stations are located relatively close to each other, the concurrent annual daily maximums can be plotted for the overlapping period of record. For some years, the annual maximums were recorded within a few days apart; these can be considered to be the same flood event. This was corroborated by reviewing lake levels on days adjacent to the peak and lake levels are steady and within a few centimetres of each other. The power function for the best fit trendline shown on Figure 4-1 was used to derive the missing 1944, 1949 and 1950 annual maximum daily water levels at Station 09AE002. Hence, a complete dataset of annual maximum daily water levels was developed between 1944 to 2022, excluding 1999.

A commentary on the 1962 peak lake levels and flow is contained later in the report (Section 4.2.3).

Table 4–1: Concurrent Events between Stations 09AE001 and 09AE002

TESLIN RIVER NEAR TESLIN (09AE001)			TESLIN LAKE AT TESLIN (09AE002)		
YEAR	MONTH, DAY	ANNUAL MAXIMUM DAILY (M^3/S)	YEAR	MONTH, DAY	ANNUAL MAXIMUM DAILY (M)
1948	June, 4	1,370	1948	June, 6	7.785
1951	June, 15	963	1951	June, 23	6.788
1952	July, 4	1,230	1952	July, 8	6.852
1953	June, 2	691	1953	June, 3	5.959
1954	June, 13	1,130	1954	June, 12	7.169
1955	July, 7	1,150	1955	July, 8	7.254
1956	June, 21	810	1956	June, 21	6.37
1957	June, 13	1,490	1957	June, 13	8.217
1958	June, 11	691	1958	June, 13	5.998
1959	June, 18	1,070	1959	June, 19	7.093
1960	July, 1	1,090	1960	June, 28	7.047
1961	June, 15	1,660	1961	June, 16	8.556
1962	June, 27	1,840	1962	June, 26	9.117
1963	June, 26	1,040	1963	July, 6	7.846
1964	June, 18	1,710	1964	June, 22	8.827
1965	June, 14	875	1965	June, 17	6.754
1966	June, 22	985	1966	June, 21	7.023
1967	June, 23	1,320	1967	June, 20	7.891
1968	June, 17	864	1968	June, 17	6.632
1969	June, 19	934	1969	June, 20	6.739
1970	June, 13	799	1970	June, 10	6.453
1971	June, 26	1,160	1971	June, 27	7.458
1972	June, 20	1,510	1972	June, 21	8.44
1973	June, 24	1,060	1973	June, 24	7.096
1974	July, 3	900	1974	July, 1	6.764
1975	July, 7	1,040	1975	July, 9	7.081
1976	July, 3	1,290	1976	July, 3	7.772
1977	June, 20	1,230	1977	June, 21	7.748
1978	July, 1	456	1978	June, 18	5.563
1979	July, 9	1,180	1979	July, 10	7.483
1980	June, 13	810	1980	June, 14	6.477
1981	June, 5	1,030	1981	June, 6	7.123
1982	June, 17	904	1982	June, 17	6.696
1983	June, 11	760	1983	June, 14	6.248
1984	June, 29	829	1984	June, 29	6.471
1985	June, 10	1,180	1985	June, 10	7.356
1986	July, 8	1,050	1986	July, 9	7.095
1987	June, 13	1,060	1987	June, 13	7.121
1988	June, 18	1,190	1988	June, 19	7.364
1989	June, 8	745	1989	June, 9	6.076
1990	June, 11	1,330	1990	June, 12	7.686
1991	June, 27	887	1991	June, 27	6.488
1992	June, 22	1,730	1992	June, 23	8.75
1993	June, 9	974	1993	June, 10	6.716
1994	June, 20	1,050	1994	June, 21	6.996

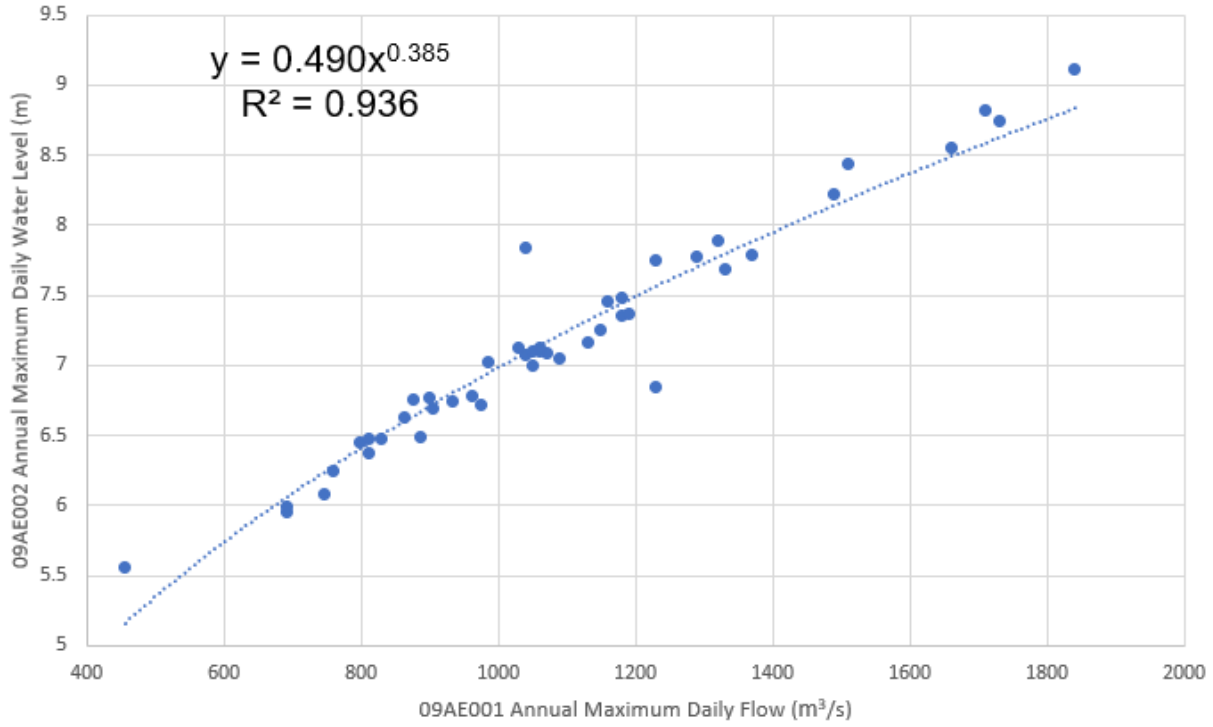


Figure 4-1: Relationship between Annual Maximum Daily Water Levels at 09AE002 Versus Annual Maximum Daily Flows at 09AE001

Figure 4-2 shows the graphical relationship used to derive the missing annual maximum instantaneous water levels at Station 09AE002. The published annual maximum instantaneous water levels versus published maximum daily water levels were plotted, and a linear function was used for the best fit trendline. As shown in Figure 4-2, the maximum daily and instantaneous water levels are basically the same values. This is to be expected for such a large waterbody as Teslin Lake which has so much storage that the inflow over a period of several hours would not have a significant impact on water levels.

The complete annual maximum instantaneous Teslin Lake water level dataset is contained in Table 4–2. This is referred to as the Teslin Lake recorded/derived dataset. The notes in Table 4–2 describe the methods used to obtain the derived dataset.

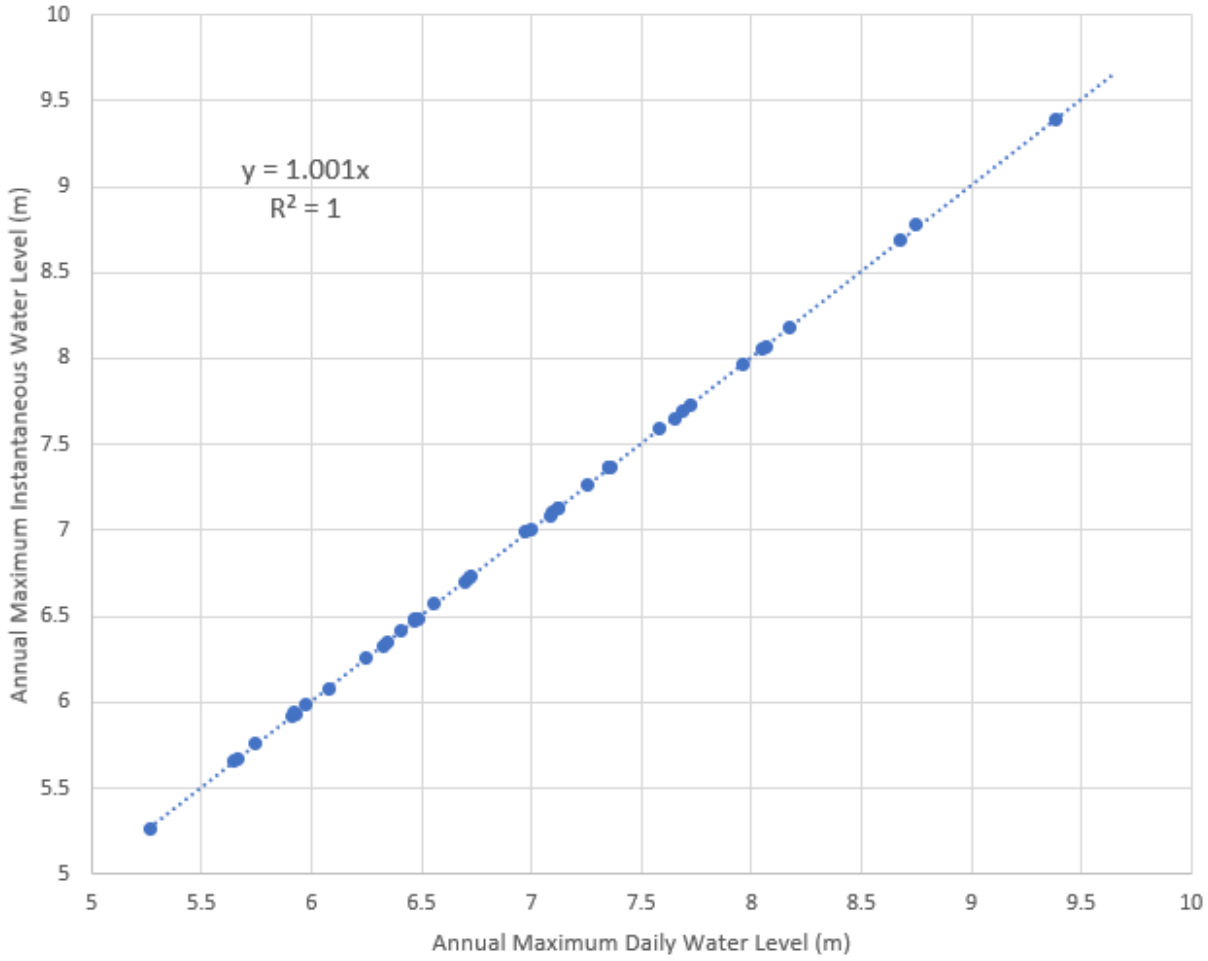


Figure 4-2: Relationship between Annual Instantaneous Water Levels Versus Annual Maximum Daily Water Level at 09AE001

Table 4–2: Teslin Lake Recorded/Derived Dataset (1944 to 2022)

TESLIN LAKE AT TESLIN (09AE002)									
ANNUAL MAXIMUM DAILY				ANNUAL MAXIMUM INSTANTANEOUS					
RECORDED				RECORDED				DERIVED	RECORDED & DERIVED GEODETIC
YEAR	MONTH	DAY	WATER LEVEL (M)	YEAR	MONTH	DAY	WATER LEVEL (M)	WATER LEVEL (M)	WATER LEVEL (M)
1944	-	-	-	1944	-	-	-	6.924	684.24
1945	06	13	6.657	1945	-	-	-	6.665	683.98
1946	06	09	6.535	1946	-	-	-	6.543	683.86
1947	06	10	8.303	1947	-	-	-	8.313	685.63
1948	06	06	7.785	1948	-	-	-	7.794	685.11
1949	-	-	-	1949	-	-	-	7.331	684.64
1950	-	-	-	1950	-	-	-	5.930	683.24
1951	06	23	6.788	1951	-	-	-	6.796	684.11
1952	07	08	6.852	1952	-	-	-	6.860	684.17
1953	06	03	5.959	1953	-	-	-	5.966	683.28
1954	06	12	7.169	1954	-	-	-	7.178	684.49
1955	07	08	7.254	1955	-	-	-	7.263	684.58
1956	06	21	6.370	1956	-	-	-	6.378	683.69
1957	06	13	8.217	1957	-	-	-	8.227	685.54
1958	06	13	5.998	1958	-	-	-	6.005	683.32
1959	06	19	7.093	1959	-	-	-	7.102	684.42
1960	06	28	7.047	1960	-	-	-	7.055	684.37
1961	06	16	8.556	1961	-	-	-	8.566	685.88
1962	07	03	9.368	1962	-	-	-	9.650	686.96
1963	07	06	7.846	1963	-	-	-	7.855	685.17
1964	06	22	8.827	1964	-	-	-	8.838	686.15
1965	06	17	6.754	1965	-	-	-	6.762	684.08
1966	06	21	7.023	1966	-	-	-	7.031	684.34
1967	06	20	7.891	1967	-	-	-	7.900	685.21
1968	06	17	6.632	1968	-	-	-	6.640	683.95
1969	06	20	6.739	1969	-	-	-	6.747	684.06
1970	06	10	6.453	1970	-	-	-	6.461	683.77
1971	06	27	7.458	1971	-	-	-	7.467	684.78
1972	06	21	8.440	1972	-	-	-	8.450	685.76
1973	06	24	7.096	1973	-	-	-	7.105	684.42
1974	07	01	6.764	1974	-	-	-	6.772	684.09
1975	07	09	7.081	1975	-	-	-	7.089	684.40
1976	07	03	7.772	1976	-	-	-	7.781	685.09
1977	06	21	7.748	1977	-	-	-	7.757	685.07
1978	06	18	5.563	1978	-	-	-	5.570	682.88
1979	07	10	7.483	1979	-	-	-	7.492	684.81
1980	06	14	6.477	1980	-	-	-	6.485	683.80
1981	06	06	7.123	1981	06	06	7.129	-	684.44
1982	06	17	6.696	1982	06	17	6.700	-	684.01
1983	06	14	6.248	1983	06	14	6.255	-	683.57
1984	06	29	6.471	1984	06	29	6.475	-	683.79
1985	06	10	7.356	1985	06	11	7.371	-	684.68
1986	07	09	7.095	1986	07	08	7.103	-	684.42
1987	06	13	7.121	1987	06	13	7.129	-	684.44
1988	06	19	7.364	1988	06	19	7.365	-	684.68
1989	06	09	6.076	1989	06	09	6.078	-	683.39
1990	06	12	7.686	1990	06	12	7.690	-	685.00
1991	06	27	6.488	1991	06	26	6.490	-	683.80
1992	06	23	8.750	1992	06	23	8.778	-	686.09
1993	06	10	6.716	1993	06	09	6.724	-	684.04
1994	06	21	6.996	1994	06	21	7.003	-	684.32
1995	05	31	5.263	1995	05	31	5.266	-	682.58
1996	06	13	5.913	1996	06	13	5.917	-	683.23
1997	06	17	6.323	1997	06	17	6.331	-	683.64
1998	06	07	5.978	1998	06	07	5.984	-	683.30
1999	-	-	-	1999	-	-	-	-	-
2000	06	21	6.470	2000	06	22	6.482	-	683.80
2001	06	22	7.348	2001	06	22	7.362	-	684.68
2002	06	13	6.342	2002	06	14	6.348	-	683.66
2003	07	11	5.93	2003	07	11	5.934	-	683.25
2004	06	15	7.083	2004	06	15	7.087	-	684.40
2005	06	03	7.649	2005	06	03	7.654	-	684.97
2006	06	20	8.066	2006	06	20	8.069	-	685.38
2007	06	14	8.170	2007	06	14	8.183	-	685.50
2008	06	29	7.579	2008	06	29	7.588	-	684.90
2009	06	15	8.047	2009	06	15	8.052	-	685.37
2010	06	08	5.743	2010	06	09	5.757	-	683.07
2011	06	07	6.561	2011	06	08	6.574	-	683.89
2012	06	27	7.726	2012	06	26	7.732	-	685.05
2013	06	13	7.963	2013	06	08	7.968	-	685.28
2014	06	13	6.721	2014	06	13	6.729	-	684.04
2015	06	02	6.976	2015	06	02	6.992	-	684.31
2016	06	06	6.408	2016	06	06	6.417	-	683.73
2017	07	19	5.663	2017	07	19	5.669	-	682.98
2018	06	22	5.919	2018	06	23	5.940	-	683.25
2019	06	27	5.648	2019	06	27	5.656	-	682.97
2020	06	23	7.259	2020	06	23	7.265	-	684.58
2021	06	24	8.674	2021	06	24	8.688	-	686.00
2022	06	23	9.388	2022	06	23	9.395	-	686.71

Notes:

Green values are derived from using the 09AE002 Annual Maximum Daily water level and 09AE001 Annual Maximum Daily Flow relationship. After the Annual Maximum Daily water level is derived, it is converted into Annual Maximum Instantaneous water level using the 09AE002 linear relationship between Maximum Daily and Maximum Instantaneous.

Blue values are derived from 09AE002 linear relationship between Maximum Daily and Maximum Instantaneous.

Purple values are derived from using incomplete year daily Maximum and 09AE002 linear relationship between Maximum Daily and Maximum Instantaneous.

4.1.2 SERIAL CORRELATION

Lakes that have year-to-year carryover storage volumes can have serially correlated maximum water levels (i.e., the annual peak water levels are not independent). Teslin Lake data was analyzed for serial correlation. The annual maximum instantaneous water level dataset (Table 4–2) was analyzed using a statistical dependent test to determine autocorrelation coefficients and t-distribution values for one and two time period offset. Results showed that the dataset had a one time period offset serial correlation at 5% significance level with an autocorrelation coefficient of 0.280. This shows that the existing serial correlation is weak since the value ranges from –1 to 1 (-1 being perfectly negative autocorrelation and 1 being perfectly positive autocorrelation). This weak statistical correlation was corroborated by reviewing concurrent annual spring (i.e., post-ice breakup) lake levels. Over several concurrent years, there were no discernable patterns of rising or falling water levels.

Even though the serial correlation was weak, the data was decorrelated in order to review against the recorded/derived data to determine if there were differences between the two datasets. To decorrelate the dataset, the Kaliq *et al.* (2006) de-correlation technique was applied. This was done by subtracting the calculated correlation value using the autocorrelation coefficient from the previous years. WSP performed flood frequency analyses for both decorrelated and correlated datasets. The calculated statistical dependent test results are presented in Table 4–3. The de-correlation of the annual maximum instantaneous water level dataset is summarized in Appendix C.

Table 4–3: Statistical Dependent Test Results for 09AE002 Annual Maximum Instantaneous Water Levels

TIME PERIOD	LENGTH OF RECORD	ONE TIME PERIOD OFFSET		TWO TIME PERIOD OFFSET	
		AUTOCORRELATION COEFFICIENT	T-DISTRIBUTION VALUE	AUTOCORRELATION COEFFICIENT	T-DISTRIBUTION VALUE
1944 to 2022, excluding 1999	78	0.280	**2.547**	0.151	1.330

The 5% significance level t-distribution value is 1.96. Only one time period offset t-distribution value exceeds this which shows only one time period offset autocorrelation is detected within the dataset.

4.1.3 LAKE LEVEL FLOOD FREQUENCY ANALYSIS

A flood frequency analysis was completed for Station 09AE002 decorrelated and recorded/derived datasets using a spreadsheet developed by WSP and the standard statistical analysis software HYFRAN. The spreadsheet is used to statistically test the dataset for trends, homogeneity, independence, outliers and dependency. The dataset is then input into HYFRAN to obtain flood frequency results for different statistical distributions. The distributions are then judged using graphical visual inspection and numerical tests such as Anderson-Darling test, Kolmogorov-Smirnov test and Least Square ranking.

The Generalized Extreme Value (GEV) distribution using method of moments yielded the best fit result for both datasets at Station 09AE002. Graphs and tables related to the flood frequency analysis are summarized in Appendix D for both datasets. The decorrelated flood frequencies were slightly lower than the recorded/derived lake levels.

Given that the correlation is weak, WSP and YG agreed to use the flood frequencies based on the recorded/derived data for the study. The recorded/derived data flood frequency estimates, with the associated upper and lower 95% confidence intervals are shown in Table 4–4 and Table 4–5, for the local datum and geodetic values, respectively.

Since the length of record for the water levels used in the flood frequency analysis is 78 years, there are greater uncertainties with the flood frequency estimates for AEP greater than 1%. This is shown in the greater range of the confidence intervals for the 0.5% AEP and 0.2% AEP flood events.

Based on the results presented below, the 2022 Teslin Lake flood was slightly less than a 1% AEP, and the 1962 was between a 1% AEP and a 0.5% AEP event. Additionally, within the 78 years of record there were eight 2% AEP events and two 2% AEP events. This occurrence of the respective flood events shows that the frequency analysis is in good agreement with the recorded data.

Table 4–4: 09AE002 Flood Frequency Estimates with Confidence Intervals for Recorded/Derived Data (without datum conversion)

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	FLOOD FREQUENCY ESTIMATE (M)		
		VALUE	LOWER 95% LIMIT	UPPER 95% LIMIT
0.2	500	10.2	8.93	11.4
0.5	200	9.82	8.86	10.8
1.0	100	9.52	8.75	10.3
2.0	50	9.20	8.59	9.81
5.0	20	8.71	8.28	9.15
10	10	8.30	7.96	8.63
20	5	7.82	7.54	8.09
50	2	6.99	6.77	7.22

Table 4–5: 09AE002 Flood Frequency Estimates with Confidence Intervals for Recorded/Derived Data (with conversion to CGVD2013 datum)

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	FLOOD FREQUENCY ESTIMATE(M)		
		VALUE	LOWER 95% LIMIT	UPPER 95% LIMIT
0.2	500	687.51	686.24	688.71
0.5	200	687.13	686.17	688.11
1.0	100	686.83	686.06	687.61
2.0	50	686.51	685.90	687.12
5.0	20	686.03	685.59	686.46
10	10	685.61	685.27	685.94
20	5	685.13	684.85	685.40
50	2	684.31	684.08	684.53

4.2 TESLIN RIVER FLOW DATA

4.2.1 HISTORIC FLOODS AND RECORDED FLOW DATA

Characteristics of the Teslin River near Teslin (09AE001) WSC streamflow gauging station is provided above in Section 2. Annual maximum daily flows were recorded from 1944 to 1994, excluding 1945, 1946 and 1947. Annual maximum instantaneous flows were only recorded from 1976 to 1992, excluding 1988. The largest recorded flood occurred in June 1962, with a maximum daily discharge of 1,840 m^3/s. Other large floods occurred in June 1964 and June 1992. Table 4–6 summarizes the six largest recorded historical floods.

Table 4–6: Summary of Six Largest Recorded Historical Floods

TESLIN RIVER NEAR TESLIN (09AE001)			
Year	**Month, Day**	**ANNUAL MAXIMUM DAILY (M^3/S)**	**ANNUAL MAXIMUM INSTANTANEOUS (M^3/S)**
1957	June 13	1,490	-
1961	June 15	1,660	-
1962	June 27	1,840	-
1964	June 18	1,710	-
1972	June 20	1,510	-
1992	June 22	1,730	1,730

Using the available annual maximum instantaneous flows and annual daily maximum flows (from 1976 to 1992), a linear line of best fit function was developed as shown in Figure 4-3. The maximum daily and instantaneous flows are similar. This is to be expected since the station was close to the outlet of Teslin Lake which smooths out daily fluctuations.

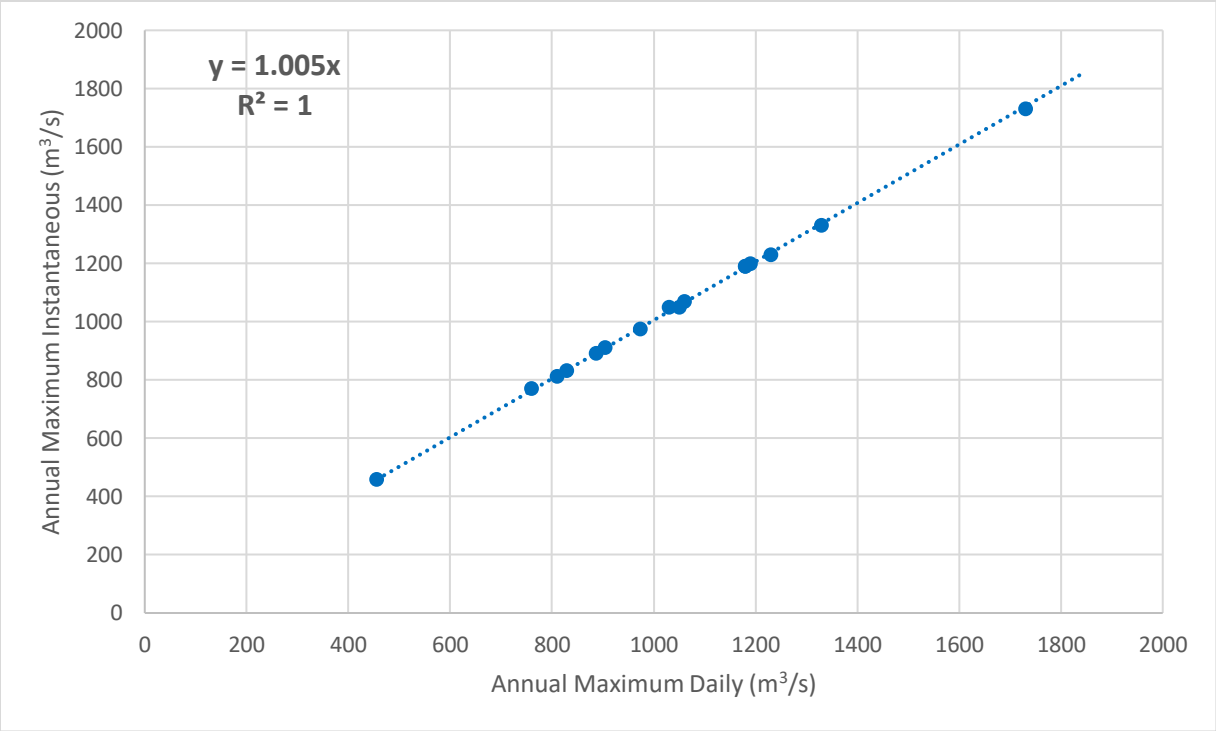


Figure 4-3: Relationship between Annual Maximum Instantaneous Flows Versus Annual Maximum Daily Flows at 09AE001

4.2.2 EXTENDING RECORDED FLOW DATA

The data from Teslin Lake at Teslin (09AE002) was used to extend the flow data for the data recorded for the Teslin River (Station 09AE001). The two stations have an overlapping period of record from 1944 to 1994 and the peaks are closely related. A relationship was developed using the available annual maximum daily river flows and lake levels for the common period of record.

In some years, the annual maximums were recorded within a few days apart; these were considered as the same flood event. This was corroborated by reviewing lake levels on days adjacent to the Teslin River peak, and lake levels were found to be steady and within a few centimetres of each other (i.e., typically there is a small variation in lake level over a period of a few days). For 1962, the lake water level was adjusted to match the same day as the annual maximum daily flow recorded at the river. A commentary on the 1962 peak lake levels and flow is contained later in the report (Section 4.2.3).

The power function for the best fit trendlines shown on Figure 4-1 and Figure 4-4 were used to derive the missing annual maximum daily flows from 1944 to 2022 at Station 09AE001. Flows less than 1,000 m^3/s were derived using Figure 4-1 best fit trendline that incorporated all available flows from the overlapping period, and flows greater than 1,000 m^3/s were derived using Figure 4-4 best fit trendline for flows greater than 1,000 m^3/s. This approach was taken since the lower flows and higher flows have different channel roughness coefficients; and are better represented using the different curves discussed in greater detail in Section 7.2. The entire concurrent years of record at Stations 09AE001 and 09AE002 (i.e., the data plotted on Figure 4-1) are shown in Table 4–1. A complete dataset of annual maximum daily flows at Station 09AE001 was developed between 1944 to 2022, excluding 1999, based on the above methodology.

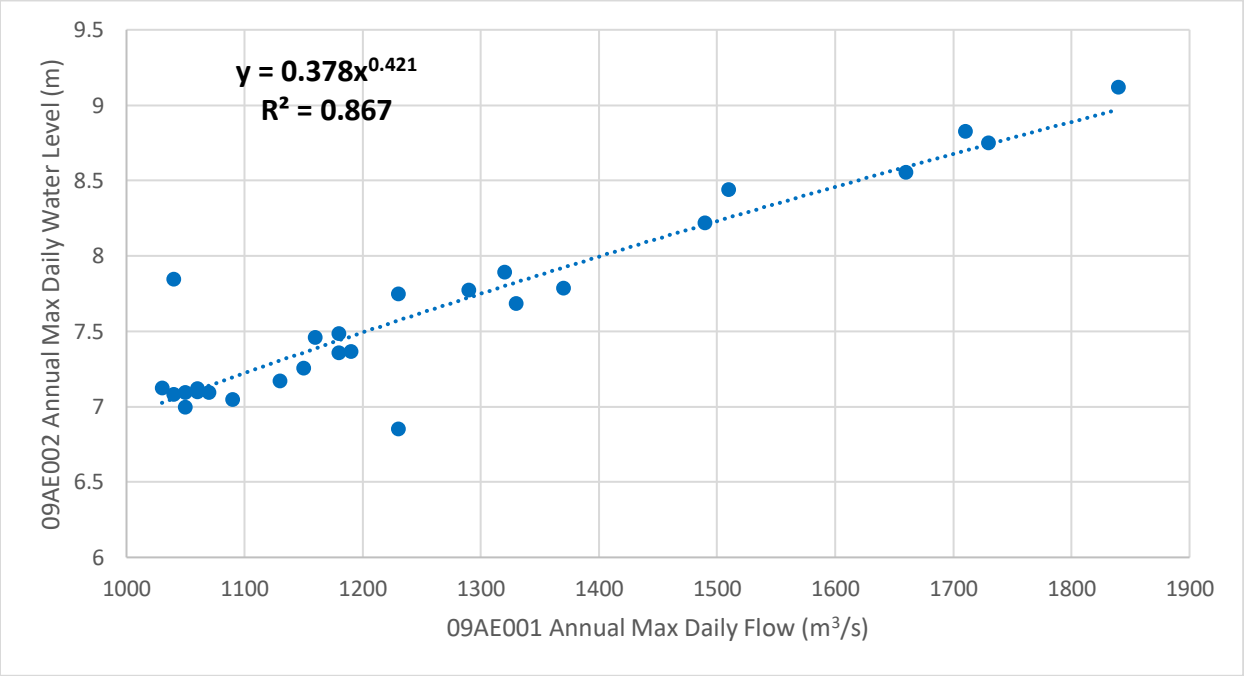


Figure 4-4: Relationship between 09AE002 Annual Maximum Daily Water Levels Versus 09AE001 Annual Maximum Daily Flows (Recorded Flows Above 1000 m^3/s)

Using the extended dataset of annual maximum daily flows and the linear line of best fit from Figure 4-3, the annual maximum instantaneous flows were derived. Annual maximum instantaneous flows from 1944 to 2022 were used for Station 09AE001 flood frequency analysis. The complete dataset of annual maximum instantaneous flows at Station 09AE001 is contained in Table 4–7.

Table 4–7: Teslin River Flows Recorded/Derived Dataset (1944-2022)

TESLIN RIVER NEAR TESLIN (09AE001)							
ANNUAL MAXIMUM DAILY				ANNUAL MAXIMUM INSTANTANEOUS			
YEAR	MONTH	DAY	FLOW (M^3/S)	YEAR	MONTH	DAY	FLOW (M^3/S)
1944	06	15	974	1944	-	-	979
1945	-	-	882	1945	-	-	887
1946	-	-	841	1946	-	-	845
1947	-	-	1,530	1947	-	-	1,538
1948	06	04	1,370	1948	-	-	1,377
1949	06	27	1,130	1949	-	-	1,136
1950	06	21	651	1950	-	-	654
1951	06	15	963	1951	-	-	968
1952	07	04	1,230	1952	-	-	1,236
1953	06	02	691	1953	-	-	695
1954	06	13	1,130	1954	-	-	1,136
1955	07	07	1,150	1955	-	-	1,156
1956	06	21	810	1956	-	-	814
1957	06	13	1,490	1957	-	-	1,498
1958	06	11	691	1958	-	-	695
1959	06	18	1,070	1959	-	-	1,075
1960	07	01	1,090	1960	-	-	1,096
1961	06	15	1,660	1961	-	-	1,668
1962	06	27	1,840	1962	-	-	1,849
1963	06	26	1,040	1963	-	-	1,045
1964	06	18	1,710	1964	-	-	1,719
1965	06	14	875	1965	-	-	879
1966	06	22	985	1966	-	-	990
1967	06	23	1,320	1967	-	-	1,327
1968	06	17	864	1968	-	-	868
1969	06	19	934	1969	-	-	939
1970	06	13	799	1970	-	-	803
1971	06	26	1,160	1971	-	-	1,166
1972	06	20	1,510	1972	-	-	1,518
1973	06	24	1,060	1973	-	-	1,065
1974	07	03	900	1974	-	-	905
1975	07	07	1,040	1975	-	-	1,045
1976	07	03	1,290	1976	-	-	1,297
1977	06	20	1,230	1977	06	20	1,230
1978	07	01	456	1978	06	30	459
1979	07	09	1,180	1979	07	09	1,190
1980	06	13	810	1980	06	14	813
1981	06	05	1,030	1981	06	06	1,050
1982	06	17	904	1982	06	17	912
1983	06	11	760	1983	06	13	771
1984	06	29	829	1984	06	29	833
1985	06	10	1,180	1985	06	11	1,190
1986	07	08	1,050	1986	07	08	1,050
1987	06	13	1,060	1987	06	13	1,070
1988	06	18	1,190	1988	06	19	1,200
1989	06	08	745	1989	-	-	749
1990	06	11	1,330	1990	06	12	1,330
1991	06	27	887	1991	06	26	891
1992	06	22	1,730	1992	06	22	1,730
1993	06	09	974	1993	06	09	976
1994	06	20	1,050	1994	-	-	1,055
1995	-	-	479	1995	-	-	481
1996	-	-	648	1996	-	-	652
1997	-	-	772	1997	-	-	776
1998	-	-	667	1998	-	-	670
1999	-	-	-	1999	-	-	-
2000	-	-	819	2000	-	-	823
2001	-	-	1,145	2001	-	-	1,151
2002	-	-	778	2002	-	-	782
2003	-	-	653	2003	-	-	656
2004	-	-	1,050	2004	-	-	1,055
2005	-	-	1,260	2005	-	-	1,266
2006	-	-	1,429	2006	-	-	1,436
2007	-	-	1,473	2007	-	-	1,480
2008	-	-	1,233	2008	-	-	1,239
2009	-	-	1,421	2009	-	-	1,428
2010	-	-	601	2010	-	-	604
2011	-	-	849	2011	-	-	854
2012	-	-	1,290	2012	-	-	1,297
2013	-	-	1,386	2013	-	-	1,393
2014	-	-	904	2014	-	-	909
2015	-	-	1,012	2015	-	-	1,018
2016	-	-	799	2016	-	-	803
2017	-	-	579	2017	-	-	582
2018	-	-	650	2018	-	-	653
2019	-	-	575	2019	-	-	578
2020	-	-	1,113	2020	-	-	1,118
2021	-	-	1,698	2021	-	-	1,706
2022	-	-	2,048	2022	-	-	2,059

Notes:
Values in black are recorded data available from 09AE001.
Values in blue are derived from using the 09AE002 Annual Maximum Daily water level and 09AE001 Annual Maximum Daily Flow relationship.
Values in green are derived from 09AE001 linear relationship between Maximum Daily and Maximum Instantaneous.

4.2.3 COMMENTARY ON 1962 FLOOD LAKE AND RIVER PEAKS

In 1962, the maximum daily flow was recorded on June 27 (1,840 m^3/s) and the maximum daily water level was recorded on July 3. The lake water level on June 26 (water level data is missing for the 27) was 9.117 m and rose to 9.638 m on July 3 (i.e., greater than 0.5 m increase). The river discharge had decreased to 1,750 m^3/s on July 3.

The above is somewhat anomalous as typically, there is little variation between the recorded maximum daily water levels and the daily water levels on the day of the river's recorded maximum daily flows. The 1962 June-July lake station data is incomplete and contains significant water level fluctuations which cannot be explained by wind-wave action. WSC did publish daily lake level data for 1962, which has been used by WSP as the highest recorded lake level for the period of record (i.e., 1948 to present). However, the 1962 data is missing in WSC's published Annual Maximum Peak dataset, likely because it is incomplete. In contrast, the recorded WSC 1962 Teslin River data is complete and 1962 is contained in the published Annual Maximum Peak dataset.

The following approach was used in this study, based on the above information:

- WSP determined that the June 26 water level data at the lake was suitable to be used with the maximum daily flow that was recorded on June 27 at the river for the relationship.
- As noted above, there are some uncertainties associated with the recorded July 3, 1962 lake level peak, which is the maximum recorded lake level. A conservative approach was used in this study and the 1962 peak data was used in the lake level analysis.

4.2.4 2022 TESLIN RIVER PEAK FLOW ESTIMATE

The latest 09AE001 rating curve (Version 5, updated on October 13, 2011) provided by WSC was used to estimate the 2022 peak flow based on extrapolating the Figure 4-5 curve up to the documented HWMs. The peak 2022 flow estimate was 2,092 m^3/s, based on the above approach.

In comparison, a flow of 2,059 m^3/s was estimated based on the lake water level versus river flow relationship (Figure 4-4). There is good agreement between the two values, further substantiating the lake water level versus river flow relationship (Figure 4-4). The 2022 peak instantaneous flow estimate of 2,059 m^3/s is used in this study. The 2022 peak instantaneous flow estimate of 2,059 m^3/s is the highest recorded/derived Teslin River value and is higher than the 1962 peak instantaneous value of 1,849 m^3/s. However, for Teslin Lake the 1962 annual peak lake level (686.96 m) is higher than 2022 (686.71 m). As discussed in the previous section, there are issues with 1962 annual peak lake level estimate.

The extrapolated rating curve using points above 1,000 m^3/s is shown in Figure 4-5.

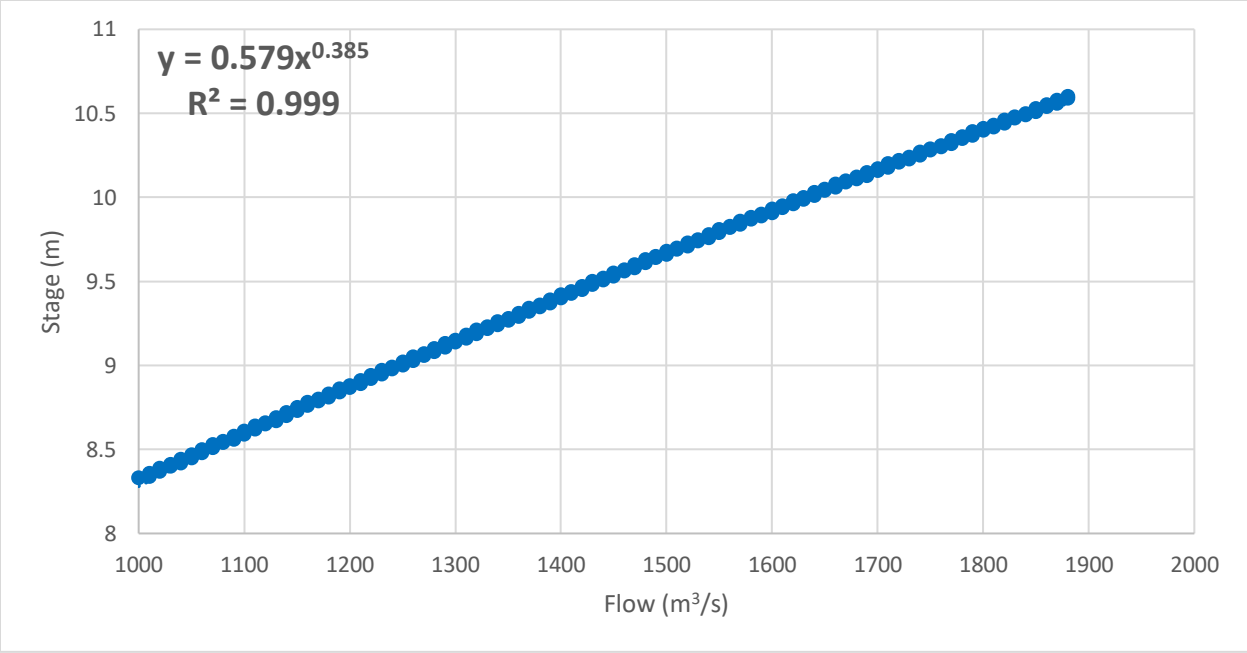


Figure 4-5: 09AE001 Rating Curve Power Function Line of Best Fit for Flows Above 1000 m³/s

4.2.5 TESLIN RIVER FLOOD FREQUENCY ANALYSIS

A flood frequency analysis was completed for the Station 09AE001 recorded/derived datasets (Table 4–7) using the standard statistical analysis software HYFRAN and a spreadsheet WSP developed that statistically tests the dataset for existing trends, homogeneity, independence, outliers and dependency. After the tests were completed, the dataset was inputted into HYFRAN to obtain frequency results for different statistical distributions. The flood frequency results were evaluated using graphical visual inspection and numerical tests such as Anderson-Darling test, Kolmogorov-Smirnov test and Least Square ranking.

The Generalized Extreme Value (GEV) distribution using method of moments yielded the best fit result at Station 09AE001. The recorded/derived data flood frequency estimates, with the associated upper and lower 95% confidence intervals are shown in Table 4–8.

The length of record for the flows used in the flood frequency analysis is 78 years. This long duration allows for a tight range in confidence intervals for AEP up to a 1%. There is a greater range in the confidence intervals for the 0.5% AEP and 0.2% AEP flood events. Based on the flood frequency estimates below, the estimated 2022 flood was between 1% and 0.5% AEP, and the recorded 1962 flood came close to 2.0% AEP.

Table 4–8: 09AE001 Flood Frequency Estimates with Confidence Intervals for Recorded/Derived Data

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	FLOOD FREQUENCY ESTIMATE (m³/s)		
		VALUE	LOWER 95% LIMIT	UPPER 95% LIMIT
0.2	500	2270	2800	1740
0.5	200	2120	2520	1720
1.0	100	1990	2310	1670
2.0	50	1860	2110	1610
5.0	20	1670	1840	1500
10	10	1510	1640	1380
20	5	1330	1440	1220
50	2	1020	1100	941

5 WIND AND WAVE ANALYSIS

From north to south, the four areas of interest analysed for wind setup and wave runup are: Brooks Brook, Deadman Creek, Teslin and Morley Bay and are shown in Figure 5-1 through Figure 5-4. These figures show the study area, the offshore wave hindcast location and the transects used for the wave runup calculations.



Figure 5-1: Brooks Brook Study Area



Figure 5-2: Deadman Creek Study Area

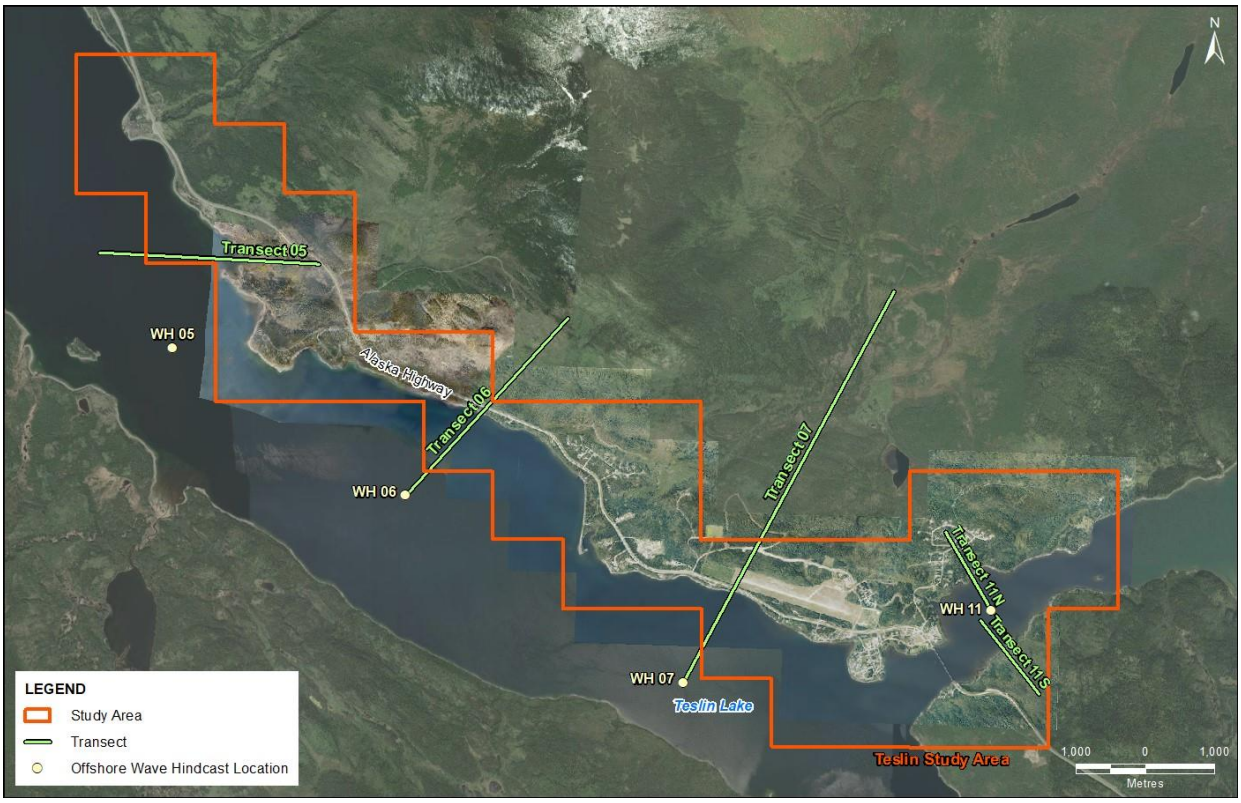


Figure 5-3: Teslin Study Area

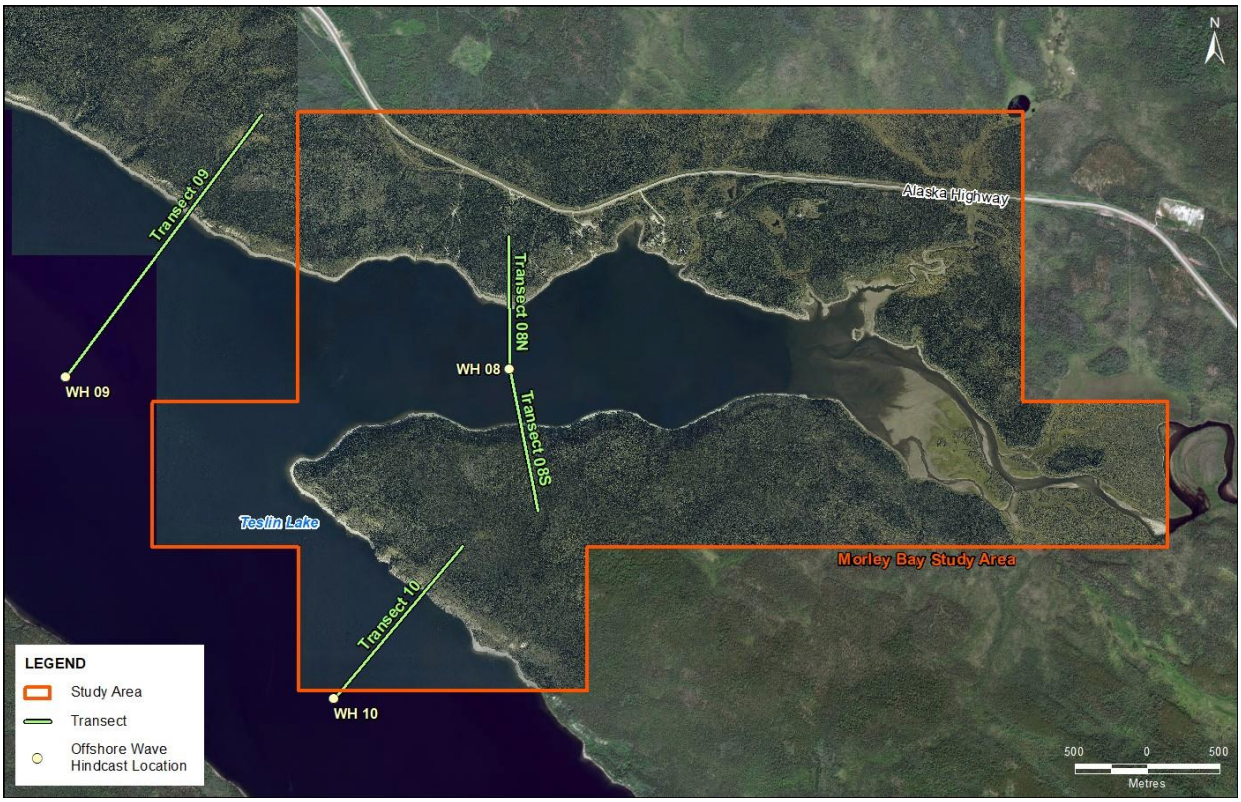


Figure 5-4: Morley Bay Study Area

Wind data is required for both the wind setup and wave runup calculations. There are 12 climate stations within 100 km of Teslin. Five stations are located at the Teslin airport and one at Johnsons Crossing. Only four stations have hourly wind data available, and these are all located at the Teslin airport. Daily records are not suitable for the wind setup and wave runup analysis as only information on maximum wind gusts are provided. Table 5–1 below summarizes the location and period of record for the four climate stations with hourly data.

Table 5–1: Summary of Climate Stations at Teslin Airport

STATION NAME	CLIMATE ID	LATITUDE	LONGITUDE	START DATE	END DATE
Teslin (AUT)	2101102	60° 10’ N	132° 44’ W	1994	Present
Teslin A	2101100	60° 10’ 26.9” N	132° 44’ 9.2” W	1953	2014
Teslin A	2101101	60° 10’ 23” N	132° 44’ 30” W	2014	Present
Teslin A	2101106	60° 10’ 23” N	132° 44’ 30” W	2014	Present

The wind data is used in a wave hindcast to generate a time series of wave heights and wave periods at several locations offshore of the study areas. These wave time-series are then used in extreme analysis to estimate various wave height probabilities. For this reason, it is important to have a long period of record of the input winds. It is also important to have recent data to be sure the current events are accounted for.

Hourly wind data was downloaded for Teslin AUT (2101102) and Teslin A (2101100). Teslin A (2101100) has a long period of record but lacks recent data. Teslin AUT (2101102) has more recent data, but the period of record is shorter than desired for an extreme analysis. By combining these two data sets, both objectives could be achieved. Using both data sets, data in the overlapping time frame was compared to ensure that the two data sets were similar. Figure 5-5 below shows a comparison of the wind speed at these two stations for the overlapping timeframe. The dashed line in this figure represents equal wind speeds at both stations. The data is closely

clustered along this line and indicates that there is reasonable agreement in the overlapping data. In order to generate a longer time-series for extremal analysis, these two data sets were merged. Data from Teslin AUT (2101102) was used in the overlapping timeframe as this station had a more complete record.

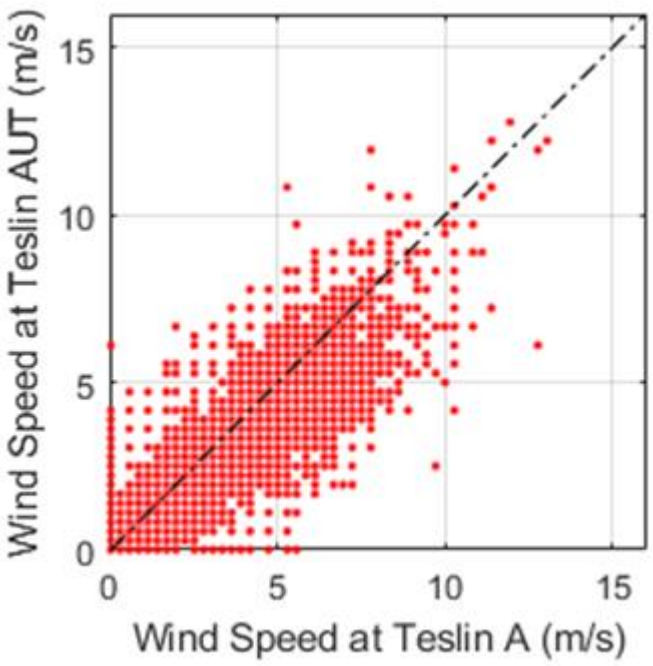


Figure 5-5: Comparison of Wind Speeds at Teslin A and Teslin AUT Climate Stations

The combined time-series is shown in Figure 5-6 (red dots indicate high wind events that were used in a peaks over threshold analysis and to determine the seasonality of the wind data), and the wind rose for this combined set is shown in Figure 5-7. There are several data gaps in the combined data set. The largest is almost two years between November 1982 and October 1984. Overall, the combined data set is 85% complete.

Due to the topography of the region, the winds would be expected to be steered in the direction of the valley. Teslin Lake is oriented roughly from the northwest to the southeast, but near the Teslin Airport the lake orientation is closer to west to east. The Teslin airport is also located at an intersection of two valleys with the Nisutlin Delta to the northeast. This makes the direction distribution much more complex at the Teslin Airport than would be expected at the other locations of interest for this Project. For each study area, several offshore locations were selected to generate offshore wave conditions, as shown in Figure 5-1 through Figure 5-4 above. These locations were near the mid-point of the lake where the water levels are deep. The empirical equations used for wave runup calculation require deep water wave inputs. The wind directions at Teslin were modified at each of these wave hindcast locations to match the local valley orientation.

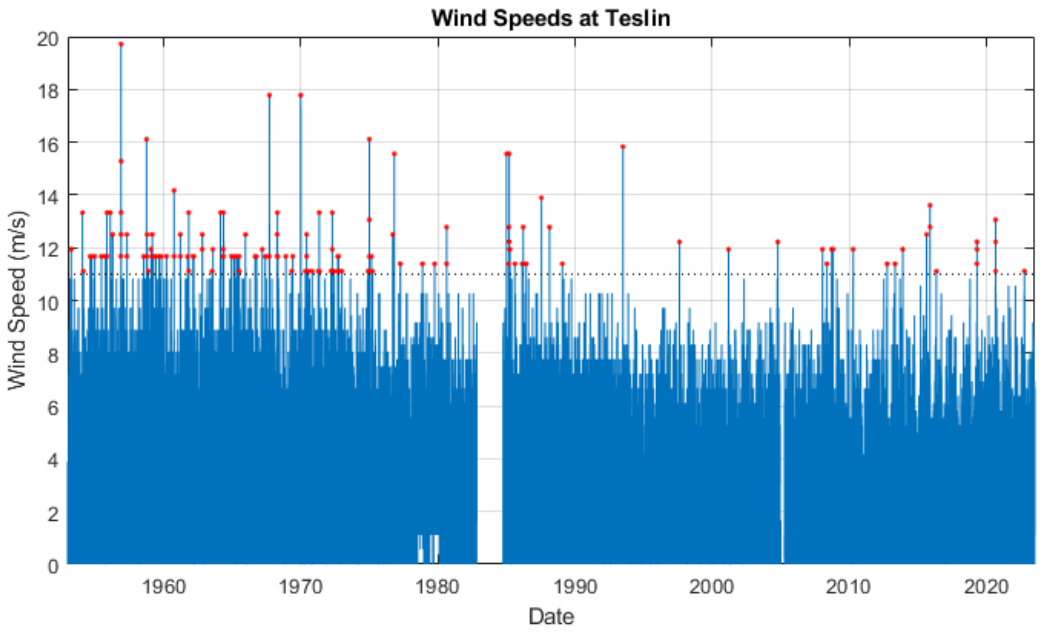


Figure 5-6: Combined Wind Time-Series (January 1953 to July 2023) for Climate Stations Teslin A (2101100, 1953-2023) and Teslin AUT (2101102, 1994-2023)

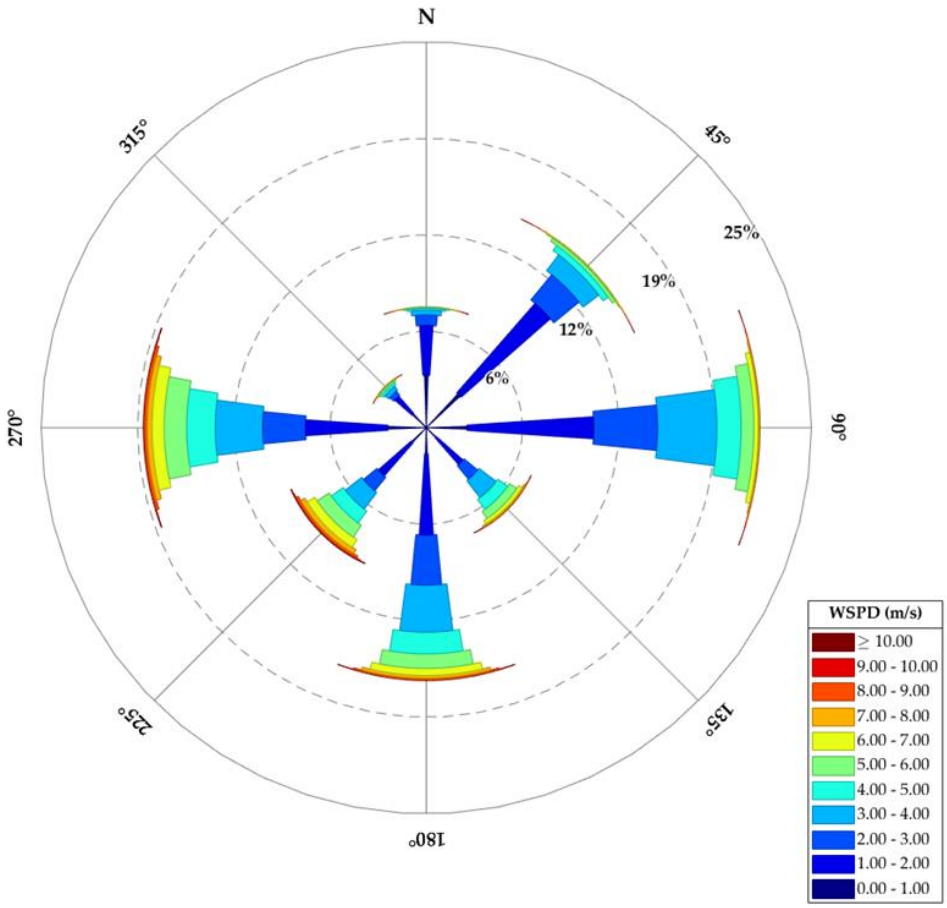


Figure 5-7: Wind Rose of Combined Wind Data at Teslin Airport

To estimate the wind setup, a DflowFM model was run with two different scenarios. Both these scenarios used the maximum observed wind speed of 20 m/s with a spatially varied direction. In the first scenario, the wind direction was blowing roughly from the northwest along the valley, and in the second scenario, the wind directions were blowing roughly from the southeast along the valley. The still water elevation for both scenarios was the 1% AEP for historic conditions and was run for a five-day duration. This allows sufficient time for the wind setup to reach an equilibrium value. For the two scenarios, the model reached equilibrium in roughly two and a half days. The largest wind setup in the study areas was modelled to be 0.13 m at the northern tip of the lake when the winds were blowing from the southeast. The wind setup for both scenarios are shown in Figure 5-8 and Figure 5-9 below. The figures show that wind setup is minor compared to the seasonal variation in water levels. This represents an extreme case as the winds would not be expected to be so strong for such an extended duration. Additionally, this value is higher than estimated at the four lake study areas. However, a wind setup of 0.13 m was applied across all sites to be conservative.

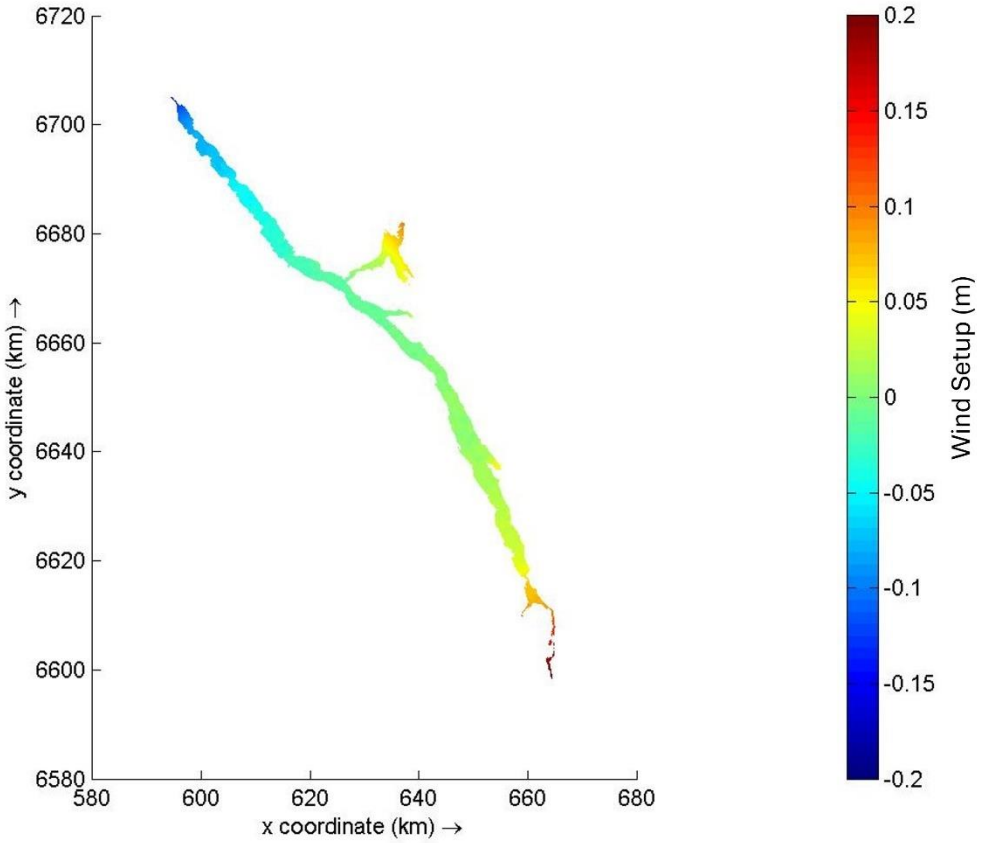


Figure 5-8: Equilibrium Wind Setup for 20 m/s Winds from the Northwest

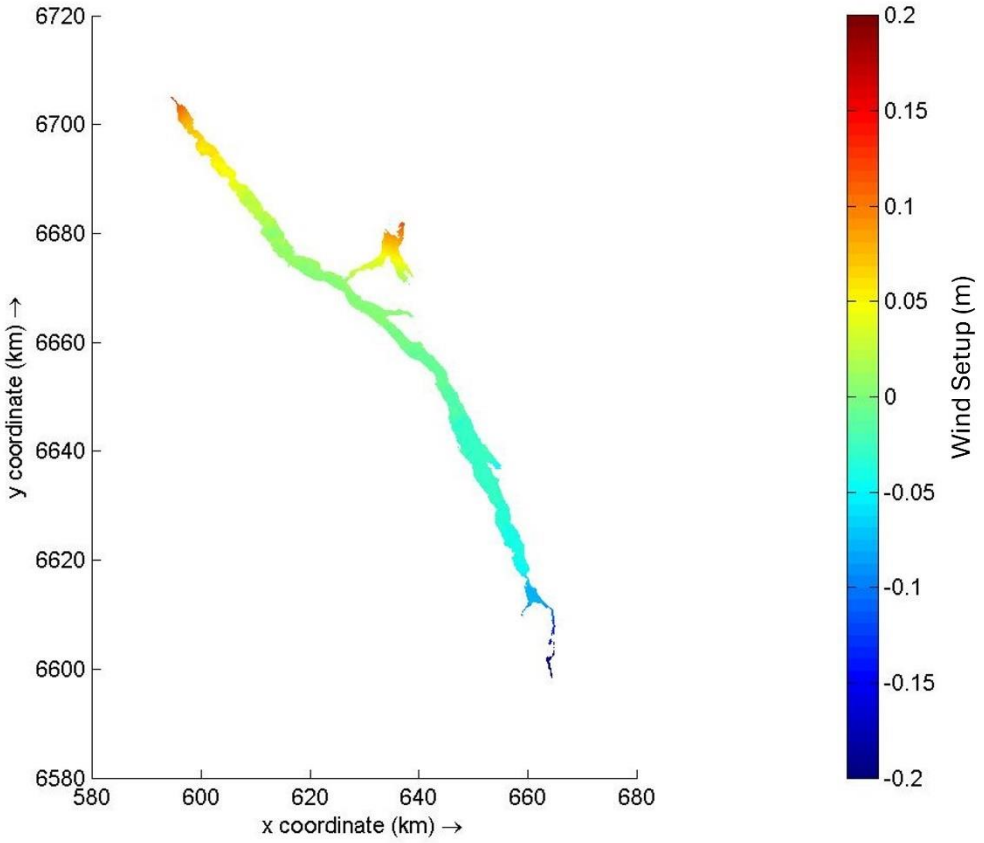


Figure 5-9: Equilibrium Wind Setup for 20 m/s Winds from the Southeast

To estimate offshore wave conditions, an in-house wave hindcast tool was run. This tool is a simple 1D fetch based model that uses empirical equations for wave growth and accounts for wave decay. The modified wind timeseries at each offshore location were used to generate a wave timeseries at each location for each study area. The modelled wave heights from this tool are less than those estimated for fully developed wave conditions. Full developed wave conditions are the wave conditions reached after the constant winds have blowing over the water for an extended duration. The duration of high wind events tends to be fairly short, often only lasting for one hour.

The wave time-series was then run through an in-house extremal analysis program. This program uses a Markov Chain Monte Carlo technique to estimate fit parameters from a peak over threshold (POT) distribution. The POT distribution can be very sensitive to the selected threshold; thus, several thresholds were tested for each location. The threshold was adjusted so that roughly 1.5 events per year were selected. The AEP levels for significant wave height and the corresponding peak wave periods at each location, along with the selected threshold and lambda values are summarized in Table 5–2 below.

Table 5–2: Summary of Extreme Offshore Wave Conditions

		BROOKS BROOK				DEADMAN CREEK				TESLIN								MORLEY BAY					
		WH01		WH02		WH03		WH04		WH05		WH06		WH07		WH11		WH08		WH09		WH10	
THRESHOLD		0.75		0.75		0.8		0.8		0.9		0.75		0.8		0.48		0.65		0.85		0.8	
LAMBDA		1.573		1.6341		1.4967		1.5883		1.6036		1.4203		1.5883		1.5578		1.8021		1.5883		1.7868	
ANNUAL EXCEEDANCE PROBABILITY (AEP)	AVERAGE RETURN PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD	SIGNIFICANT WAVE HEIGHT	PEAK WAVE PERIOD
%	YEARS	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC	M	SEC
50	2	0.89	4.03	0.88	4.02	0.92	4.07	0.93	4.08	1.04	4.33	0.84	3.90	0.93	4.09	0.55	3.03	0.77	3.67	0.99	4.23	0.94	4.10
20	5	0.99	4.25	0.99	4.25	1.02	4.27	1.02	4.27	1.13	4.51	0.94	4.10	1.02	4.29	0.61	3.19	0.87	3.88	1.09	4.41	1.03	4.29
10	10	1.07	4.41	1.07	4.41	1.08	4.40	1.09	4.41	1.19	4.62	1.02	4.26	1.09	4.42	0.66	3.32	0.95	4.05	1.15	4.53	1.09	4.41
5	20	1.15	4.56	1.16	4.57	1.15	4.53	1.15	4.52	1.24	4.71	1.11	4.44	1.16	4.55	0.72	3.45	1.05	4.23	1.21	4.64	1.15	4.52
4	25	1.17	4.61	1.19	4.62	1.17	4.56	1.17	4.56	1.26	4.74	1.14	4.49	1.18	4.59	0.74	3.49	1.08	4.29	1.22	4.67	1.17	4.56
2	50	1.25	4.75	1.27	4.78	1.23	4.68	1.23	4.67	1.30	4.82	1.24	4.68	1.24	4.71	0.81	3.64	1.18	4.48	1.27	4.75	1.22	4.65
1	100	1.33	4.88	1.36	4.93	1.29	4.78	1.29	4.77	1.34	4.89	1.35	4.88	1.31	4.82	0.88	3.79	1.29	4.68	1.31	4.83	1.28	4.75
0.5	200	1.40	5.01	1.45	5.08	1.35	4.88	1.34	4.86	1.37	4.94	1.48	5.08	1.37	4.92	0.96	3.95	1.42	4.88	1.35	4.90	1.32	4.83
0.2	500	1.49	5.17	1.56	5.28	1.42	5.01	1.40	4.97	1.41	5.01	1.66	5.38	1.44	5.05	1.09	4.18	1.60	5.17	1.40	4.97	1.38	4.93

Wave runup was then calculated using empirical equations. Wave runup is typically defined as the 2% exceedance value of all runup heights. There are many different empirical equations that can be used based on the beach slope and wave parameters at a given location. The most common are Mase (1989) and Technical Advisory Committee on Flood Defence (TAW, 2002) equations, but the Stockton (2006) equations are becoming more popular (Melby, 2012). The Mase and Stockton equations are well suited for mildly sloping beaches, 1:5 to 1:30 for Mase and 1:100 to 1:6.25 for Stockton, while the TAW equations are valid for steeper slopes. For very steep beach slopes, these empirical equations return extremely large values for wave runup. The TAW manual has modified equations for using extreme slopes. The FEMA guidelines for the Great Lakes (2014) recommend using the Stockton equation (Stockton *et al.*, 2006) for very gently sloping beaches, or a modified form of the Mase equation for more general cases. However, the FEMA guidelines for wave runup and overtopping (2018) recommend using either the Stockdon or TAW equations while the FEMA guidelines for the Pacific Coast (2004) only recommend using the TAW equations. These FEMA guidelines incorporate the information in both the Shore Protection Manual (SPM) and the Coastal Engineering Manual (CEM). The beach slopes in the study area tend to be steeper than allowable for the Mase or Stockdon equations so the TAW equations are used.

While vegetation would be expected to reduce the runup values, the empirical equations do not have any parameters to account for this reduction. These factors tend to be more significant for marshy areas with shallow beach slopes. A more detailed numerical model would be needed to account for the presence of vegetation.

Transects were placed starting in deep water near each wave hindcast location and moving shoreward. Each transect is placed to capture a representative section of the nearby shoreline. The runup values calculated along this transect are applied to reaches that have similar beach profiles. Where the character of the shoreline is changing, there will be a transition region where the runup values will be transitioned between the calculated runup values for the two separate reaches. The LiDAR data was used to estimate the beach slope at the still water location. The beach slope used in the runup equations is the average slope of the transect in the region where waves are interacting with the shoreline. The TAW guidelines specify that the range to use for estimating the beach slope. For the bottom position, the still water level minus 1.5 times the offshore wave height (SWL – 1.5*H_0) is used. The top position is based on the calculated $R_{2\%}$ and is determined in an iterative manner. Initially the runup is assumed equal to 1.5 times the offshore wave height based on that beach slope. That slope is then used to calculate the wave runup and the new beach slope is checked with this value. The process is repeated until the beach slope is roughly the same between iterations. Since these calculations are based on the water level, when the water level changes, different segments of the beach slope are analysed. If the beach slope is roughly constant, a small change in the water level won't make much of a difference. However, if the beach slope has a lot of variations, even a small change in the water level can change the average slope over that region. The still water level used in the wave runup calculations is the 1% AEP lake level plus the wind setup value (686.83 + 0.13 = 686.96 m CGVD2013). This level is the midpoint for the extreme AEPs. Transect profiles and estimated beach slopes for each transect are shown in Appendix E.

The TAW equations have a simple linear equation for beaches with gentle slope (under 1:2.5). For steeper slopes, the TAW manual provides a piece-wise function that limits the wave runup at large slopes. For five locations, the beach slopes were too steep for the linear TAW equation, and the piece-wise equation were used. Wave runup values are summarized in Table 5–3 to Table 5–6 below. These runup estimates assume that the offshore waves are moving perpendicular to the shore. Wave reduction factors can be applied to the equations to account for non-perpendicular waves; however, these reduction factors were not applied to obtain conservative runup estimates.

Transect 7 in the Teslin study area had a moderately sloping beach with a flat plateau behind. The estimated runup exceeded the crest elevation of the sloping beach and resulted in the runup elevation being significantly offset from the shoreline. The FEMA guidelines for the Great Lakes (2014) provide guidance on reducing runup values on plateau. This method involves estimating the inland limit of the runup from a chart of the excess runup above the beach crest. A copy of this chart is provided in Appendix E (i.e., Figure E-19). The reduced runup values are provided in Table 5–3 to Table 5–6 below.

Table 5–3: Wave Runup for the Brooks Brook Area

BROOKS BROOK											
TRANSECT 01						TRANSECT 02					
AEP	RETURN PERIOD	H_0	T_{PEAK}	BEACH SLOPE	$R_{2\%}$	AEP	RETURN PERIOD	H_0	T_{PEAK}	BEACH SLOPE	$R_{2\%}$
%	(YEARS)	(m)	(s)		(m)	%	(YEARS)	(m)	(s)		(m)
100	1	0.80	3.85	1: 3.43	2.02	100	1	0.81	3.85	1: 4.00	1.74
50	2	0.89	4.03		2.22	50	2	0.88	4.02		1.90
20	5	0.99	4.25		2.48	20	5	0.99	4.25		2.13
10	10	1.07	4.41		2.67	10	10	1.07	4.41		2.30
5	20	1.15	4.56		2.86	5	20	1.16	4.57		2.47
4	25	1.17	4.61		2.92	4	25	1.19	4.62		2.53
2	50	1.25	4.75		3.11	2	50	1.27	4.78		2.71
1	100	1.33	4.88		3.29	1	100	1.36	4.93		2.89
0.5	200	1.40	5.01		3.47	0.5	200	1.45	5.08		3.08
0.2	500	1.49	5.17		3.70	0.2	500	1.56	5.28		3.32

Table 5–4: Wave Runup for the Deadman Creek Area

DEADMAN CREEK																	
Transect 03A							TRANSECT 03B						TRANSECT 04				
AEP	Return Period	H_0	T_{peak}	Beach Slope	$R_{2\%}$	AEP	RETURN PERIOD	H_0	T_{PEAK}	BEACH SLOPE	$R_{2\%}$	AEP	RETURN PERIOD	H_0	T_{PEAK}	BEACH SLOPE	$R_{2\%}$
%	(Years)	(m)	(s)		(m)	%	(YEARS)	(m)	(S)		(m)	%	(YEARS)	(m)	(s)		(m)
100	1	0.85	3.91	1: 3.17	2.28	100	1	0.85	3.92	1: 38.17	0.19	100	1	0.85	3.92	1: 1.16	2.79
50	2	0.92	4.07		2.48	50	2	0.93	4.08		0.21	50	2	0.93	4.08		3.03
20	5	1.02	4.27		2.73	20	5	1.02	4.27		0.23	20	5	1.02	4.27		3.34
10	10	1.08	4.40		2.90	10	10	1.09	4.41		0.24	10	10	1.09	4.41		3.56
5	20	1.15	4.53		3.08	5	20	1.15	4.52		0.26	5	20	1.15	4.52		3.76
4	25	1.17	4.56		3.13	4	25	1.17	4.56		0.26	4	25	1.17	4.56		3.83
2	50	1.23	4.68		3.29	2	50	1.23	4.67		0.27	2	50	1.23	4.67		4.02
1	100	1.29	4.78		3.45	1	100	1.29	4.77		0.29	1	100	1.29	4.77		4.20
0.5	200	1.35	4.88		3.60	0.5	200	1.34	4.86		0.30	0.5	200	1.34	4.86		4.37
0.2	500	1.42	5.01		3.79	0.2	500	1.40	4.97		0.31	0.2	500	1.40	4.97		4.58

Table 5–5: Wave runup for the Teslin Area

TESLIN																								
TRANSECT 05					TRANSECT 06					TRANSECT 07					TRANSECT 11N					TRANSECT 11S				
AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$
%	(m)	(s)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)
100	0.96	4.17		0.17	100	0.78	3.76		0.77	100	0.85	3.93		1.29	100	0.50	2.92		0.42	100	0.50	2.92		0.59
50	1.04	4.33		0.18	50	0.84	3.90		0.83	50	0.93	4.09		1.38	50	0.55	3.03		0.45	50	0.55	3.03		0.64
20	1.13	4.51		0.20	20	0.94	4.10		0.92	20	1.02	4.29		1.51	20	0.61	3.19		0.50	20	0.61	3.19		0.71
10	1.19	4.62		0.21	10	1.02	4.26		1.00	10	1.09	4.42		1.60	10	0.66	3.32		0.54	10	0.66	3.32		0.77
5	1.24	4.71		0.22	5	1.11	4.44		1.08	5	1.16	4.55		1.70	5	0.72	3.45		0.59	5	0.72	3.45		0.83
4	1.26	4.74	1: 48.78	0.22	4	1.14	4.49	1: 8.70	1.11	4	1.18	4.59	1: 3.18 1: 31.75 (Plateau)	1.75	4	0.74	3.49	1: 10.06	0.60	4	0.74	3.49	1: 7.08	0.85
2	1.30	4.82		0.23	2	1.24	4.68		1.20	2	1.24	4.71		1.86	2	0.81	3.64		0.65	2	0.81	3.64		0.93
1	1.34	4.89		0.23	1	1.35	4.88		1.31	1	1.31	4.82		1.96	1	0.88	3.79		0.71	1	0.88	3.79		1.01
0.5	1.37	4.94		0.24	0.5	1.48	5.08		1.43	0.5	1.37	4.92		2.05	0.5	0.96	3.95		0.78	0.5	0.96	3.95		1.10
0.2	1.41	5.01		0.25	0.2	1.66	5.38		1.60	0.2	1.44	5.05		2.25	0.2	1.09	4.18		0.87	0.2	1.09	4.18		1.24

Table 5–6: Wave runup for the Morley Bay Area

MORLEY BAY																			
TRANSECT 08N					TRANSECT 08S					TRANSECT 09					TRANSECT 10				
AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$	AEP	H_0	T_{PEAK}	BEACH	$R_{2\%}$
%	(M)	(S)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)	%	(m)	(s)	SLOPE	(m)
100	0.70	3.51		2.34	100	0.70	3.51		2.16	100	0.91	4.06		2.68	100	0.87	3.95		3.12
50	0.77	3.67		2.56	50	0.77	3.67		2.37	50	0.99	4.23		2.93	50	0.94	4.10		3.38
20	0.87	3.88		2.89	20	0.87	3.88		2.68	20	1.09	4.41		3.20	20	1.03	4.29		3.71
10	0.95	4.05		3.17	10	0.95	4.05		2.93	10	1.15	4.53		3.39	10	1.09	4.41		3.94
5	1.05	4.23		3.47	5	1.05	4.23		3.21	5	1.21	4.64		3.55	5	1.15	4.52		4.15
4	1.08	4.29	1: 0.97	3.57	4	1.08	4.29	1: 1.80	3.31	4	1.22	4.67	1: 2.37	3.60	4	1.17	4.56	1: 0.34	4.21
2	1.18	4.48		3.92	2	1.18	4.48		3.62	2	1.27	4.75		3.74	2	1.22	4.65		4.41
1	1.29	4.68		4.29	1	1.29	4.68		3.97	1	1.31	4.83		3.87	1	1.28	4.75		4.59
0.5	1.42	4.88		4.70	0.5	1.42	4.88		4.35	0.5	1.35	4.90		3.98	0.5	1.32	4.83		4.76
0.2	1.60	5.17		5.29	0.2	1.60	5.17		4.90	0.2	1.40	4.97		4.11	0.2	1.38	4.93		4.97

6 JOINT PROBABILITY

Lake levels have a strong seasonal dependence, and typically peak in June. The wave runup is directly related to the wind conditions and thus, will have the same dependence as the winds. The winds were examined to see if there was any seasonal dependence that could be related to water levels. Table 6–1 gives a summary of the maximum and average wind speed by month. Threshold testing with omnidirectional winds found that a threshold of 11 m/s results in approximately two high wind events per year (135 total events over the 71-year period of record). Table 6–1 also contains a count for the number of hours that the record winds were above this threshold for each month.

Table 6–1: Summary of Seasonal Variations in Wind Conditions

MONTH	MAXIMUM WIND SPEED (m/s)	AVERAGE WIND SPEED (m/s)	HOURS ABOVE 11 m/s
December	17.8	1.8	10
January	15.6	1.4	8
February	13.3	1.7	18
March	15.6	2.1	25
April	13.3	2.5	24
May	13.3	2.6	16
June	15.8	2.5	11
July	12.8	2.4	6
August	13.6	2.2	12
September	17.8	2.2	11
October	16.1	2.5	26
November	19.7	2.4	15

There are slightly more wind events occurring during the spring and late fall, but high wind events could occur at any time during the year. This indicates that the water levels and wind events are independent, and the joint probability of a given water level and wave runup is the product of their individual probabilities. This means the 1% AEP water level has an equal chance of being from a combination of the 100% AEP wave occurring at the 1% AEP still water level or from the 1% AEP wave occurring at the 100% AEP still water level, or any combination between. Since the range of still water levels is much larger than the range of wave runup, it is expected that the highest total water levels would be from a combination of the 1% AEP still water level and the 100% AEP wave runup. Several combinations were checked, and it was confirmed that the 100% AEP wave condition occurring on the 1% AEP still water level results in the highest total water level. Additionally, this was confirmed for the 100% AEP wave condition occurring on the 0.5% AEP and 5% AEP still water levels.

Table 6–2 summarizes the different AEP still water levels plus setup and 100% AEP wave runup for each transect and the resulting total (still water + setup + wave runup) water level.

The Nisutlin Bay Bridge is currently being replaced with a new structure. The low chord elevations for the existing and new structures are listed in Table 6–3. The low chord elevations are based on WSP's Hydraulic Study Report Nisutlin Bay Bridge Replacement (April 29, 2021). The 0.5% AEP Total Water Level at the bridge (based on Transect 7) is 688.55 m. At the centre bridge spans (e.g., Pier 5), the freeboard at the existing and new structures, is 0.3 m and 1.74 m, respectively. At the designed navigation channel, the freeboard (with respect to the 0.5% AEP historic total water level) at the existing and new bridge structures, is 1.7 m and 3.3 m, respectively.

Table 6–2: Total 5%, 1% and 0.5% AEP Water Levels

PARAMETER	BROOKS BROOK		DEADMAN CREEK			TESLIN					MORLEY BAY			
	TRANSECT 1	TRANSECT 2	TRANSECT 3A	TRANSECT 3B	TRANSECT 4	TRANSECT 5	TRANSECT 6	TRANSECT 7	TRANSECT 11N	TRANSECT 11S	TRANSECT 8N	TRANSECT 8S	TRANSECT 9	TRANSECT 10
5% AEP Total Water Level														
5% AEP SWL (m, CGVD2013) + setup	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16	686.16
100% AEP Wave Runup (m)	2.02	1.74	2.28	0.19	2.79	0.17	0.77	1.29	0.42	0.59	2.34	2.16	2.68	3.12
5% AEP Total Water Level (m, CGVD2013)	688.18	687.90	688.44	686.35	688.95	686.33	686.93	687.45	686.58	686.75	688.50	688.33	688.85	689.28
1% AEP Total Water Level														
1% AEP SWL (m, CGVD2013) + setup	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96	686.96
100% AEP Wave Runup (m)	2.02	1.74	2.28	0.19	2.79	0.17	0.77	1.29	0.42	0.59	2.34	2.16	2.68	3.12
1% AEP Total Water Level (m, CGVD2013)	688.98	688.70	689.24	687.15	689.75	687.13	687.73	688.25	687.38	687.55	689.30	689.13	689.65	690.08
0.5% AEP Total Water Level														
0.5% AEP SWL (m, CGVD2013) + setup	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26	687.26
100% AEP Wave Runup (m)	2.02	1.74	2.28	0.19	2.79	0.17	0.77	1.29	0.42	0.59	2.34	2.16	2.68	3.12
0.5% AEP Total Water Level (m, CGVD2013)	689.28	689.00	689.54	687.45	690.05	687.43	688.03	688.55	687.68	687.85	689.60	689.43	689.95	690.38

Table 6–3: Existing and New Nisutlin Bay Bridge – Low Chord Elevation

LOCATION	NEW BRIDGE LOW CHORD ELEVATION (m)	EXISTING BRIDGE LOW CHORD ELEVATION (m)
South Abutment	688.532	686.575
Pier 5	690.294	688.851
North Abutment	688.537	688.278
Design Navigation Channel	691.85 (Span 6)	690.25 (Pier 3)

7 TESLIN RIVER HYDRAULIC MODELLING

7.1 OVERVIEW

The hydraulic modelling was completed using the HEC-RAS software (version 6.3.1). Teslin River study reach extends approximately 8.75 km downstream from the outlet of Teslin Lake and the Teslin River Bridge is located 4.3 km downstream from the Teslin Lake outlet. A 1D steady state modelling approach was selected since the floodplain hydraulics are relatively straightforward. The Teslin River has a relatively narrow floodplain that is confined in a deep river valley. A steady state flow simulation is appropriate due to the steady and gentle channel gradient, simple hydraulic structure modelling, and a flood hydrograph that maintains a constant flow.

7.1.1 CROSS SECTIONS AND DIGITAL TERRAIN MODEL

Digital terrain models (DTMs) were developed from the LiDAR point clouds provided by YG. Bare earth LiDAR point cloud were utilized. An average binning method was utilized as well as suitable output grid cell sizes of 1 m by 1 m. The DTM was referenced as stated above and all work was in accordance with the Federal Flood Mapping Guidelines and Specifications (NRCan 2019).

The LiDAR point clouds provided by YG did not cover the full extent of the proposed hydraulic modelling extent. It only covered up to 6.70 km downstream of the Teslin Lake outlet and left overbank terrain elevation information was not included for the first 0.45 km of the study reach. The missing elevation information was obtained from the HRDEM provided by NRCan and combined with the DEM created using the LiDAR point clouds provided by YG (resampled to be 1 m by 1m grid and combined to reduce discontinuity). Cross sections with overbank sections outside of the LiDAR point clouds extent were cross-referenced with the surveyed nearby ground points taken during the bathymetric survey. The elevation differences from the surveyed elevations to the HRDEM elevations were calculated and applied as correction factors for the cross-sectional overbank points. The cross-sections generated for modelling are discussed below and shown in the general plan view (Figure 7-1):

- Eighteen channel cross sections were surveyed.
- Nineteen cross sections were generated for the entire hydraulic modelling boundary. Based on cross-section numbering ascending from downstream to upstream, cross-sections 5 to 17 were compiled by merging the overland LIDAR information with the bathymetry surveys. Cross-sections 1 to 4 and 18 to 19 were compiled by merging the corrected overland LIDAR information with the surveyed ground points and the bathymetry surveys.
- A cross-section was linearly interpolated at the discontinued station 09AE001.
- The Manning's 'n' coefficient assignment was divided into 3 sections, consisting of left bank, channel, and right bank.

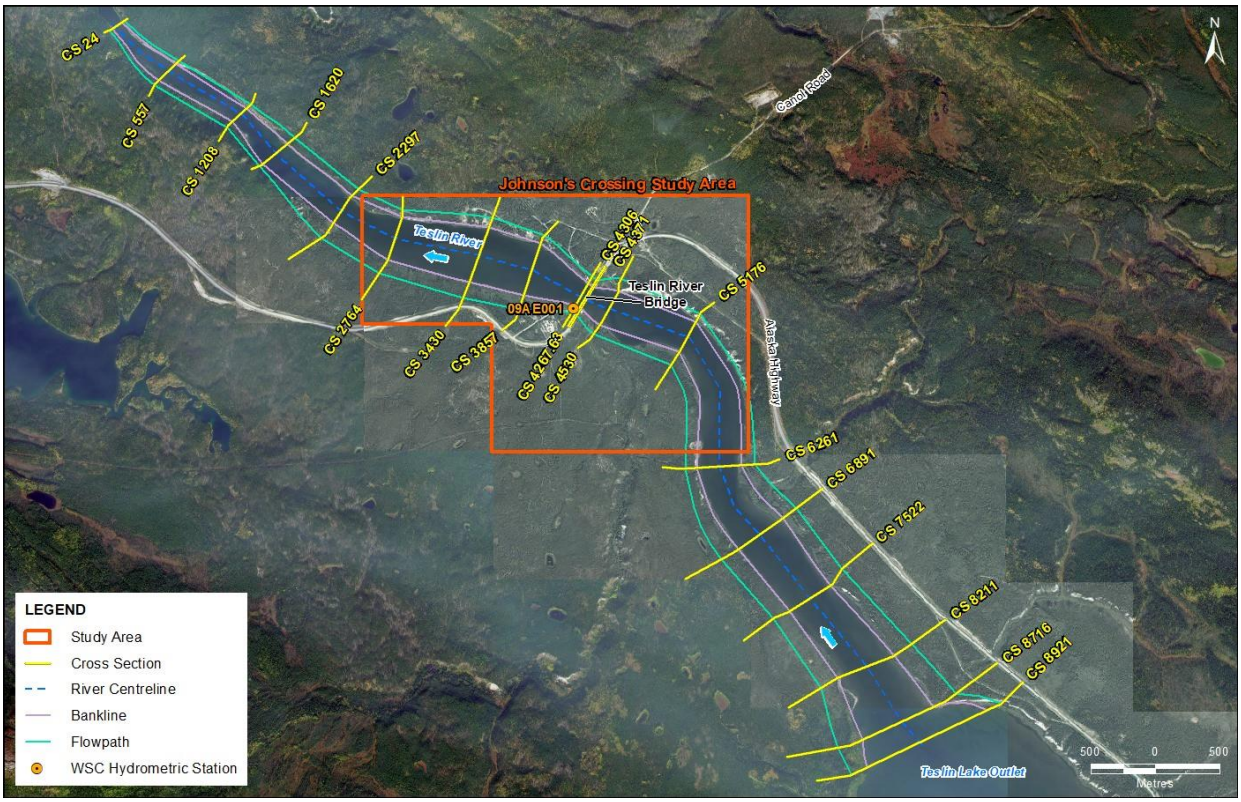


Figure 7-1: Hydraulic Model Plan View with Cross Sections

7.1.2 HYDRAULIC STRUCTURES

Hydraulic modelling features were generated using the RAS Mapper tools. For the Teslin River Bridge cross-section, pier and bridge deck geometries from as-built drawings and Underhill Geomatics Ltd. survey information were used. The truss section of the bridge (i.e., the lowest portion of the bridge superstructure) is located well above the modelled floods. Hence, this information is not required for hydraulic modeling. Based on the results contained in Section 7.3, the lowest elevation of the truss (689.67 m) is 2.79 m higher than the 0.5 % AEP water level (686.88 m).

7.1.3 STREAM AND VALLEY FEATURES

The Teslin River study reach extends approximately 8.75 km downstream from the outlet of Teslin Lake (Figure 7-1). The flood hazard mapping area at Johnson's Crossing is located at approximately the mid-point of the study reach. The Teslin River channel is relatively well confined in a valley that is 500 m to 700 m wide and up to 100 m deep. The approximate channel bankfull depth and width are 15 m and 200 m, respectively. The channel is bounded on both sides by relatively narrow (100 m to 200 m) wide floodplain that is well vegetated. The channel gradient of 0.0001 m/m is very flat (equivalent to a drop of 10 cm per kilometre).

7.2 MODEL CALIBRATION

The model calibration discussed below is based on the rating curve at station 09AE001 – Teslin River near Teslin and the 2022 HWM's.

7.2.1 RATING CURVE AT WSC STATION

The WSC rating curve at Station 09AE001 was used for calibration of the model. The rating curve was used to obtain the geodetic stage elevation for flows from 1,600 m^3/s to 1,880 m^3/s in 100 m^3/s intervals. These values were compared with the corresponding modeled discharges at Cross Section 4267.63, which is at the location of Station 09AE001. The Manning's 'n' values were adjusted iteratively to obtain good agreement with the rating curve water levels. A comparison of water levels for various flows are shown in Table 7–1 and Figure 7-2. Good agreement was obtained for the higher flows, which are important for flood mapping. The difference in water levels is greater for the lower flows, which reflects the change in the roughness coefficient between the lower and higher flows.

Table 7–1: Comparison between Rating Curve at 09AE001 and Simulated Water Levels

FLOW (m^3/s)	09AE001 GEODETIC STAGE (m)	SIMULATED STAGE AT CS 4267.63 (m)
1600	685.59	685.45
1700	685.84	685.74
1800	686.07	686.01
1880	686.26	686.24

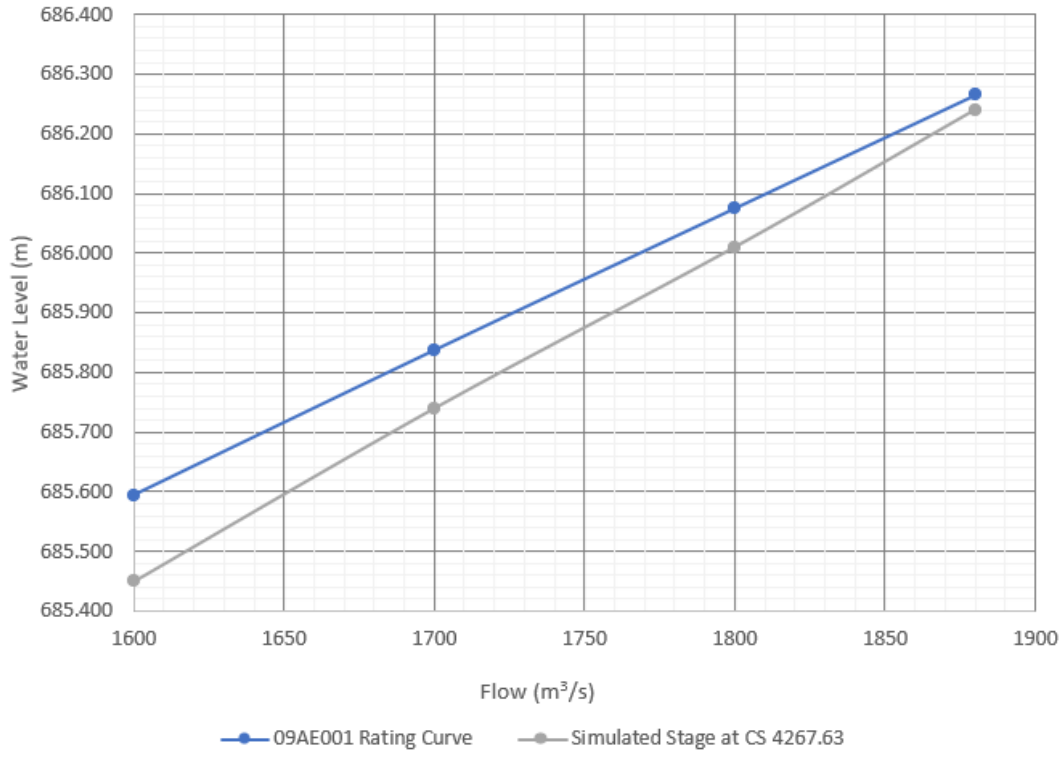


Figure 7-2: Graphical Comparison between WSC Rating Curve at 09AE001 and Simulated Water Levels

7.2.2 2022 HIGHWATER MARKS

The 2022 highwater mark near a local resident's cabin (HWM 1) was used for calibration. HWM 2 (at the bridge crossing) was also used for validation. HWM 1 is located near modeled Cross Section 3430. A flow of 2,059 m^3/s was used for the 2022 simulation. The results are shown in Table 7–2 and Figure 7-3.

Table 7–2: Simulated Water Levels for 2022 Event

CROSS SECTION	HWM ELEVATION (m)	SIMULATED WATER LEVEL FOR 2022 (m)	COMMENTS
CS 4267.63	686.51	686.72	HWM 2
CS 3430	686.69	686.69	HWM 1

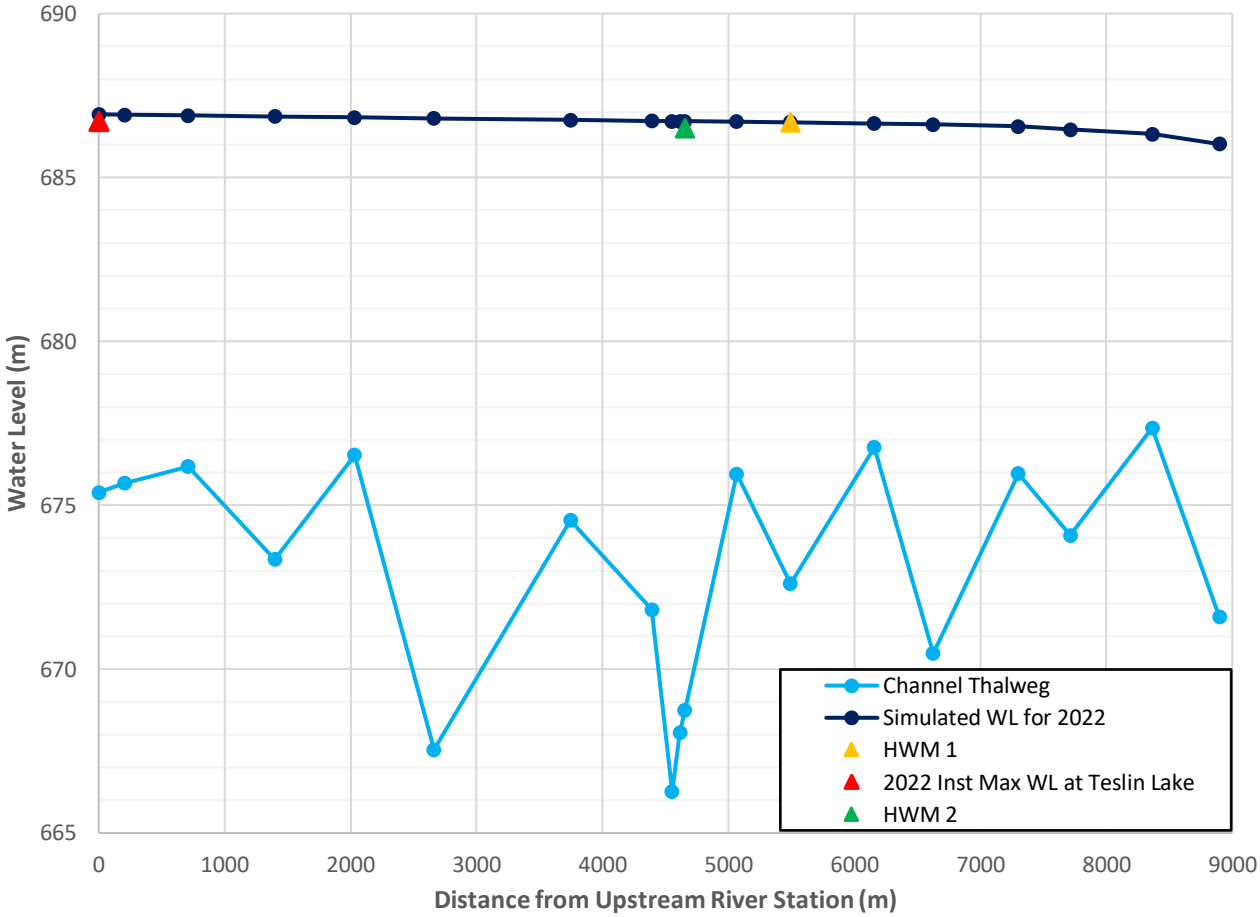


Figure 7-3: Simulated Water Level Profile for 2022 Event

The model calibration shows excellent agreement with 2022 HWMs. HWM 1 exactly matches the model simulation. HWM 2 (in the vicinity of the bridge) is 0.21 m lower than the model simulation. While this agreement is still good, the difference can be explained by: (1) the photos documenting HWM 2 taken on June 19, 2022, which was 3 days before the peak on June 22, 2022; and (2) the rise in peak water levels from the time the photos were taken to the peak, was based on notes taken by local residents.

7.2.3 ROUGHNESS COEFFICIENTS

After calibrating against the rating curve at 09AE001 and 2022 highwater mark, the Manning's 'n' values adopted are listed below (Table 7–3) and are in agreement with published data for a large flat-gradient channel and for streambanks/floodplain that are well vegetated with trees and shrubs. Lower flows were calibrated using the surveyed water levels during the time of the bathymetric survey and rating curve water levels at lower flows from 700 m^3/s to 1,000 m^3/s in 100 m^3/s intervals. The channel roughness coefficient at low flows was 0.037 and the floodplain roughness coefficient did not change.

Table 7–3: Calibrated Manning's 'n' for Flood Frequency Estimates

SECTION	MANNING'S N VALUE
Left Floodplain	0.12
Channel	0.032
Right Floodplain	0.12

7.3 RESULTS

The flood frequency estimates for 5%, 1% and 0.5% AEPs were used to generate flood hazard map inundation boundaries. Water level profiles for different flood frequency estimates are shown in Figure 7-4 and a plan view of flood hazard map inundation boundaries near Johnson's Crossing is shown in Figure 7-5, for various AEPs. The 5%, 1%, and 0.5% AEPs flood levels for Section CS4267.63 (rating curve section), upstream of Teslin River bridge, and downstream of Teslin River bridge are shown in Figure 7-6 to 7-8. Simulated water levels for the different AEPs are listed in Table 7–4.

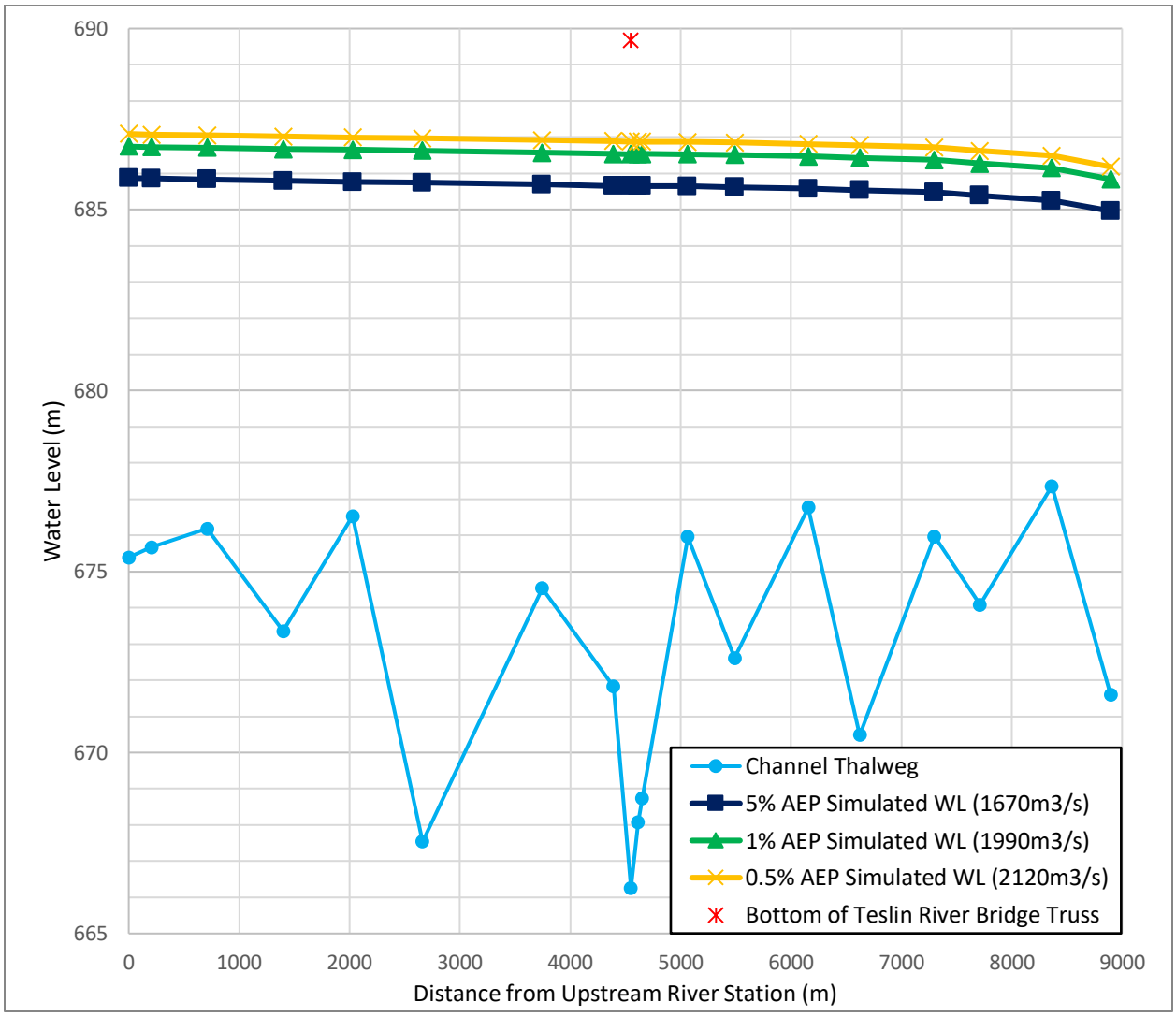


Figure 7-4: Water Level Profiles for 5%, 1% and 0.5% AEPs (20-, 100-, 200-year Flood Frequency Estimates)

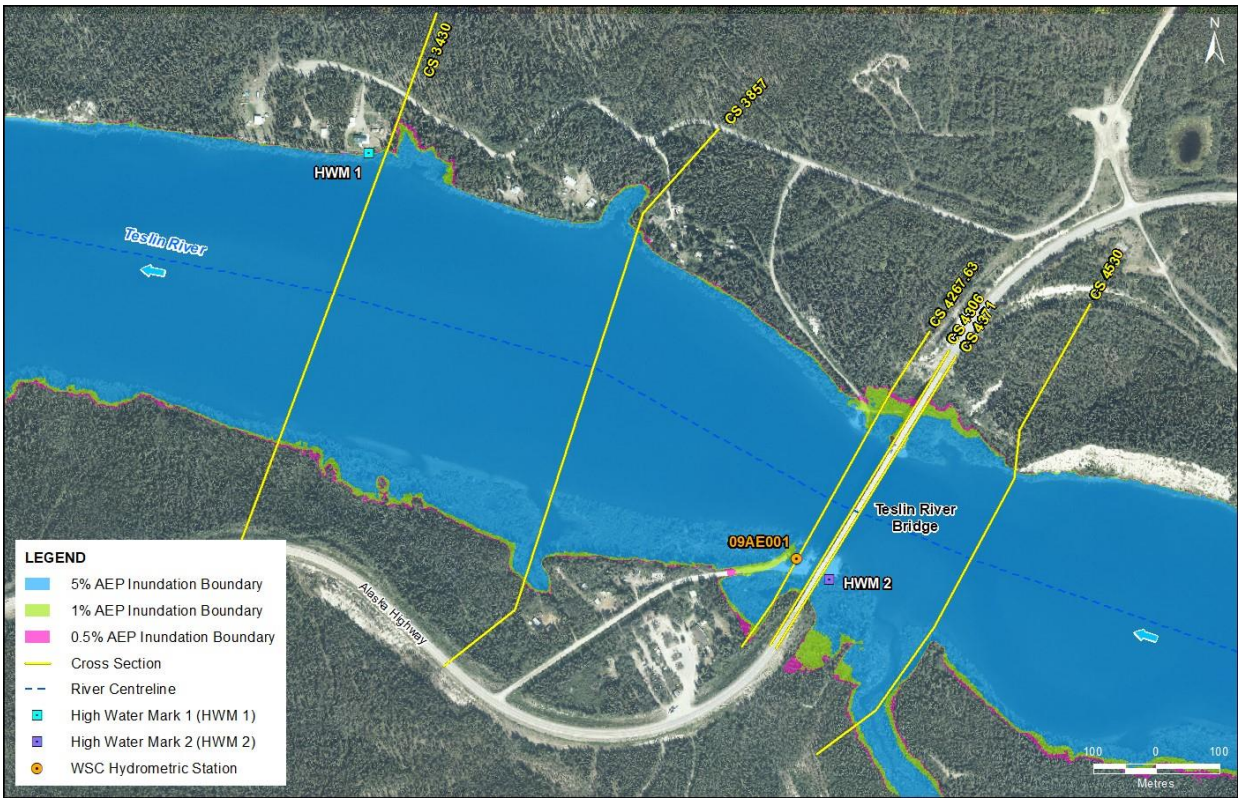


Figure 7-5: Inundation Boundaries 5%, 1% and 0.5% AEPs (20-, 100-, and 200-year Flood Frequency Estimates) near Johnson's Crossing

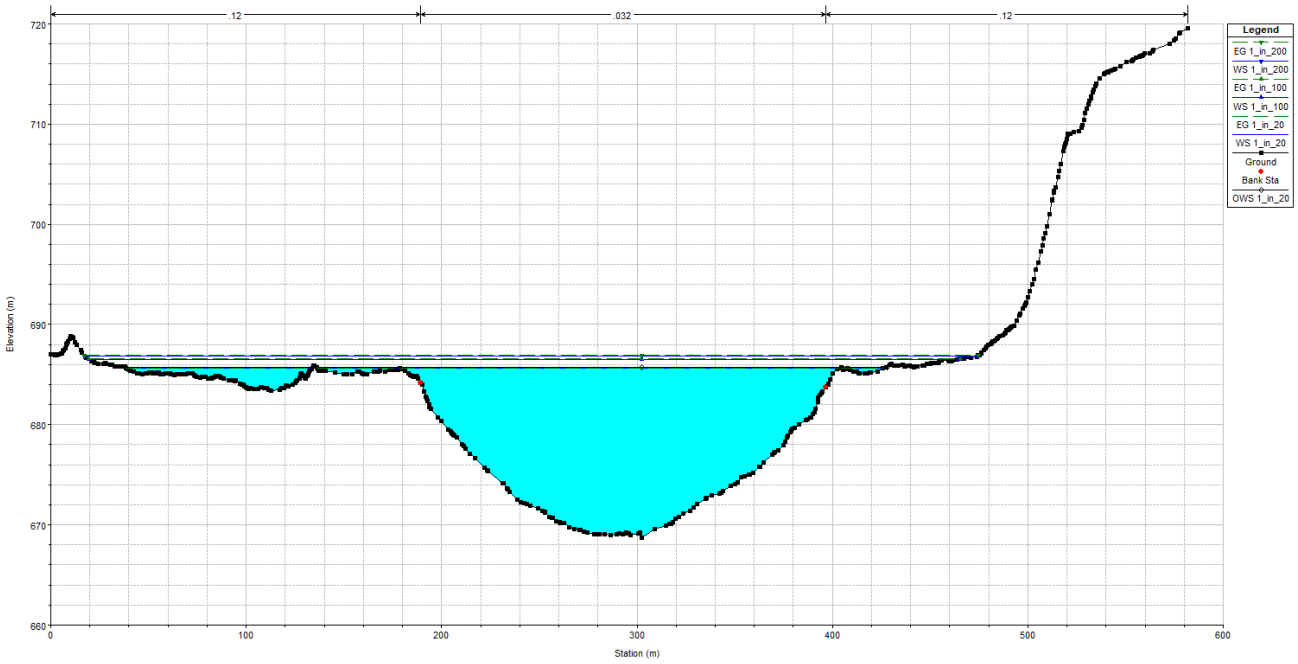
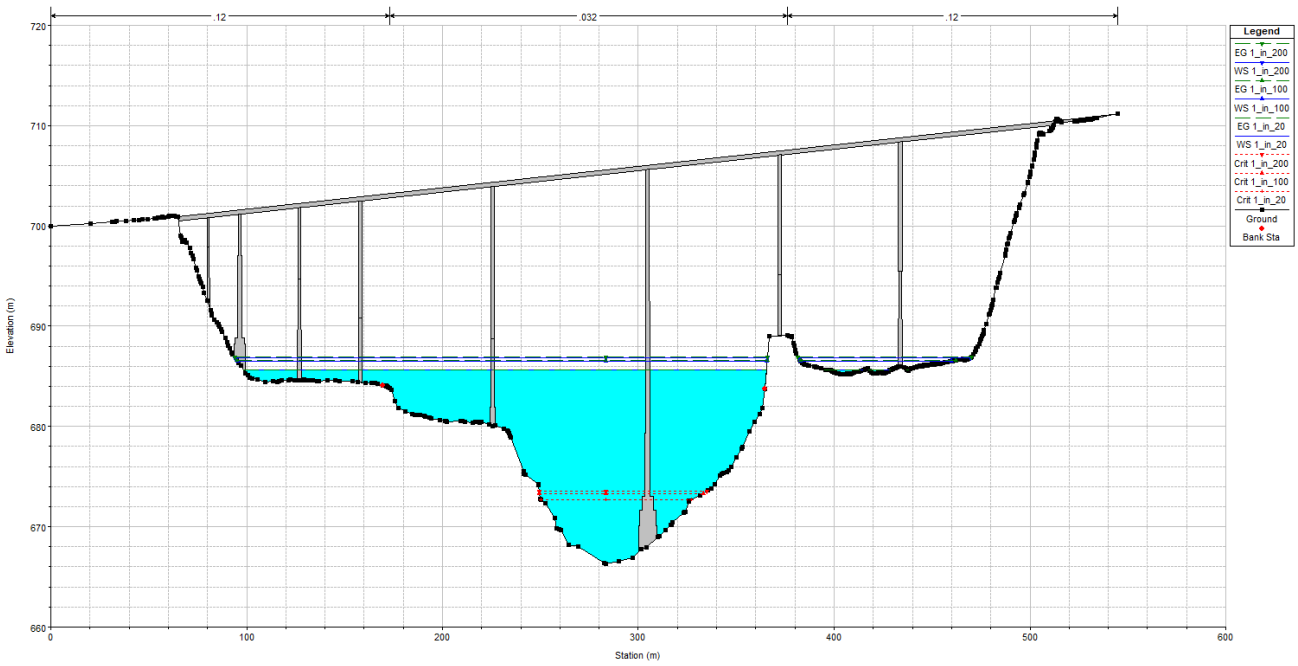
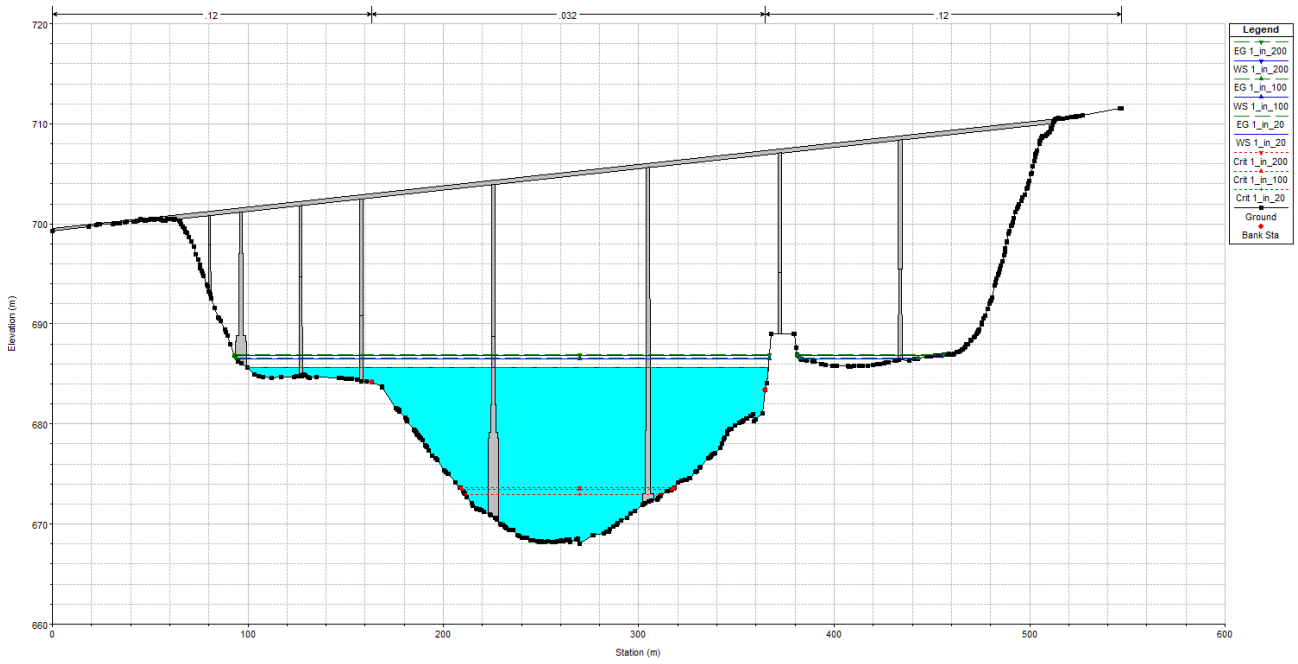


Figure 7-6: Section CS 4267.63 5%, 1% and 0.5% AEP (20-, 100-, and 200-year Flood Frequency) Levels



Note:
The lowest elevation of the Teslin River Bridge truss is 689.67 m. This is 2.80 m higher than the 0.5 % AEP simulated Teslin River Bridge upstream water level (686.87 m).

Figure 7–7: Upstream of Teslin River Bridge 5%, 1% and 0.5% AEP (20-, 100-, and 200-year Flood Frequency) Levels



Note:
The lowest elevation of the Teslin River Bridge truss is 689.67 m. This is 2.79 m higher than the 0.5 % AEP simulated Teslin River Bridge downstream water level (686.88 m).

Figure 7–8: Downstream of Teslin River Bridge 5%, 1% and 0.5% AEPs (20-, 100-, and 200-year Flood Frequency) Levels

Table 7–4: Teslin River Simulated Water Levels for 50%, 5%, 1% and 0.5% AEPs

River Station	AEP Profile	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G., Elev (m)	E.G., Slope (m/m)	Vel Chnl (m/s)	Flow Area (m^2)	Top Width (m)	Froude # Chl
8921	50%	1,020	675.39	684.36	-	684.36	0.000017	0.26	4,309.62	1365.82	0.04
8921	5%	1,670	675.39	685.87	-	685.87	0.00001	0.3	6,410.63	1406.14	0.04
8921	1%	1,990	675.39	686.74	-	686.75	0.000009	0.31	7,648.9	1420.37	0.04
8921	0.5%	2,120	675.39	687.09	-	687.09	0.000008	0.31	8,134.21	1423.94	0.04
8716	50%	1,020	675.67	684.34	-	684.35	0.000043	0.43	2,519.97	765.05	0.07
8716	5%	1,670	675.67	685.86	-	685.87	0.000028	0.51	3,752.09	854.81	0.07
8716	1%	1,990	675.67	686.73	-	686.75	0.000024	0.51	4,518.25	902.66	0.07
8716	0.5%	2,120	675.67	687.07	-	687.09	0.000022	0.52	4,828.38	914.11	0.06
8211	50%	1,020	676.18	684.31	-	684.33	0.000059	0.54	1,876.42	442.84	0.08
8211	5%	1,670	676.18	685.83	-	685.85	0.000045	0.65	2,568.78	469.36	0.09
8211	1%	1,990	676.18	686.71	-	686.73	0.000039	0.67	3,016.92	550.59	0.08
8211	0.5%	2,120	676.18	687.05	-	687.07	0.000037	0.67	3,212.97	591.2	0.08
7522	50%	1,020	673.35	684.27	-	684.29	0.000055	0.57	1,823.71	410.17	0.08
7522	5%	1,670	673.35	685.79	-	685.82	0.000044	0.7	2,463.02	430.84	0.09
7522	1%	1,990	673.35	686.67	-	686.7	0.00004	0.73	2,848.27	443.24	0.09
7522	0.5%	2,120	673.35	687.02	-	687.04	0.000039	0.75	3,001.73	453.05	0.09
6891	50%	1,020	676.53	684.23	-	684.25	0.000073	0.6	1,693.01	403.16	0.09
6891	5%	1,670	676.53	685.76	-	685.79	0.000053	0.72	2,382.67	485.11	0.1
6891	1%	1,990	676.53	686.65	-	686.67	0.000046	0.73	2,813.9	489.19	0.09
6891	0.5%	2,120	676.53	686.99	-	687.02	0.000044	0.74	2,982.23	490.28	0.09
6261	50%	1,020	667.54	684.2	-	684.22	0.000036	0.51	1,998.36	371.88	0.07
6261	5%	1,670	667.54	685.74	-	685.76	0.000032	0.66	2,579.45	382.52	0.08
6261	1%	1,990	667.54	686.63	-	686.65	0.000031	0.7	2,919.72	385.4	0.08
6261	0.5%	2,120	667.54	686.97	-	686.99	0.000031	0.71	3,052.71	390.77	0.08
5176	50%	1,020	674.54	684.15	-	684.17	0.000044	0.6	1,692.86	289.04	0.08
5176	5%	1,670	674.54	685.69	-	685.72	0.000042	0.79	2,205.5	362.58	0.09
5176	1%	1,990	674.54	686.57	-	686.61	0.000041	0.84	2,531.07	372.95	0.09
5176	0.5%	2,120	674.54	686.92	-	686.96	0.000041	0.86	2,660.17	378.25	0.09
4530	50%	1,020	671.82	684.12	-	684.14	0.000062	0.65	1,576.25	310.46	0.09
4530	5%	1,670	671.82	685.65	-	685.69	0.000056	0.82	2,219.37	476.68	0.1
4530	1%	1,990	671.82	686.54	-	686.58	0.000052	0.85	2,646.11	483.45	0.1
4530	0.5%	2,120	671.82	686.89	-	686.93	0.00005	0.87	2,813.62	486.78	0.1
4371	50%	1,020	666.26	684.11	670.96	684.13	0.000023	0.56	1,813.56	195.47	0.06
4371	5%	1,670	666.26	685.65	672.2	685.68	0.000027	0.79	2,198.82	298.17	0.08
4371	1%	1,990	666.26	686.53	672.76	686.57	0.00003	0.87	2,487.85	348	0.08
4371	0.5%	2,120	666.26	686.88	672.97	686.92	0.000031	0.89	2,609.66	360.07	0.08
4338.5	-	Bridge	-	-	-	-	-	-	-	-	-
4306	50%	1,020	668.07	684.11	-	684.13	0.000016	0.5	2,053.48	201.17	0.05
4306	5%	1,670	668.07	685.65	-	685.67	0.00002	0.71	2,427.96	266.44	0.07
4306	1%	1,990	668.07	686.53	-	686.57	0.000022	0.78	2,695.21	332.43	0.07
4306	0.5%	2,120	668.07	686.88	-	686.91	0.000023	0.81	2,811.26	347.85	0.07
4267.63	50%	1,020	668.74	684.11	-	684.12	0.000015	0.48	2,118.1	236.55	0.05
4267.63	5%	1,670	668.74	685.65	-	685.67	0.000019	0.69	2,563.46	383.65	0.06
4267.63	1%	1,990	668.74	686.54	-	686.56	0.000021	0.76	2,934.5	445.14	0.07
4267.63	0.5%	2,120	668.74	686.88	-	686.91	0.000021	0.78	3,089.65	457.01	0.07
3857	50%	1,020	675.96	684.1	-	684.11	0.000058	0.55	1,977.61	560.56	0.08
3857	5%	1,670	675.96	685.64	-	685.66	0.000041	0.65	2,855.05	578.69	0.09
3857	1%	1,990	675.96	686.53	-	686.55	0.000036	0.67	3,372.91	588.76	0.08
3857	0.5%	2,120	675.96	686.87	-	686.89	0.000035	0.68	3,576.1	592.21	0.08
3430	50%	1,020	672.61	684.07	-	684.08	0.00007	0.56	1,809.2	465.75	0.09
3430	5%	1,670	672.61	685.62	-	685.64	0.000047	0.66	2,550.88	487.37	0.09
3430	1%	1,990	672.61	686.51	-	686.53	0.00004	0.68	2,990.59	497.39	0.09
3430	0.5%	2,120	672.61	686.85	-	686.88	0.000038	0.69	3,164.32	518.63	0.08
2764	50%	1,020	676.77	684.02	-	684.04	0.000074	0.64	1,602.14	356.74	0.1

Table 7–4: Teslin River Simulated Water Levels for 50%, 5%, 1% and 0.5% AEPs

River Station	AEP Profile	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G., Elev (m)	E.G., Slope (m/m)	Vel Chnl (m/s)	Flow Area (m^2)	Top Width (m)	Froude # Chl
2764	5%	1,670	676.77	685.58	-	685.61	0.000056	0.78	2,165.97	366.81	0.1
2764	1%	1,990	676.77	686.47	-	686.5	0.00005	0.81	2,496.56	373.26	0.1
2764	0.5%	2,120	676.77	686.81	-	686.85	0.000048	0.82	2,625.89	375.48	0.1
2297	50%	1,020	670.48	683.98	-	684	0.000064	0.69	1,503.52	290.51	0.09
2297	5%	1,670	670.48	685.54	-	685.58	0.000057	0.88	1,983.22	317.95	0.1
2297	1%	1,990	670.48	686.43	-	686.48	0.000055	0.93	2,269.67	323.49	0.1
2297	0.5%	2,120	670.48	686.78	-	686.82	0.000054	0.95	2,381.7	325.4	0.1
1620	50%	1,020	675.97	683.92	-	683.95	0.000097	0.8	1,272.42	242.63	0.11
1620	5%	1,670	675.97	685.48	-	685.53	0.000082	1.01	1,659.39	251.83	0.12
1620	1%	1,990	675.97	686.37	-	686.43	0.000077	1.06	1,885.99	256.22	0.12
1620	0.5%	2,120	675.97	686.72	-	686.78	0.000075	1.08	1,974.68	257.31	0.12
1208	50%	1,020	674.08	683.85	-	683.9	0.000125	1.05	973	149.22	0.13
1208	5%	1,670	674.08	685.39	-	685.49	0.000125	1.39	1,210.5	158.53	0.16
1208	1%	1,990	674.08	686.27	-	686.39	0.000125	1.49	1,352.23	161.3	0.16
1208	0.5%	2,120	674.08	686.62	-	686.73	0.000125	1.53	1,407.5	162	0.16
557	50%	1,020	677.36	683.68	-	683.77	0.000359	1.32	772.63	185.25	0.21
557	5%	1,670	677.36	685.25	-	685.37	0.000251	1.57	1,066.18	190.11	0.21
557	1%	1,990	677.36	686.15	-	686.28	0.000219	1.62	1,238.91	193.34	0.2
557	0.5%	2,120	677.36	686.49	-	686.63	0.000209	1.64	1,306.07	194.24	0.2
24	50%	1,020	671.59	683.44	677.9	683.58	0.000324	1.66	615.71	97.23	0.21
24	5%	1,670	671.59	684.96	679.25	685.21	0.000324	2.21	768.34	104.67	0.25
24	1%	1,990	671.59	685.84	679.83	686.12	0.000324	2.37	862.72	109.98	0.25
24	0.5%	2,120	671.59	686.18	680.04	686.47	0.000324	2.43	900.25	111.88	0.25

8 POTENTIAL CLIMATE AND LANDUSE CHANGES

8.1 NORTHERN CANADA

Canada is warming approximately twice as fast as the globe, and the north is warming about 1.5 times as fast as southern Canada. Further, northern Canada is expected to experience over a 30% increase in precipitation, as compared to precipitation over the years 1986-2005 (Zhang *et al.*, 2019). In the northern territories of Canada, including Yukon, Northwest Territories and Nunavut, average annual temperature increases of 3 to 5 degrees Celsius are projected, which is nearly twice the global average. Permafrost, a critical component of the region's landscape, is expected to thaw rapidly, changing hydrology and releasing significant quantities of greenhouse gases, further exacerbating global warming. Looking forward to 2080, average temperatures are expected to increase 5 to 7.5 °C (Hancock, 2022). The Arctic landscape will be fundamentally altered, with ice-free summers becoming the new norm.

8.2 LITERATURE REVIEW OF CLIMATE CHANGE AND FLOODING AT TESLIN LAKE

The anticipated impacts of climate change on Teslin Lake are significant and could lead or contribute to increased flood hazards having the ability to threaten the surrounding ecosystems and communities. Over the past 50 years, annual temperatures in Yukon have risen by 2°C, with winters experiencing the most significant warming (Streicker, 2016). This warming trend has been accompanied by a 6% increase in annual precipitation, with projections indicating a further rise of 10% to 20% in the next 50 years (Research Northwest & Morrison Hershfield, 2017). Such climatic changes are altering hydrological patterns, particularly with increased summer precipitation (Rasouli *et al.*, 2014), and leading to a higher frequency and intensity of rain and storm events, which elevate flood risks (Streicker, 2016; Reid *et al.*, 2022).

The rise in warm temperatures has resulted in more rain-on-snow events during the fall and spring, further exacerbating flood risks. Heavy snowpacks combined with warmer springs are causing earlier freshet flooding (Streicker, 2016), while snowfall patterns are becoming more variable, with later onset in the fall and more intense events expected (Research Northwest & Morrison Hershfield, 2017). Warmer temperatures are also reducing overall snow accumulation, shifting the timing of peak snow accumulation and decreasing the duration of the snow season (Perrin & Jolkowski, 2022; Rasouli *et al.*, 2014).

Projections for mid-century (2041–2070) indicate an earlier peak in snowmelt and the resulting spring freshet across western Canada, especially in northern basins, under a high emission scenario. Additionally, several Coupled Model Intercomparison Project (CMIP), e.g., CMIP5 models, project earlier spring freshet flows for the mid-century period under both medium (RCP4.5) and high (RCP8.5) emission scenarios. The most significant observed changes in freshwater availability include alterations in the seasonal distribution of streamflow in many snow-fed catchments. Winter flows have increased, spring peak flows now occur earlier, and there has been a general reduction in summer flows (Bush and Lemmen, 2019).

These climatic shifts underscore the sensitivity of snowpacks to both warming and changes in precipitation, with snowpacks showing greater sensitivity during wet years compared to dry ones (Rasouli *et al.*, 2014). A 5°C increase in temperature without changes in precipitation can lead to a 38% decline in maximum snow accumulation (Rasouli *et al.*, 2014). For example, the Wolf Creek Research Basin, a research watershed near Whitehorse, showed that a 5°C increase in temperature combined with a 20% decrease in precipitation can severely impact the hydrology of the basin and result in the reduction of snow accumulation, streamflow volume and peak runoff approximately by half (Rasouli *et al.*, 2014). This would result in predicted peak flows occurring one month earlier than current normals and lengthen the snow-free period by 2 months (Rasouli *et al.*, 2014). The interplay between temperature and precipitation changes is critical in modulating hydrological responses (Rasouli *et al.*, 2014), indicating the need for a comprehensive understanding of both factors to accurately predict future hydrological dynamics (Rasouli *et al.*, 2014).

Permafrost thawing, another consequence of warming temperatures, poses additional hazards. Thawing permafrost leads to more landslides and increased silt runoff, further raising the risk of flooding (Streicker, 2016; Reid *et al.*, 2022). It also affects groundwater pathways, attenuating peak flows and impacting water quality through increased turbidity and potential contamination (Northwest Hydraulic Consultants Ltd., 2023; Streicker, 2016). Streamflow trends in the Yukon River Basin over 20 to 50 years show significant increases in estimated groundwater flow, with minimal changes in annual flow (Government of Yukon, 2011).

The degradation of permafrost, along with intensified precipitation events and wildfires, significantly alters vegetation and soil dynamics, influencing hydrological processes and exacerbating flooding risks (Rasouli *et al.*, 2019; Reid *et al.*, 2022). Wildfires, influenced by changing climatic conditions, also contribute to the evolving landscape. The number of hectares burned annually in Yukon has increased over the past 50 years, although longer observation periods are needed to confirm a significant trend (Streicker, 2016). Notable wildfire events, such as the 3.4 million hectares burned in the Northwest Territories in 2014 and the 2.1 million hectares burned in Alaska in 2015, highlight the increasing severity of wildfires (Streicker, 2016).

8.3 METHODOLOGY FOR QUANTITATIVE CLIMATE CHANGE ASSESSMENT

In addition to the literature review and qualitative assessment above, a detailed quantitative assessment of climate change and associated impacts is presented in Section 8.3 to 8.6.

8.3.1 CLIMATE CHANGE SCENARIOS

The Coupled Model Intercomparison Project (CMIP) is an international effort to develop global climate models for the purpose of better understanding past, present and future climate change. One of the outputs of CMIP are sets of climate models used by practitioners in many fields for projections of climate variables and derived climate indicators.

The current generation of these models, referred to as CMIP6, uses combinations of global development scenarios with targeted radiative forcing scenarios to provide a set of models that describe possible ways that the global climate system is affected by development and climate mitigation and adaptation policies. Riahi *et al.,* (2017) provides a comprehensive overview of the development scenarios called Shared Socioeconomic Pathways (SSPs), and O'Neill *et al.,* (2016) describe the scenarios with forcing.

The SSPs describe different future development scenarios. These include descriptions of population growth, the replacement of fossil fuels by renewable energy sources, and levels of international cooperation. They provide a background level of climate change that do not include new climate change policies. Superimposed on the SSPs are levels of mitigation policies that target a given amount of radiative forcing by 2100. In this way, the SSPs and added policies provide scenarios that reflect the uncertainty of global socioeconomic changes and future climate policy decisions.

Out of the many possible combinations of SSPs and radiative forcing scenarios, several have been selected as representative of possible futures (Riahi *et al.*, 2017). The scenarios describe various levels of mitigation and adaptation combined with radiative forcing targets. Table 8–1 and Figure 8-1 shows the projected range of modelled global temperature increases for several SSPs. The higher the radiative forcing, the higher the increase in global temperature.

A set of models are associated with each SSP. These are a collection that come from several worldwide institutions. Each model is run with a set of assumptions, parametrizations and simulation methodologies. When many of the models agree on a trend or magnitude, there is confidence that the trend is not a result of a model's bias but is a real physical characteristic.

This study focuses on the SSP for the worst-case scenario – SSP5-8.5. This scenario describes a global future with high challenges to climate change mitigation and low challenges to adaptation with a radiative forcing target of 8.5 W/m^2 (Riahi *et al.*, 2017). Figure 8-2 shows that "worst-case" applies to both temperature and precipitation. In order to determine for the Teslin Lake basin whether this SSP5-8.5 "worst-case" results in the severest flooding, the following two additional scenarios were reviewed: (1) SSP1-2.6 represents the lower range temperature rise; and (2) SSP2-4.5 represents a mid-range temperature rise.

Table 8–1: Projected Changes in Global Surface Temperature Relative to 1850-1900 (From IPCC, 2021; Table SPM.1 page 14)

SCENARIO	2021-2040		2041-2060		2081-2100	
	BEST ESTIMATE (°C)	VERY LIKELY RANGE (°C)	BEST ESTIMATE (°C)	VERY LIKELY RANGE (°C)	BEST ESTIMATE (°C)	VERY LIKELY RANGE (°C)
SSP1-2.6	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

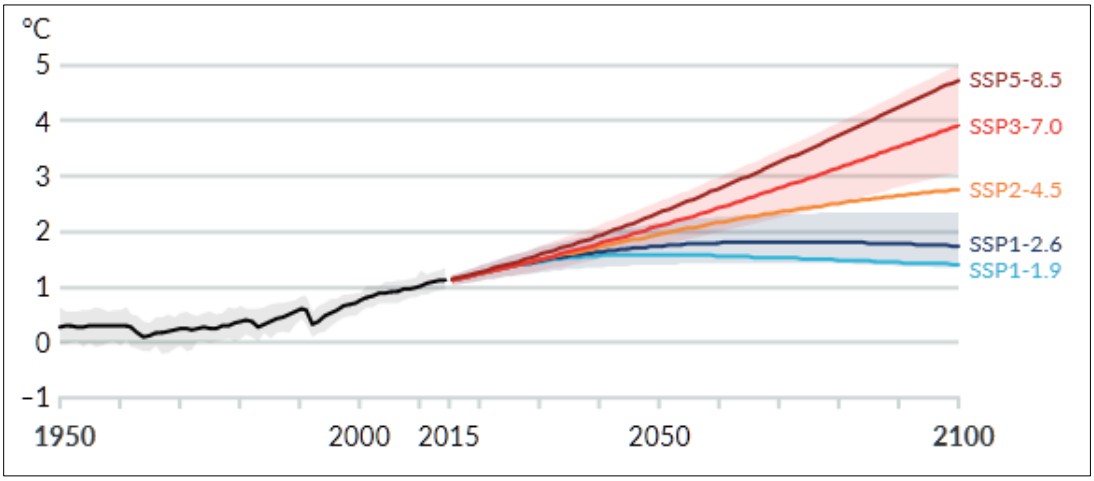
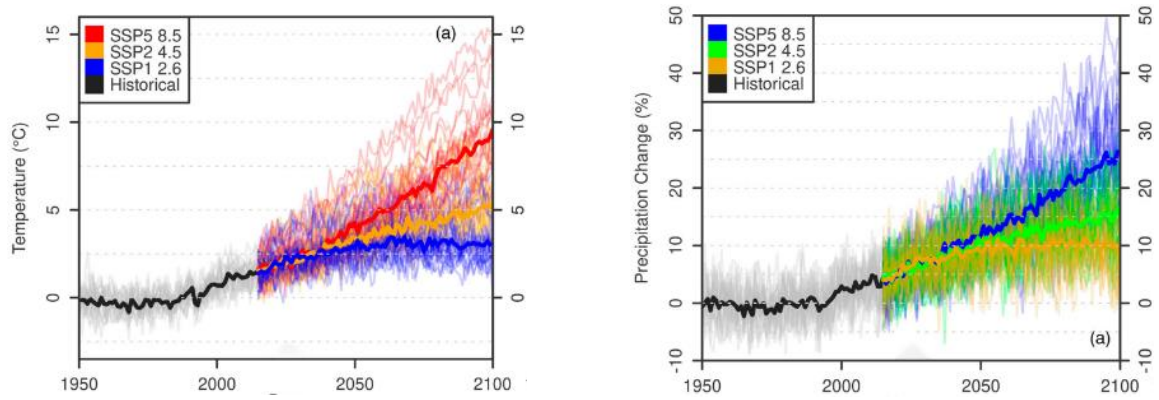


Figure 8-1: Global Surface Temperature Change Relative to 1850-1900 (from IPCC 2021, page 22)

The Intergovernmental Panel on Climate Change (IPCC) provides the following statements relevant to Canada in their Summary for Policy Makers of the Sixth Assessment Report (IPCC, 2021):

- (Page 15, B2) Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, heavy precipitation, and, in some regions, agricultural and ecological droughts; an increase in the proportion of intense tropical cyclones; and reductions in Arctic Sea ice, snow cover and permafrost.
- (Page 15, B.2.1) It is virtually certain that the Arctic will continue to warm more than global surface temperature, with high confidence above two times the rate of global warming.
- (Page 16, B.2.4) Heavy precipitation events will intensify and become more frequent in most regions.
- (Page 16, B.2.5) Permafrost thawing and loss of seasonal snow cover is projected.

For Canada, the projected changes in temperature and precipitation are shown in Figure 8-2. Projected temperature is double the global projection (Figure 8-2) by the end of the century.



Source: Sobie *et al.*, 2021
Note:.
Global Average is Relative to the 1850-1900 Average.

Figure 8-2: Projected Change in Surface Temperature and Precipitation for Canada, Relative to 1971-2000

8.3.2 TIME HORIZONS

The climate change time horizons evaluated in this study are listed in Table 8–2. Climate indicators are averaged over the 30 year period of each term so that reported values reflect the climate rather than annual variability. The *Historical* time horizon represents the recent past and provides a baseline for computing changes. The *Near-* and *Long-Term* horizons represent time periods in the near- and long-term future and are appropriate for short- and long-term planning, respectively.

Table 8–2: Time Horizons

TIME HORIZON	HISTORICAL	NEAR-TERM	LONG-TERM
Years	1981-2010	2036-2065	2066-2095

8.3.3 DATASETS

Climate projections are made on a grid that covers a region of the earth. Each grid cell encompasses an area so that the climate data for the grid cell is an estimate of the climate data for every point in the grid cell. Datasets and their resolutions that were used in this study are listed in Table 8–3 and shown in Figure 8-3 and Figure 8-4. The figures show the grid cells plotted in degrees, so the latitude and longitude lines of each grid are the same size. The table gives the actual grid size in kilometres. The resolution of the data sets is such that many grid cells cover the Teslin Lake basin, so basin-level climate statistics will show spatial variation. The more grid cells in the basin, the more refined the variation will be. Specific points in the basin will be better represented by a grid cell from a higher-resolution dataset than a lower-resolution one.

Data from the Pacific Climates Impacts Consortium (PCIC, 2021) is CMIP6 model data that was downscaled for all of Canada. Downscaling is the process of taking a low-resolution model (usually a global model) and using statistical or dynamical techniques to create a higher-resolution model. The PCIC data consists of 26 models, each containing daily data for the years 1950-2100. The collection of models is known as an *ensemble*. Climate data statistics (including indicators) are calculated using the data from all of the models. For example, the average annual daily temperature for the years 1981-2010 is calculated by taking the average of the daily temperatures from all of the models over the years 1981 through 2010. This method treats every model as generating an equally likely future climate and provides a measure of daily variability by having 26 values for each day.

PCIC data includes daily minimum and maximum temperatures and daily precipitation. Average daily temperature is estimated as the average of the minimum and maximum temperatures.

CanRCM4 (Scinocca *et al.*, 2016) is a North American downscaled dataset. CanRCM4 is from the earlier Phase 5 of CMIP and is a single model that was used for maximum sustained wind speed. Wind speed is a more complex variable than temperature and precipitation because of its small-scale nature. Speeds are affected by local elements (e.g., hills) that are too small to be accurately resolved by climate models, so modelled wind speed is generally less reliable than precipitation and temperature. Downscaled wind speed projections are not yet available for CMIP6.

The maximum daily windspeed is *sustained*, i.e., the average speed over a time interval. It is not *gust* (or *instantaneous*). As such, the maximum daily windspeed is less than gust speeds.

Table 8–3: Datasets Used in this Study

DATASET	GRID CELL SIZE (DEGREES)	GRID CELL SIZE AT 60°N (KM E-W, KM N-S)
PCIC[(1)] CMIP6 (PCIC)	1/12 (~0.083)	(5, 9)
CanRCM4[(2)] RCP8.5 (CanRCM4)	0.22	(12, 24)

Notes:
(1) Pacific Impacts Climate Consortium (PCIC, 2021). Ensembles used were SSP1-2.6, SSP2-4.5, SSP5-8.5.
(2) Canadian Centre for Climate Analysis (Scinocca *et al.*, 2016).

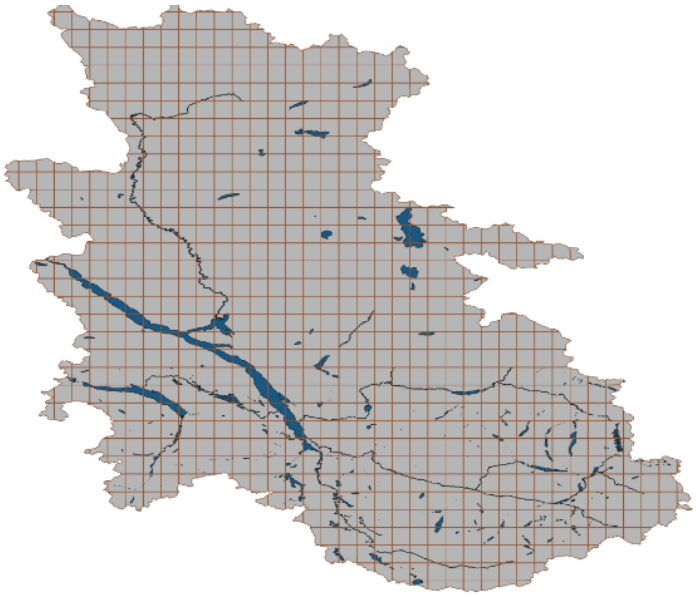


Figure 8-3: Teslin Lake Basin with the PCIC Grid Overlaid

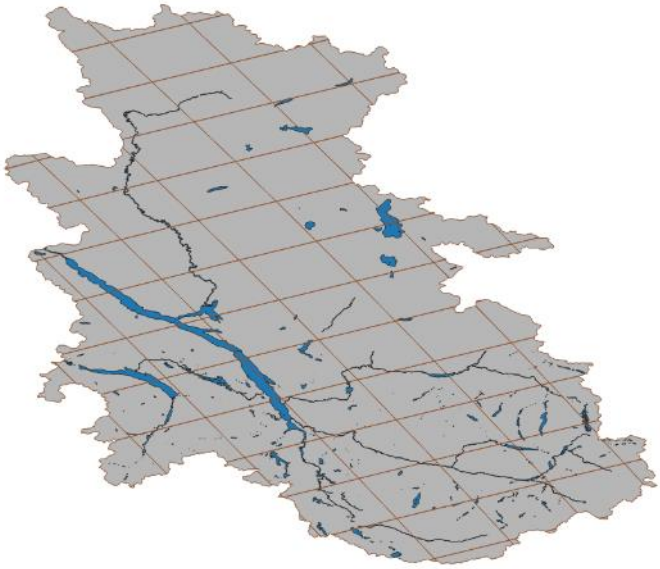


Figure 8-4: Teslin Lake Basin with the CanRCM4 Grid Overlaid

8.3.4 BIAS CORRECTION

Bias correction is an adjustment of modelled projections so that the historical modelled climatology matches the historical observed climatology. For this study, the climatology was the monthly averages of the climate variables (e.g., daily average temperature) over the years 1981-2010. Given monthly observed normals, $\bar{x}_{o,j}$, and modelled normals $\bar{x}_{m,j}$ where the "o" indicates observed data, the "m" modelled data and $j = 1, 2, \ldots, 12$ the month. For example, $\bar{x}_{o,6}$ is the average observed daily temperature for June for the years 1981-2010, and $\bar{x}_{m,6}$ the same for modelled data.

An *absolute* correction factor is calculated as $a_j = \overline{x}_{o,j} - \overline{x}_{m,j}$ and a *scale* correction factor as $r_j = \overline{x}_{o,j} / \overline{x}_{m,j}$.

Absolute corrections are made by adding the appropriate month's correction factor to modelled data (e.g., June's correction factor to June data), and scale corrections are made by multiplying. That is, writing x for a model data point and $\tilde{x}$ for the corrected model data point, the absolute corrected data is (where j^* is the month that x falls in) is:

$$\tilde{x} = x + a_{j^*},$$

and the scale corrected data is:

$$\tilde{x} = x \times r_{j^*}.$$

To perform bias correction, an historical observed dataset is required that covers the study site, which in this case, is the Teslin Lake basin. Such datasets are not generally available because they would require an observation station at every model grid cell.

To overcome this data deficiency, ClimateNA (i.e., ClimateNA is a free MS Windows software package that generates scale-free climate data for specific locations and for gridded climate data at any spatial resolution) was used for precipitation and temperature variables (Wang *et al.*, 2016). ClimateNA provides monthly normals on a 1 km × 1 km grid, developed by interpolation and elevation corrections.

The PCIC data used has a resolution of about 5 km east-to-west and 9 km north-to-south. This means that several ClimateNA grid cells intersect or are contained in a single PCIC grid cell. The ClimateNA grid cell with the centre closest to the centre of the PCIC grid cell was used to represent the normal for the entire PCIC grid cell. The method used is not as sensitive to elevation changes within the PCIC grid as one in which we use all the ClimateNA grids that intersect the PCIC grid. Other methods of up-scaling are available (e.g., taking the area-weighted average of all ClimateNA values for cells in the PCIC cell), but time and resources precluded anything more complex.

ClimateNA does not provide normals for wind speed. To bias correct for maximum sustained daily wind speed, hourly wind speed data for Teslin Airport (ECCC, 2024) was obtained for the years 1981-2010 and monthly normals were calculated. The bias correction scale factor was calculated for the grid cell that contained Teslin Airport and used for all grid cells in the basin.

Temperature variables were bias corrected by using the absolute correction (adding the absolute correction factor), and precipitation variables were bias corrected using the scale correction (multiplying by the scale correction factor). Temperature variables are absolutely corrected, rather than scale corrected, because a monthly average could be close to zero, making the scale correction factor very large. On the other hand, precipitation data is scale corrected, because many days have zero precipitation, and using the scale correction will preserve those. Further, total monthly precipitation averages are not usually close to zero in Canada, so the scale correction factor will not be arbitrarily large.

All indicators were computed from the bias corrected data.

8.3.5 CLIMATE INDICATORS

Climate indicators that have an impact on the hydrological cycle are presented in this section. Maps are shown for each of the three time horizons. The maps are the median value for all the model projections over all the years. This treats each model as an equally likely representation of projected climate.

Additionally, tables of values are provided that summarize the indicator values and their projected change over all grid cells in the Teslin Lake basin. The change values shown are for the computed change, not for the change in the statistic, i.e., the minimum change is the smallest change projected over all grid cells, not the change in the minimum values.

CanRCM4 data is lower resolution than PCIC, and in a different geographic projection, so the images of computed indicators look different.

Indicators were computed with WSP Canada's in-house software *Tango* (WSP, 2024). Tango uses the industry standard library, *xclim* (Bourgault *et al.*, 2023) for calculating indicators.

8.3.5.1 SNOWMELT

The snowmelt indicator is a combination of the total snowfall for a season followed by the average April-June temperature for the following year. April was the first month with an average temperature above zero (ECCC, 2024b), and snowpack was assumed to persist through to June. Figure 8-5, Figure 8-6 and Figure 8-7 show the average temperature over the melt-season of April through June for the three SSPs considered. There is a clear indication that the average temperature is projected to increase for all SSPs. Moreover, the increase is nearly uniform over the entire basin.

Figure 8-8, Figure 8-9 and Figure 8-10 show the projected total snowfall over the basin. SSP1-2.6 (Figure 8-8) and SSP2-4.5 (Figure 8-9) project little change in snowfall over both horizons. The SSP5-8.5 projection suggests a decrease in snowfall that is more substantial for the 2066-2095 time period. The change variability over the basin depends on the SSP, with SSP1-2.6 and SSP2-4.5 showing a similar range (maximum change minus minimum change). SSP5-8.5 a larger change.

Figure 8-11, Figure 8-12 and Figure 8-13 are examples of the joint distribution of total snowfall and melt-season temperatures for a single grid cell for each SSP, where the pairing is by the melt-season that follows the snowfall, i.e., the snowfall over July 2021 through June 2022 (i.e., winter 2021) is paired with the average temperature over April 2022 through July 2022 (melt-season/freshet 2022). The grid cell selected had the largest snowfall over the historical time horizon. The plots include all models.

For SSP5-8.5 (Figure 8-13), the data shows that the melt-season average temperatures are increasing for the given grid cell, with variability increasing for both total snowfall and melt-season average temperatures. A further observation is that the projections are for more low-snowfall-high-temperature years, progressing over both time horizons (the lower right quadrant in the plot is becoming more populated).

8.3.5.2 ANNUAL RAINFALL

Figure 8-14 to Figure 8-16 show the projections for total annual rainfall. All SSPs project increases for both time horizons. SSP1-2.6 (Figure 8-14) projects an average 22% increase over the basin for the 2036-2065 horizon and 26% for the 2066-2095 horizon. SSP2-4.5 is slightly more, 26% for the 2036-2065 period and 10% more (36%) for the 2066-2095 period. For SSP5-8.5, the increases are projected to be more substantial, with increases in the near-term and long-term of 31% and 57%, respectively.

8.3.5.3 MAXIMUM ONE DAY RAINFALL

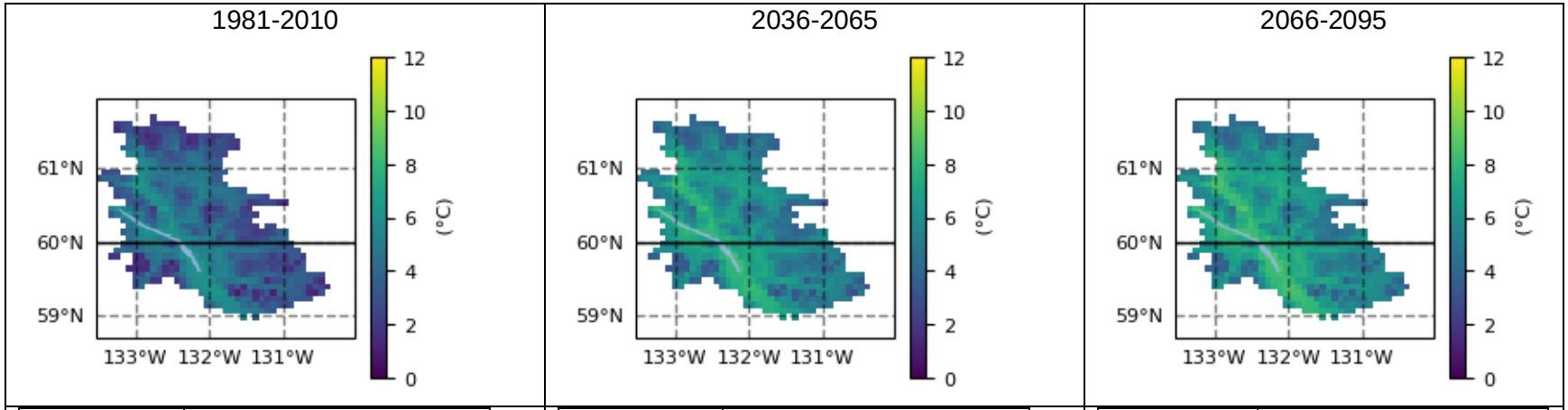
Maximum one-day rainfall events (Figure 8-17 to Figure 8-19) are projected to increase. The increases follow a pattern similar to Total Rainfall: smaller for SSP1-2.6 (14% near-term and 16% long-term), slightly larger for SSP2-4.5 (17% for near-term and 24% for long-term), and substantially larger for SSP5-8.5 (21% for short-term and 39% for long-term).

8.3.5.4 MAXIMUM SUSTAINED WIND SPEED

Maximum annual sustained wind speed, shown in Figure 8-20, was computed from the lower resolution CanRCM4 model. There is little overall change projected, with the near-term between -1% and 9%, and the long-term between -2% and 18%. See Section 4 for a description of maximum sustained wind speed. Table 8–4 shows the annual maximum sustained wind speed for the grid cell containing Teslin.

Table 8–4: Annual Maximum Sustained Wind Speed at Teslin Showing the 10th, 50th, and 90th Percentiles over the Years

INDICATOR	HISTORICAL (1981-2010)	NEAR-TERM (2036-2065)	LONG-TERM (2065-2066)
Annual Maximum Sustained Wind Speed at Teslin	[33, 36, 41]	[33, 38, 43]	[34, 38, 43]

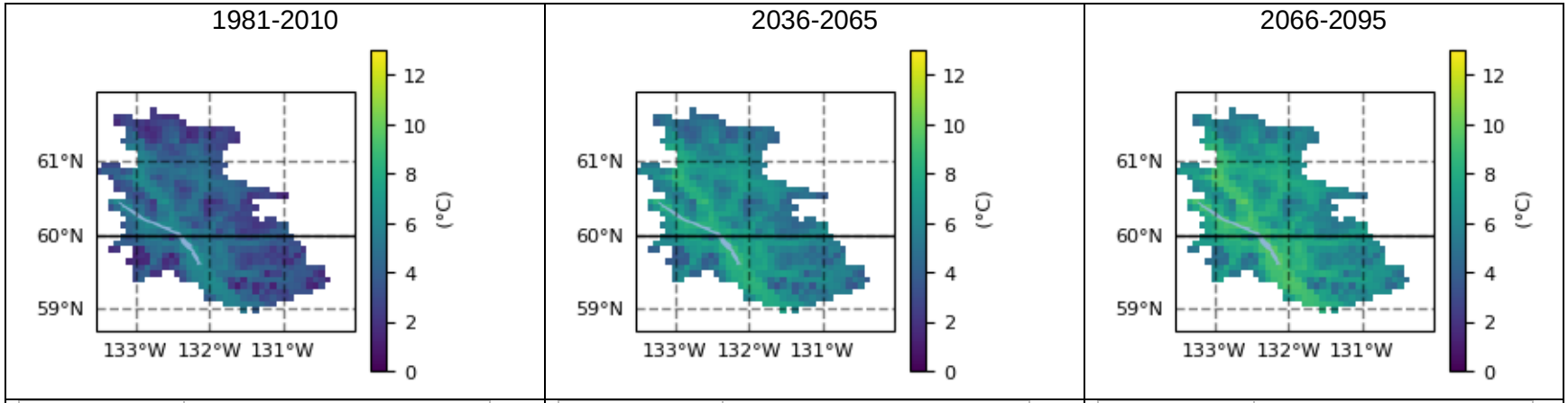


Min	1.01°C
Max	6.60°C
Mean	3.92°C

Min	2.81°C
Max	8.42°C
Mean	5.73°C
Min Change	1.76°C
Max Change	1.87°C
Mean Change	1.81°C

Min	3.24°C
Max	8.81°C
Mean	6.13°C
Min Change	2.15°C
Max Change	2.28°C
Mean Change	2.21°C

Figure 8-5: PCIC SSP1-2.6. Average Temperature for April-June (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

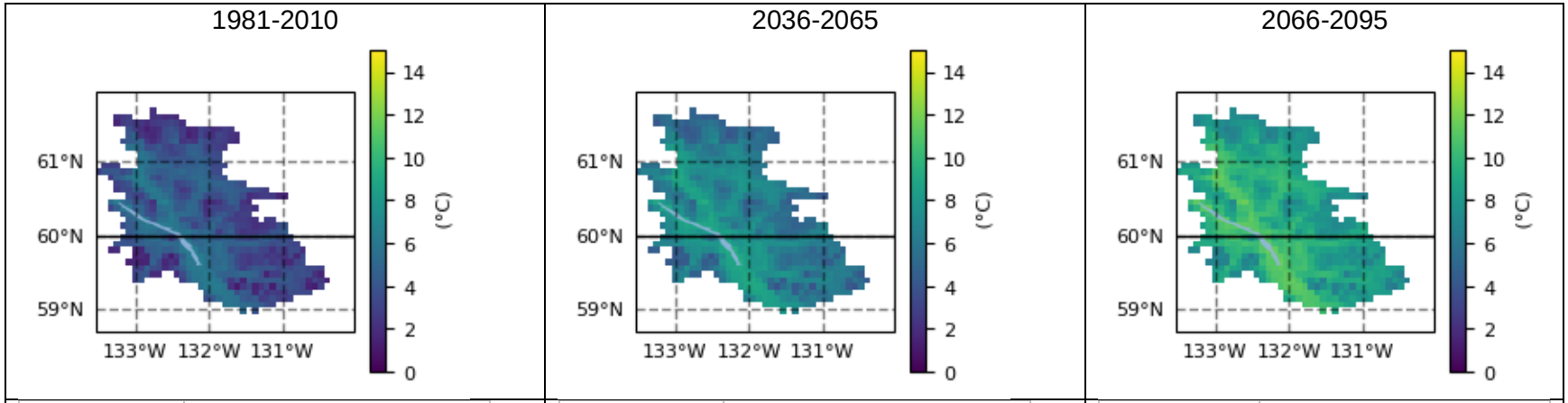


Min	1.01°C
Max	6.60°C
Mean	3.92°C

Min	3.22°C
Max	8.80°C
Mean	6.12°C
Min Change	2.14°C
Max Change	2.25°C
Mean Change	2.20°C

Min	4.17°C
Max	9.77°C
Mean	7.05°C
Min Change	3.04°C
Max Change	3.22°C
Mean Change	3.13°C

Figure 8-6: PCIC SSP2-4.5. Average Temperature for April-June (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

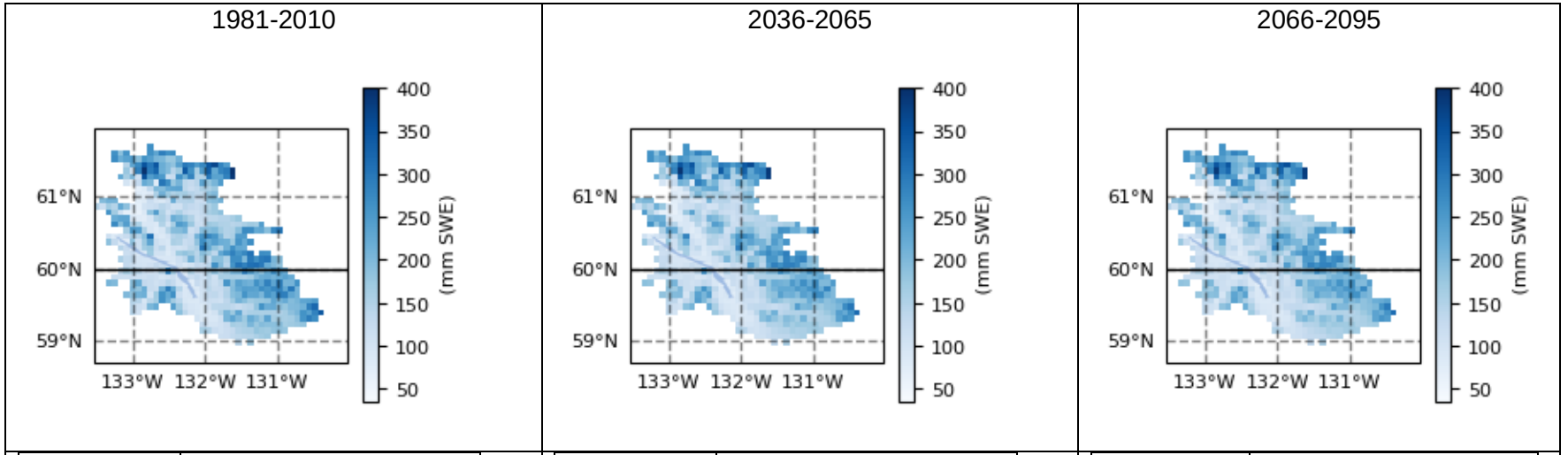


Min	1.01°C
Max	6.60°C
Mean	3.92°C

Min	3.79°C
Max	9.27°C
Mean	6.61°C
Min Change	2.58°C
Max Change	2.80°C
Mean Change	2.70°C

Min	6.07°C
Max	11.66°C
Mean	8.96°C
Min Change	4.88°C
Max Change	5.21°C
Mean Change	5.04°C

Figure 8-7: PCIC SSP5-8.5. Average Temperature for April-June (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)



Min	61 mm SWE
Max	397 mm SWE
Mean	176 mm SWE

Min	62 mm SWE
Max	392 mm SWE
Mean	169 mm SWE
Min Change	-12%
Max Change	3%
Mean Change	-4%

Min	62 mm SWE
Max	387 mm SWE
Mean	167 mm SWE
Min Change	-13%
Max Change	3%
Mean Change	-5%

Figure 8-8: PCIC SSP1-2.6. Total Snowfall for July-June (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

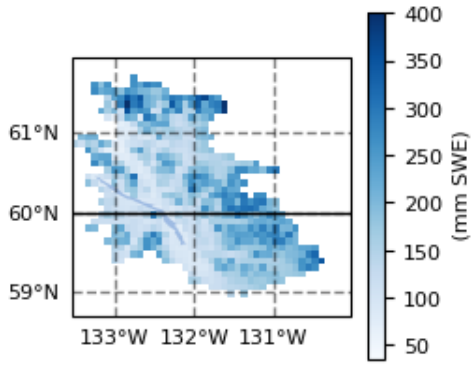
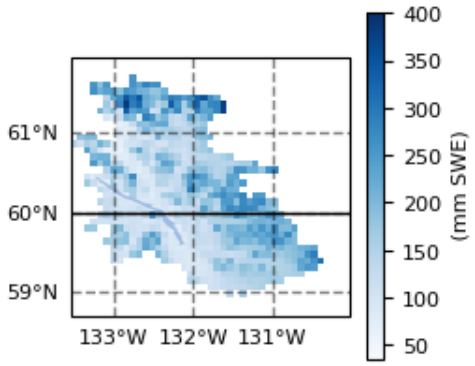
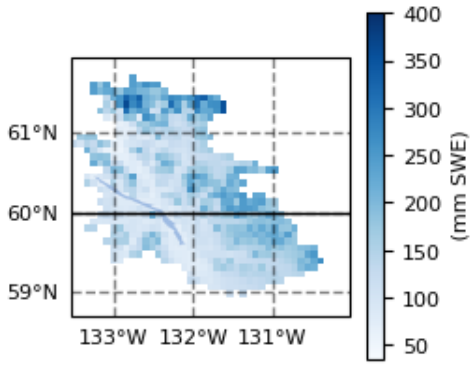
1981-2010	2036-2065	2066-2095
		
Min: 61 mm SWE Max: 397 mm SWE Mean: 176 mm SWE	Min: 61 mm SWE Max: 387 mm SWE Mean: 166 mm SWE Min Change: -13% Max Change: 3% Mean Change: -6%	Min: 59 mm SWE Max: 381 mm SWE Mean: 160 mm SWE Min Change: -19% Max Change: 2% Mean Change: -9%

Figure 8-9: PCIC SSP2-4.5. Total Snowfall for July-June (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

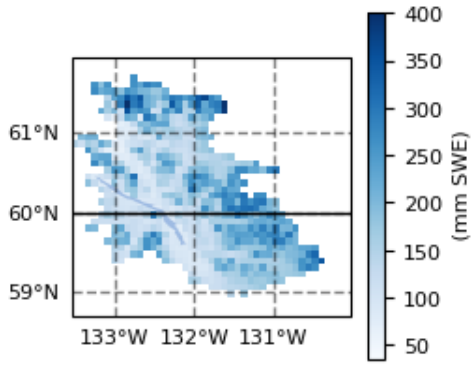
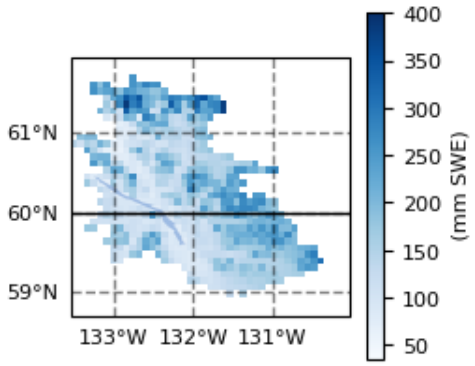
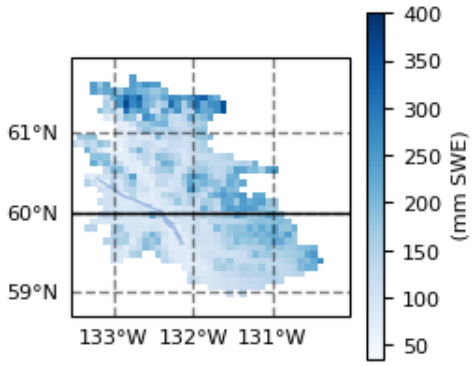
1981-2010	2036-2065	2066-2095
		
Min: 61 mm SWE Max: 398 mm SWE Mean: 176 mm SWE	Min: 60 mm SWE Max: 385 mm SWE Mean: 165 mm SWE Min Change: -16% Max Change: 3% Mean Change: -6%	Min: 54 mm SWE Max: 363 mm SWE Mean: 149 mm SWE Min Change: -30% Max Change: 2% Mean Change: -15%

Figure 8-10: PCIC SSP5-8.5. Total Snowfall for July-June (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

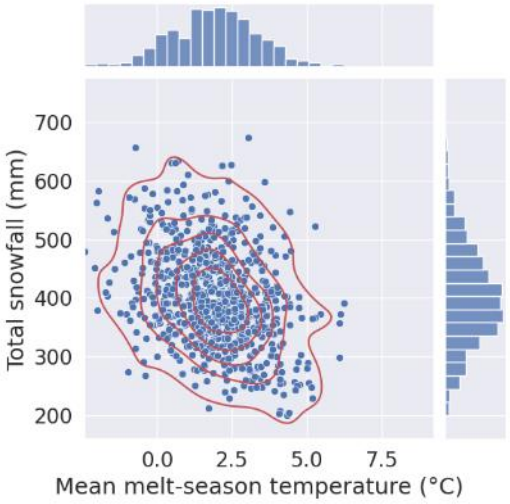
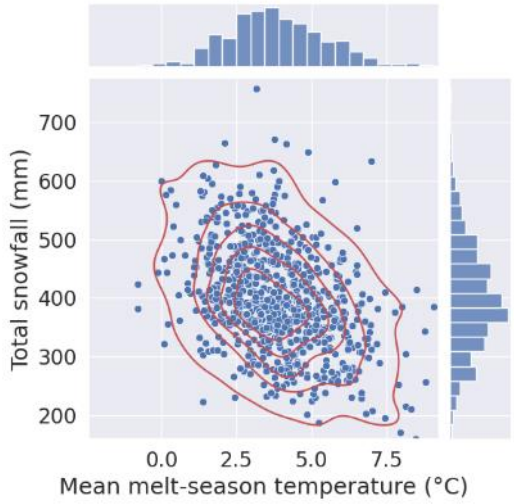
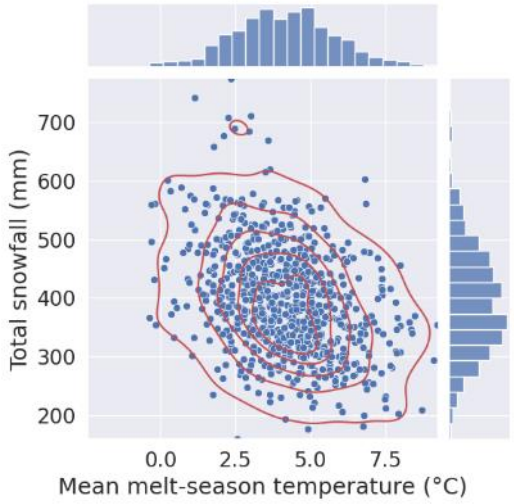
1981-2010	2036-2065	2066-2095
		
	Temperature variability is increasing. Temperatures are increasing.	More extreme snowfall for low-medium melt-season temperatures.

Figure 8-11: PCIC SSP1-2.6. Joint Melt Season and Total Snowfall Distribution for Data from all Models for the Grid Point that had the Highest Median Snowfall over the 1981-2010 period (132.9°W, 61.37°N) (WSP Tango, 2024)

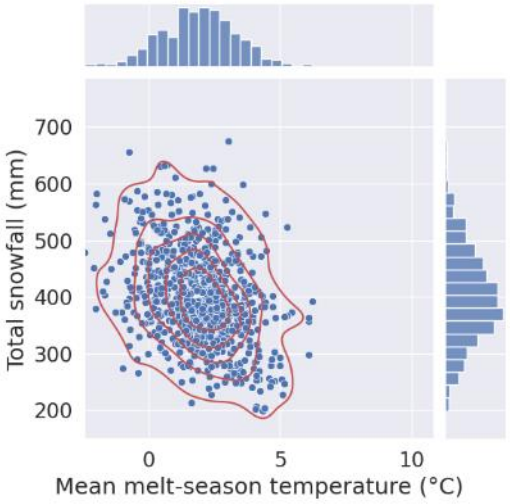
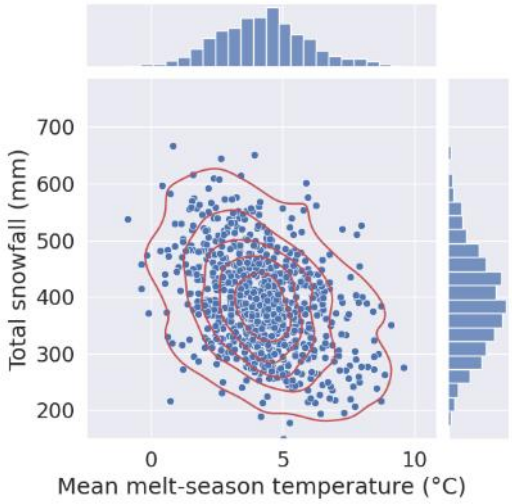
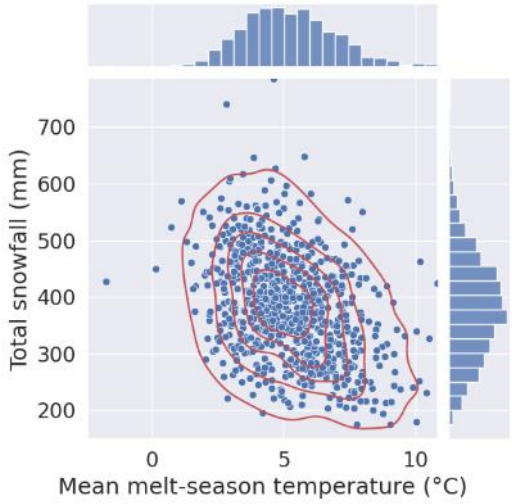
1981-2010	2036-2065	2066-2095
		
	Temperature variability is increasing. Temperatures are increasing.	More low-snowfall-high-temperature years (lower-right quadrant). More extreme melt season temperatures (low and high).

Figure 8-12: PCIC SSP2-4.5. Joint Melt Season and Total Snowfall Distribution for Data from all Models for the Grid Point that had the Highest Median Snowfall over the 1981-2010 period (132.9°W, 61.37°N) (WSP Tango, 2024)

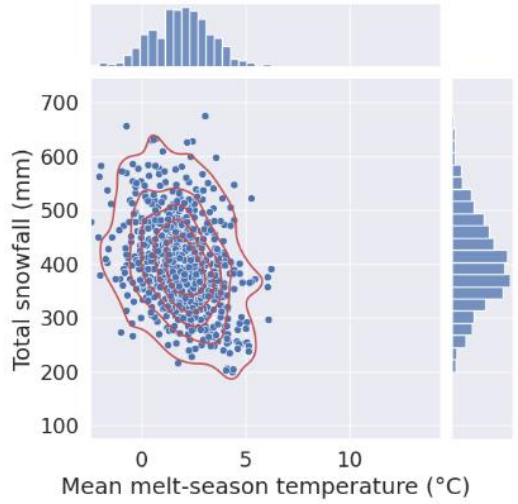
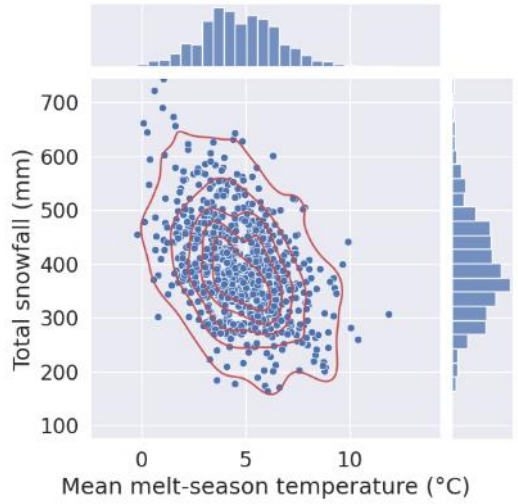
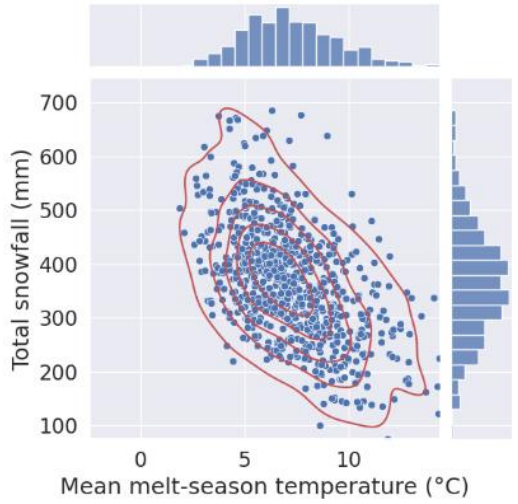
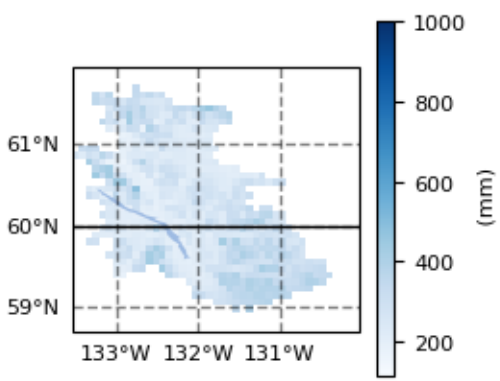
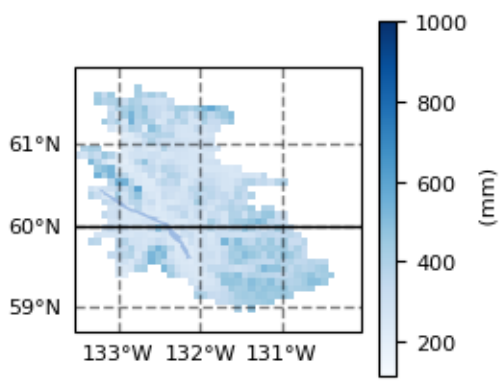
1981-2010	2036-2065	2066-2095
		
	Total snowfall and temperature variability is increasing. Temperatures are increasing.	More low-snowfall-high-temperature years (lower-right quadrant).

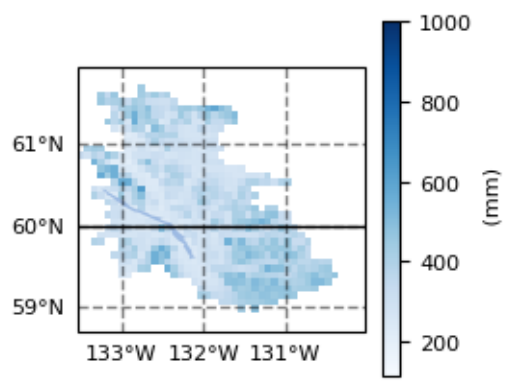
Figure 8-13: PCIC SSP5-8.5. Joint Melt Season and Total Snowfall Distribution for Data from all Models for the Grid Point that had the Highest Median Snowfall over the 1981-2010 period (132.9°W, 61.37°N) (WSP Tango, 2024



Min	164 mm
Max	483 mm
Mean	278 mm

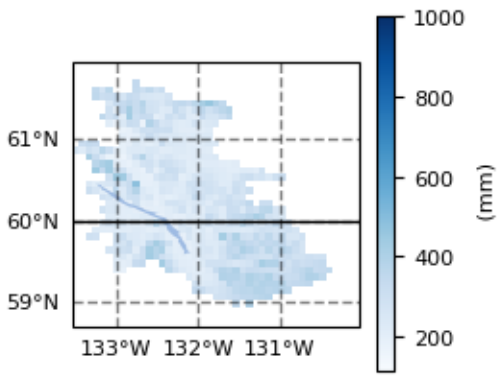


Min	198 mm
Max	597 mm
Mean	341 mm
Min Change	18%
Max Change	29%
Mean Change	22%

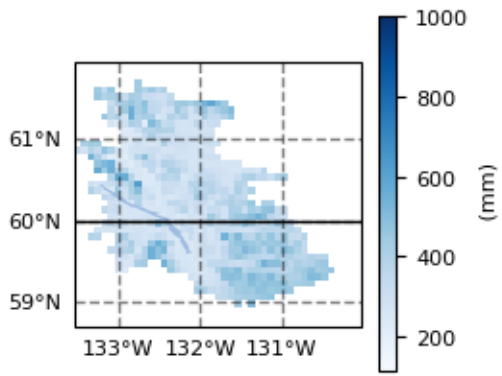


Min	203 mm
Max	622 mm
Mean	352 mm
Min Change	21%
Max Change	34%
Mean Change	26%

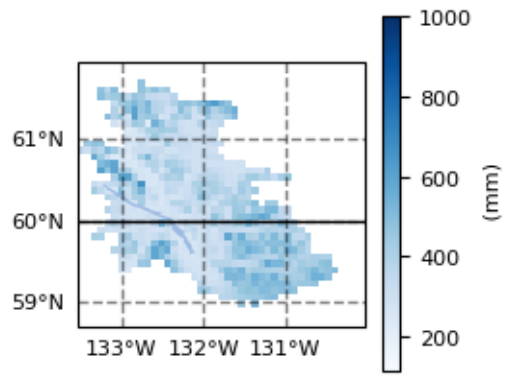
Figure 8-14: PCIC SSP1-2.6. Total Annual Rainfall (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)



Min	164 mm
Max	483 mm
Mean	278 mm

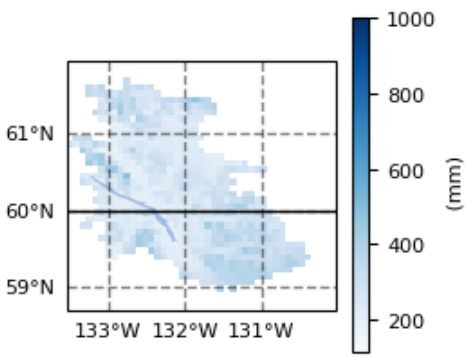


Min	203 mm
Max	620 mm
Mean	352 mm
Min Change	21%
Max Change	33%
Mean Change	26%

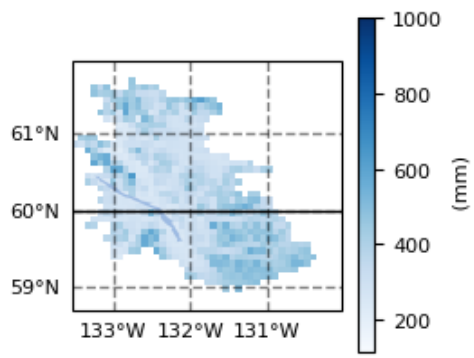


Min	217 mm
Max	671 mm
Mean	379 mm
Min Change	28%
Max Change	45%
Mean Change	36%

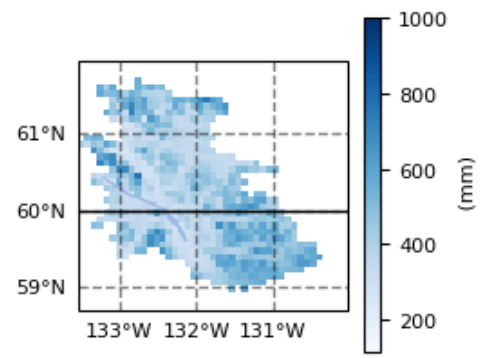
Figure 8-15: PCIC SSP2-4.5. Total Annual Rainfall (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)



Min	164 mm
Max	482 mm
Mean	278 mm

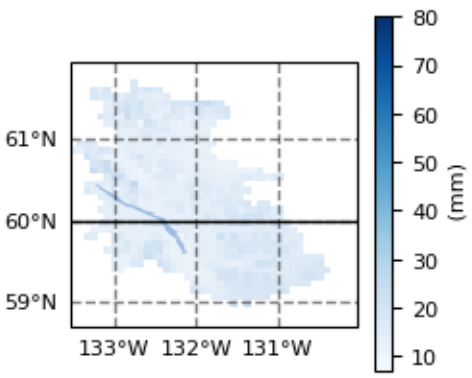


Min	210 mm
Max	640 mm
Mean	365 mm
Min Change	25%
Max Change	38%
Mean Change	31%

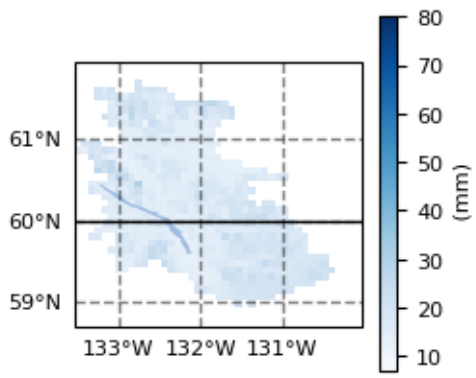


Min	252 mm
Max	775 mm
Mean	437 mm
Min Change	44%
Max Change	74%
Mean Change	57%

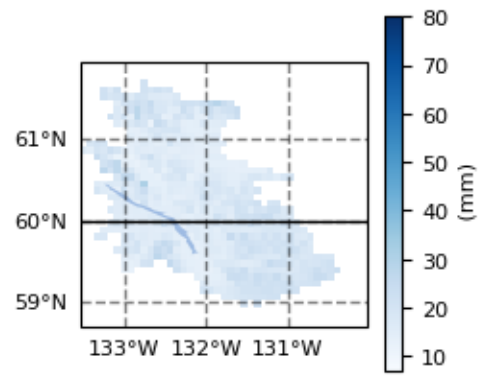
Figure 8-16: PCIC SSP5-8.5. Total Annual Rainfall (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)



Min	10 mm
Max	26 mm
Mean	15 mm



Min	11 mm
Max	30 mm
Mean	17 mm
Min Change	10%
Max Change	20%
Mean Change	14%



Min	12 mm
Max	31 mm
Mean	18 mm
Min Change	11%
Max Change	21%
Mean Change	16%

Figure 8-17: PCIC SSP1-2.6. Maximum one-day Rainfall (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

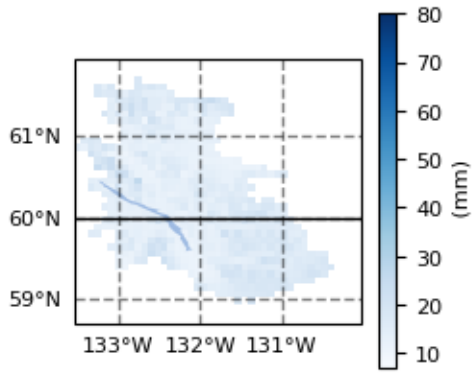
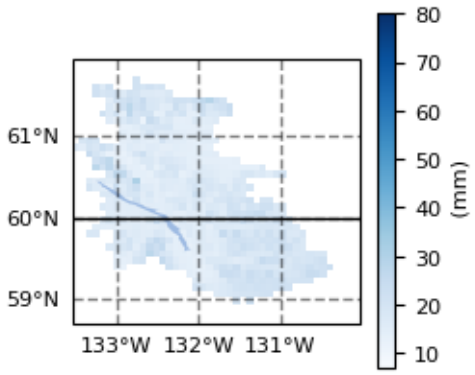
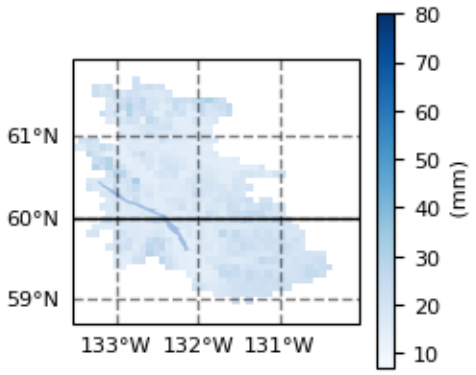
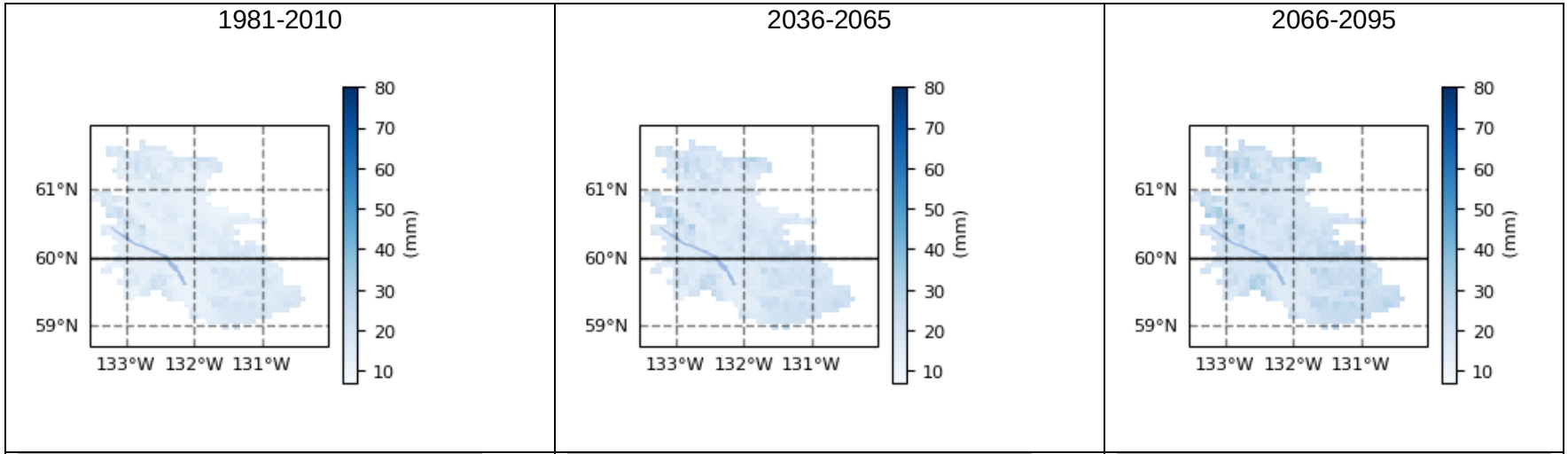
1981-2010	2036-2065	2066-2095
		
Min 10 mm Max 26 mm Mean 15 mm	Min 12 mm Max 31 mm Mean 18 mm Min Change 10% Max Change 22% Mean Change 17%	Min 12 mm Max 32 mm Mean 19 mm Min Change 16% Max Change 32% Mean Change 24%

Figure 8-18: PCIC SSP2-4.5. Maximum one-day Rainfall (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)



Min	10 mm
Max	26 mm
Mean	15 mm

Min	12 mm
Max	32 mm
Mean	18 mm
Min Change	17%
Max Change	24%
Mean Change	21%

Min	14 mm
Max	37 mm
Mean	21 mm
Min Change	32%
Max Change	48%
Mean Change	39%

Figure 8-19: PCIC SSP5-8.5. Maximum one-day Rainfall (median over all models) and Statistics over all Grid Cells (WSP Tango, 2024)

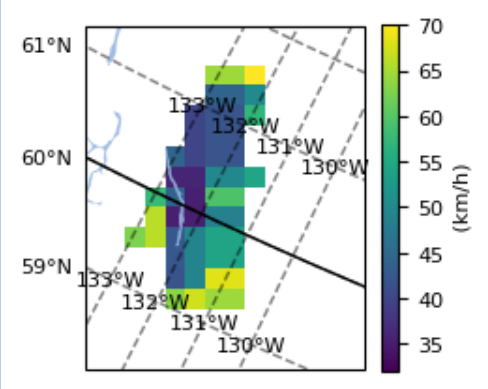
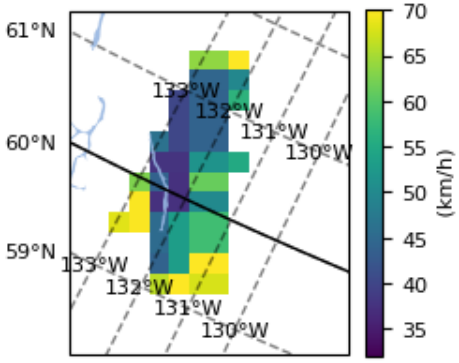
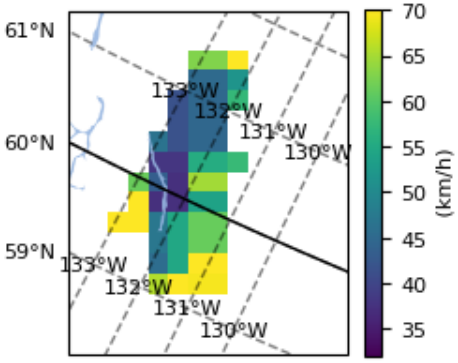
1981-2010	2036-2065	2066-2095
		
Min 33 km/h Max 104 km/h Mean 58 km/h	Min 33 km/h Max 105 km/h Mean 60 km/h Min Change -1% Max Change 9% Mean Change 4%	Min 33 km/h Max 107 km/h Mean 61 km/h Min Change -2% Max Change 18% Mean Change 7%

Figure 8-20: Maximum Annual Surface Wind (Median) (WSP Tango, 2024)

8.3.6 LANDUSE CHANGES

Extreme events such as wildfires can contribute to a changing landscape. When coupled with permafrost degradation, these events can lead to natural disasters such as landslides and silt runoff (Streicker, 2016). The loss of vegetation due to wildfires destabilizes the soil, making it more susceptible to erosion and landslides (Streicker, 2016). Simultaneously, the thawing of permafrost weakens the ground structure, further contributing to the risk of landslides and increasing silt runoff into water bodies, which can have significant ecological and infrastructural impacts (Reid *et al.*, 2022; Streicker, 2016).

The Carmack Flood Mapping Study conducted by Stantec Consulting Ltd (2024) anticipates that in the watershed area around the Nordenskiold and Yukon Rivers, impacts due to wildfires can cause land cover changes, such as changes in forest cover and increases in hydrophobic soils that can lead to landslides and silt runoff. In contrast, given that urban development in these areas is less than 1%, future development is unlikely to significantly impact flood hydrology (Stantec Consulting Ltd, 2024). Moreover, studies show that the fire risk in the Yukon Plateau is anticipated to stay steady or decline in the future and as such will have a minimal impact on the flood hydrology in the Teslin basin (AECOM, 2016; Stantec Consulting Ltd., 2024).

Reid *et al.* (2022) observed that in recent decades, vegetation changes are often the first sign of permafrost degradation in the Arctic Tundra. While this could have significant impacts on hydrological processes, Stantec Consulting Ltd. (2024) deems these impacts as negligible in the Yukon River watershed region. This area falls within low-impact zones for insect infestations, and although forests may transition to deciduous types, this change is not expected to significantly affect flood flows. Similarly, shrub tundra expansion due to climate warming suggests a potential decrease in peak flows but does not result in major changes in land cover (Rasouli *et al.*, 2019). However, it should be noted that significant erosion rates and occasional avulsions could alter sediment supply and erosion processes, which would be exacerbated during high flow events (Cronmiller *et al.*, 2020).

Generally, the potential changes in land cover, such as shifts in vegetation types and the risk of forest fires, are not expected to significantly increase flood flows.

8.4 ESTIMATED INCREASED FRESHET VOLUMES AND ASSOCIATED FLOOD PEAKS

As noted in Section 2, peak Teslin Lake levels typically occur in mid to late-June and are the result of snowmelt and rainfall that occurs in the spring/early-summer (i.e., the freshet) and then drains via surface and groundwater flow into the lake.

In addition to the above runoff, the lake receives precipitation directly on its surface and is subject to lake evaporation. Detailed hydrologic lake modelling is required to accurately model these processes and the impact of climate change on Teslin Lake flood levels. This is beyond the scope of this study. However, a more simplistic approach can provide a reasonable basis for quantifying the level of climate change impacts on lake levels. The relatively detailed climate change analysis presented in Section 8.3 provides a sound and site-specific basis to build upon.

These quantitative climate change impacts are compared in Section 8.6 with those obtained from other relevant studies as well as guidance from government agencies and professional regulatory bodies.

The approach for estimating the increase in freshet runoff volumes and peak water levels is presented below.

For the larger floods that are the primary focus of this study, there is assumed to be no significant change in factors such as lake evaporation, infiltration and evapotranspiration. For this basic model, this is not an unreasonable assumption. Especially for large floods, the ground during freshet is saturated and both snowmelt and rainfall would drain into the lake at rates that are similar for historic and climate change scenarios. Hence, for a basic model, it is reasonable to assume that an increase (or decrease) in precipitation would result in a similar change in runoff volume to the lake.

Delayed melting of the snowpack followed by warm temperatures promoting a rapid melt (and with any added precipitation) will result in a compressed runoff period and a higher peak water level, as was experienced in 2022. This shows that timing is important. A climate change scenario of earlier melts may tend to decrease the peak water levels experienced because of an earlier and potentially slower/longer melt period. However, a compressed melt could still occur, particularly for the large flood events that result in high lake levels. Additionally, the lake's ability to store freshet volumes would assist in smoothing out some of the temporal differences in runoff (e.g., earlier melt period).

Figure 8-10 shows the projected total snowfall (i.e., winter snowpack) for SSP5-8.5 (the scenario that results in largest climate change indicator increases) over the basin for historic and climate change scenarios. This is the snowpack that melts during freshet.

Figure 8-16 shows the projections for total annual rainfall for SSP5-8.5. However, for peak lake levels, the rainfall during the freshet is required. Table 8–5 shows the spring (April through June) rainfall and the snow water equivalent of the winter snowpack and their sum, which is the total precipitation input into the lake during freshet. The bottom row of the table shows the total median precipitation for historic and the near-term (2036-2065) and long-term (2066-2095) climate change scenarios. The table also shows the upper and lower decile precipitation values for the various scenarios. The median total precipitation (bottom row of Table 8–5) was selected as an appropriate indicator of climate change for the purpose of this study. As shown, the total freshet median precipitation increases range from 3.4% to 4.5%. The larger of the median values (4.5% for the long-–term 8.5 SSP scenario) was selected to determine climate change impacts on lake levels. The calculation for how the 4.5 % long-term 8.5 SSP increase was estimated is provided below.

- The historical value for total median precipitation contributing to freshet (254 mm) is the sum of following two values:
  - Historic median winter-spring snowfall = 185.2 mm.
  - Historic median April – June rain = 68.8 mm.
- The long-term 8.5 SSP value for total median precipitation contributing to freshet (265.4 mm) is the sum of following two values:
  - Long-term 8.5 SSP median winter-spring snowfall = 157.0 mm.
  - Long-term 8.5 SSP April – June rain = 108.4 mm.
- The percentage increase for precipitation contributing to freshet, between historical and long-term 8.5 SSP is (265.4 mm-254 mm)/254 mm = 4.5%.

Table 8–5: Precipitation and Percent Change Contributing to Freshet (April through June) Lake Inflow Volume For Historical and Climate Change Scenarios

INDICATOR	HISTORICAL (1981-2010)	SSP 8.5				SSP 4.5				SSP 2.6			
		NEAR-TERM (2036-2065)		LONG-TERM (2066-2095)		NEAR-TERM (2036-2065)		LONG-TERM (2066-2095)		NEAR-TERM (2036-2065)		LONG-TERM (2066-2095)	
	Amount (mm)	Amount (mm)	Percent Change	Amount (mm)	Percent Change	Amount (mm)	Percent Change	Amount (mm)	Percent Change	Amount (mm)	Percent Change	Amount (mm)	Percent Change
Winter-Spring Snowfall – Lower Decile	134.0	120.1	-10.4%	97.1	-27.5%	120.6	-10.0%	114.6	-14.5%	125.9	-6.0%	123.4	-7.9%
Winter-Spring Snowfall – Upper Decile	240.1	240.0	0.0%	224.0	-6.7%	236.4	-1.6%	233.7	-2.7%	238.9	-0.5%	236.5	-1.5%
Winter-Spring Snowfall - Median	185.2	174.1	-6.0%	157.0	-15.2%	174.7	-5.7%	169.1	-8.7%	178.0	-3.9%	176.0	-5.0%
April-June Rain – Lower Decile	41.9	56.0	33.7%	69.6	66.2%	55.0	31.4%	58.9	40.6%	52.6	25.6%	55.2	31.8%
April-June Rain – Upper Decile	103.4	135.6	31.2%	164.6	59.2%	131.2	26.9%	145.4	40.7%	125.3	21.1%	129.6	25.4%
April-June Rain - Median	68.8	90.8	31.9%	108.4	57.6%	88.4	28.4%	94.2	36.9%	84.6	23.0%	87.9	27.8%
Total Precipitation – Lower Decile	175.9	176.1	0.1%	166.7	-5.2%	175.7	-0.1%	173.5	-1.4%	178.5	1.5%	178.6	1.6%
Total Precipitation – Upper Decile	343.5	375.7	9.4%	388.6	13.1%	367.6	7.0%	379.2	10.4%	364.1	6.0%	366.2	6.6%
Total Precipitation – Median	**254.0**	**264.9**	**4.3%**	**265.4**	**4.5%**	**263.0**	**3.6%**	**263.3**	**3.6%**	**262.6**	**3.4%**	**263.9**	**3.9%**

Note:
Units for snowfall are mm Snow Water Equivalent (SWE).

As previously noted, the increase in precipitation contributing to freshet is assumed to result in an equivalent increase in freshet lake inflow volume. For example, the long term 4.5% median increase in precipitation contributing to freshet would result in a 4.5% increase in freshet lake inflow volume. The impact on the 0.5% AEP lake level of 687.13 m is evaluated below.

A relationship between lake volume and water levels (referred to as the stage-storage curve) is required to convert the above noted increases in freshet lake inflow volume to increases in lake levels. Figure 8-21 is an approximate Teslin Lake stage-storage curve for the higher lake levels that are of interest. The development and limitation of the stage-storage curve are discussed below:

Teslin Lake is extremely large with a surface area of 385 km^2. Although detailed LiDAR information is available for the study area, less detailed topographic information is available for other areas. The stage-storage curve was developed using the detailed and other topographic information and as such should be considered approximate.

Using the Global Mapper GIS software and HRDEM provided by NRCan, contours were developed around the lake for the higher lake levels that are of interest to the study. The area encompassed by each of the contours can be estimated in Global Mapper. The relationship between lake area and lake level is shown by the thinner/lighter line on Figure 8-21.

The above noted lake areas can be converted to lake volumes using standard formulas such as Simpson's rule or the volume of a partial cone (referred to as the Frustum of a cone). Based on this, the thicker/darker line on Figure 8-21 represents the lake volume versus lake level.

At the start of the freshet, the lake is typically at its low spring level, in the order of 680.3 m or slightly lower. For the climate change component of the study, the incremental change in flood lake levels is of interest. The lake storage below the low spring levels (i.e., 680.3 m) is not required. The volume shown on Figure 8-21 is incremental lake storage above elevation 677.313 m, which corresponds to a gauge height of zero on WSC Teslin Lake Station 09AE002. Storage below this elevation is not included.

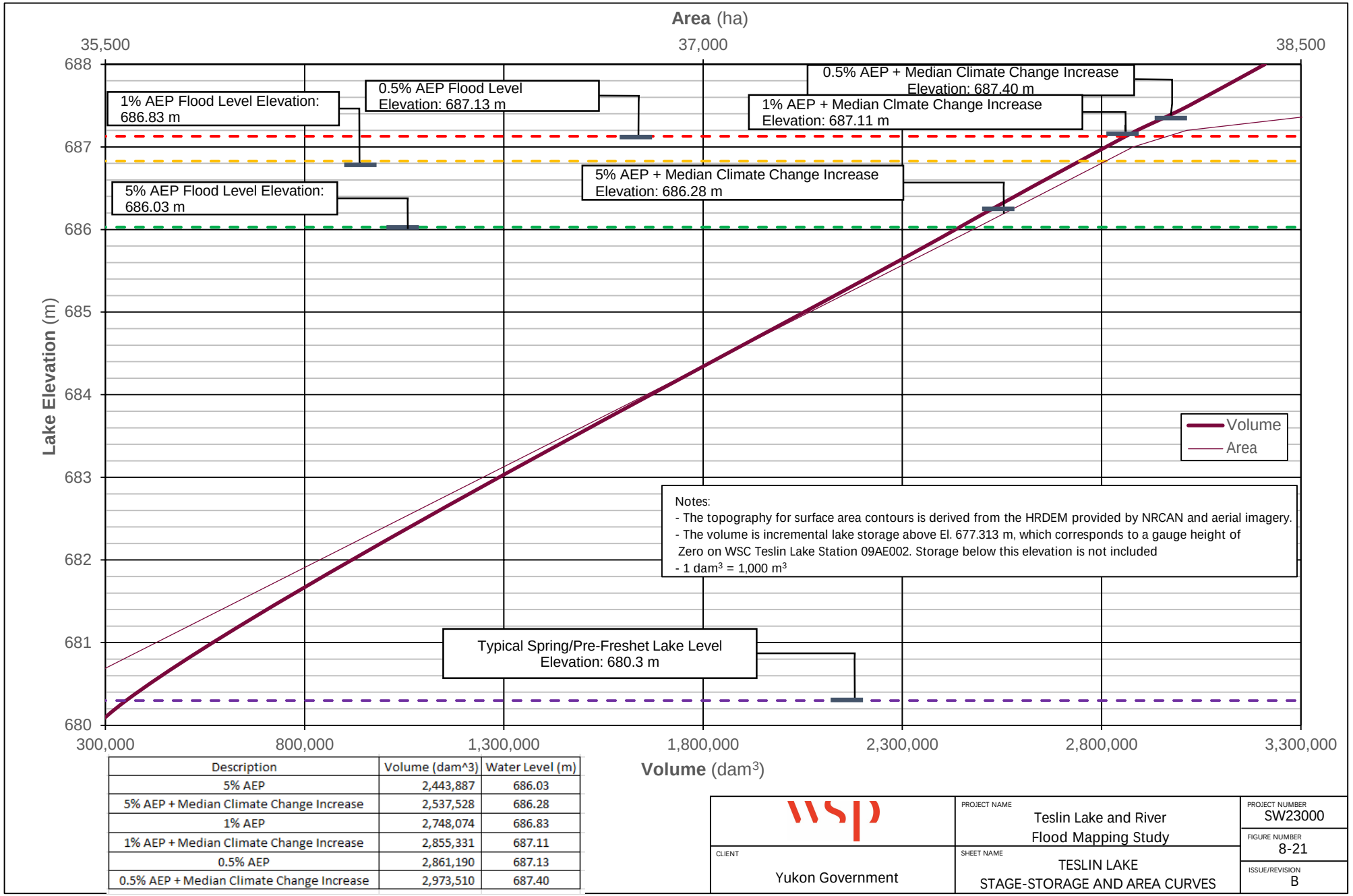
The methodology to determine the increase in the 0.5% AEP lake level of 687.13 m is detailed below with reference to Figure 8-21.

The lake increases from its low spring (pre-freshet) level of 680.3 m to its flood levels, for example 687.13 m for the 0.5% AEP. The volume between the low spring level and the peak flood level can be considered the freshet lake inflow volume. This lake inflow freshet volume can be increased by the aforementioned 4.5% to estimate the median long-term climate change freshet volume. The stage storage relationship, shown on Figure 8-21, can be used to determine the 0.5% AEP climate change lake level.

Table 8–6 below shows the static lake level values for the 5%, 1% and 0.5% AEPs, based on this calculation. The recommended 0.5% AEP climate change lake inflow freshet volume is 4.5% (or 78,500 dam^3) greater than existing (historic) conditions. The 0.5% AEP static lake level is 687.4 m and is associated with the median long-term climate change scenario. This is 0.27 m higher than the 0.5% AEP historic lake level of 687.13 m.

Table 8–6: Stage-Storage Relationship For Historical and Climate Change Scenarios

DESCRIPTION	LAKE LEVEL (m)	SURFACE AREA (ha)	STORAGE (dam3)
Baseflow	680.3	35,341	0
5% AEP Historic	686.03	37,689	2,443,887
1% AEP Historic	686.83	38,012	2,748,074
0.5% AEP Historic	687.13	38,166	2,861,190
5% AEP Median Climate Change	686.28	37,789	2,537,528
1% AEP Median Climate Change	687.11	38,156	2,855,331
0.5% AEP Median Climate Change	687.40	38,567	2,973,510



Description	Volume (dam^3)	Water Level (m)
5% AEP	2,443,887	686.03
5% AEP + Median Climate Change Increase	2,537,528	686.28
1% AEP	2,748,074	686.83
1% AEP + Median Climate Change Increase	2,855,331	687.11
0.5% AEP	2,861,190	687.13
0.5% AEP + Median Climate Change Increase	2,973,510	687.40

wsp	PROJECT NAME: Teslin Lake and River Flood Mapping Study	PROJECT NUMBER: SW23000
CLIENT: Yukon Government	SHEET NAME: TESLIN LAKE STAGE-STORAGE AND AREA CURVES	FIGURE NUMBER: 8-21
		ISSUE/REVISION: B

8.5 TESLIN RIVER CLIMATE CHANGE ESTIMATES

The climate change flows at Teslin River were derived using the Teslin Lake vs Teslin River relationship (Figure 8-22) and climate change Teslin Lake water levels (Table 8–6). The 5% and 0.5% AEPs for climate change flows and the percent increases are presented in Table 8–7 and are 10.2 % and 14.8%, respectively.

Table 8–7: Teslin River Climate Change Flow Estimates

AEP	FLOOD FREQUENCY ESTIMATE (m^3/s)	FLOOD FREQUENCY ESTIMATE WITH CLIMATE CHANGE (m^3/s)	PERCENT INCREASE (%)
5%	1,670	1,841	10.2
0.5%	2,120	2,434	14.8

Teslin River flows are controlled by Teslin Lake levels (i.e., the curve shown in Figure 4-4), which is a non-linear relationship. Hence, the 0.5% AEP increase of 14.8 % for the Teslin River is a higher percentage than the 5% AEP increase of 10.2%.

The Teslin River HEC-RAS model was run for the Teslin River 5% AEP and 0.5% AEP climate change estimates. Johnson's Crossing climate change flood hazard maps were developed based on these results. The HEC-RAS model simulation results are presented in Table 8–8 and Figure 8-22. Climate change water level increases in the area downstream of the Teslin River bridge at Johnson's Crossing for 5% and 0.5% AEP estimates are 0.5 m and 0.8 m respectively.

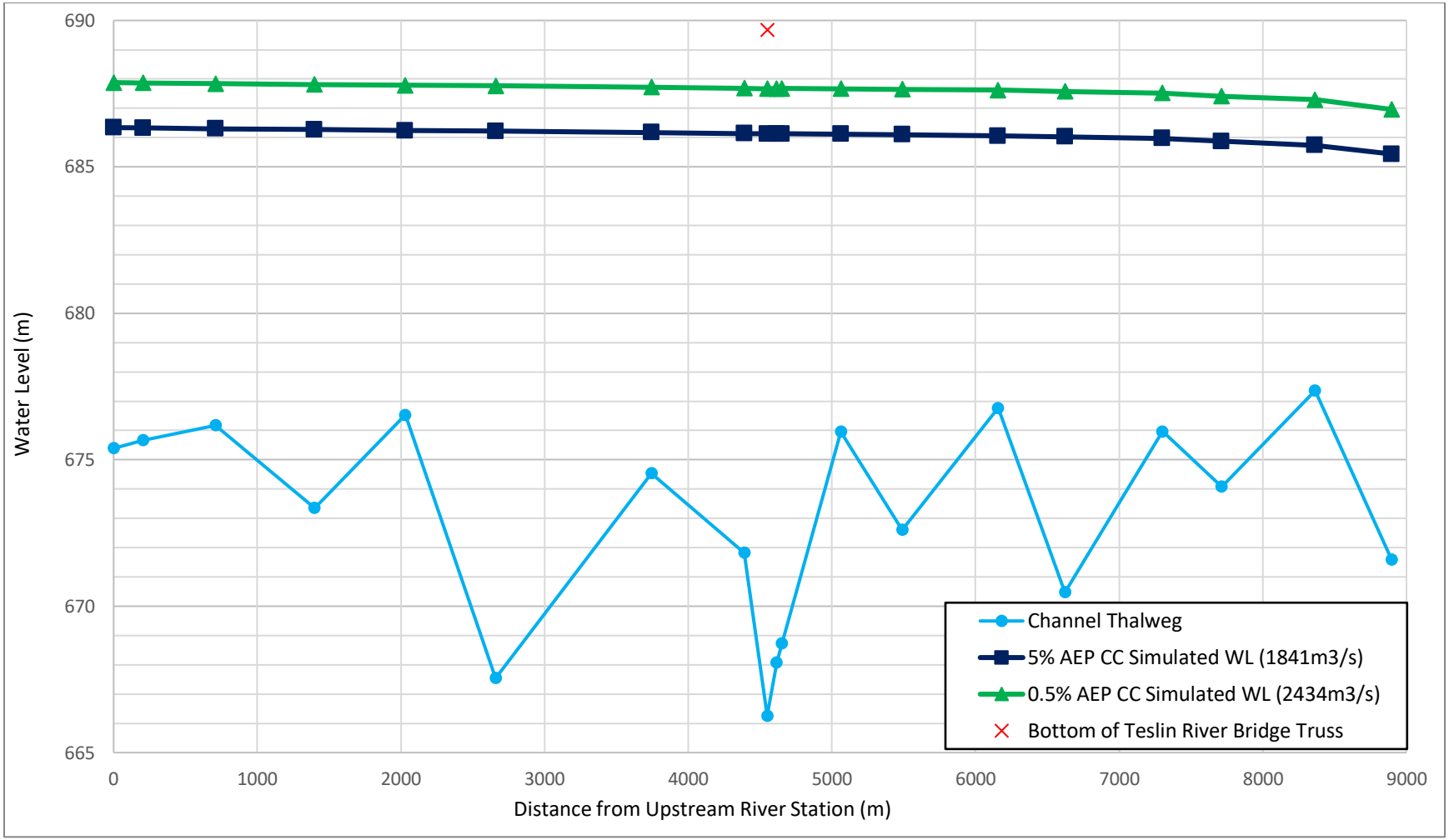


Figure 8-22: Water Level Profiles for 5%, and 0.5% AEPs with Climate Change Effects (20-, 200-year Flood Frequency Estimates with Climate Change)

Table 8–8: HEC-RAS Teslin River Climate Change Flow Estimates Simulation Results

River Station	Profile	Q Total (m^3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G., Elev (m)	E.G., Slope (m/m)	Vel Chnl (m/s)	Flow Area (m^2)	Top Width (m)	Froude # Chl
8921	5% Climate Change	1,841	675.39	686.34	-	686.35	0.000009	0.3	7,080.55	1,412.03	0.04
8921	0.5% Climate Change	2,434	675.39	687.88	-	687.89	0.000007	0.31	9,269.27	1,431.5	0.04
8716	5% Climate Change	1,841	675.67	686.33	-	686.34	0.000025	0.51	4,162.68	871.28	0.07
8716	0.5% Climate Change	2,434	675.67	687.87	-	687.88	0.00002	0.53	5,563.42	934.43	0.06
8211	5% Climate Change	1,841	676.18	686.3	-	686.33	0.000042	0.66	2,799.12	515.5	0.09
8211	0.5% Climate Change	2,434	676.18	687.84	-	687.87	0.000033	0.69	3,695.64	618.59	0.08
7522	5% Climate Change	1,841	673.35	686.27	-	686.3	0.000042	0.72	2,670.84	437.89	0.09
7522	0.5% Climate Change	2,434	673.35	687.81	-	687.84	0.000036	0.77	3,367.63	466.65	0.09
6891	5% Climate Change	1,841	676.53	686.24	-	686.27	0.000049	0.73	2,616.24	487.44	0.09
6891	0.5% Climate Change	2,434	676.53	687.79	-	687.82	0.00004	0.76	3,375.06	492.7	0.09
6261	5% Climate Change	1,841	667.54	686.22	-	686.24	0.000032	0.68	2,763.82	384.13	0.08
6261	0.5% Climate Change	2,434	667.54	687.77	-	687.8	0.00003	0.75	3,386.39	433.52	0.08
5176	5% Climate Change	1,841	674.54	686.17	-	686.2	0.000042	0.82	2,381.03	367.63	0.09
5176	0.5% Climate Change	2,434	674.54	687.72	-	687.76	0.00004	0.9	2,965.73	386.64	0.09
4530	5% Climate Change	1,841	671.82	686.14	-	686.17	0.000054	0.84	2,450.24	480.64	0.1
4530	0.5% Climate Change	2,434	671.82	687.69	-	687.73	0.000047	0.9	3,207.56	494.69	0.1
4371	5% Climate Change	1,841	666.26	686.13	672.48	686.16	0.000029	0.83	2,350.24	330.73	0.08
4371	0.5% Climate Change	2,434	666.26	687.67	673.44	687.72	0.000032	0.96	2,899.81	366.97	0.09
4338.5		Bridge	-	-	-	-	-	-	-	-	-
4306	5% Climate Change	1,841	668.07	686.13	-	686.16	0.000021	0.75	2,566.29	305.24	0.07
4306	0.5% Climate Change	2,434	668.07	687.68	-	687.71	0.000024	0.87	3,096	361.71	0.07
4267.63	5% Climate Change	1,841	668.74	686.13	-	686.16	0.00002	0.73	2,758.17	427.55	0.07
4267.63	0.5% Climate Change	2,434	668.74	687.68	-	687.71	0.000023	0.84	3,461.39	471.6	0.07
3857	5% Climate Change	1,841	675.96	686.12	-	686.14	0.000038	0.66	3,135.45	583.56	0.08
3857	0.5% Climate Change	2,434	675.96	687.67	-	687.69	0.000032	0.7	4,052.61	600.06	0.08
3430	5% Climate Change	1,841	672.61	686.1	-	686.13	0.000043	0.67	2,788.92	495.27	0.09
3430	0.5% Climate Change	2,434	672.61	687.65	-	687.68	0.000035	0.7	3,589.55	547.18	0.08
2764	5% Climate Change	1,841	676.77	686.06	-	686.09	0.000052	0.79	2,345.1	370.52	0.1
2764	0.5% Climate Change	2,434	676.77	687.62	-	687.65	0.000045	0.85	2,930.17	383.16	0.09
2297	5% Climate Change	1,841	670.48	686.03	-	686.07	0.000056	0.91	2,138.47	321.3	0.1
2297	0.5% Climate Change	2,434	670.48	687.58	-	687.63	0.000052	1	2,643.62	328.8	0.1
1620	5% Climate Change	1,841	675.97	685.97	-	686.02	0.000079	1.04	1,782.23	253.46	0.12
1620	0.5% Climate Change	2,434	675.97	687.52	-	687.59	0.000072	1.13	2,182.06	261.18	0.12
1208	5% Climate Change	1,841	674.08	685.87	-	685.98	0.000125	1.44	1,287.32	160.36	0.16
1208	0.5% Climate Change	2,434	674.08	687.41	-	687.54	0.000125	1.61	1,536.51	163.61	0.16
557	5% Climate Change	1,841	677.36	685.74	-	685.87	0.000232	1.59	1,159.86	192.57	0.2
557	0.5% Climate Change	2,434	677.36	687.29		687.44	0.000191	1.68	1,462.99	196.39	0.19
24	5% Climate Change	1,841	671.59	685.44	679.58	685.7	0.000324	2.3	819.19	107.65	0.25
24	0.5% Climate Change	2,434	671.59	686.96	680.55	687.29	0.000324	2.56	989.85	117.7	0.26

8.6 COMPARISON OF CLIMATE CHANGE ESTIMATES WITH OTHER STUDIES AND GUIDANCE

According to *Case Studies on Climate Change in Floodplain Mapping* (NRCAN, 2018b), the Flood Mapping and Climate Change City of Surrey Case Study states that by the year 2100, a moderate climate change scenario will increase precipitation by 33% and the severe scenario up to 50% and that this will result in higher runoff.

An additional case study entitled *Flood Mapping and Climate Change Case Study - Integration of Climate Change in Flood Mapping in British Columbia's Lower Mainland – Fraser River and Coast* (NRCAN, 2018b) states that the projected increase in the design flows in the year 2100 could range from 17% to 30% depending on the emission output scenarios.

EGBC (2017) noted that most of British Columbia (BC) will receive more precipitation (up to 26% more in some locations). For example, EGBC (2017) notes that in the summer, northern BC is expected to be 15% wetter. It was also noted by EGBC (2017) that given the broad range of climate model outputs that a median increase to the 1:500 annual exceedance probability (AEP) under a moderate emission scenario for the 2050s could be approximately 10%.

The Teslin Lake median annual rainfall is projected to increase 32% to 57%, for the near-term and long-term scenarios, respectively. This is similar in range to the above references. However, the decrease in snowfall (6.7% to 16%), results in an overall precipitation contributing to freshet increase of 3.4% and 4.5%, for the median near-term and long-term scenarios. The long-term upper decile precipitation change estimate of 13.1%, is similar in magnitude to the references noted above. However, the median climate change values appear reasonable to apply to the Teslin study, given the site-specific climate change analysis undertaken herein. Therefore, a preliminary 200-year median climate change static lake level of 687.4 m (which is based on a 4.5% increase in overall precipitation contributing to freshet and the same increase in freshet lake inflow volume) is recommended for the purpose of floodplain mapping. This can be further evaluated in future more detailed hydrologic modelling studies. Table 8–9 contains the Total (including wind-wave) 5% AEP, 1% AEP and 0.5% AEP lake levels with climate change. Flood hazard maps incorporating climate change were produced for the 5% AEP and 0.5% AEP lake levels.

Table 8–9: Total 5%, 1% and 0.5% AEP Water Levels with Climate Change

PARAMETER	BROOKS BROOK		DEADMAN CREEK			TESLIN					MORLEY BAY			
	TRANSECT 1	TRANSECT 2	TRANSECT 3A	TRANSECT 3B	TRANSECT 4	TRANSECT 5	TRANSECT 6	TRANSECT 7	TRANSECT 11N	TRANSECT 11S	TRANSECT 8N	TRANSECT 8S	TRANSECT 9	TRANSECT 10
5% Total Water Level														
5% SWL (m, CGVD2013) + setup	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41	686.41
100% Wave Runup (m)	1.83	2.03	2.36	0.12	2.80	0.16	0.61	1.25	0.36	0.46	2.34	2.14	2.80	3.14
5% Total Water Level (m, CGVD2013)	688.24	688.44	688.77	686.53	689.21	686.57	687.02	687.66	686.77	686.87	688.75	688.55	689.21	689.55
1% Total Water Level														
1% SWL (m, CGVD2013) + setup	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24	687.24
100% Wave Runup (m)	1.83	2.03	2.36	0.12	2.80	0.16	0.61	1.25	0.36	0.46	2.34	2.14	2.80	3.14
1% Total Water Level (m, CGVD2013)	689.07	689.27	689.60	687.36	690.04	687.40	687.85	688.49	687.60	687.70	689.58	689.38	690.04	690.38
0.5% Total Water Level														
0.5% SWL (m, CGVD2013) + setup	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53	687.53
100% Wave Runup (m)	1.83	2.03	2.36	0.12	2.80	0.16	0.61	1.25	0.36	0.46	2.34	2.14	2.80	3.14
0.5% Total Water Level (m, CGVD2013)	689.36	689.56	689.89	687.65	690.33	687.69	688.14	688.78	687.89	687.99	689.87	689.67	690.33	690.67

9 FLOOD HAZARD MAPPING

Flood Hazard maps are designed to illustrate the potential extent of floodwater coverage, such as the likelihood of flooding on an annual basis. They are essential tools for aiding emergency preparedness in communities located within floodplains and flood hazard zones.

Following assessments including hydrology, wind and wave patterns, joint probabilities, and considerations of climate and land-cover changes, as well as hydraulic modelling, WSP collaborated with YG to determine the Annual Exceedance Probabilities (AEPs) that needed to be mapped. All activities adhered to the Federal Floodplain Mapping Guidelines and Specifications (NRCan 2017).

Base Map Preparation:

- Base mapping layers included the project aerial photography as a background and labels for major and local roadways, communities, First Nations names and other significant infrastructure included bridges, water/wastewater treatment plants, railways, schools and hospitals. All production mapping conformed to established cartographic conventions. ArcGIS software and the required coordinate system datum were used throughout (i.e., horizontally to the North American Datum of 1983 Yukon Albers, Canadian Spatial Reference System, Epoch 2002 (NAD83 Yukon Albers CSRS, Epoch 2002); and, vertically, the data is referenced to CGVD2013). The mapping scale ranged between 1:2,500 and 1:5,000 depending on the location.

Design Flood Selection:

- Design Levels for AEPs of 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% were completed, although only the 50%, 5%, 1% and 0.5% were used for mapping historic conditions, and the 5% and 0.5% AEPs were mapped for climate change impact. Flood hazard mapping tasks are described below.
- The selection of the design floods was based on discussions with YG and Partners and an evaluation of the impacts and protection offered to existing and future developments. Flood hazard maps were prepared for the 50%, 5% and 0.5% AEPs. The inclusion of the flood protection berms on the Teslin flood hazard maps were derived from as-built surveys provided by VoT which was merged with the LiDAR data.

Flood Hazard Map Production:

- All open water flood model output was integrated with the DTM using ArcGIS to provide a preliminary set of digital flood overlays including:
  a) Polygons representing the inundated areas for AEPs of 0.5%, 5% and 50%-AEPs based on the DTM;
  b) A TIN representation of the water surface; and
  c) A depth grid file that represents the arithmetic difference between the water surface and the underlying DTM grid point elevation.
- Polygon features representing the inundated areas at each flood AEP were overlaid on the base maps.
- 185 flood hazard maps were produced for the study plus 1 overall project overview map and one overview map for each location for a total of 191 maps (Table 9-1). All the maps are contained in Appendix F.

Table 9–1: Total Number of Maps Produced

	Overview Maps	5% AEP	1% AEP	0.5% AEP	5% AEP Climate Change	0.5% AEP Climate Change	Total
Project Overview Map	1	-	-	-	-	-	-
Johnson's Crossing	1	3	3	3	3	3	16
Brooks Brook	1	2	2	2	2	2	11
Deadman Creek	1	4	4	4	4	4	21
Teslin	1	18	18	18	18	18	91
Morley Bay	1	10	10	10	10	10	51
Total	6	37	37	37	37	37	191

Water Surface Elevation & Flood Depth Grid Creation:

- Once the flood mapping overlays were prepared using ArcGIS and refined using a detailed quality assurance/quality control (QA/QC) procedure, the conversion of flood water surface to triangular irregular network (TIN) was completed using the ArcGIS conversion tool "Raster to TIN", within the ESRI set of GIS tools. A TIN data product was developed for the final AEPs of 0.5%, 5%, 50%-AEPs.
- A flood extent polygon was created in ArcGIS 10.8.2 using the modelled flood depths and Spatial Analyst tools.

Identification of culverts

- Select culverts associated with YG infrastructure are identified on the mapping. Other culverts, particularly those associated with VoT infrastructure, were not identified. The LiDAR base mapping is of a high degree of accuracy and the locations of some culverts may be inferred by the low drainage paths identified in the mapping, that would lead to the culvert crossings. These areas are located behind roadways that may not be overtopped by the design flood but are shown in the mapping as being inundated. However, there may be instances where these topographic lows were not identified in the mapping and culvert crossings at these locations could be subject to back flooding.

Areas impacted by flooding at the 0.5% AEP

Residential and commercial areas as well as select infrastructure impacted by flooding at the historic 0.5% AEP are described below. The flood inundation maps should be consulted for further details.

- Within the study area, the Alaska Highway is located adjacent to Teslin Lake at numerous locations but is not overtopped by the 0.5% AEP historic total water level.
- Johnson's Crossing
  - Boat launches and associated access roads on both sides of the bridge are inundated.
- Brooks Brook
  - Some residences north of the TTC campground located at the margins of inundation (i.e., just start to get flooded).
  - The TTC campground is mostly inundated with inundation extending back to the outlet of the Brooks Brook culvert crossing of the Alaska Highway.

- Deadman Creek
  - Backwater occurs upstream of the Alaska Highway at the crossing.
  - Agricultural land/structures south of the Deadman's Creek confluence are inundated.
- Teslin
  - North of Teslin to the southeast of Teslin Cottage Road, some residences on the east shore of the bay are subject to flooding.
  - North of Teslin, backwater of the Alaska Highway Fox Creek culvert extends to the northeast side of the Alaska Highway. residences to the north of the confluence of Fox Creek are inundated.
  - The Teslin Lake Lookout platform and parking lot is inundated.
  - Residences west of Smarchville along the shores of Teslin Lake and south of the Alaska Highway across from the airport, are inundated.
  - In Smarchville, residences northeast of Geddes Drive and Smarch Crescent are inundated.
  - Residences to the east of Jackson Avenue and south of Nisutlin Drive are inundated.
  - Nisutlin Drive gets overtopped and the southeast portion of the Tom Dewhurst Recreation Centre parking lot is flooded as are portions of the George Johnston Museum building and parking lot and to the east, extending up to Fox Street.
  - At Village Point
    - The northwest portion of Tlingit Drive gets overtopped and a residence to the north is inundated.
    - Jackson Avenue gets overtopped and properties on both sides are inundated.
  - Properties to the west of the cemetery and south of Nisutlin Drive and the southern portions of the cemetery are inundated.
  - East of the cemetery, south of Nisutlin Drive and west of the Alaska Highway, buildings, the park and boat launch are inundated.
  - Northeast of the Alaska Highway and just north of the bridge, most of the Yukon Motel and Restaurant property, including the campground and cabins are inundated.
  - North of the motel, Sawmill Road is overtopped and residences along the bay south of Sawmill Road are inundated.
- Morley Bay
  - There are a few properties just west of the confluence of the Morley River on the north shore that are subject to inundation.

10 COMMUNITY ENGAGEMENT

The community engagement was in collaboration with local partners including the Village of Teslin (VoT), the Teslin Tlingit Council (TTC) and the Deisleen Development Corporation (DDC). YG and WSP met with Local Elders and Knowledge Keepers, local residents and representatives from VoT, TTC and DDC to discuss historical and recent flood events in the area.

Early input to the study was gathered at the following community engagement events:

- YG attended the May 18, 2023 community dinner to inform the community about the recently initiated study and spoke with residents who could identify high water marks from past years; and,
- On May 30, 2023, YG and WSP met with Elders and Knowledge Holders, supported by DDC – this discussion focused on significant flood events from the 1960s onwards, and provided insights to validate the flood history documentation.

Once completed in draft, the flood hazard maps were shared with the community to validate the mapped extents and gather suggestions for how the presentation of information could be improved. Engagement on the draft maps was done through the following means:

- Draft maps, a plain language summary and a survey were available on the Yukon Flood Atlas website from June 3 to July 5, 2024. Input was solicited on the flood mapping suggestions for improvements; and,
- A public open house was held on June 13, 2024. Additionally, discussions were held with VoT and TTC staff on this date.

The key takeaways from engagement on the draft maps were:

- There was limited public response. However, there was general agreement with the mapped extents from those who attended the open house / responded to the survey.
- A culvert was identified on Nisutlin Drive near the municipal office that conveyed water north/east of the road in 2022 (this was updated on the final maps).
- Identification of local road names on the flood mapping would make it easier to find specific properties on the maps (this was updated on the final maps).
- VoT noted that it is planning to build additional dikes and shoreline armoring to mitigate flooding impacts.
- VoT and TTC noted that the mapped extents generally align with staff experience with recent flooding.
- TTC noted that regional flood mapping would be beneficial given that the regional land use planning process was starting.

11 CONCLUSIONS

The still water flood frequency lake levels mapped for the main AEPs/return periods of interest, for historic conditions and with climate change (where available) are shown below in Table 11–1.

Table 11–1: Summary of Still Water Flood Frequency Lake Levels

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	FLOOD FREQUENCY ESTIMATE (M, CGVD2013)	
		HISTORIC CONDITIONS	CLIMATE CHANGE
0.5	200	687.13	687.40
1.0	100	686.83	687.11
5.0	20	686.03	686.28
0.5	2	684.31	NA

The wind setup and wave runup components are both dominated by seasonal variations in the still water levels. A conservative estimate of 0.13 m was used throughout the study area for wind setup for all flood frequencies (i.e., from 50% AEP to 0.5% AEP). This value was added directly to the still water lake levels for all flood frequencies.

The joint probability analysis showed that the highest estimated 1% AEP total water level was found as a combination of the 1% AEP still water levels plus the wind setup and the 100% AEP wave runup events. The same was found for the combination of 0.5% AEP and 5% AEP still water levels plus the wind setup and the 100% AEP wave runup events. Table 11–2 shows the joint probability wind-wave levels at the four lake areas of interest for the three AEPs that are mapped, for historic and climate change conditions.

Table 11–2: Summary of Total Water Levels for Teslin Lake Areas

PROJECT SITE	TRANSECT	5% AEP TOTAL WATER LEVEL (M, CGVD2013		1% AEP TOTAL WATER LEVEL (M, CGVD2013)		0.5% AEP TOTAL WATER LEVEL (M, CGVD2013)	
		HISTORIC	CLIMATE CHANGE	HISTORIC	CLIMATE CHANGE	HISTORIC	CLIMATE CHANGE
Brooks Brook	1	688.18	688.24	688.98	689.07	689.28	689.36
	2	687.90	688.44	688.70	689.27	689.00	689.56
Deadman Creek	3A	688.44	688.77	689.24	689.6	689.54	689.89
	3B	686.35	686.53	687.15	687.36	687.45	687.65
	4	688.95	689.21	689.75	690.04	690.05	690.33
Teslin	5	686.33	686.57	687.13	687.4	687.43	687.69
	6	686.93	687.02	687.73	687.85	688.03	688.14
	7	687.45	687.66	688.25	688.49	688.55	688.78
	11N	686.58	686.77	687.38	687.6	687.68	687.89
	11S	686.75	686.87	687.55	687.7	687.85	687.99
Morley Bay	8N	688.50	688.75	689.30	689.58	689.60	689.87
	8S	688.33	688.85	689.13	689.38	689.43	689.67
	9	688.85	689.21	689.65	690.04	689.95	690.33
	10	689.28	689.55	690.08	690.38	690.38	690.67

The flood frequency flow estimates at Teslin River that were used to determine the mapping elevations at Johnson's Crossing for historic conditions and with climate change (for the AEPs mapped) are shown below in Table 11–3.

Table 11–3: Summary of Flows for Teslin River

ANNUAL EXCEEDANCE PROBABILITY (%)	RETURN PERIOD (YEARS)	FLOOD FREQUENCY ESTIMATE (m^3/s)	FLOOD FREQUENCY ESTIMATE WITH CLIMATE CHANGE (m^3/s)
		VALUE	VALUE
0.5	200	2,120	2434
1.0	100	1,990	-
5.0	20	1,670	1841
50	2	1,020	-

Flood probabilities are typically based on historical data, but future conditions might differ from past trends. As discussed in Section 8.3.6, the project evaluated potential changes in land cover, such as shifts in vegetation types and the risk of forest fires and concluded that these factors are unlikely to increase flood flows (Stantec Consulting Ltd., 2024; Northwest Hydraulic Consultants Ltd., 2023; Reid *et al.*, 2022; Cronmiller *et al.*, 2020; Rasouli et al., 2019; Streicker, 2016).

Additionally, the project considered the potential impacts of climate change. There is considerable uncertainty regarding future conditions and their effect on flooding. According to global climate models and research specific to the Yukon.

Climate change impacts on the Teslin Lake basin are expected to be significant based on a literature review of climate change impacts in northern Canada and the Yukon. These impacts are summarized below:

- It is expected that there will be more precipitation and higher temperatures on average. However, the increase in precipitation may be offset by a reduction in annual snowfall, as warmer temperatures will lead to more precipitation falling as rain instead of snow. On average, the Teslin Lake basin is projected to experience a decrease in total seasonal snowfall.
- The basin-average melt season (April through June) temperature is projected to more than double by the end of the century. This above is coupled with an expected increase in total rain and maximum one-day rainfall. The highest rainfall months overlap the melt season (ECCC, 2024b for 1981-2010), providing the possibility of heavy rain days during the melt season.
- Basin averaged maximum sustained windspeed is projected to increase by 3 km/h by the end of the century, and by 2 km/h for Teslin. This small amount is consistent with what is expected, however wind projections are generally less accurate than temperature and precipitation variables, so these values have *low confidence*.

These complex climate changes make it challenging to accurately estimate impacts on lake levels, though there is a general trend toward higher lake levels and streamflows. This finding was confirmed by a quantitative based assessment undertaken for the Teslin basin, which determined a 4.5% increase in overall precipitation contributing to freshet and the same increase in freshet lake inflow volume. This is based on median climate change values for worst-case scenario – SSP5-8.5.

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Appendix A

Site Visit and 2022 Flood Photos



Photo 1: Nisutlin Bay Bridge (2022 Flood)



Photo 2: Jonhson's Crossing (2022 Flood) outhouse structure. South bank Teslin River 60 m downstream of bridge



Photo 3: Fish Species Signs Jonhson's Crossing (2022 Flood). South (left) bank Teslin River just upstream of bridge



Photo 4: Village of Teslin flood response at Nisutlin Bay (2022 Flood)



Photo 5: View north Johnson's Crossing Bridge (30 May 2023). Note fish species sign at right edge of photo is same as shown on Photo 3



Photo 6: View west (downstream) Johnson's Crossing (30 May 2023). Note green outhouse structure in background is same as shown on Photo 2



Photo 7: North (right) bank of Teslin River 1 km downstream of Johnson's Crossing (30 May 2023)



Photo 8: Brooks Brook campground adjacent to Teslin Lake (30 May 2023) was subject to inundation during the 2022 flood



Photo 9: View upstream of Brooks Brook 3.7 m diameter culvert crossing of Alaska Highway (30 May 2023). 2022 Flood HWM was at top of culvert.

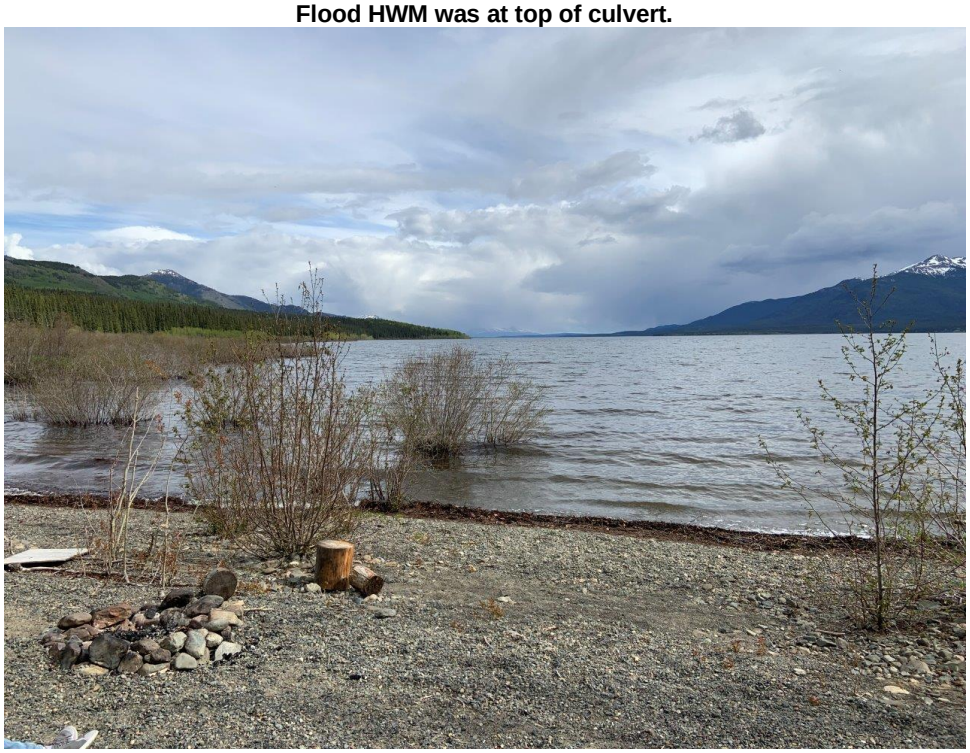

Photo 10: Typical lakeshore at Brooks Brook (30 May 2023)



Photo 11: Brooks Brook (30 May 2023). 2022 HWM shown by red line on wooden structure



Photo 12: View upstream Deadman's Creek (30 May 2023) Alaska Highway Bridge Crossing. 2022 flood HWM was at low chord of bridge



Photo 13: Deadman's Creek downstream of bridge crossing (30 May 2023)



Photo 14: Village of Teslin (30 May 2023). Typical lakeshore characteristics adjacent to Alaska Highway. Note considerable amount of driftwood deposited by waves/prevailing winds



Photo 15: Village of Teslin view west at Lift Station # 4 (30 May 2023). Note 2022 flood berm constructed between the building and the lake



Photo 16: Village of Teslin (30 May 2023), Residence located where Sawmill Road is adjacent to Nisutlan Bay. Tree staining from 2022 flood evident approximately 1.2 m above ground level



Photo 17: Village of Teslin (30 May 2023) campground was subject to inundation during the 2022 flood.



Photo 18: Village of Teslin (30 May 2023) motel/cabins



Photo 19: Morley Bay (30 May 2023). Residence (6666073.69 N, 636706.02 E) was protected by sandbags during the 2002 flood.



Photo 20: Morley Bay (30 May 2023) shed associated with residence shown in Photo 19. Staining of stacked logs indicates 2022 HWM



Photo 21: Morley Bay (30 May 2023). Yard associated with residence shown in Photo 19. Red line indicates tree staining from 2022 flood.

Appendix B

Highwater Mark Survey Report

Survey Report of

2023 Flood Highwater Mark and Benchmark Locations

2024-04-12

Rev1

Prepared for:

Martin Lacroix

WSP

UNDERHILL GEOMATICS

Professional Land Surveyors and Geomatics Engineers

Vancouver • Kamloops • Whitehorse • Vancouver Island

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Summary

Underhill Geomatics collected flood mapping highwater mark (HWM) data and benchmarks between Johnson Crossing and Teslin, located in the Yukon Territory. Coordinates (XY) are UTM Zone 8 North, NAD 83 (CSRS) derived from Real Time Kinematic GPS observations. Elevations are Orthometric and are derived from CGVD2013 Datum using the CGG2013a Geoid Model. Data collected in Johnson Crossing, Brooks Brook and Deadman Creek were holding UGL Base Control Point "999" fixed in 3D. Data Collected North of Teslin, Teslin and South of Teslin were holding UGL Base Control Point "608" fixed in 3D. Coordinates and elevations of 999 and 608 are derived from NRCan's Precise Point Position Service.

Control	Northing	Easting	Elevation	Description
999	6706474.518	593205.102	700.924	UGL999
608	6672112.414	626248.117	689.073	UGL608

Benchmark Locations	Number of Benchmarks
Johnson Crossing	2
Teslin	3

HWM Location	Number of HWM Measurements
Johnson Crossing	11
Brooks Brook	9
Deadman Creek	6
North of Teslin	3
Teslin	34
South of Teslin	4

Flood Highwater Mark and
Benchmark Locations



Johnson Crossing – Benchmarks





Point ID	Northing	Easting	Elevation	BM Description
12	6706565.62	593244.12	685.12	BM1

Highwater Mark Description:

Benchmark 1 located on a bridge abutment on the west side of the bridge, just north of the existing boat launch. Top of nail set in concrete on northeast corner of bridge abutment.





Point ID	Northing	Easting	Elevation	BM Description
13	6706565.78	593201.68	684.57	BM3

Highwater Mark Description:

Benchmark 3 is in metal casing with a cap. The benchmark is a 2cm rod inside the metal casing. Located on the west side of the river, north of the bridge approximately 45m and west of the riverbank 30m.







Point ID	Northing	Easting	Elevation	BM Description
03	6706541.962	593183.904	686.362	OHWM
04	6706548.006	593272.924	686.344	OHWM1



Highwater Mark Description:

Benchmark 03 is a metal garbage bin; high water mark is estimated based on picture provided by Wsp at high water.



Benchmark 04 is a metal sign; high water mark is estimated based on picture provided by Wsp at high water.



Teslin – Benchmarks

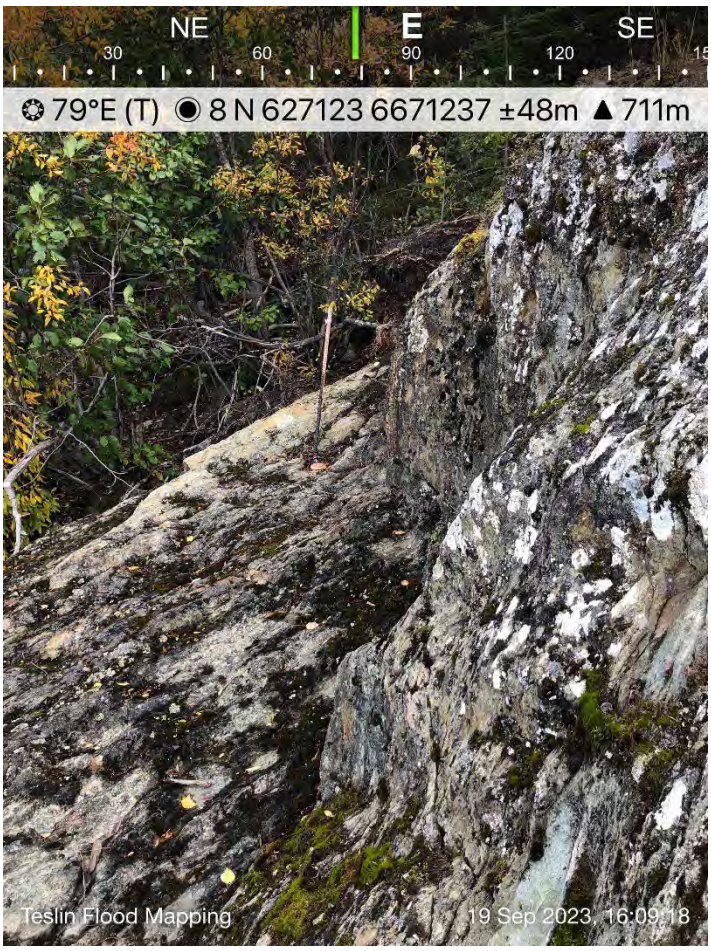


Point ID	Northing	Easting	Elevation	BM Description
337	6671228.15	627138.64	685.83	BM10

Highwater Mark Description:

Benchmark 10 is a brass cap mounted in bedrock. The bedrock is located Approximately 540 meters from the highway on the southwest side of the Teslin Bridge near a water gauge structure.





Point ID	Northing	Easting	Elevation	BM Description
338	6671227.88	627132.96	684.40	BM13

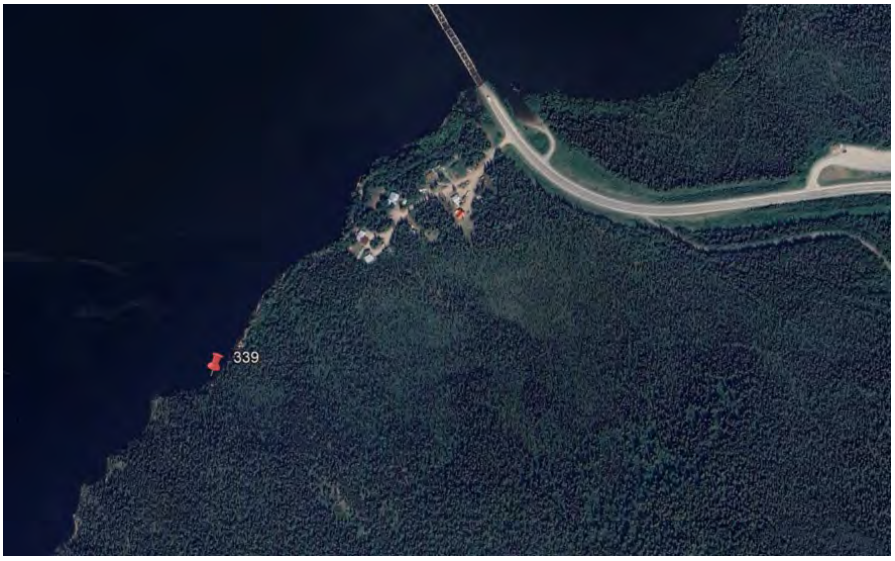
Highwater Mark Description:
Benchmark 13 is a brass cap mounted in bedrock. The bedrock is located Approximately 540 meters from the highway on the southwest side of the Teslin Bridge near a water gauge structure.





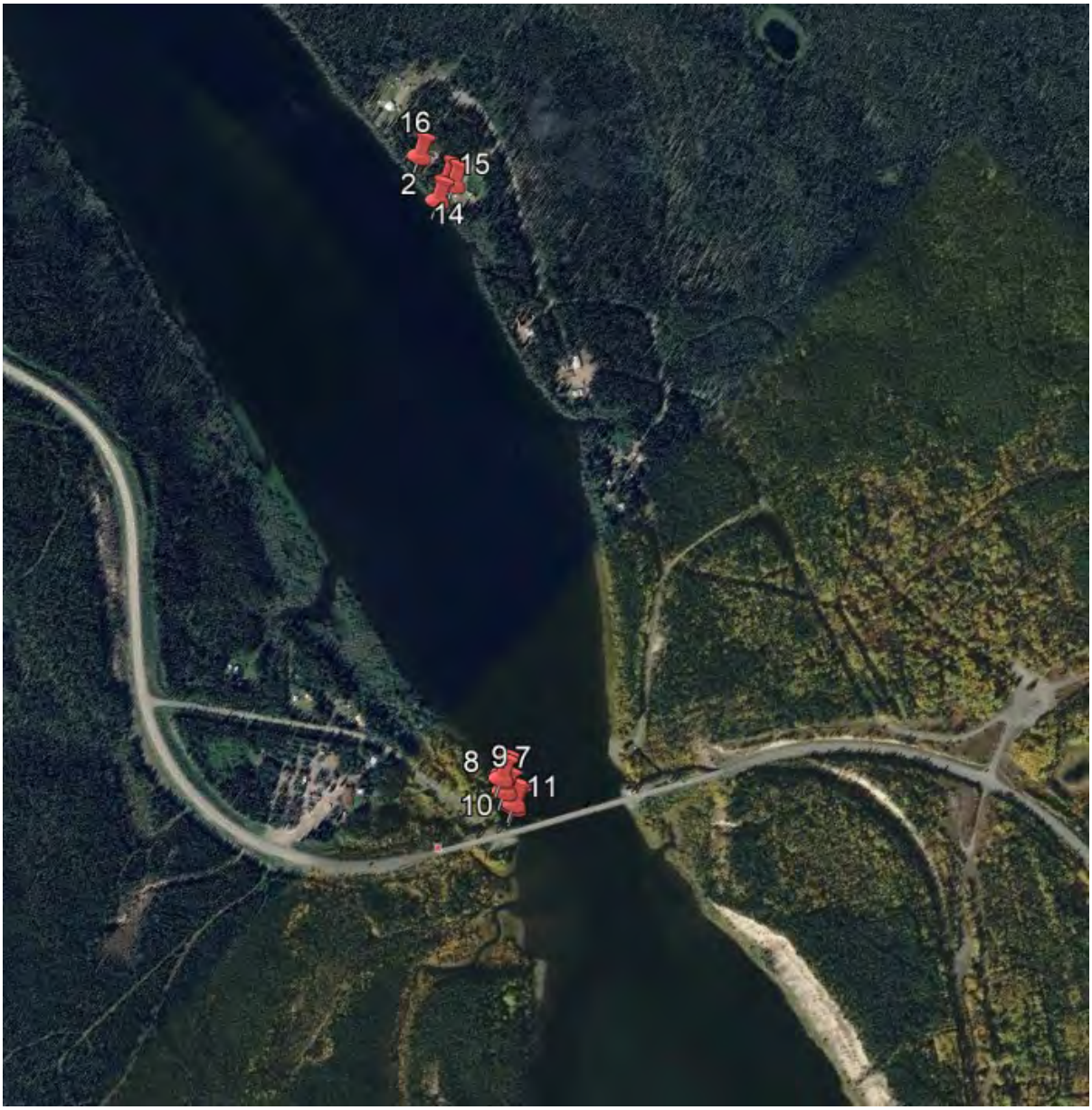
Point ID	Northing	Easting	Elevation	BM Description
339	6671225.60	627126.29	683.32	BM12

Highwater Mark Description:
Benchmark 12 is rebar mounted in bedrock. The bedrock is located Approximately 540 meters from the highway on the southwest side of the Teslin Bridge near a water gauge structure.





Johnson Crossing – Highwater Marks




8
7
9
11
10
Image © 2024 Airbus
Image © 2024 CNES / Airbus


16
15
2
14

Point ID	Northing	Easting	Elevation	BM Description
2	6707147.80	592502.32	681.05	WE

Highwater Mark Description:
Waters edge on the east side of the river, north of the Johnson Crossing bridge.



Point ID	Northing	Easting	Elevation	BM Description
7	6706599.51	593209.36	682.57	HWM STUMP

Highwater Mark Description:

On a stump, staining caused by highwater levels. Located on the west riverbank, just north of the bridge.

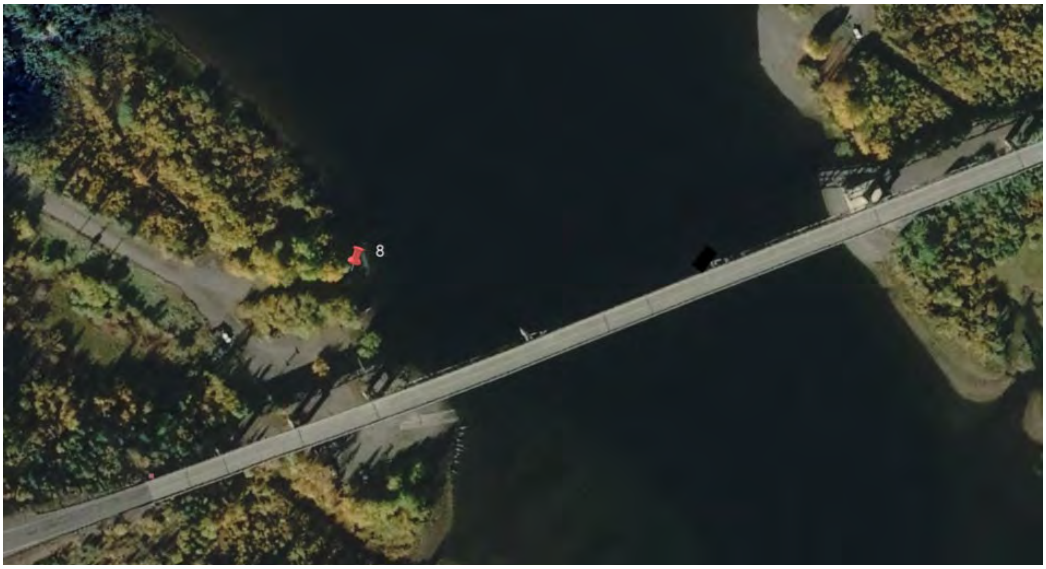




Point ID	Northing	Easting	Elevation	BM Description
8	6706593.76	593212.90	682.68	HWM2 SHORE

Highwater Mark Description:

Original ground erosion caused by highwater. Located on the west riverbank, just north of the bridge.





Point ID	Northing	Easting	Elevation	BM Description
9	6706583.06	593229.74	682.59	HWM2 SHORE

Highwater Mark Description:

Original ground erosion caused by highwater. Located on the west riverbank, just north of the bridge.





Point ID	Northing	Easting	Elevation	BM Description
10	6706577.54	593257.96	683.85	HWM2 PILE

Highwater Mark Description:

On an old dock pile, staining caused by highwater levels. Located on the west riverbank, just north of the bridge.





Point ID	Northing	Easting	Elevation	BM Description
11	6706580.87	593252.89	683.95	HWM2 PILE

Highwater Mark Description:

On an old dock pile, staining caused by highwater levels. Located on the west riverbank, just north of the bridge.





Point ID	Northing	Easting	Elevation	BM Description
14	6707182.38	592501.40	686.84	HWM1 STAFF GAUGE AT 60

Highwater Mark Description:

On a homemade staff gauge at 60cm mark. Located on the east riverbank, north of the bridge.





Point ID	Northing	Easting	Elevation	BM Description
15	6707179.21	592489.82	685.63	HWM1 SLUMP

Highwater Mark Description:

On original ground, erosion caused by highwater levels. Located on the east riverbank, north of the bridge.





Point ID	Northing	Easting	Elevation	BM Description
16	6707176.86	592431.05	684.82	HWM1 STAIRS

Highwater Mark Description:

On stairs in front a home, staining caused by highwater levels. Located on the east riverbank, north of the bridge.





Brooks Brook – Highwater Marks



Point ID	Northing	Easting	Elevation	BM Description
100	6699125.96	599401.04	690.97	CULVERT TOP DIAM 3.7M

Highwater Mark Description:

On top of a culvert with a diameter of 3.7m. Located on the west side of the highway.





Point ID	Northing	Easting	Elevation	BM Description
101	6699117.91	599399.60	687.70	WE

Highwater Mark Description:

At the waters edge of Brooks Brook. Located on the west of the highway.





Point ID	Northing	Easting	Elevation	BM Description
102	6699118.71	599402.50	687.82	HWM3

Highwater Mark Description:

At the highwater mark on Brooks Brook where the original ground has eroded. Located on the west of the highway.





Point ID	Northing	Easting	Elevation	BM Description
103	6698950.54	599152.80	686.35	HWM4 POLE

Highwater Mark Description:

On a wooden pole, staining caused by highwater. Located west of the highway, neat the edge of Teslin Lake.



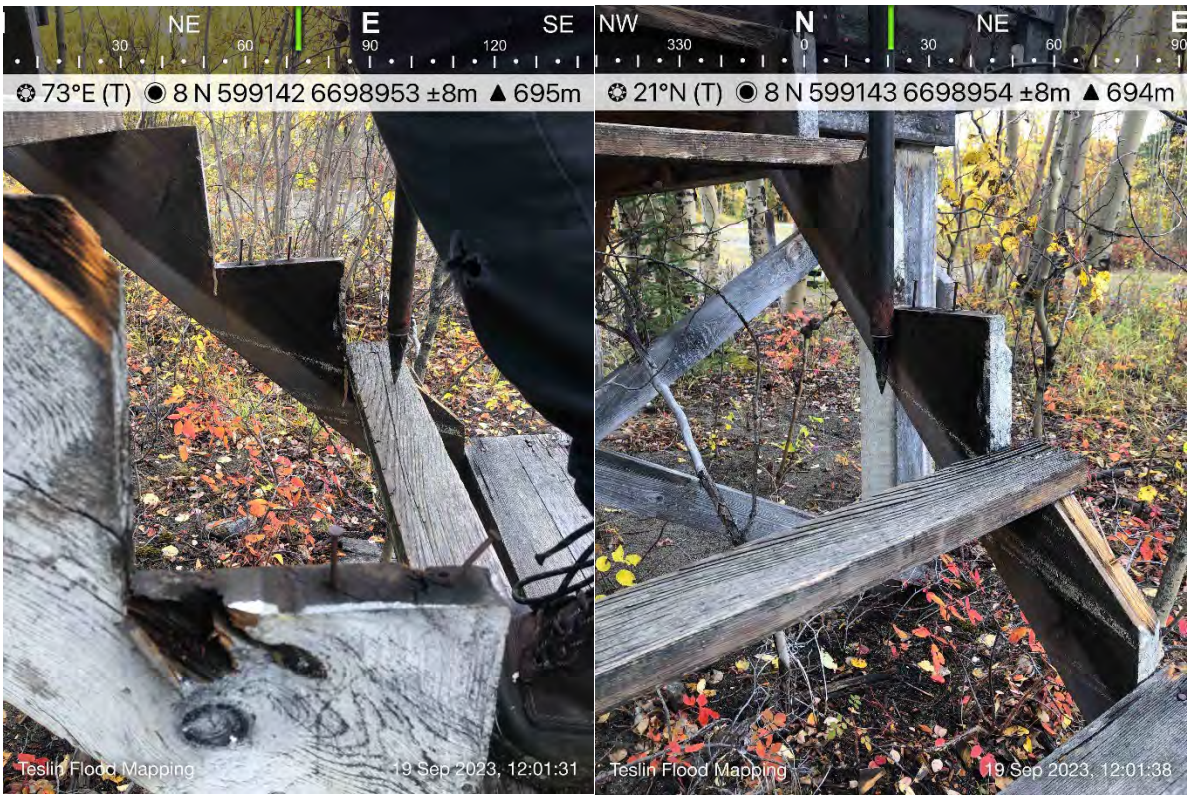


Point ID	Northing	Easting	Elevation	BM Description
104	6698955.62	599146.47	686.63	HWM4 SHACK

Highwater Mark Description:

On a wooden shack staircase, staining caused by highwater. Located west of the highway, neat the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
105	6698950.34	599145.92	686.78	HWM4 VEGETATION

Highwater Mark Description:

On a tree, staining caused by highwater. Located west of the highway, neat the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
106	6698941.88	599134.21	686.78	HWM4 FRAME

Highwater Mark Description:

On a wooden structure, staining caused by highwater. Located west of the highway, neat the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
107	6698931.50	599123.19	686.70	HWM4 VEG

Highwater Mark Description:

On a tree, staining caused by highwater. Located west of the highway, neat the edge of Teslin Lake.



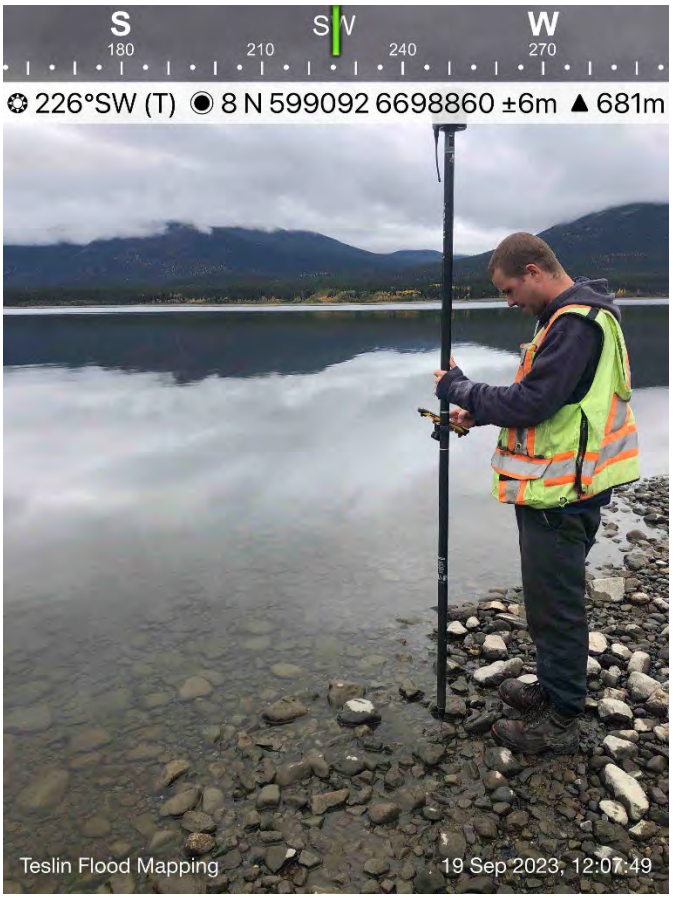


Point ID	Northing	Easting	Elevation	BM Description
108	6698862.24	599097.33	681.29	HWM4 WE

Highwater Mark Description:

At the waters edge of Teslin Lake.





Deadman Creek – Highwater Marks

Flood Highwater Mark and
Benchmark Locations



Point ID	Northing	Easting	Elevation	BM Description
200	6690915.60	606806.38	687.92	LOWER CORD

Highwater Mark Description:

On top of the bridge concrete on the downstream side. Measured down 52cm to the lower cord of the bridge. Located at Deadman Creek.





Point ID	Northing	Easting	Elevation	BM Description
201	6690899.29	606811.68	687.83	LOWER CORD

Highwater Mark Description:

On top of the bridge concrete on the downstream side. Measured down 52cm to the lower cord of the bridge. Located at Deadman Creek.





Point ID	Northing	Easting	Elevation	BM Description
202	6690897.19	606824.54	687.80	LOWER CORD

Highwater Mark Description:

On top of the bridge concrete on the upstream side. Measured down 52cm to the lower cord of the bridge. Located at Deadman Creek.





Point ID	Northing	Easting	Elevation	BM Description
203	6690913.64	606819.21	687.88	LOWER CORD

Highwater Mark Description:

On top of the bridge concrete on the upstream side. Measured down 52cm to the lower cord of the bridge. Located at Deadman Creek.





Point ID	Northing	Easting	Elevation	BM Description
204	6690900.58	606806.39	684.85	HWM5

Highwater Mark Description:

On original ground where highwater has caused erosion. Located downstream of bridge.



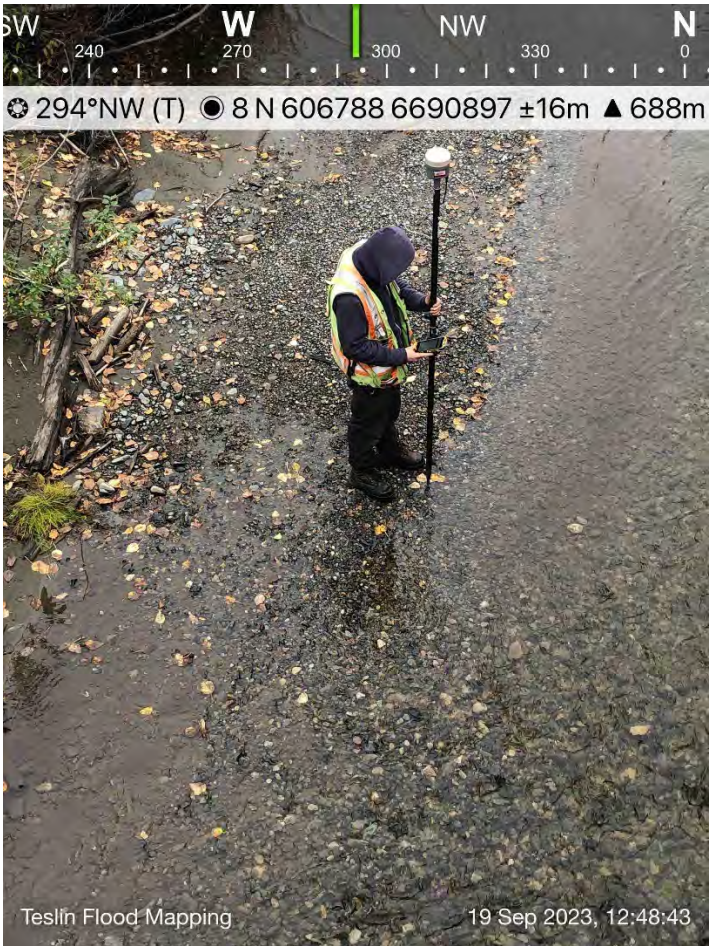


Point ID	Northing	Easting	Elevation	BM Description
205	6690904.41	606804.72	683.58	WE

Highwater Mark Description:

At waters edge of Deadman Creek. Located downstream of bridge.





North of Teslin – Highwater Marks



Point ID	Northing	Easting	Elevation	BM Description
300	6673734.11	622105.34	686.58	HWM6 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located north of Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
301	6673725.51	622102.51	686.17	HWM6 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located north of Teslin, on the west side of the highway, near the Teslin Lake.







Point ID	Northing	Easting	Elevation	BM Description
302	6673726.62	622067.03	681.32	WE

Highwater Mark Description:

Waters edge on Teslin Lake. Located north of Teslin.



Teslin – Highwater Marks



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Point ID	Northing	Easting	Elevation	BM Description
303	6672792.18	624496.53	686.79	HWM7 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located north of Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
304	6672799.68	624481.81	686.82	HWM7 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located north of Teslin, on the west side of the highway, near the Teslin Lake.



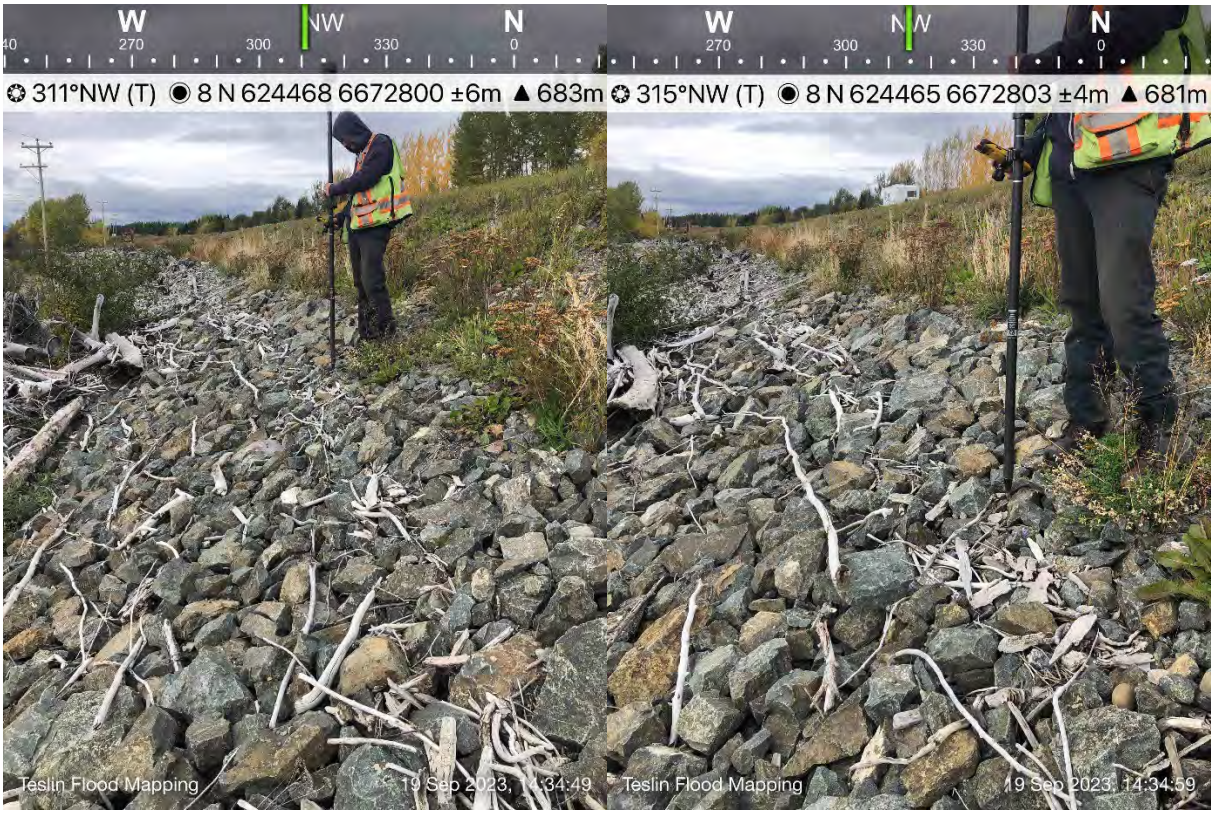


Point ID	Northing	Easting	Elevation	BM Description
305	6672808.16	624464.25	686.78	HWM7 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located north of Teslin, on the west side of the highway, near the Teslin Lake.



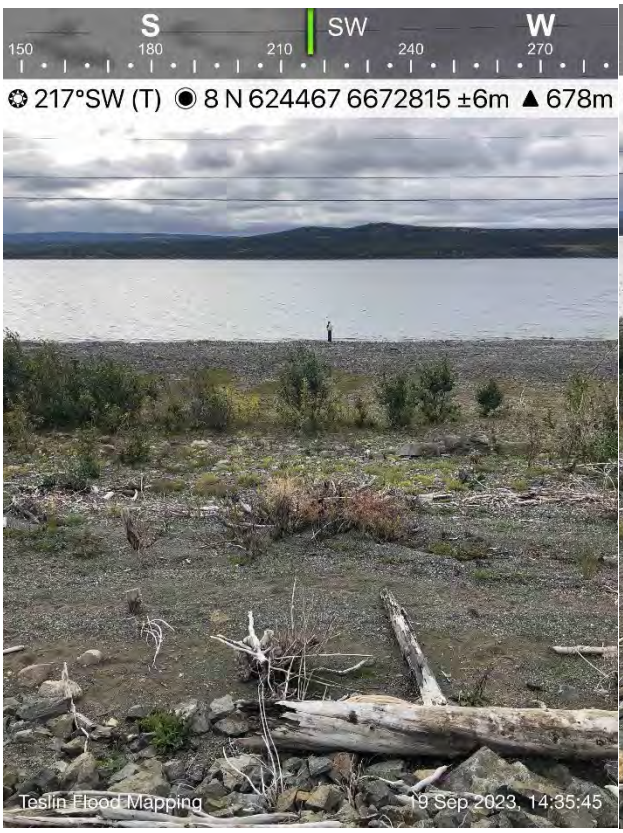


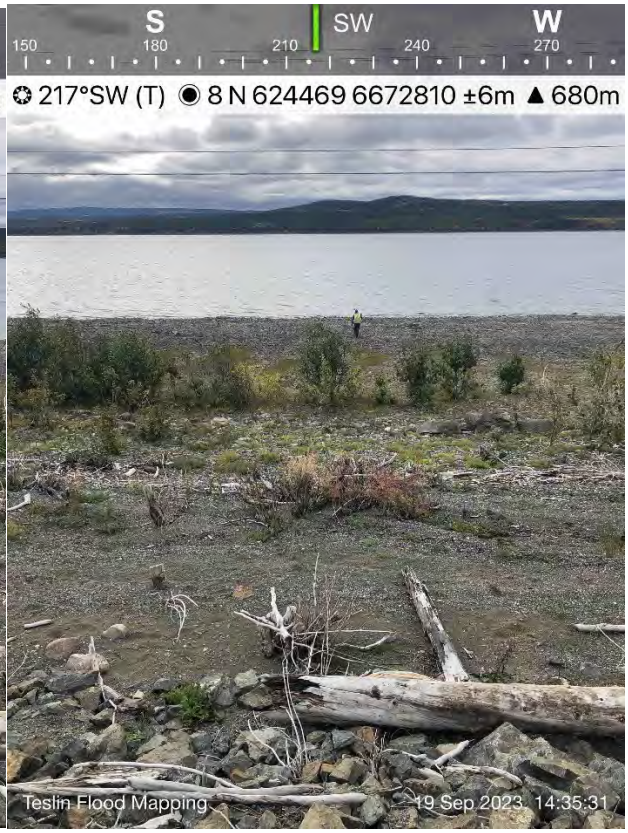
Point ID	Northing	Easting	Elevation	BM Description
306	6672754.10	624444.20	681.29	WE

Highwater Mark Description:

Waters edge on Teslin Lake. Located north of Teslin.







Point ID	Northing	Easting	Elevation	BM Description
308	6672413.43	625377.58	687.40	HWM8 TOP RIPRAP
309	6672413.98	625373.72	686.37	HWM8 TOE RIPRAP

Highwater Mark Description:

At top and toe of Riprap. Located in Teslin.





Point ID	Northing	Easting	Elevation	BM Description
307	6672402.12	625378.17	687.32	HWM8 TOP RIPRAP
310	6672401.94	625374.09	686.28	HWM8 TOE RIPRAP

Highwater Mark Description:

At top and toe of Riprap. Located in Teslin.







Point ID	Northing	Easting	Elevation	BM Description
311	6672306.68	625374.37	687.31	HWM9 TOP RIPRAP
314	6672307.04	625369.83	684.99	HWM9 TOE RIPRAP

Highwater Mark Description:

At top and toe of Riprap. Located in Teslin.





Point ID	Northing	Easting	Elevation	BM Description
312	6672293.04	625373.97	687.33	HWM9 TOP RIPRAP
313	6672293.81	625368.80	685.04	HWM9 TOE RIPRAP

Highwater Mark Description:

At top and toe of Riprap. Located in Teslin.





Point ID	Northing	Easting	Elevation	BM Description
315	6672266.91	625374.85	686.78	HWM9 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
316	6672248.37	625380.37	686.74	HWM9 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
317	6672233.19	625388.37	686.79	HWM9 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.



Point ID	Northing	Easting	Elevation	BM Description
318	6672166.08	625623.09	686.41	HWM10 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
319	6672167.25	625634.90	686.36	HWM10 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
320	6672124.92	625638.16	681.27	WE

Highwater Mark Description:

Waters edge on Teslin Lake. Located in Teslin.

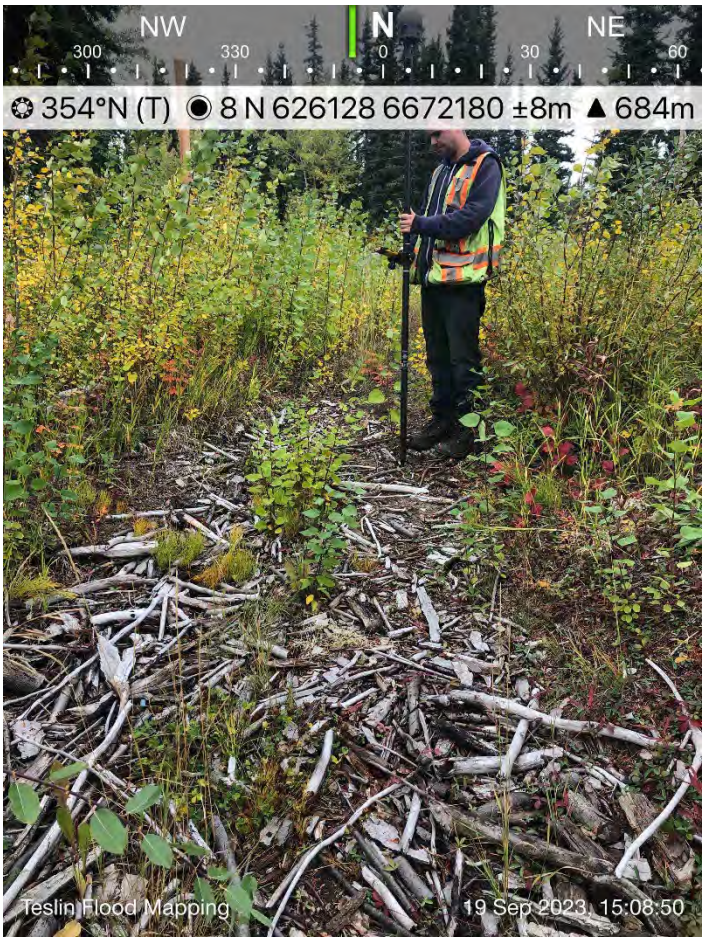


Point ID	Northing	Easting	Elevation	BM Description
321	6672176.11	626139.76	686.64	HWM11 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
322	6672188.46	626132.00	686.58	HWM11 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
323	6672161.21	626144.09	686.65	HWM11 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.



Point ID	Northing	Easting	Elevation	BM Description
324	6671952.77	626458.56	685.52	HWM12 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.



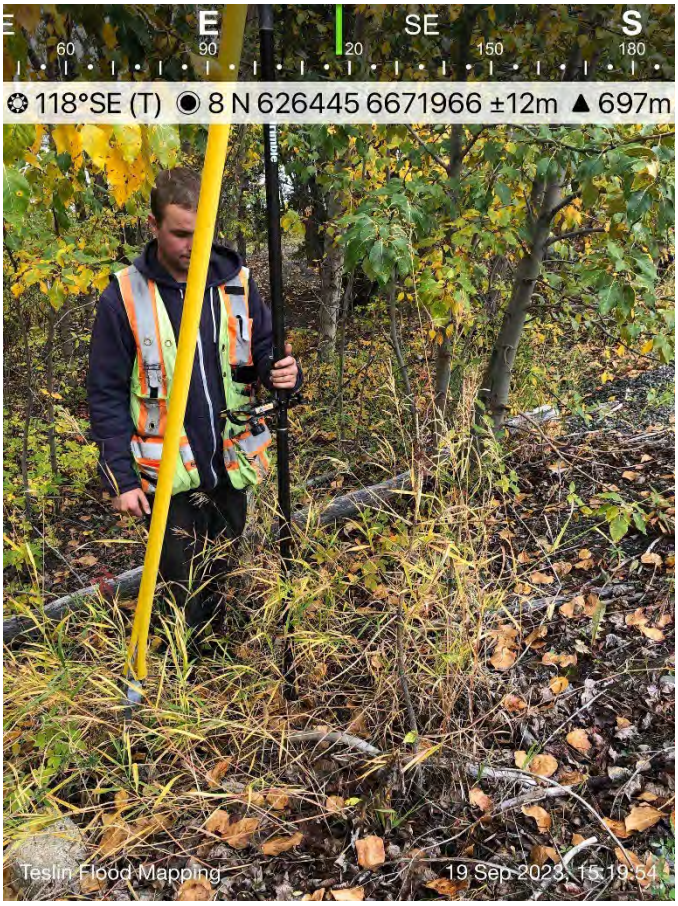


Point ID	Northing	Easting	Elevation	BM Description
325	6671962.26	626454.36	685.50	HWM12 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
326	6671970.04	626451.03	685.69	HWM12 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the west side of the highway, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
327	6671954.96	626520.12	681.26	WE

Highwater Mark Description:

Waters edge on Teslin Lake. Located in Teslin.



Point ID	Northing	Easting	Elevation	BM Description
328	6672328.29	627292.05	684.81	HWM13 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the northeast side of the Teslin bridge, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
329	6672340.28	627285.13	684.49	HWM13 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the northeast side of the Teslin bridge, near the Teslin Lake.



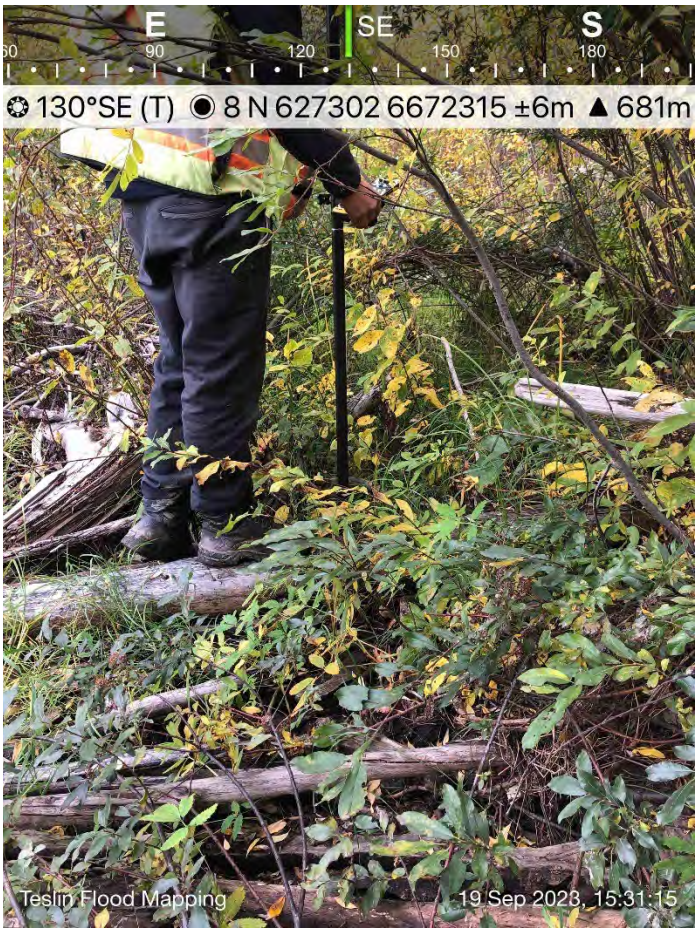


Point ID	Northing	Easting	Elevation	BM Description
330	6672318.14	627306.63	683.96	HWM13 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the northeast side of the Teslin bridge, near the Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
331	6672347.79	627433.39	681.24	WE

Highwater Mark Description:

Waters edge on Teslin Lake. Located in Teslin, on the northeast side of the Teslin Bridge.



Point ID	Northing	Easting	Elevation	BM Description
332	6672836.76	627117.33	686.52	HWM14 TREE

Highwater Mark Description:

On a tree, staining caused by highwater. Located east of the highway in Teslin, near the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
333	6672827.97	627122.76	685.89	HWM14 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the east side of the highway.

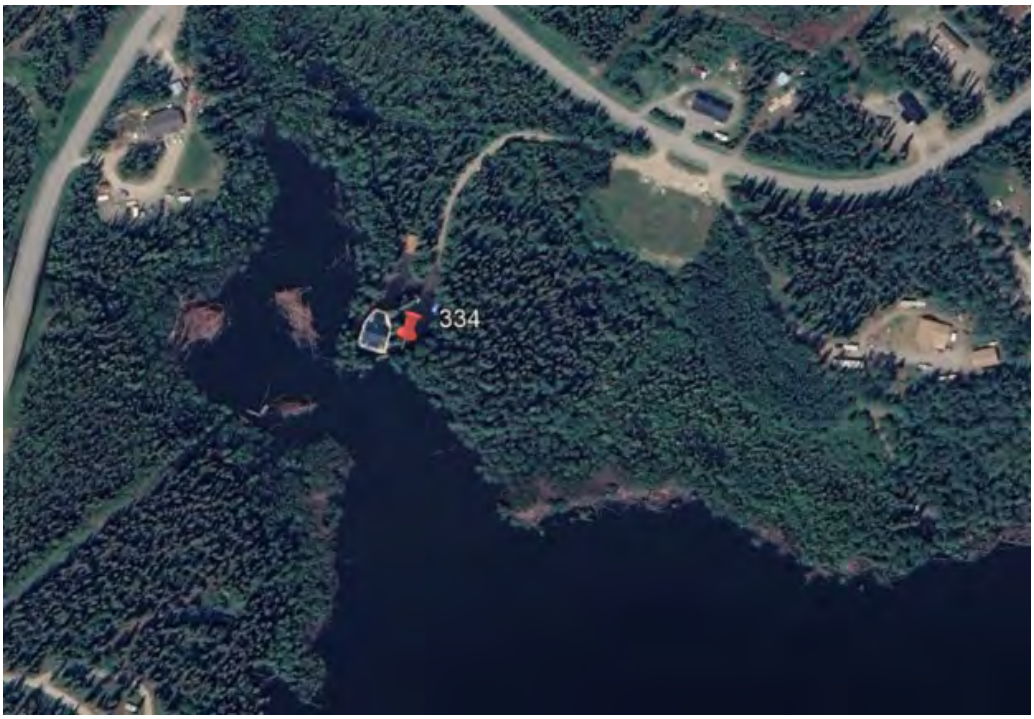




Point ID	Northing	Easting	Elevation	BM Description
334	6672822.29	627118.57	685.71	HWM14 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the east side of the highway.





Point ID	Northing	Easting	Elevation	BM Description
335	6672812.59	627109.40	685.61	HWM14 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the east side of the highway.





Point ID	Northing	Easting	Elevation	BM Description
336	6672809.06	627092.04	684.85	HWM14 DRIFTWOOD

Highwater Mark Description:

Where driftwood collected, caused by highwater. Located in Teslin, on the east side of the highway.





South of Teslin – Highwater Marks



Point ID	Northing	Easting	Elevation	BM Description
400	6666073.69	636706.02	686.68	HWM15 TREE

Highwater Mark Description:

On a tree, staining caused by highwater. Located west of the highway south of Teslin, near the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
401	6666084.19	636706.11	686.78	HWM15 POWER POLE

Highwater Mark Description:

On a power pole, staining caused by highwater. Located west of the highway south of Teslin, near the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
402	6666058.28	636743.52	686.73	HWM15 WOODSHED

Highwater Mark Description:

On a wood pile, staining caused by highwater. Located west of the highway south of Teslin, near the edge of Teslin Lake.





Point ID	Northing	Easting	Elevation	BM Description
403	6666039.25	636738.54	686.70	HWM15 TREE

Highwater Mark Description:

On a tree, staining caused by highwater. Located west of the highway south of Teslin, near the edge of Teslin Lake.





Appendix C

Flood Frequency Analysis Data Preparation and De-correlation

This Appendix includes documentation of decorrelated annual maximum instantaneous water level dataset and de-correlation calculations completed for the Teslin Lake water level flood frequency analysis. Station 09AE001 and 09AE002 data from Water Survey of Canada were used.

De-correlation Calculations

In the Frequency Analysis of a Sequence of Dependent and/or Non-Stationary Hydro-meteorological Observations: a Review Journal of Hydrology, Vol 339, Issue 3-4 by Kaliq, M.N., T.B.M.J. Ouarda, J.C. Gachon and B. Bobee (2007), a de-correlation method is discussed for the first order correlated dataset. The formula removes year to year correlations by subtracting the multiplication of order 1 autocorrelation coefficient with the previous year values (formula is shown below). The decorrelated values are presented in Table C-1 with the correlated values.

$$y'_t = y_t - \hat{r}_1 \cdot y_{t-1}$$

Where:

y'_t is the decorrelated value of the observation at time *t*;

$\hat{r}_1$ is the estimated autocorrelation coefficient of order 1 from the sample y_1, y_2, …y_n; and

y_t and y_{t-1} are observations at time points *t* and *t-1*, respectively.

After the de-correlation is completed, the data is used to complete the flood frequency analysis. The flood frequency results can be re-transformed using the following equation:

$$y_T = y'_T + (\hat{r}_1 * y_{50})$$

Where:

y'_T is the quantile value of the transformed data series for recurrence interval, *T*;

y_T is the inverted (re-transformed) quantile value for recurrence interval, *T*; and

y_{50} is the median value of the original series of observations.

As discussed above, the dataset is required to be analyzed using a statistical dependent test and the test results are shown in Table 4-3 in the Teslin Flood Mapping Study Final Report. For the statistical dependent test equations, it is added in Appendix B with other statistical tests that were completed for the flood frequency analysis datasets.

Table C-1 Teslin Lake Decorrelated Values and Correlated Values for Entire Period

Year	Correlated Values (m)	Decorrelated Values (m)
1944	6.924	6.924
1945	6.665	4.726
1946	6.543	4.677
1947	8.313	6.481
1948	7.794	5.467
1949	7.331	5.149
1950	5.930	3.877
1951	6.796	5.136
1952	6.860	4.957
1953	5.966	4.045
1954	7.178	5.507
1955	7.263	5.253
1956	6.378	4.344
1957	8.227	6.441
1958	6.005	3.702
1959	7.102	5.420
1960	7.055	5.067
1961	8.566	6.591
1962	9.650	7.251
1963	7.855	5.154
1964	8.838	6.638
1965	6.762	4.288
1966	7.031	5.138
1967	7.900	5.932
1968	6.640	4.428
1969	6.747	4.888
1970	6.461	4.572
1971	7.467	5.658
1972	8.450	6.359
1973	7.105	4.738
1974	6.772	4.783
1975	7.089	5.193
1976	7.781	5.796
1977	7.757	5.579
1978	5.570	3.398
1979	7.492	5.932
1980	6.485	4.387
1981	7.129	5.313
1982	6.700	4.704
1983	6.255	4.379

Table C-1 Teslin Lake Decorrelated Values and Correlated Values for Entire Period

Year	Correlated Values (m)	Decorrelated Values (m)
1984	6.475	4.724
1985	7.371	5.558
1986	7.103	5.039
1987	7.129	5.140
1988	7.365	5.369
1989	6.078	4.016
1990	7.690	5.988
1991	6.490	4.337
1992	8.778	6.961
1993	6.724	4.266
1994	7.003	5.120
1995	5.266	3.305
1996	5.917	4.443
1997	6.331	4.674
1998	5.984	4.211
1999		
2000	6.482	4.806
2001	7.362	5.547
2002	6.348	4.287
2003	5.934	4.157
2004	7.087	5.425
2005	7.654	5.670
2006	8.069	5.926
2007	8.183	5.924
2008	7.588	5.297
2009	8.052	5.927
2010	5.757	3.502
2011	6.574	4.962
2012	7.732	5.891
2013	7.968	5.803
2014	6.729	4.498
2015	6.992	5.108
2016	6.417	4.459
2017	5.669	3.872
2018	5.94	4.353
2019	5.656	3.993
2020	7.265	5.681
2021	8.688	6.654
2022	9.395	6.962

Appendix D

Flood Frequency Analysis

This appendix includes flood frequency analysis of Teslin Lake (Station 09AE002) and Teslin River (Station 09AE001). Teslin Lake data consisted of recorded/derived and de-correlated annual maximum instantaneous water levels (de-correlation methodology is presented in Appendix C). Teslin River data consisted of recorded/derived annual maximum instantaneous flows. All three datasets were analyzed using the same methodology to derive the flood frequency estimates used for flood mapping. Recorded/derived Teslin Lake dataset was picked as an example to demonstrate the overall methodology for the flood frequency analysis. Numerical test comparison between different flood frequency distributions for each dataset and final flood frequency estimates for the decorrelated Teslin Lake data is presented at the end of the appendix.

Recorded/derived Data

Table D-1 Statistical Tests for Trend and Jumps

Stationarity

Test for Trend:

Choose Significance Level (alpha): 5%

1) Spearman Rank Order Correlation Coefficient

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}.$$

H_0= Data has no trend

Spearman Correlation Coefficient:	-0.093

based on z: No Significant Trend at 0.05 Significance Level

When there are no ties in rankings: based on t: No Significant Trend at 0.05 Significance Level

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}.$$

Spearman Correlation Coefficient:	-0.093	T (Adjustment for ties) =	0.5
t-distribution value	-0.818	Standard Normal (z)=	-0.811
Degrees of freedom	76		

Tests for Jump:

2) Mann-Whitney Test for jump (a.k.a. Mann-Whitney U test)

Index number of subsample divide	20

H_0= Independent samples drawn from the same population (No Jump)

$$U_1 = R_1 - \frac{n_1(n_1 + 1)}{2}$$

Number of values in sample 1 n_1=	20
Number of values in sample 2 n_2=	58
Total of Ranking in sample 1 R_1=	863
Total of Ranking in sample 2 R_2=	2218
U_1=	653

No Jump at 0.05 Significance Level

$$U_1 + U_2 = n_1 n_2.$$

U_2=	507
U (Minimum of U_1 and U_2)=	507
Standard Normal (z)=	-0.835

3) Wald-Wolfowitz Test (The runs test)

$$\mu = \frac{2 N_+ N_-}{N} + 1, \qquad \sigma^2 = \frac{2 N_+ N_- (2 N_+ N_- - N)}{N^2 (N-1)} = \frac{(\mu - 1)(\mu - 2)}{N - 1}.$$

Number of data greater than median N_+ =	39
Number of data less than median N_- =	39
Total number of runs =	32

H_0= Data represent sample of single independently distributed random variable (No Jump)

Mean =	40.0
Variance =	19.2
Standard Normal (z)=	-1.9

No Jump at 0.05 Significance Level

Table D-2 Statistical Tests for Homogeneity

Homogeneity			
		Choose Significance Level (alpha):	5%
Mann-Whitney Test for homogeneity (a.k.a. Mann-Whitney U test)			
Index number of subsample divide	39		
$U_1 = R_1 - \frac{n_1(n_1+1)}{2}$		H_0= There is homogeneity between samples with respect to probability of random drawing of a larger observation	
		Sample is Homogeneous at 0.05 Significance Level	
Number of values in sample 1 n_1=	39		
Number of values in sample 2 n_2=	39		
Total of Ranking in sample 1 R_1=	1670.5		
Total of Ranking in sample 1 R_2=	1410.5		
U_1=	891		
$U_1 + U_2 = n_1 n_2.$			
U_2=	630.5		
U (Minimum of U_1 and U_2)=	630.5		
Standard Normal (z)=	-1.299		
Terry Test			
Index number of subsample divide	39	H_0= There is homogeneity between samples with respect to probability of random drawing of a larger observation	
Total sample size	78		
Subsample 1 (m)	39		
Subsample 2 (n)	39		
		Sample is Homogeneous at 0.05 Significance Level	
Standard Deviation =	4.368		
Sum of ranks in first subsample c =	-5.992		
z =	-1.372		

Table D-3 Statistical Tests for Outliers

Outliers			
		Significance Level (alpha):	10%
Grubbs and Beck test for Outliers			
1) High Outliers		Assumption: logarithms of sample are normally distributed	
X_h = exp (xmean+K_nS)			
K(n) =-3.62201+6.2844N^1/4-2.49835N^1/2+0.491436N^3/4-0.037911N			
K(n) = -0.9043+3.345*SQRT(log(n))-0.4046log(n)		for 5<n<150	
Sample Size (n) =	78		
K(n) =	2.93		
K(n) for 5<n<150 =	2.93		
X_h=	10.2	< Any value higher than X_h is considered a high outlier	
Maximum Value	9.65		
High Outliers	No High Outliers Present		
2) Low Outliers			
X_h = exp (xmean-K_nS)			
K(n) =-3.62201+6.2844N^1/4-2.49835N^1/2+0.491436N^3/4-0.037911N			
K(n) = -0.9043+3.345*SQRT(log(n))-0.4046log(n)		for 5<n<150	
Sample Size (n) =	78		
K(n) =	2.93		
K(n) for 5<n<150 =	2.93		
X_h=	4.83	< Any value lower than X_h is considered a low outlier	
Minimum Value	5.27		
Low Outliers	No Low Outliers Present		

Table D-4 Statistical Tests for Independence

Independence

		Choose Significance Level (alpha):	5%
1) Spearman Rank Order Correlation Coefficient			
$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}$.		H_0= Data is independent	
Spearman Correlation Coefficient:	0.22	Non-independence Detected at 0.05 Significance Level	
When there are no ties in rankings: $\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$.			
Spearman Correlation Coefficient:	0.22		
t-distribution value	2.03		
Degrees of freedom	76		
2) Wald-Wolfowitz Test			
$R = \sum_{i=1}^{N-1} x_i x_{i+1} + x_1 x_N$			
Statistic R	3930		
Mean	3910	H_0= Data is independent	
Variance	52.3		
		Non-independence Detected at 0.05 Significance Level	
Standard Normal (z)=	2.4		
2) Anderson Test			
$r_1 = \left[\sum_{i=1}^{N-1} x_i x_{i+1} + x_1 x_N - \left(\sum_{i=1}^{N} x_i\right)^2 / N\right] / \left[\sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2 / N\right]$			
Statistic r	0.252		
Mean	-0.013	H_0= Data is independent	
Variance	0.013		
		Non-independence Detected at 0.05 Significance Level	
Standard Normal (z)=	2.3		

Table D-5 Statistical Test of Dependence

Dependent Dataset

		Choose Significance Level (alpha):	5%
Autocorrelation coefficient			
$R_c(\tau) = \frac{\sum_{i=1}^{N-\lvert\tau\rvert} X_i Y_{i+\tau} - \frac{1}{N-\lvert\tau\rvert}\left(\sum_{i=1}^{N-\lvert\tau\rvert} X_i\right)\left(\sum_{i=\tau+1}^{N} Y_i\right)}{\left[\sum_{i=1}^{N-\lvert\tau\rvert} X_i^2 - \frac{1}{N-\lvert\tau\rvert}\left(\sum_{i=1}^{N-\lvert\tau\rvert} X_i\right)^2\right]^{0.5}\left[\sum_{i=1+\lvert\tau\rvert}^{N} Y_i^2 - \frac{1}{N-\lvert\tau\rvert}\left(\sum_{i=1+\lvert\tau\rvert}^{N} Y_i\right)^2\right]^{0.5}}$			
		H_0 - The data is not serially correlated	
One Time Period Offset			
Autocorrelation coefficient offset by one time period	r(1) = 0.271	Serial Correlation Detected at 0.05 Significance Level	
t-distribution values for one time period offset	t = 2.454		
Two Time Periods Offset			
Autocorrelation coefficient offset by two time periods	r(2) = 0.158	No Serial Correlation at 0.05 Significance Level	
t-distribution values for two time periods offset	t = 1.392		

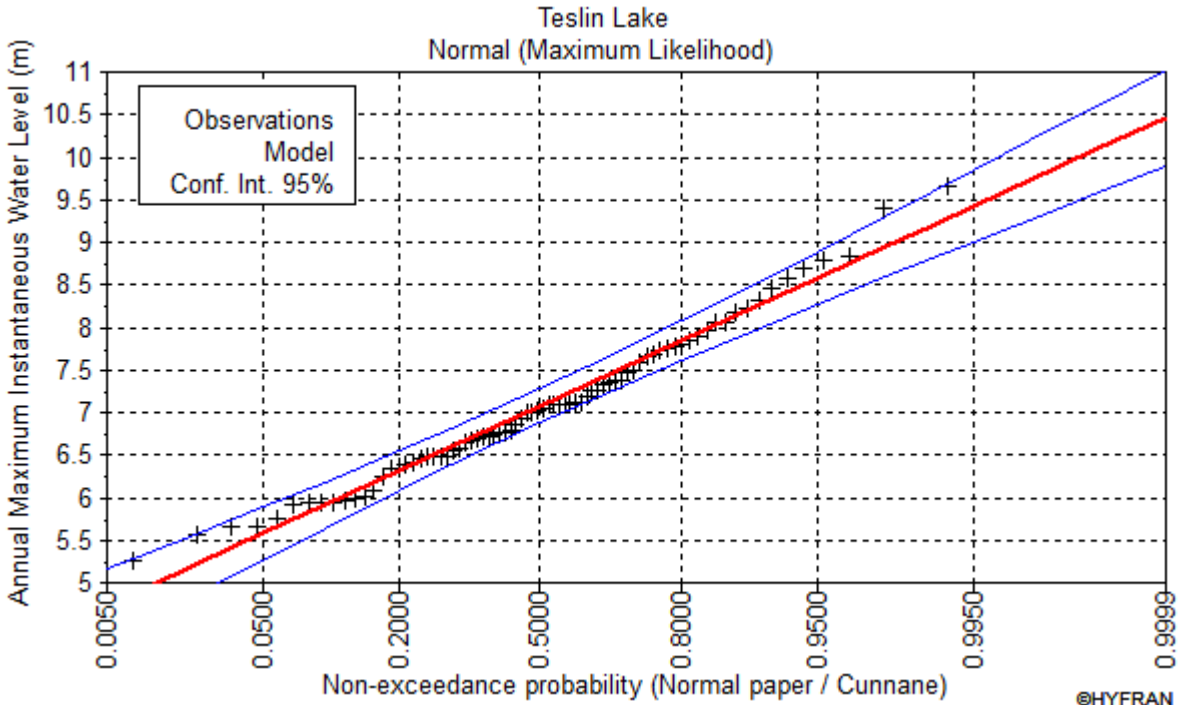


Figure D-1 Normal Distribution Flood Frequency Estimate

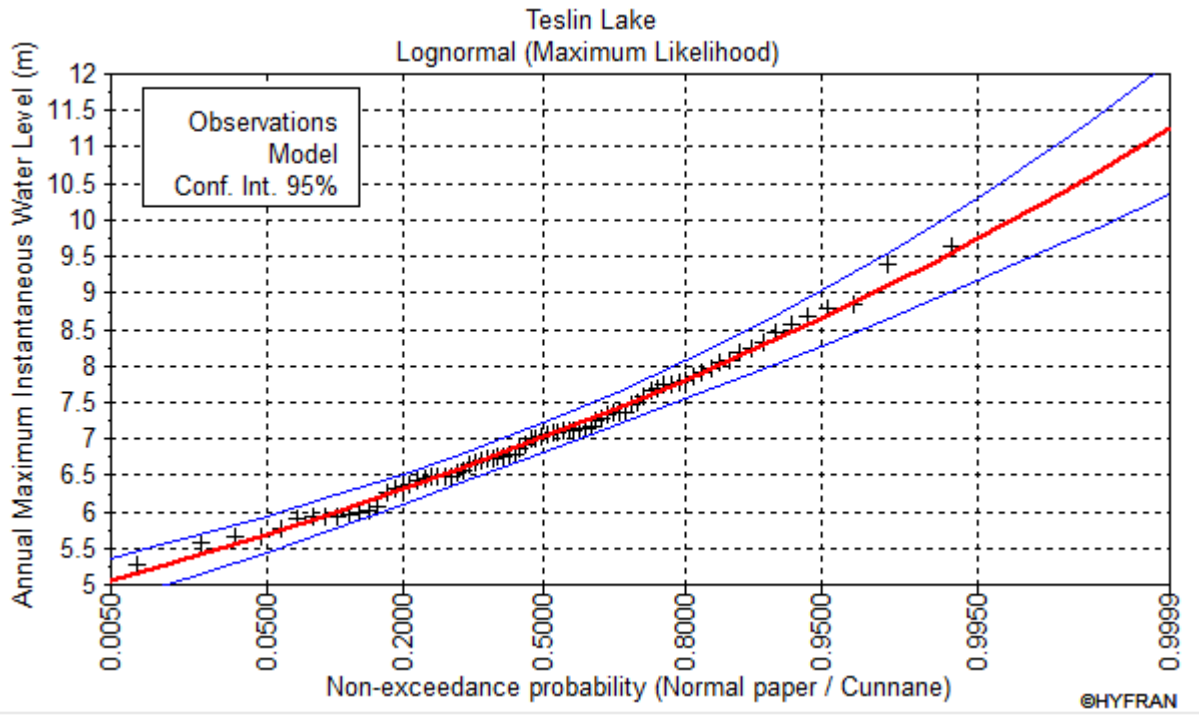


Figure D-2 Log Normal Distribution Flood Frequency Estimate

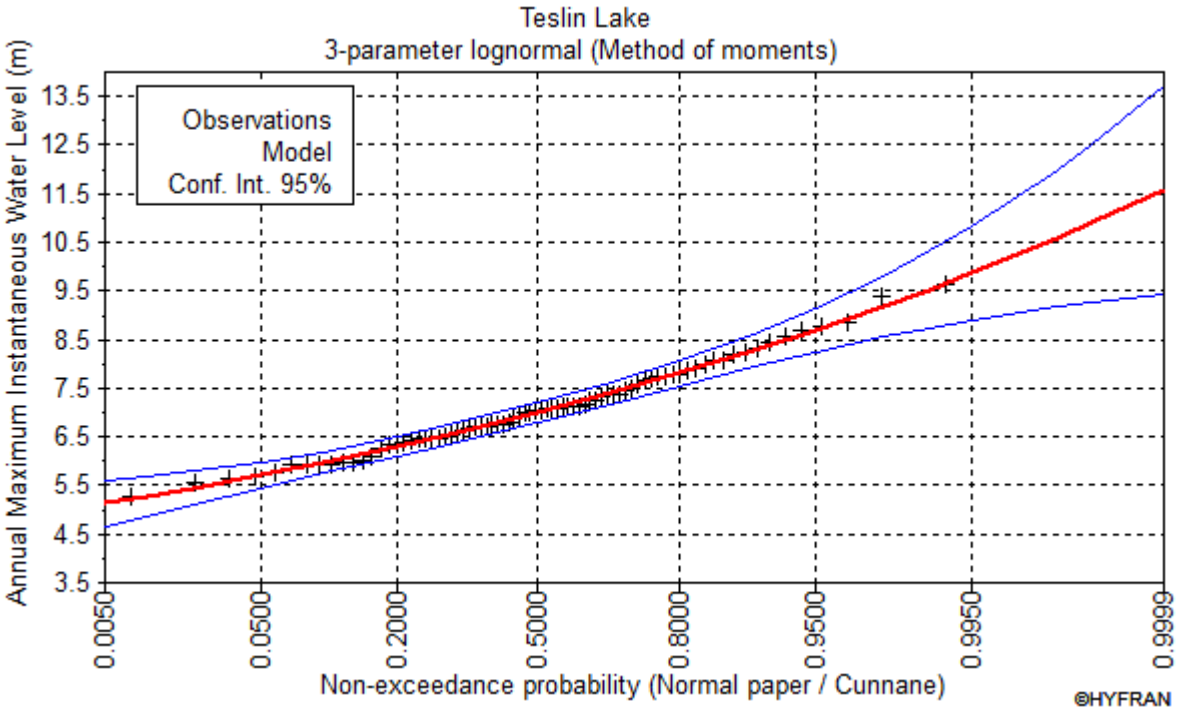


Figure D-3 Three Parameter Log Normal Distribution Flood Frequency Estimate

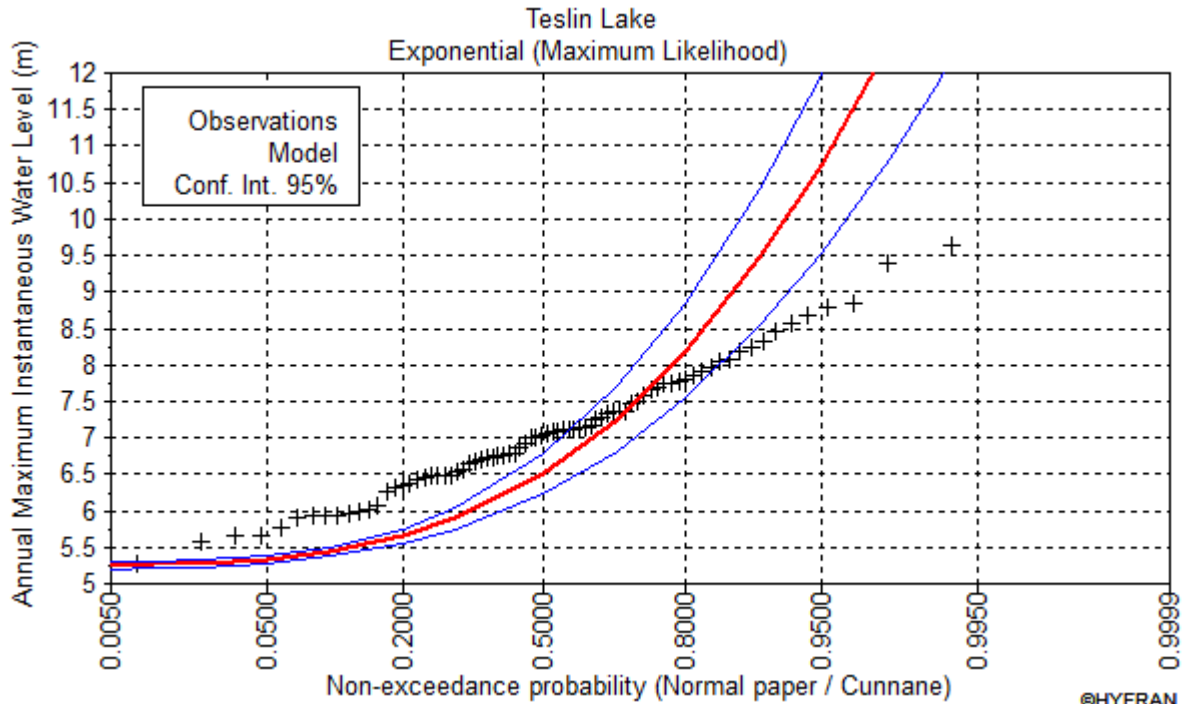


Figure D-4 Exponential Distribution Flood Frequency Estimate

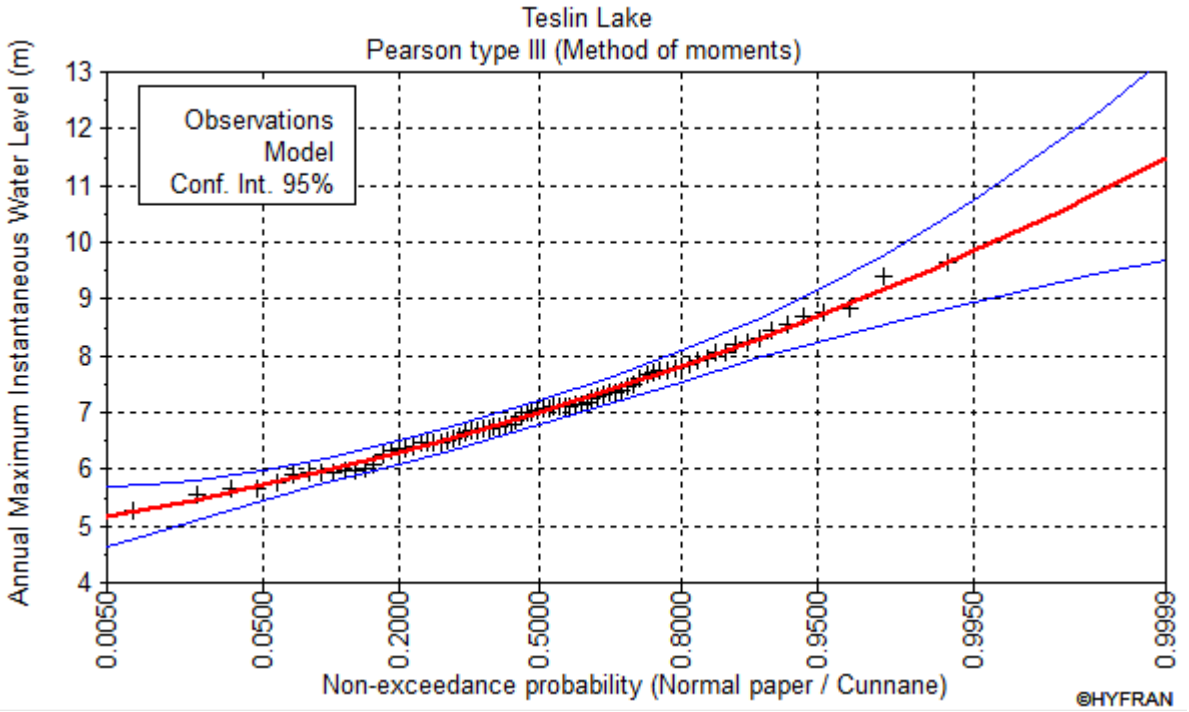


Figure D-5 Pearson 3 Distribution Flood Frequency Estimate

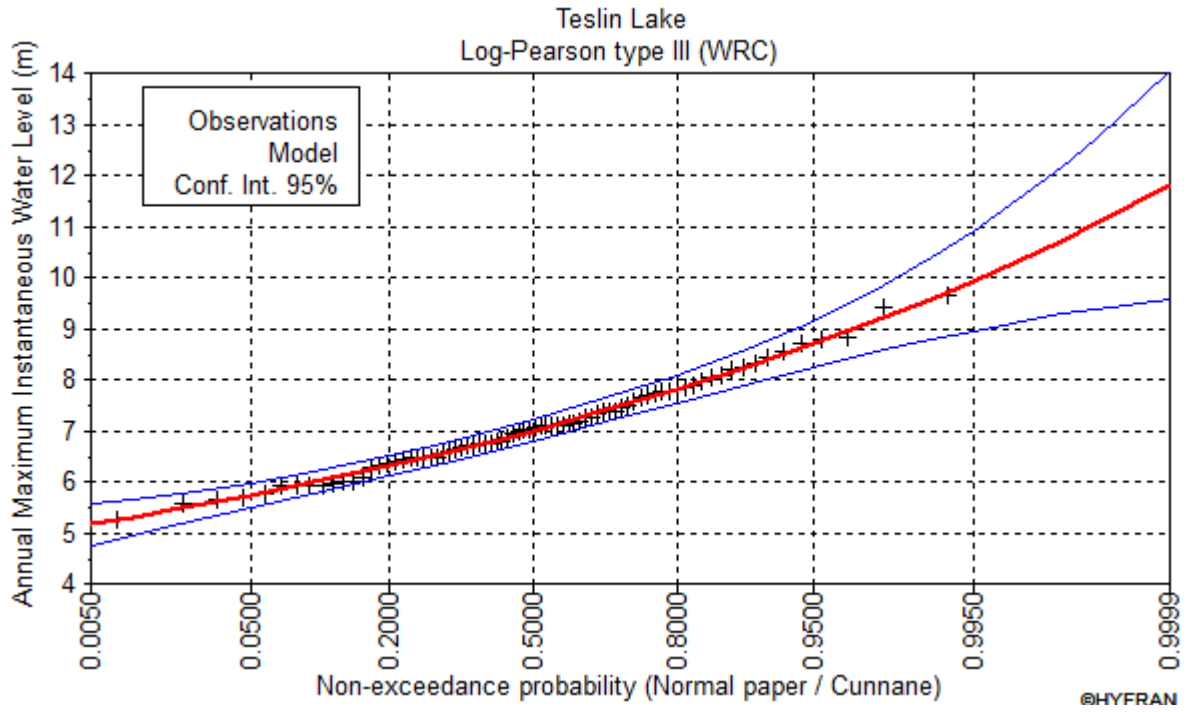


Figure D-6 Log Pearson 3 Distribution Flood Frequency Estimate

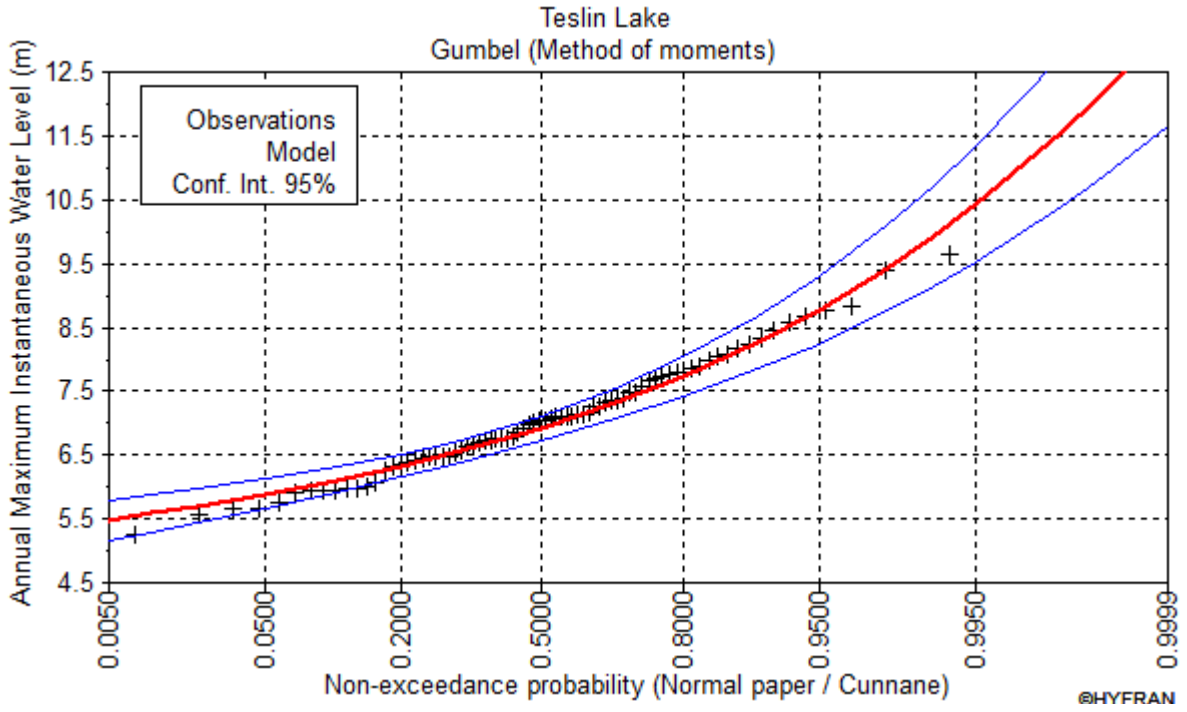


Figure D-7 Gumbel Distribution Flood Frequency Estimates

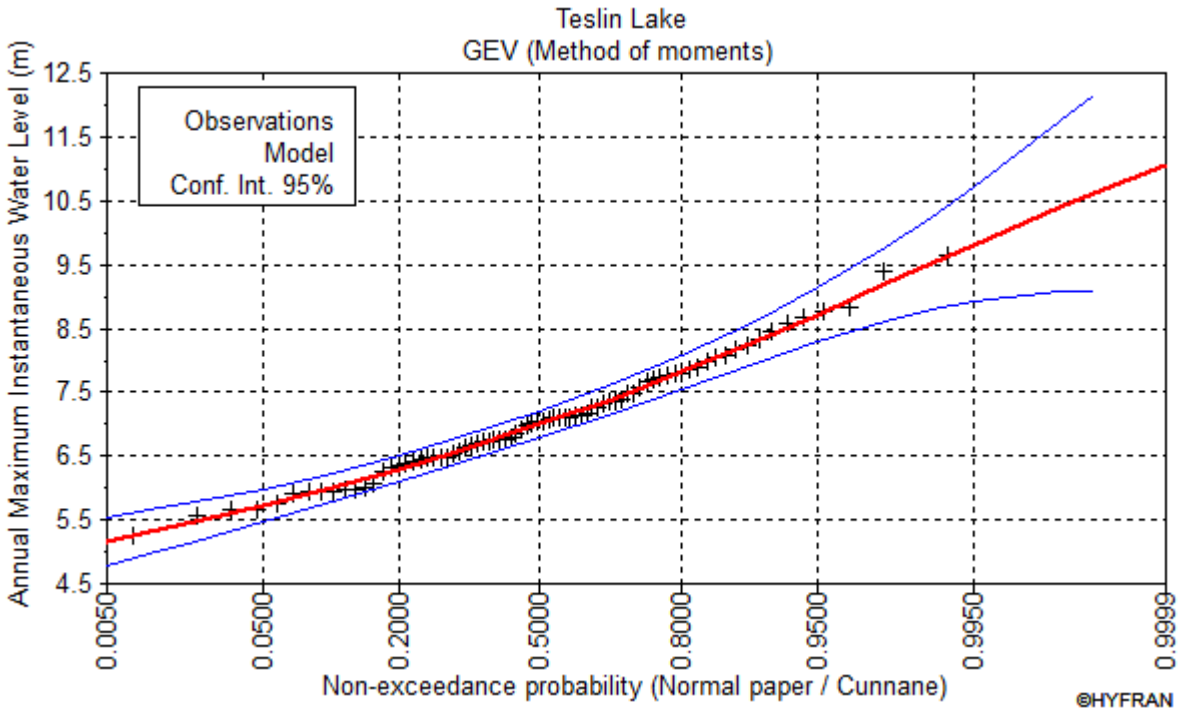


Figure D-8 General Extreme Value Distribution Flood Frequency Estimates

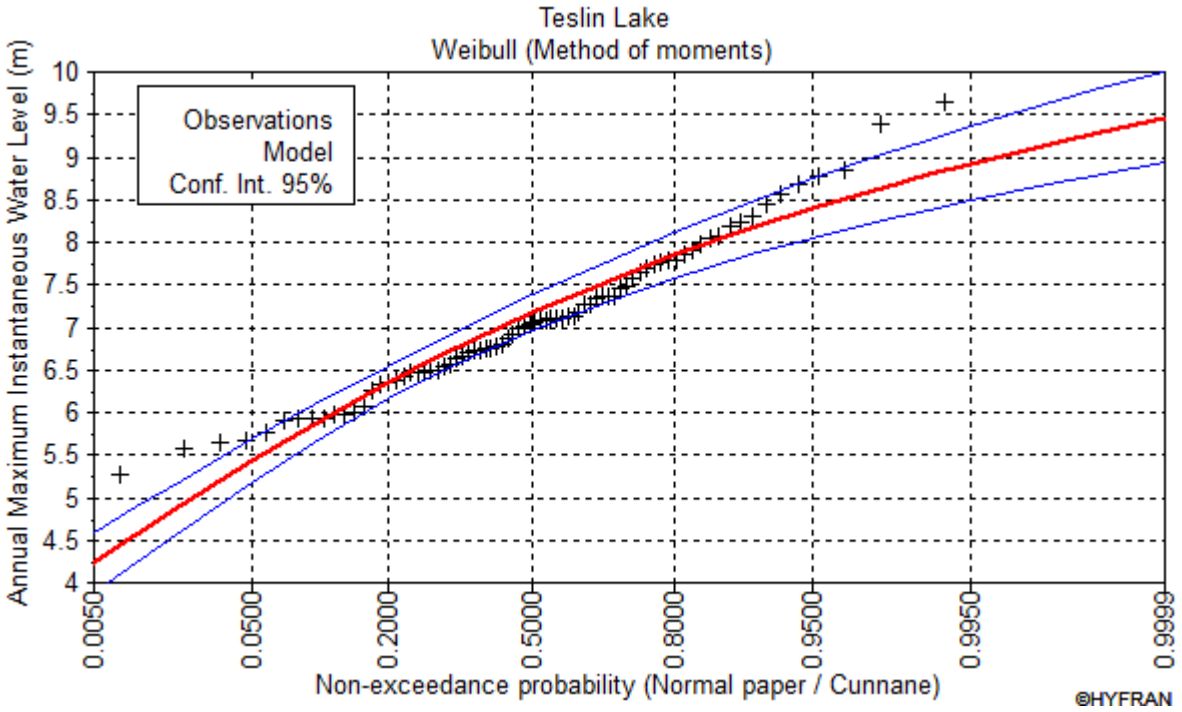


Figure D-9 Weibull Distribution Flood Frequency Estimates

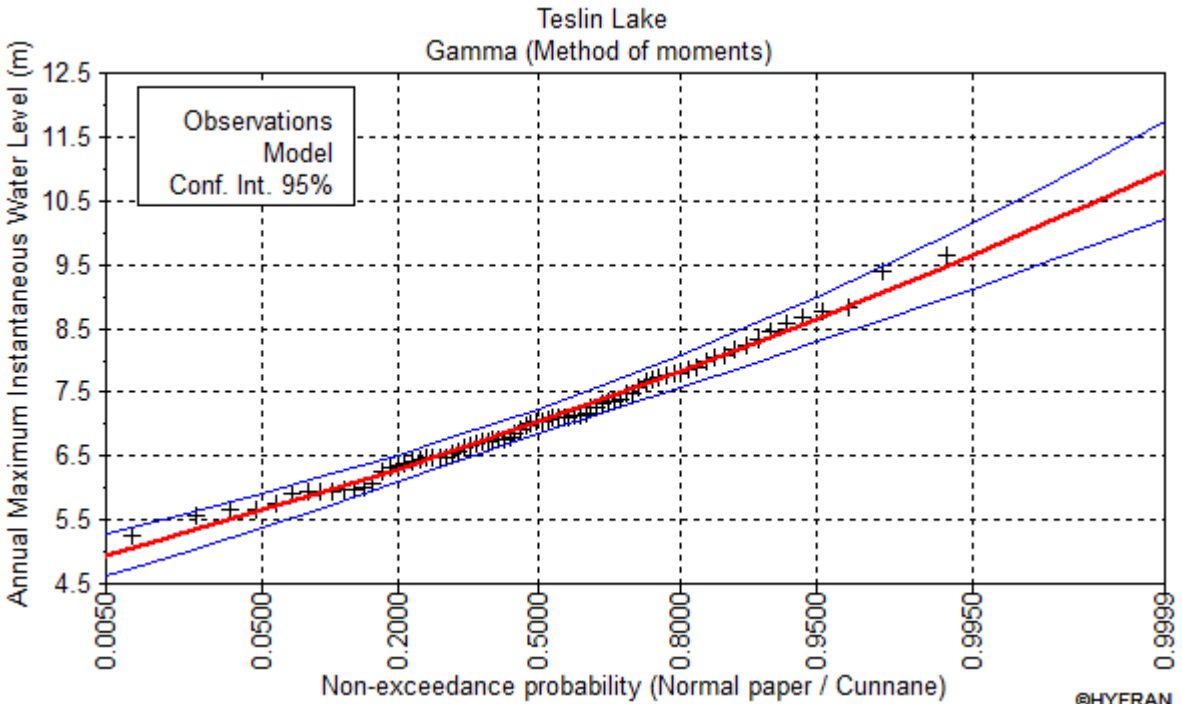


Figure D-10 Gamma Distribution Graph and Flood Frequency Estimates

Numerical Goodness of Fit Test Ranking

Three numerical goodness of fit tests were completed to evaluate the best fitted distribution for the final flood frequency estimate. They are Anderson-Darling Test, Kolmogorov-Smirnov Test and Least Squares Ranking (numerical equations are shown below).

Anderson-Darling Test (1962):

$$A^2 = -n - \frac{1}{n}\sum_{i=1}^{n}(2i-1)\cdot[\ln F(X_i) + \ln(1 - F(X_{n-i+1}))]$$

Kolmogorov-Smirnov Test (1933):

$$F_n(x) = \frac{1}{n}\cdot\left[\text{Number of observations} \leq x\right] \qquad D_n = \sup_x |F_n(x) - F(x)|$$

Least Squares Ranking:

$$SE_j = \sqrt{\frac{1}{n-m_j}\sum_{i=1}^{n}(x_i - y_i)^2}$$

Following tables show the rankings for all three datasets and the final frequency distribution selected for the flood mapping in Teslin.

Table D-6 Teslin Lake Recorded/derived Data Numerical Test Comparison Ranking

Distribution - Method of Estimation	Anderson-Darling Test Ranking	Kolmogorov-Smirnov Test Ranking	Least Squares Ranking	Average Ranking
Lognormal III-MOM	5	1	8	4.7
Pearson III-MOM	1	3	5	3.0
Log Pearson III-MOM	3	4	2	3.0
Gumbel-MOM	14	14	12	13.3
GEV-MOM	2	6	1	3.0
Weibull-MOM	16	16	15	15.7
Gamma-MOM	10	11	10	10.3
Normal-MLH	13	12	13	12.7
Lognormal-MLH	9	2	9	6.7
Lognormal III-MLH	7	8	4	6.3
Exponential-MLH	17	17	17	17.0
Pearson III-MLH	8	9	5	7.3
Log Pearson III-WRC	3	4	2	3.0
Gumbel-MLH	12	13	14	13.0
GEV-MLH	6	7	7	6.7
Weibull-MLH	15	15	16	15.3
Gamma-MLH	11	10	11	10.7

Note: The General Extreme Value distribution flood frequency estimate was selected for Teslin Lake recorded/derived dataset.

Table D-7 Teslin Lake Decorrelated Data Numerical Test Comparison Ranking

Distribution - Method of Estimation	Anderson-Darling Test Ranking	Kolmogorov-Smirnov Test Ranking	Least Squares Ranking	Average Ranking	Comment
Lognormal III-MOM	11	2	7	6.7	
Pearson III-MOM	9	1	5	5.0	
Log Pearson III-MOM	2	8	8	6.0	Failed Alpha Shape Test
Gumbel-MOM	15	16	13	14.7	
GEV-MOM	1	3	1	1.7	
Weibull-MOM	16	14	14	14.7	
Gamma-MOM	6	6	3	5.0	
Normal-MLH	12	11	12	11.7	
Lognormal-MLH	5	12	11	9.3	
Lognormal III-MLH	7	7	10	8.0	
Exponential-MLH	17	17	17	17.0	
Pearson III-MLH	4	10	5	6.3	
Log Pearson III-WRC	2	8	8	6.0	Failed Alpha Shape Test
Gumbel-MLH	13	15	16	14.7	
GEV-MLH	10	4	2	5.3	
Weibull-MLH	14	13	15	14.0	
Gamma-MLH	8	5	4	5.7	

Note: The General Extreme Value distribution flood frequency estimate was selected for Teslin Lake decorrelated dataset.

Table D-8 Teslin River Recorded/derived Data Numerical Test Comparison Ranking

Distribution - Method of Estimation	Anderson-Darling Test Ranking	Kolmogorov-Smirnov Test Ranking	Least Squares Ranking	Average Ranking	Comment
Lognormal III-MOM	9	1	9	6.3	
Pearson III-MOM	6	4	5	5.0	
Log Pearson III-MOM	1	7	1	3.0	Failed Alpha Shape Test
Gumbel-MOM	13	15	12	13.3	
GEV-MOM	4	5	3	4.0	
Weibull-MOM	16	16	16	16.0	
Gamma-MOM	8	3	4	5.0	
Normal-MLH	14	14	15	14.3	
Lognormal-MLH	11	11	11	11.0	
Lognormal III-MLH	5	9	8	7.3	
Exponential-MLH	17	17	17	17.0	
Pearson III-MLH	3	10	5	6.0	
Log Pearson III-WRC	1	7	1	3.0	Failed Alpha Shape Test
Gumbel-MLH	12	12	13	12.3	
GEV-MLH	7	6	7	6.7	
Weibull-MLH	15	13	14	14.0	
Gamma-MLH	10	2	10	7.3	

Note: The General Extreme Value distribution flood frequency estimate was selected for Teslin River recorded/derived dataset.

Flood Frequency Results for De-correlated Data at Teslin Lake

Table D-6 Flood Frequency Estimates with Confidence Intervals for De-Correlated Dataset (without datum conversion)

Return Period (years)	Annual Probability of Exceedance (%)	Flood Frequency Estimate, De-Correlated (m)		
		Value	Lower 95% Limit	Upper 95% Limit
500	0.998	9.82	8.84	10.78
200	0.995	9.56	8.79	10.34
100	0.99	9.34	8.69	9.98
50	0.98	9.08	8.56	9.59
20	0.95	8.67	8.29	9.05
10	0.9	8.30	7.99	8.60
5	0.8	7.86	7.59	8.11
3	0.667	7.45	7.21	7.69
2	0.5	7.05	6.82	7.28

Table D-7 Flood Frequency Estimates with Confidence Intervals for De-Correlated Dataset (with datum conversion)

Return Period (years)	Annual Probability of Exceedance (%)	Flood Frequency Estimate, De-Correlated (m)		
		Value	Lower 95% Limit	Upper 95% Limit
500	0.998	687.14	686.16	688.10
200	0.995	686.88	686.11	687.66
100	0.99	686.65	686.01	687.30
50	0.98	686.39	685.88	686.91
20	0.95	685.98	685.61	686.37
10	0.9	685.61	685.31	685.92
5	0.8	685.17	684.91	685.43
3	0.667	684.77	684.53	685.01
2	0.5	684.36	684.14	684.60

Appendix E

Wind-Wave Analysis Transects

This appendix includes an overview image of each of the project sites. These overview images included the project area, the offshore wave hindcast locations, and the locations of the transects used in the wave runup calculations. Each transect profile is also included along with the estimated beach slope for each transect for both the current climate conditions and with lake level rise.

Brooks Brook Project Area

The northern most project site is the Brooks Brook Area shown in the figure below. This area contains two offshore wave hindcast location along with two transects. The estimated beach slope for transect 1 in the northern region of the project area is slightly steep than that estimated for transect 2 in the southern region of the project area.



Figure E-1 Overview of Brooks Brook project location

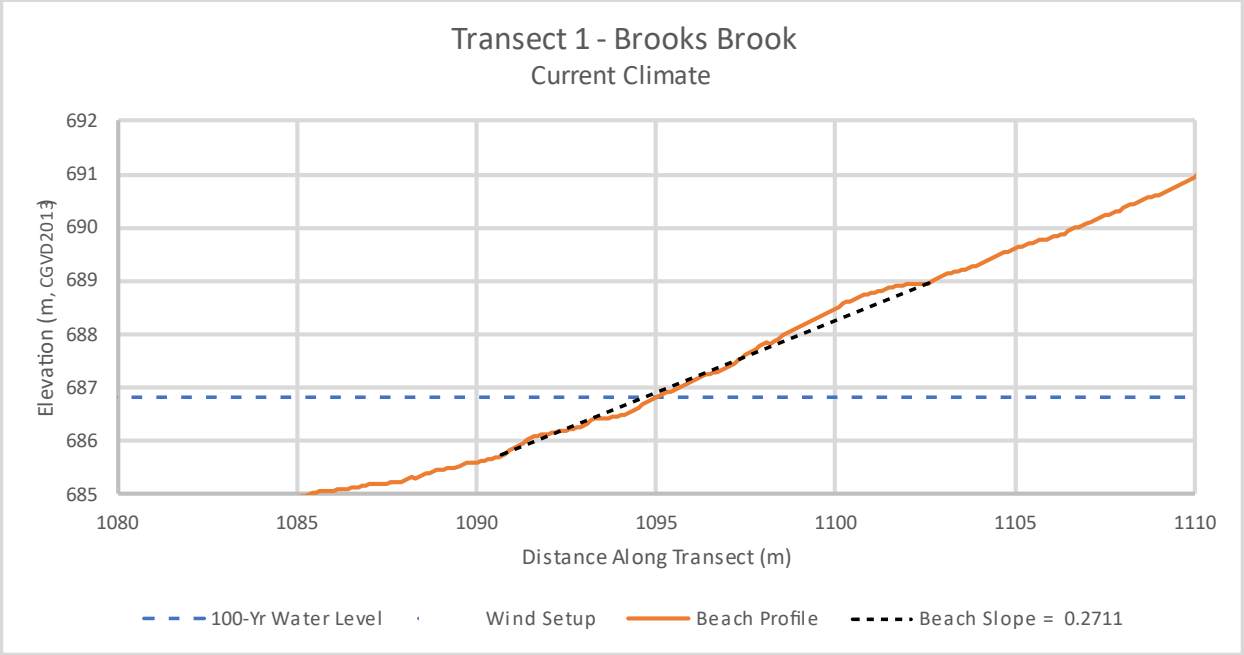


Figure E-2a Transect 1 located in the Brooks Brook study area (current climate)

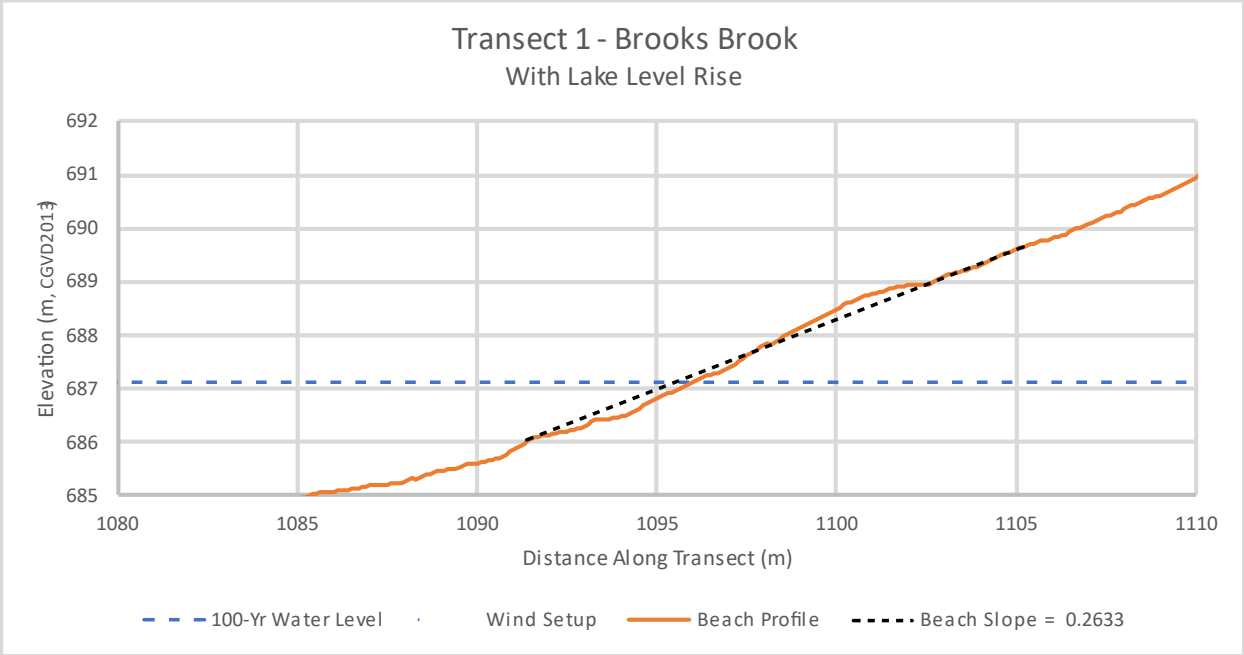


Figure E-2b Transect 1 located in the Brooks Brook study area (with lake level rise)

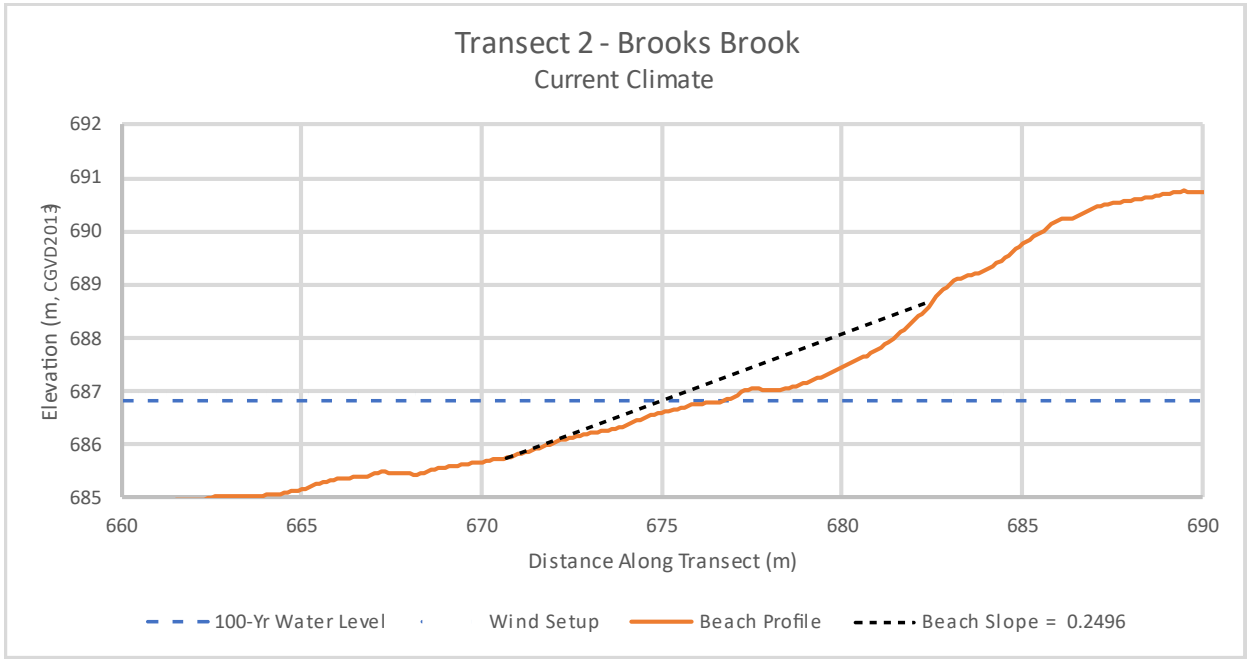


Figure E-3a Transect 2 located in the Broos Brook study area (current climate)

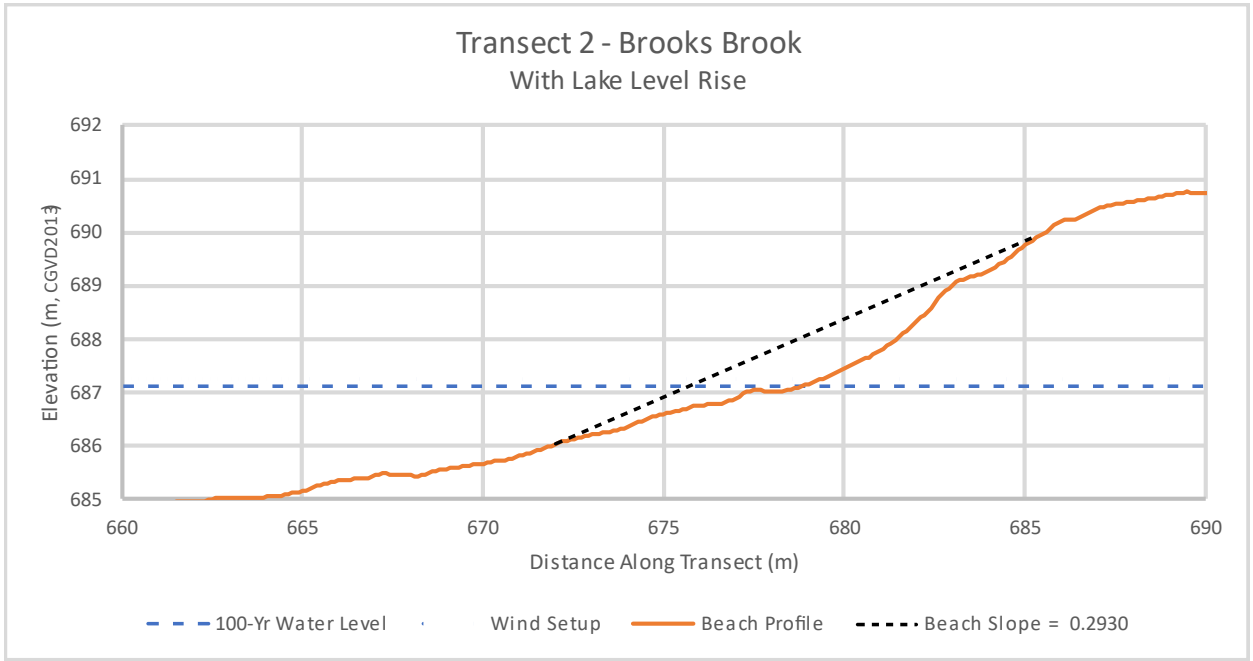


Figure E-3b Transect 2 located in the Broos Brook study area (with lake level rise)

Deadman Creek

The next most northern project site is the Deadman Creek Area shown in the figure below. This area contains two offshore wave hindcast location and three transects. The two northern Transects, 3A and 3B, both used the offshore wave conditions at hindcast location WH03, while the remaining Transect 04, uses the offshore wave conditions at hindcast location WH04. The estimated beach slope for the middle Transect 3B is very shallow compared with other locations in the project sites while the southern Transect 4 is relatively steep. The linear TAW equations (TAW, 2002) are not applicable for this steep of a beach and the piece-wise function provide in the TAW manual was used.



Figure E-4 Overview of Deadman Creek project location

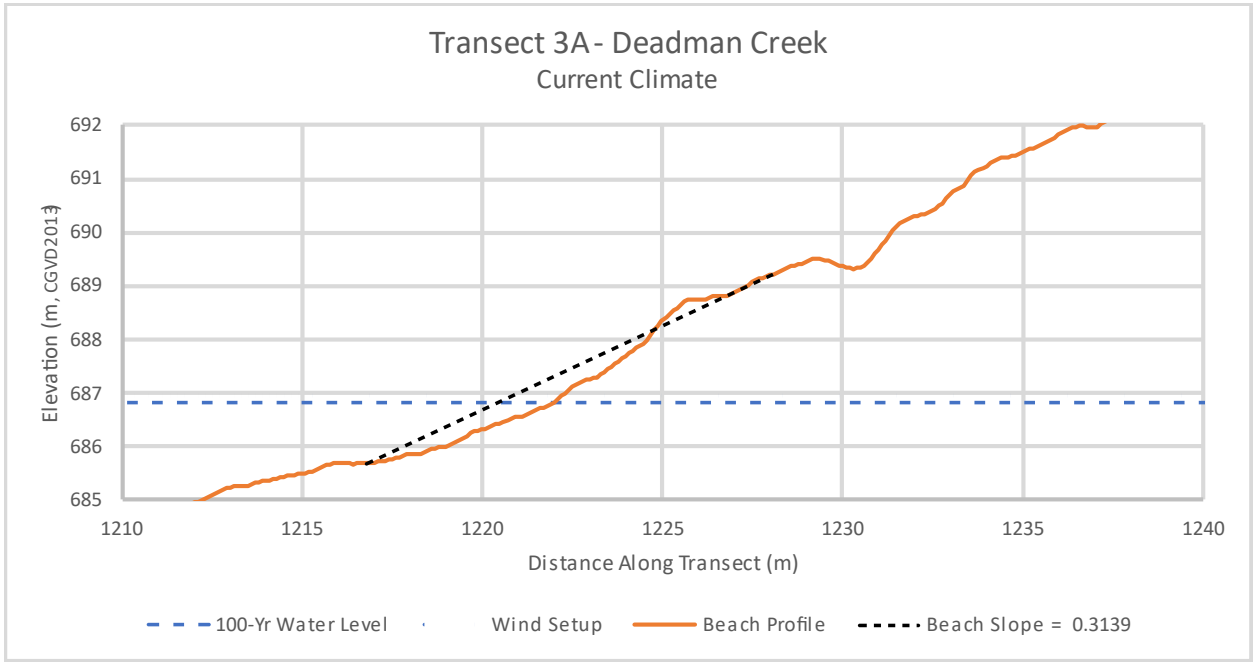


Figure E-5a Transect 3A located in the Deadman Creek study area (current climate)

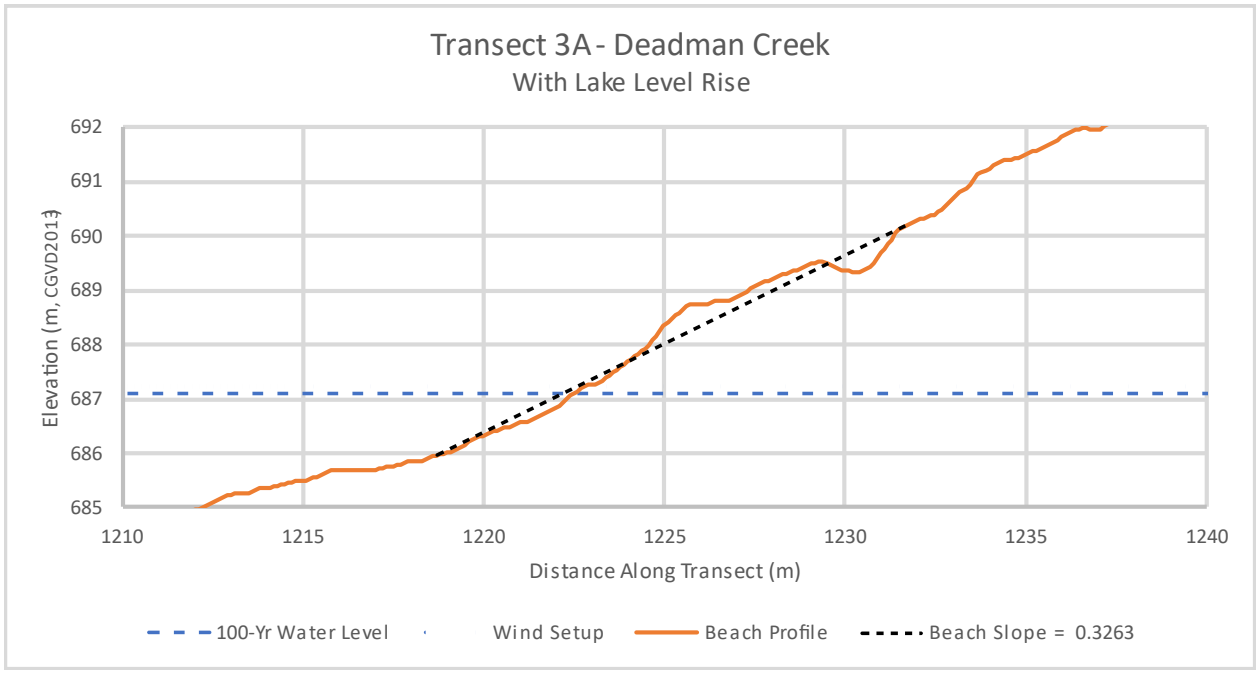


Figure E-5b Transect 3A located in the Deadman Creek study area (with lake level rise)

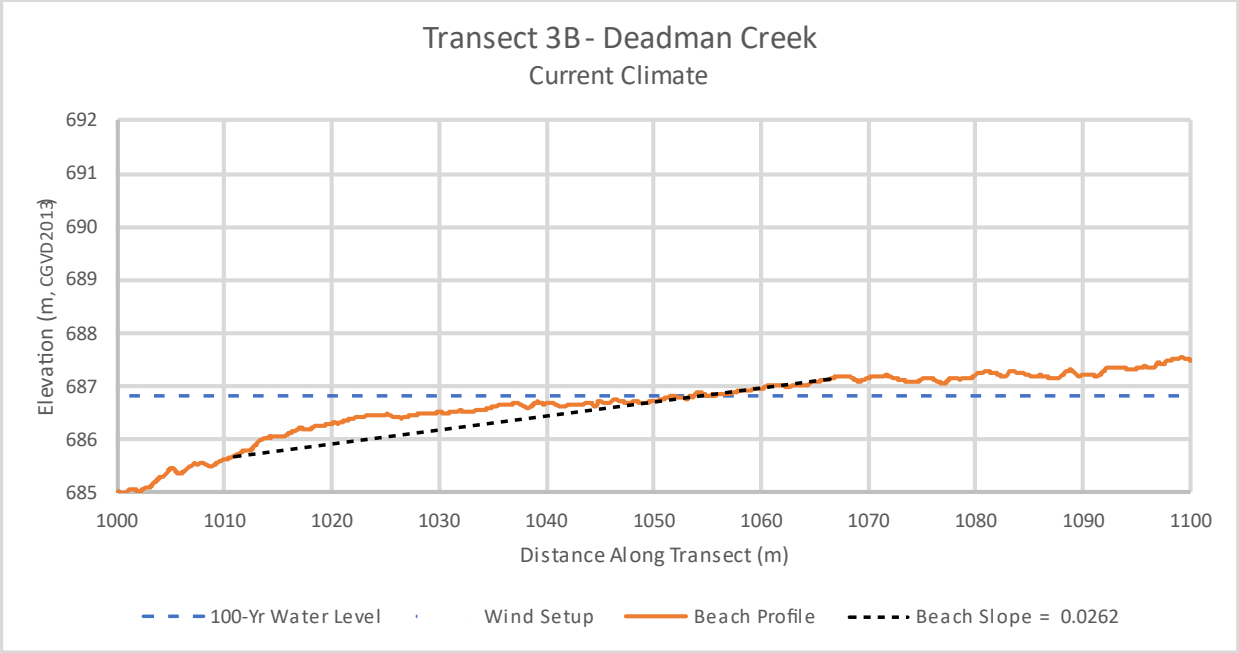


Figure E-6a **Transect 3B located in the Deadman Creek study area (current climate). Note that x-axis scale in this image varies from those found elsewhere in this appendix.**

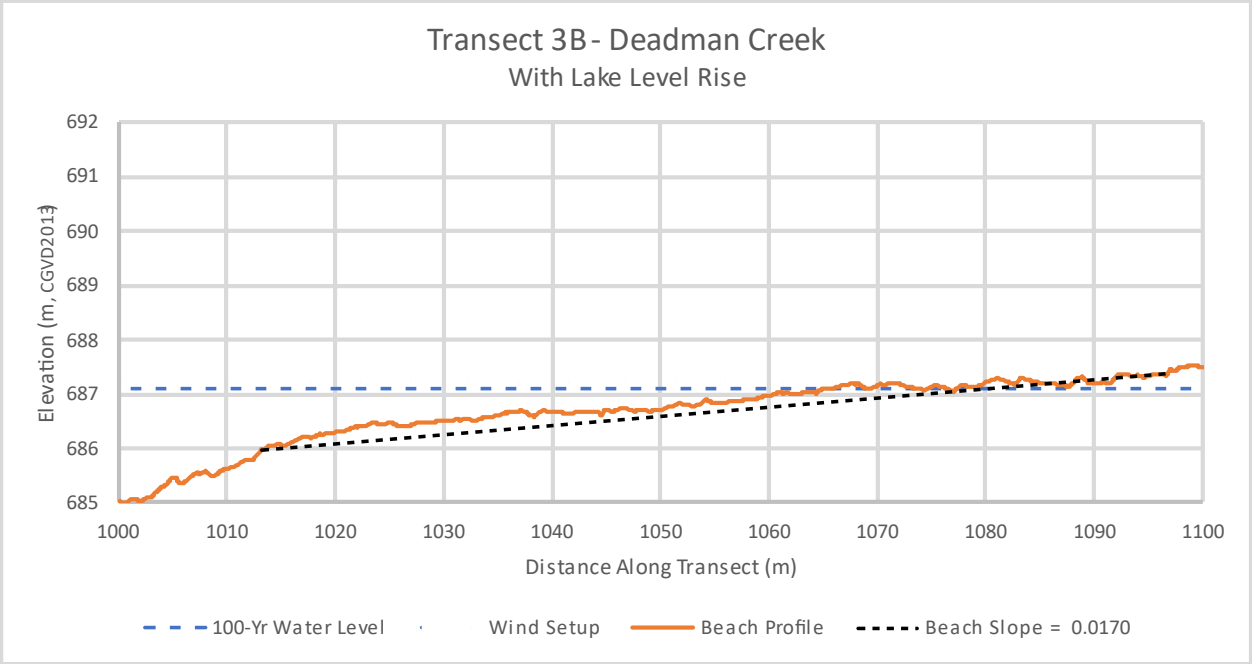


Figure E-6b **Transect 3B located in the Deadman Creek study area (with lake level rise) . Note that x-axis scale in this image varies from those found elsewhere in this appendix.**

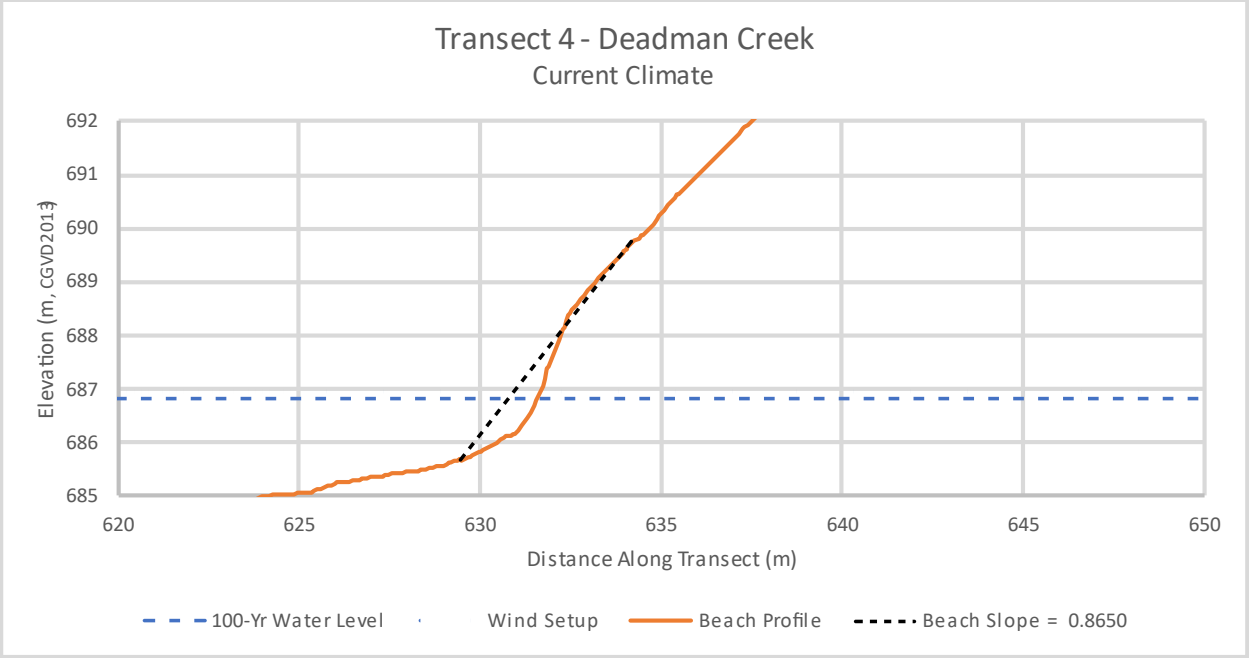


Figure E-7a Transect 4 located in the Deadman Creek study area (current climate)

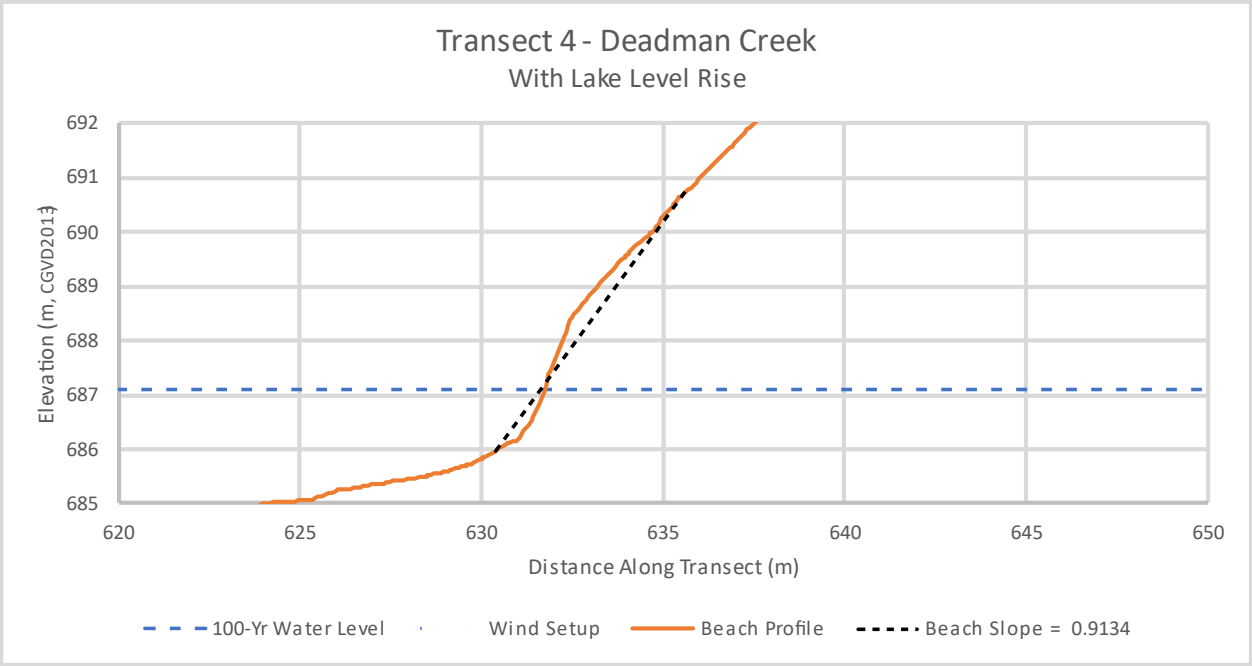


Figure E-7b Transect 4 located in the Deadman Creek study area (with lake level rise)

Teslin

The next project site is the Teslin Area shown in the figure below. This area contains four offshore wave hindcast location and five transects. The two transects located along the Nisutlin inlet, 11N and 11S, both used the same offshore wave conditions from hindcast location WH11. The estimated beach slope for the northern most Transect 5 is very shallow compared with other locations in the project sites. Transect 7 located near the Teslin Airport, effectively has a plateau and the FEMA guidelines for the great lakes (FEMA 2014) were used to estimate the runup at this location. The charts used in this method are presented at the end of this appendix.

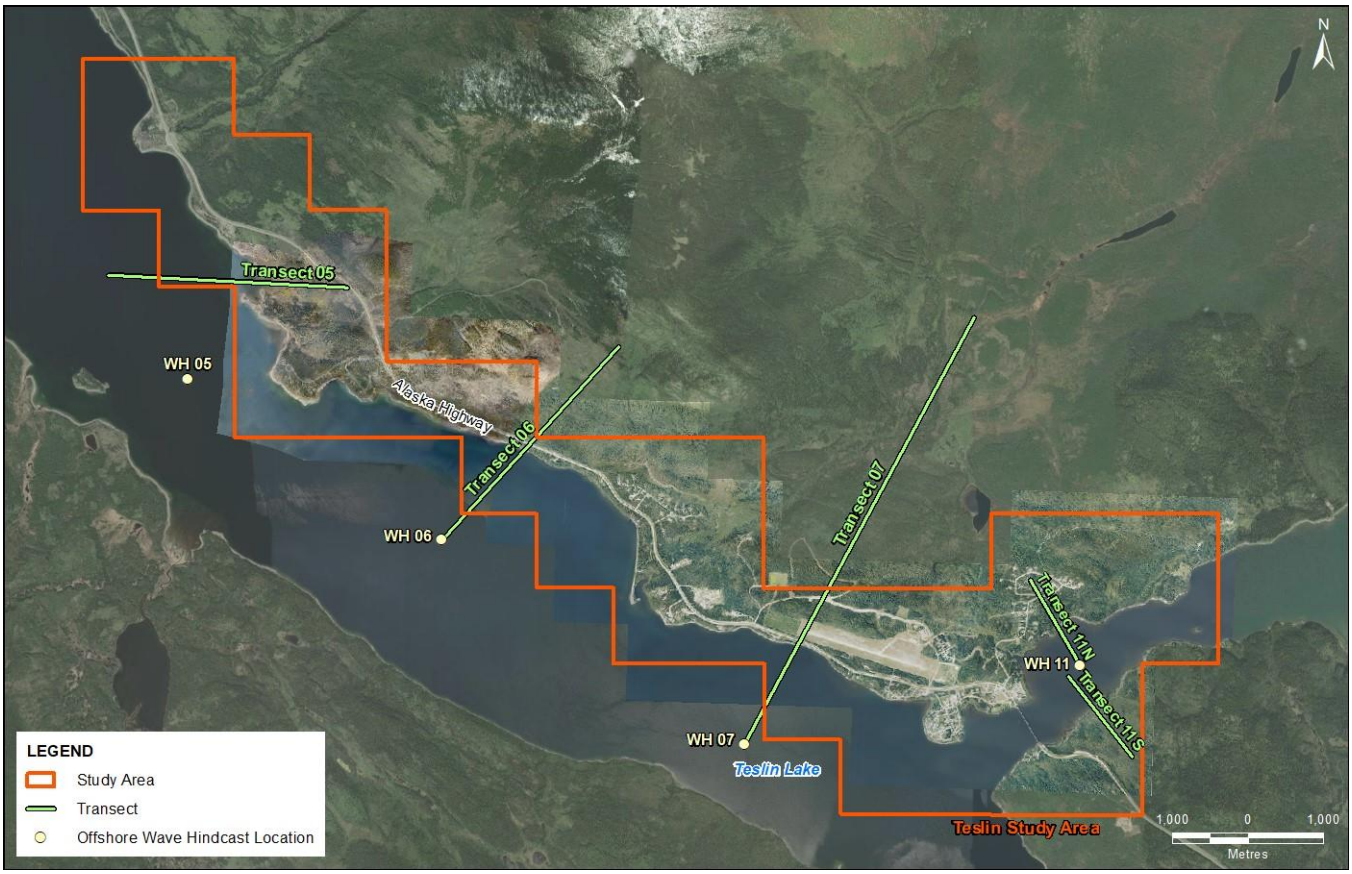


Figure E-8 Overview of Teslin project location

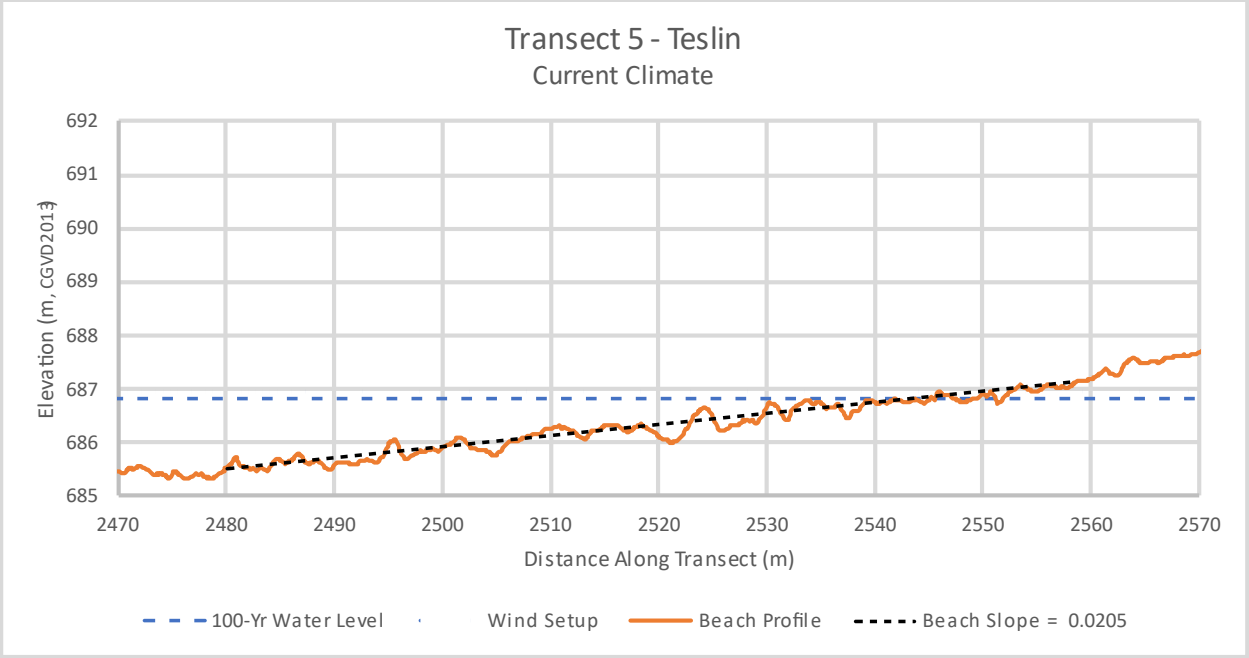


Figure E-9a **Transect 5 located in the Teslin study area (current climate. Note that x-axis scale in this image varies from those found elsewhere in this appendix.**

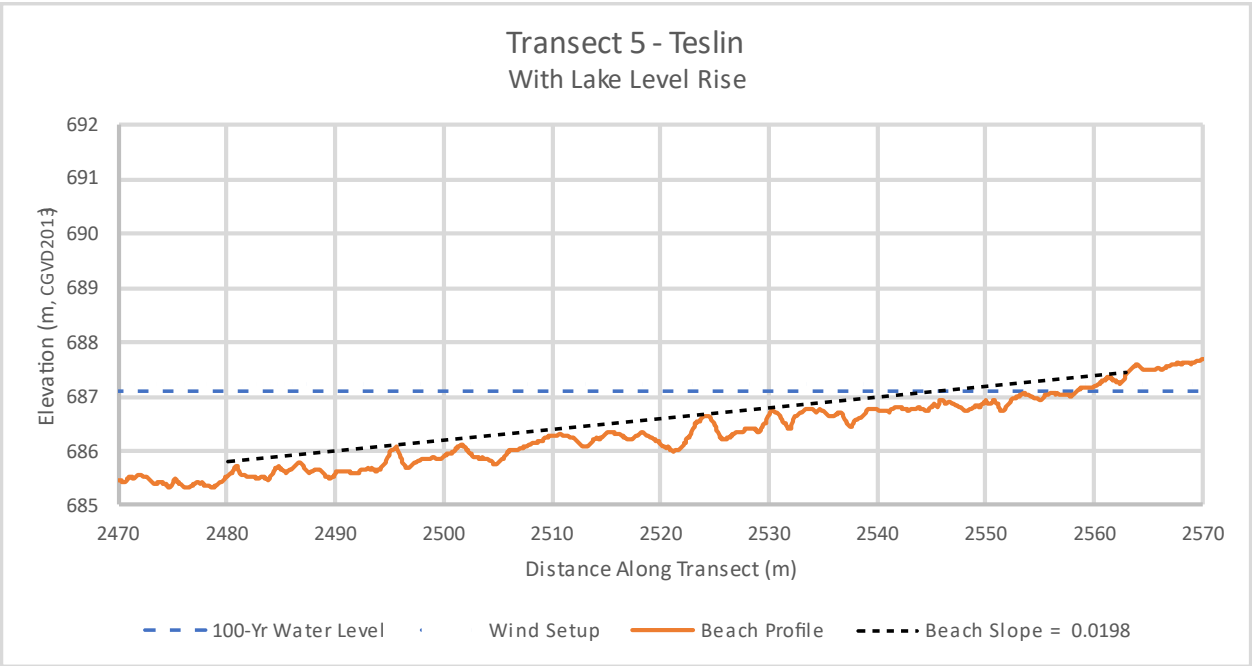


Figure E-9b **Transect 5 located in the Teslin study area (with lake level rise). Note that x-axis scale in this image varies from those found elsewhere in this appendix.**

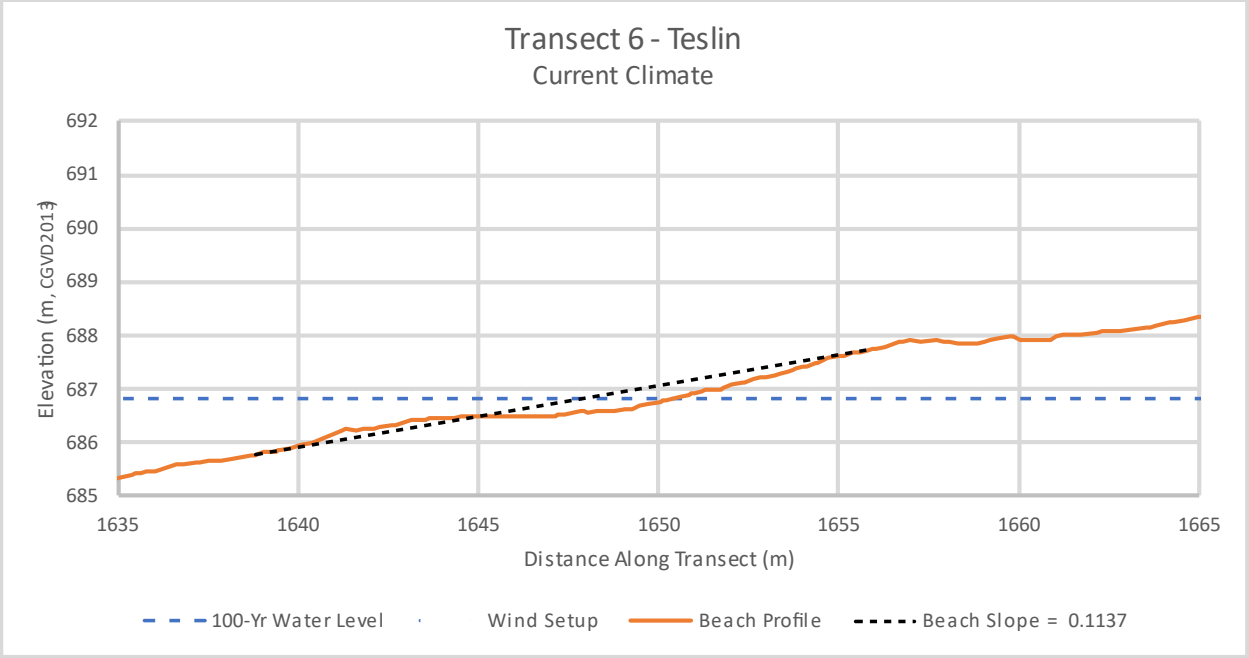


Figure E-10a Transect 6 located in the Teslin study area (current climate)

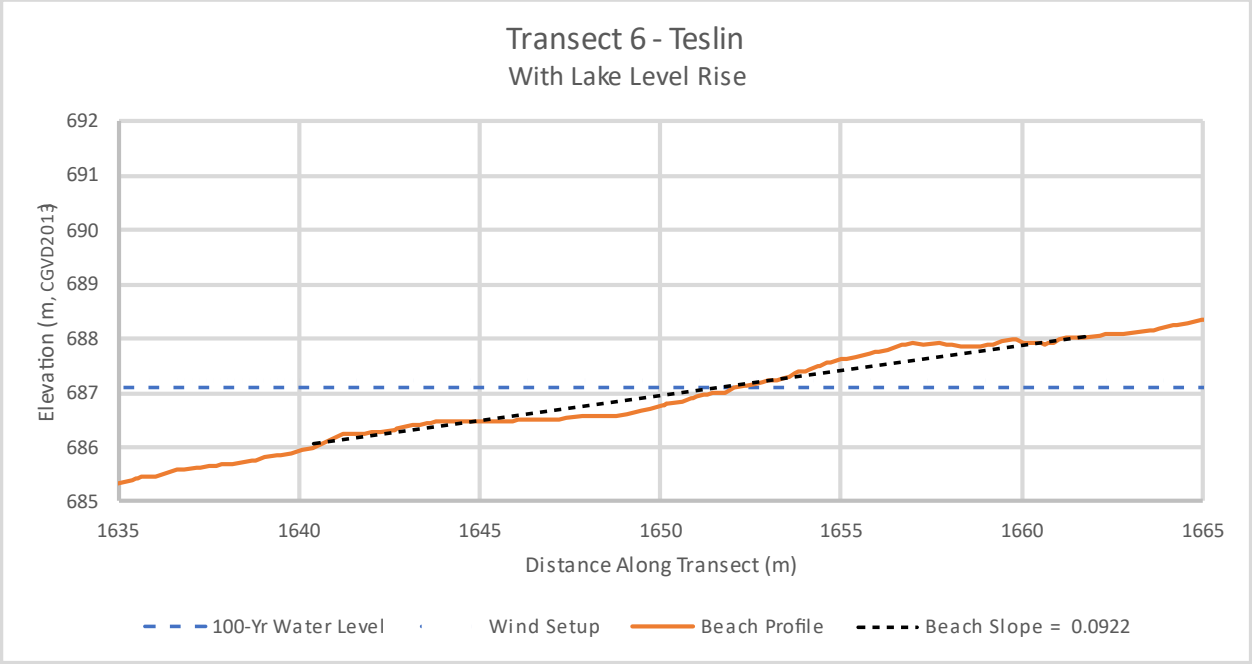


Figure E-10b Transect 6 located in the Teslin study area (with lake level rise)

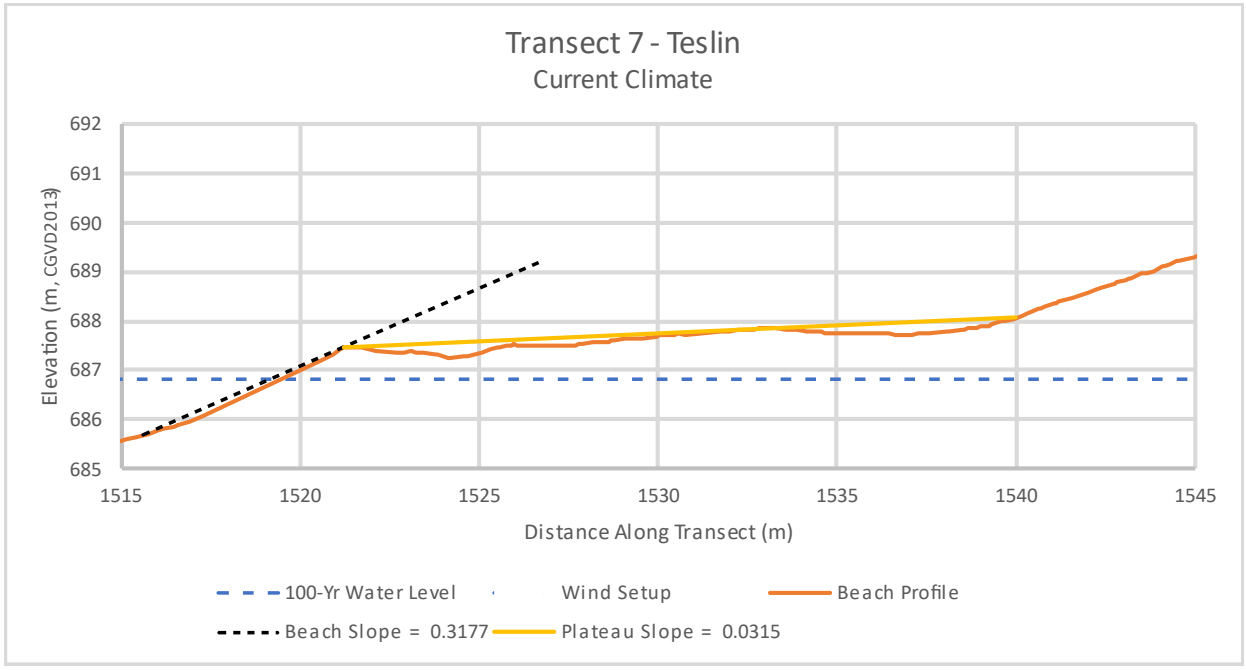


Figure E-11a Transect 7 located in the Teslin study area (current climate)

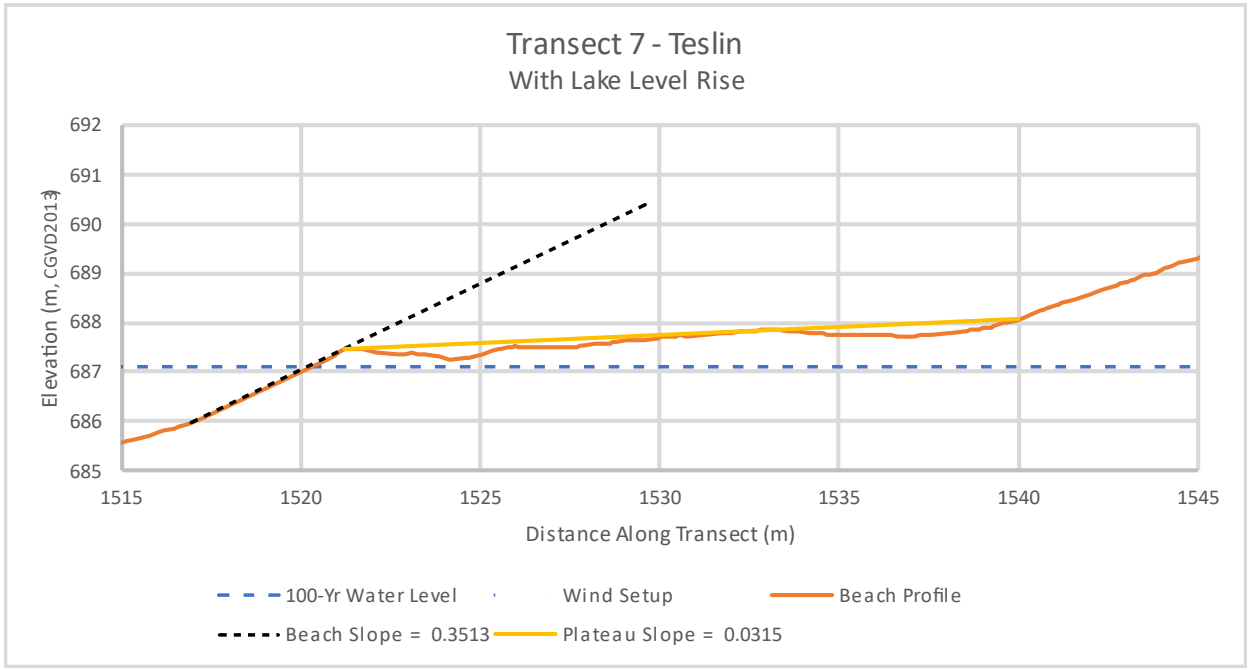


Figure E-11b Transect 7 located in the Teslin study area (with lake level rise)



Figure E-12a Transect 11N located in the Teslin study area (current climate)



Figure E-12b Transect 11N located in the Teslin study area (with lake level rise)

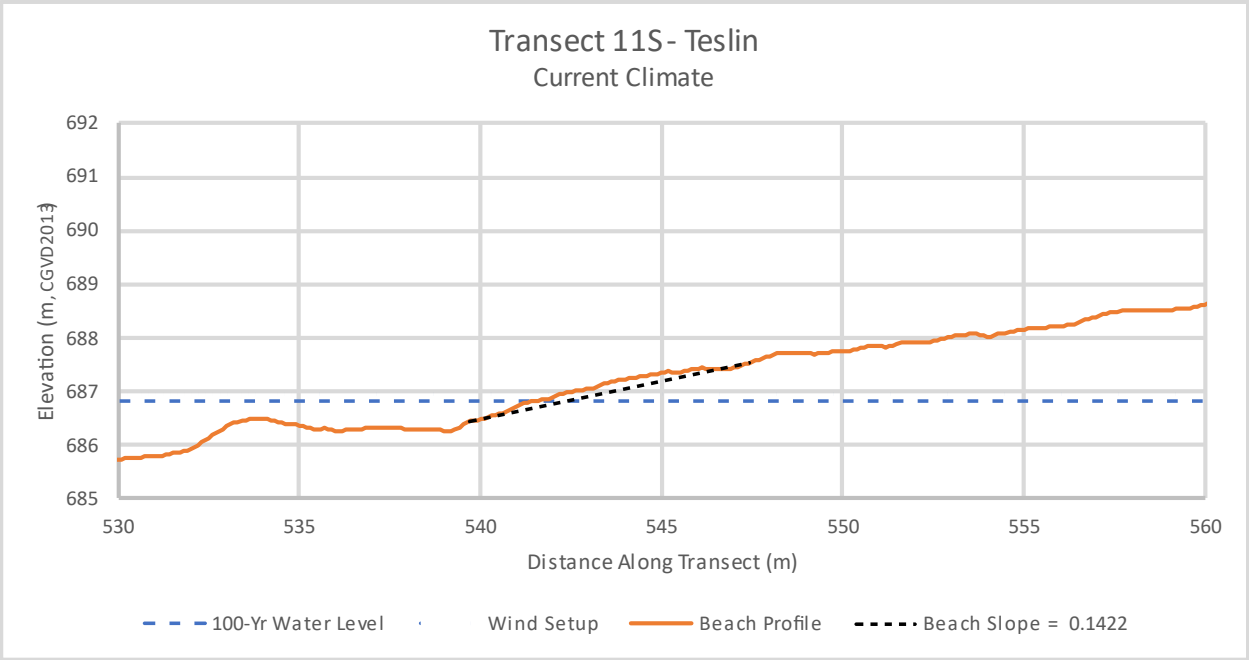


Figure E-13a Transect 11S located in the Teslin study area (current climate)

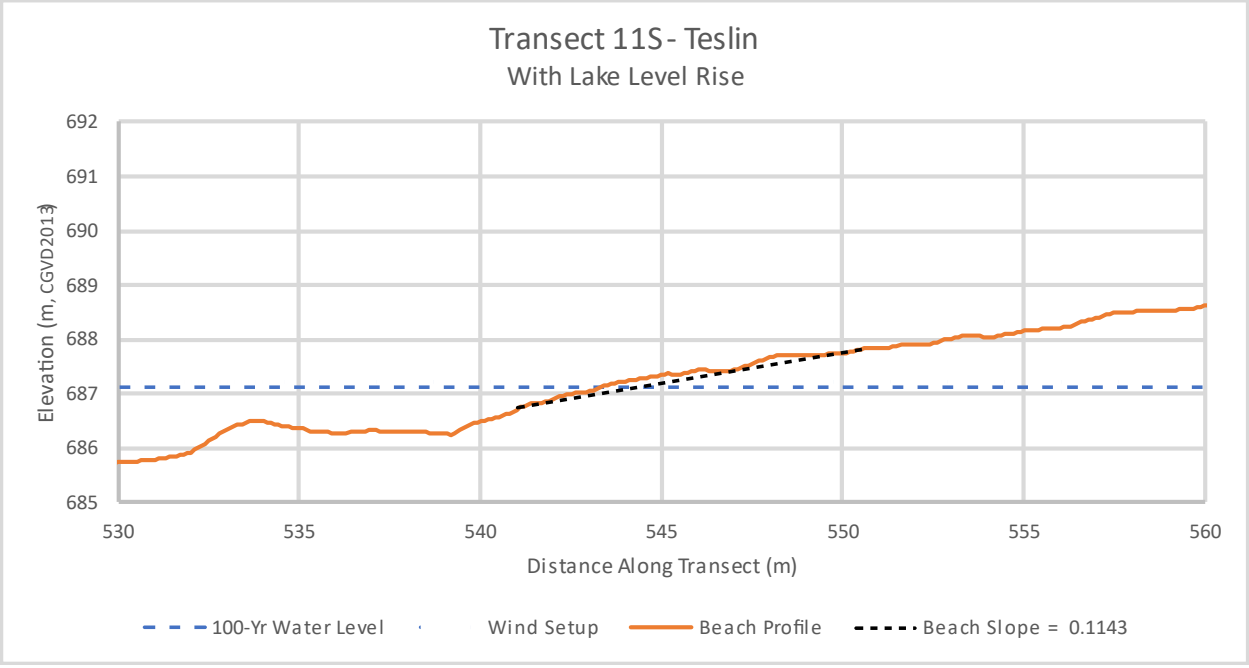


Figure E-13b Transect 11S located in the Teslin study area (with lake level rise)

Morley Bay

The southern most project site is the Morley Bay Area shown in the figure below. This area contains three offshore wave hindcast location and four transects. The two transects located inside the bay, 8N and 8S, both used the offshore wave conditions at hindcast location WH08. The estimated beach slope for all these transects are relatively steep. The linear TAW equations (TAW, 2002) are not applicable for this steep of a beach and the piece-wise function provide in the TAW manual was used.

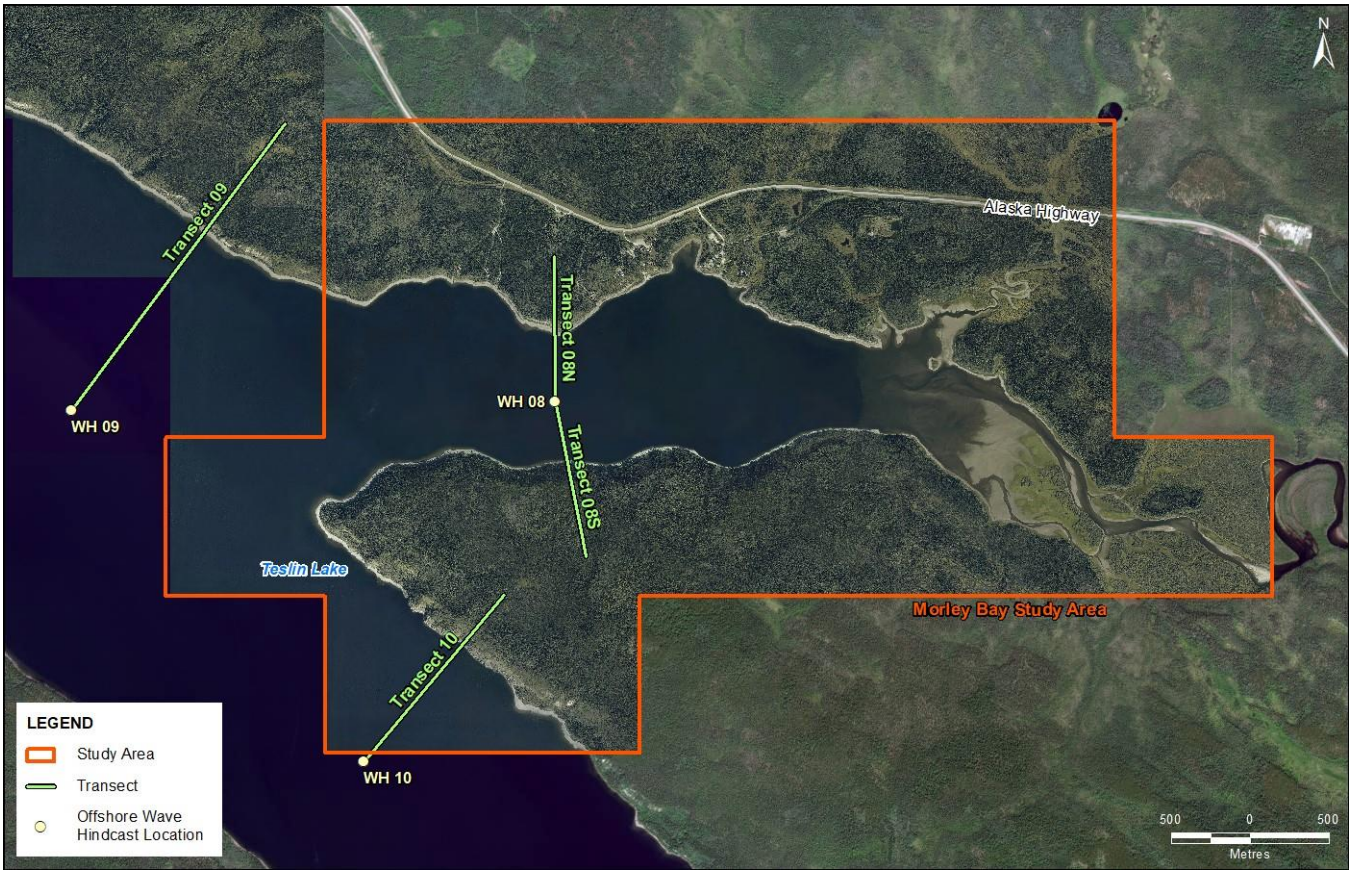


Figure E-14 Overview of Morley Bay project location

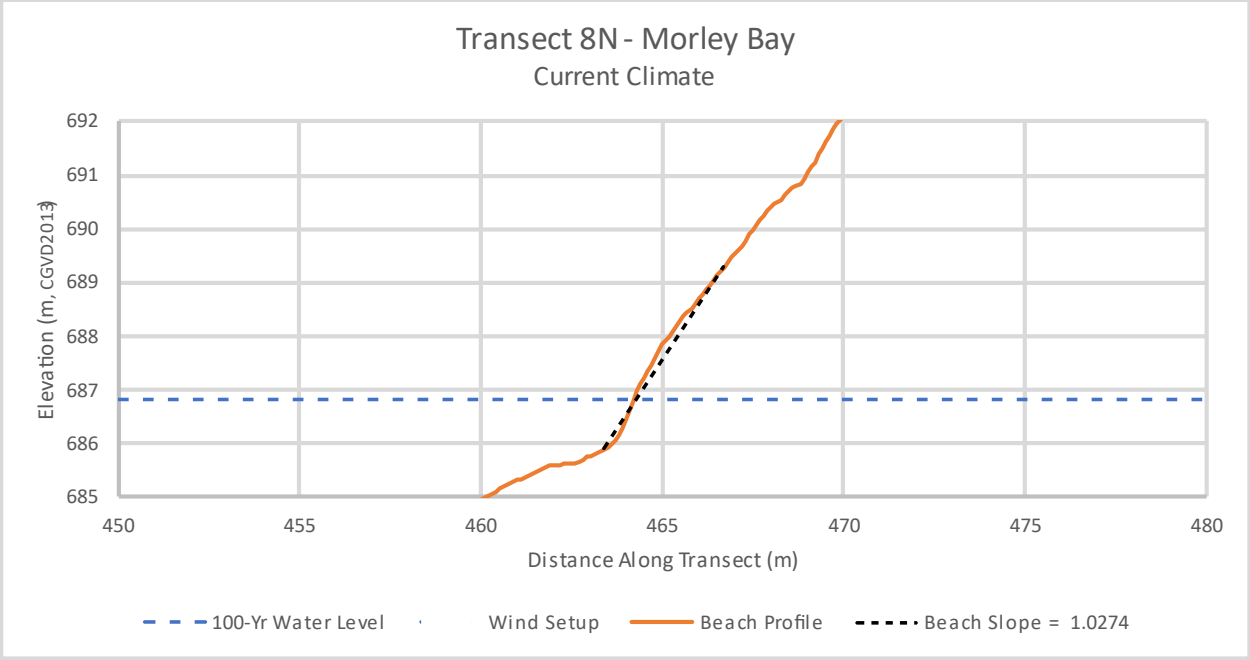


Figure E-15a Transect 8N located in the Morley Bay study area (current climate)

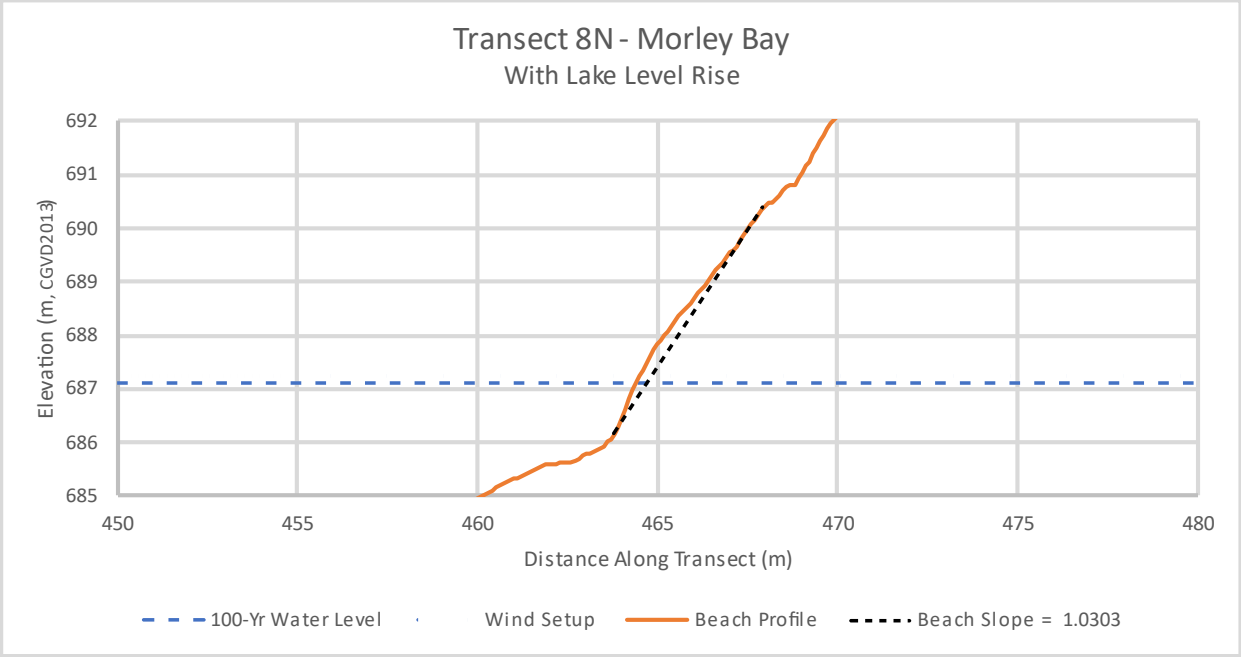


Figure E-15b Transect 8N located in the Morley Bay study area (with lake level rise)

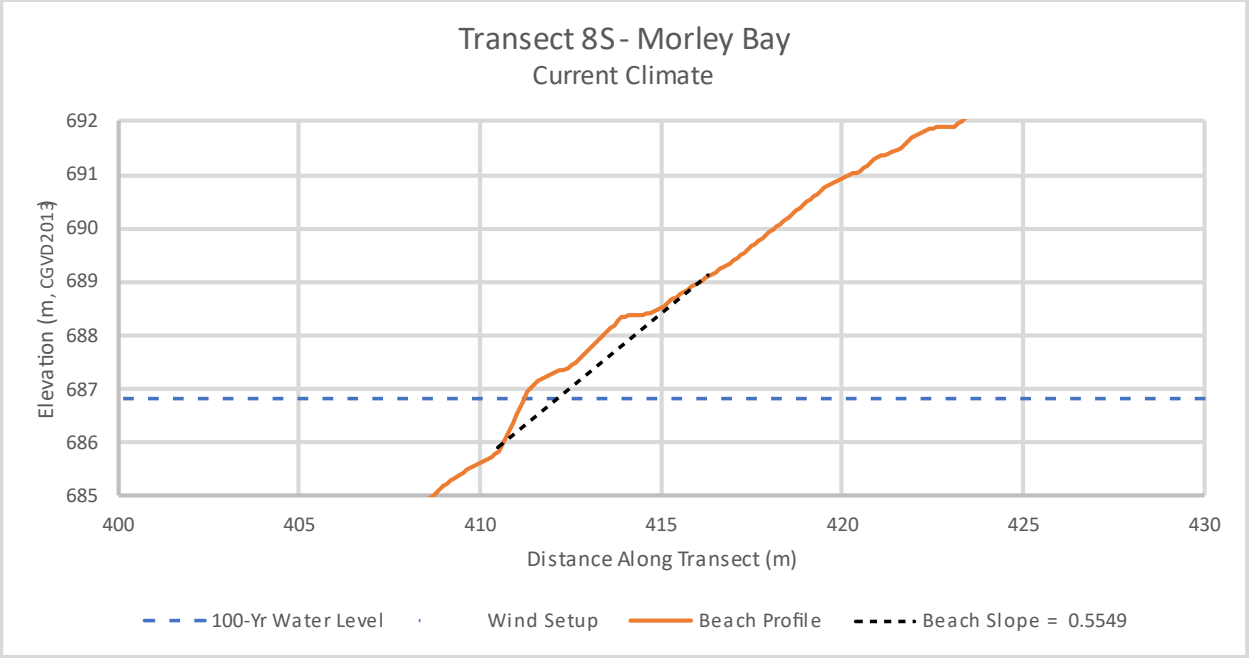


Figure E-16a Transect 8S located in the Morley Bay study area (current climate)

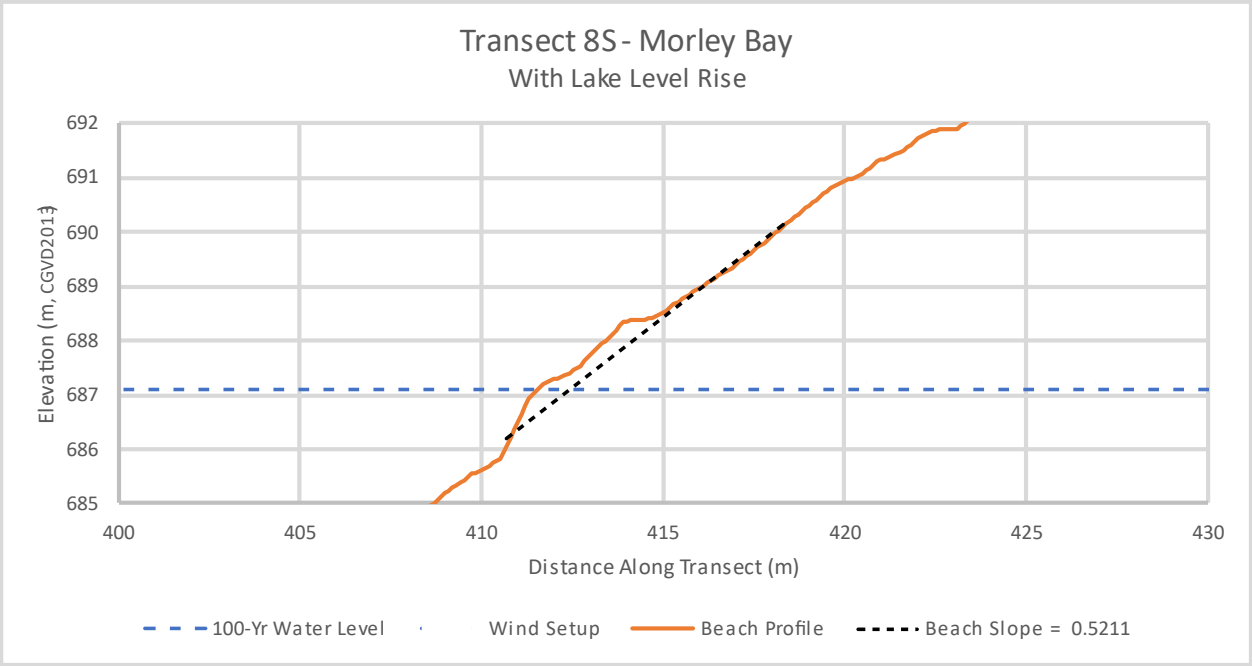


Figure E-16b Transect 8S located in the Morley Bay study area (with lake level rise)

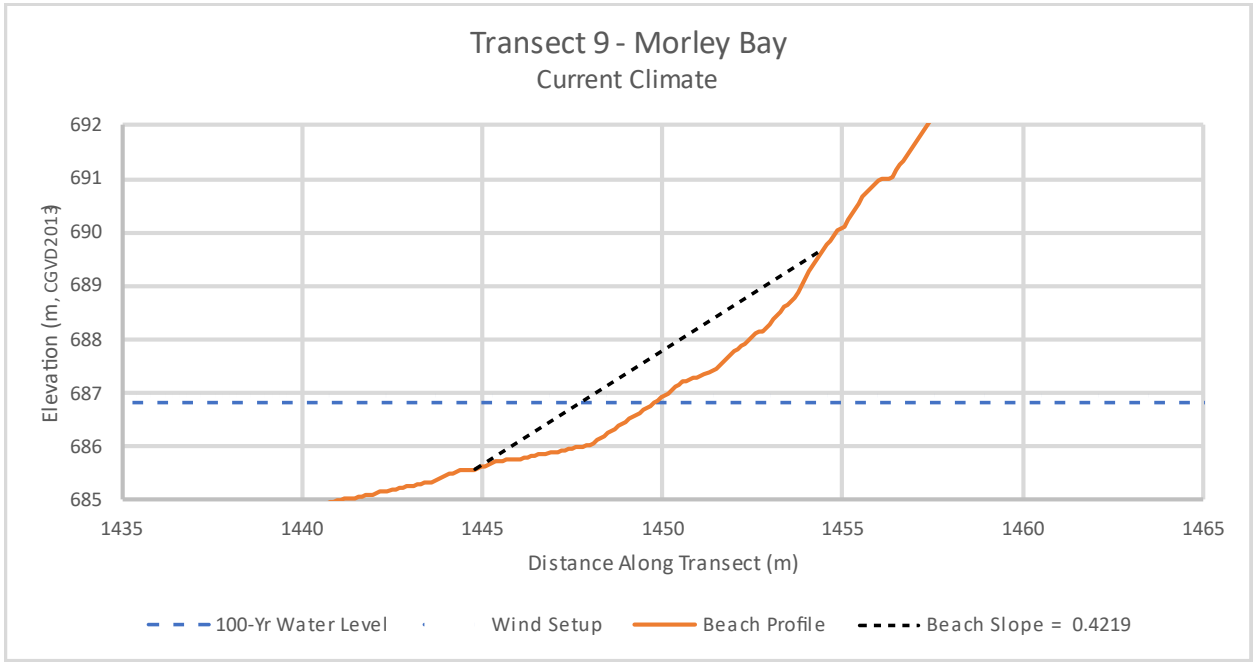


Figure E-17a Transect 9 located in the Morley Bay study area (current climate)

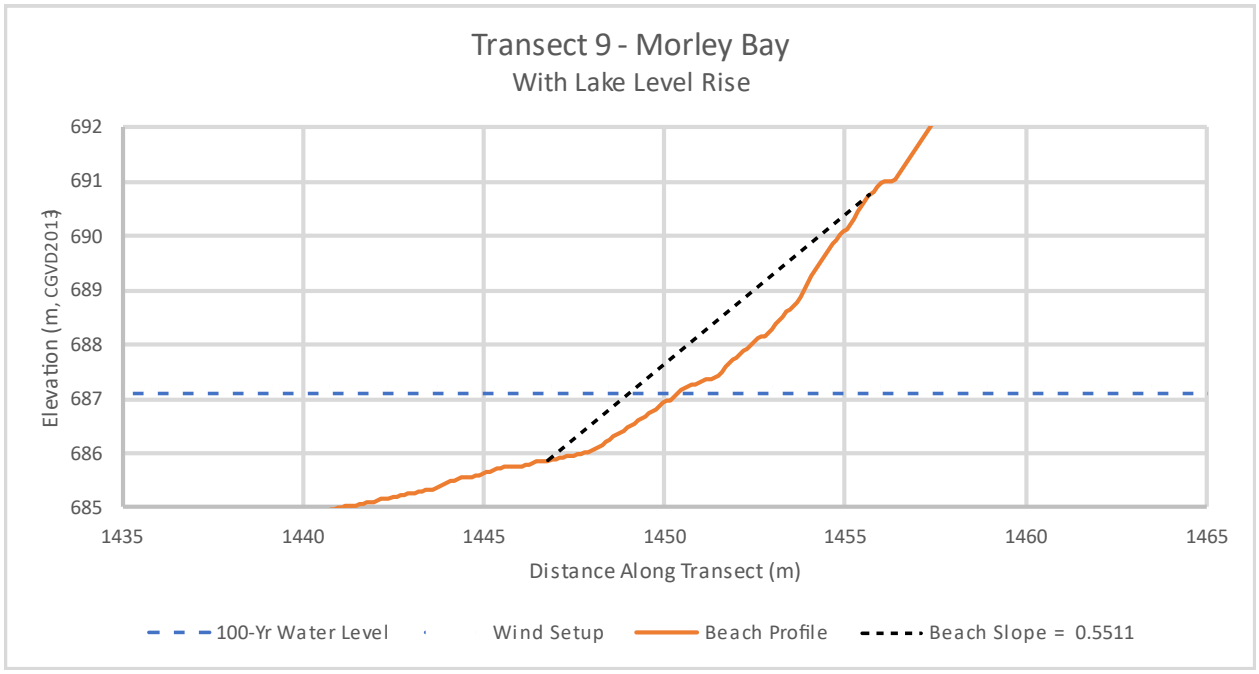


Figure E-17b Transect 9 located in the Morley Bay study area (with lake level rise)

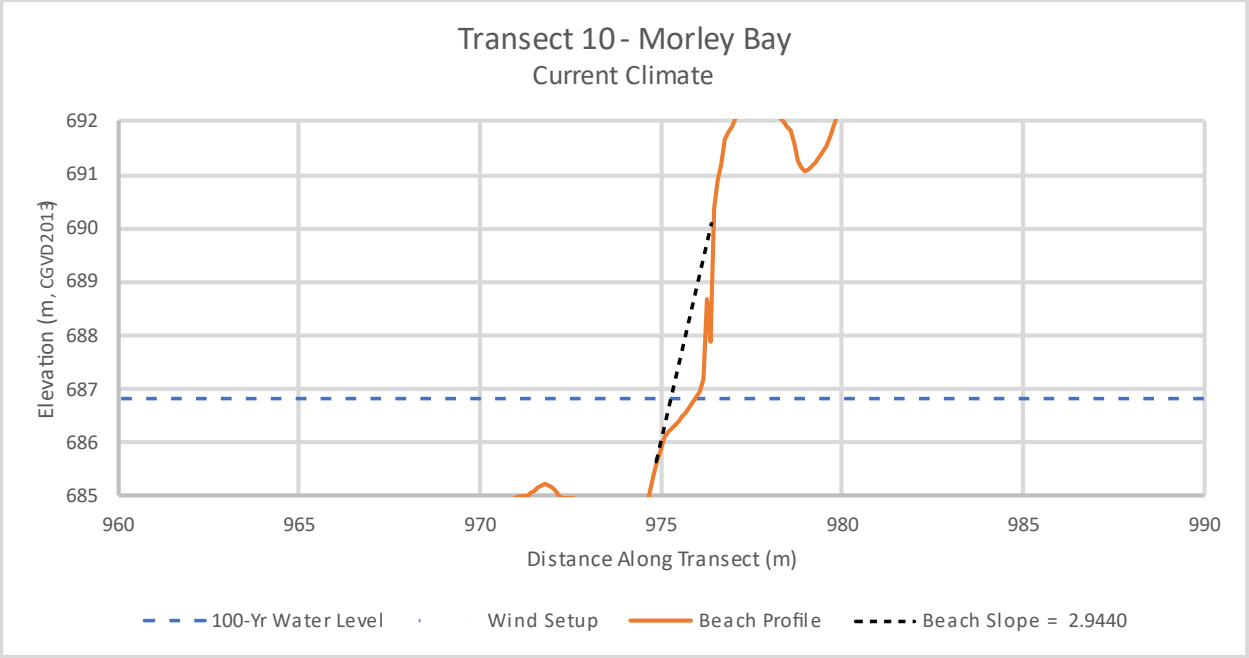


Figure E-18a Transect 10 located in the Morley Bay study area (current climate)

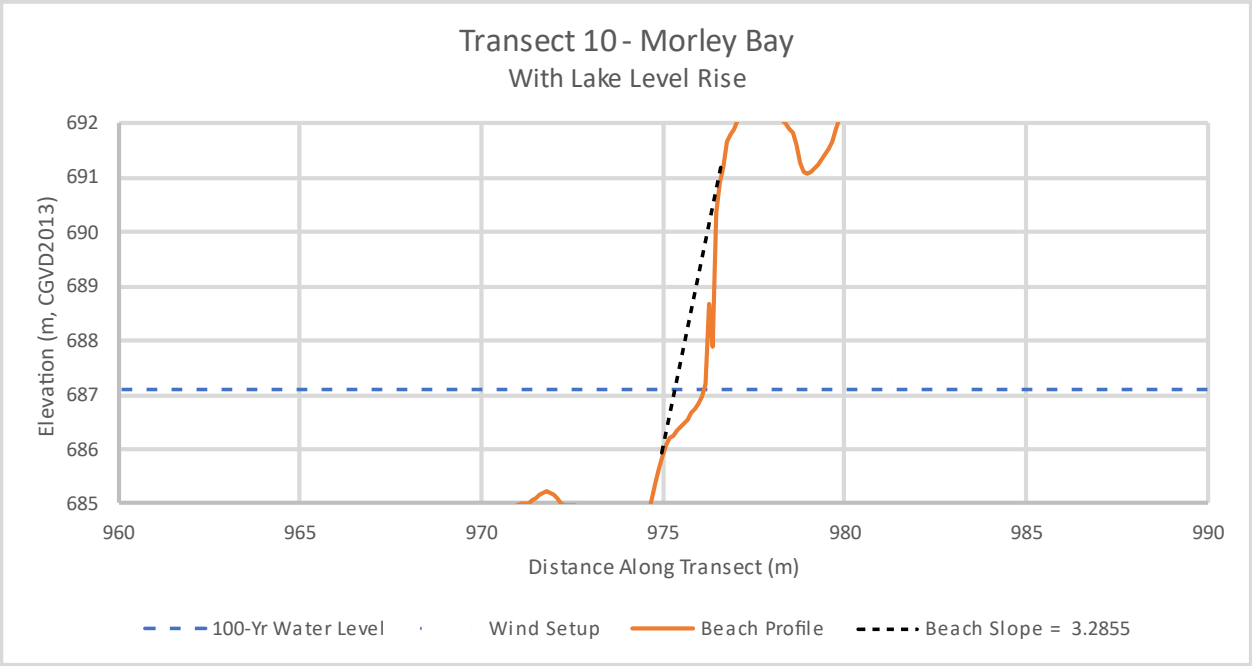
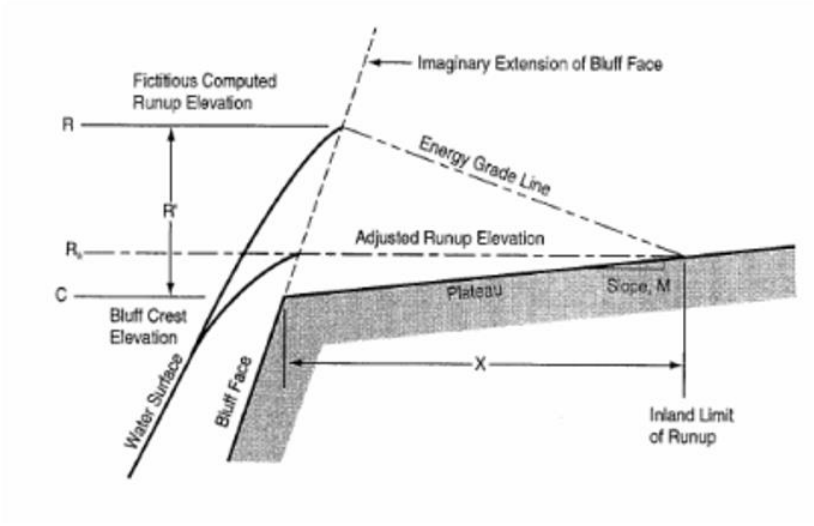


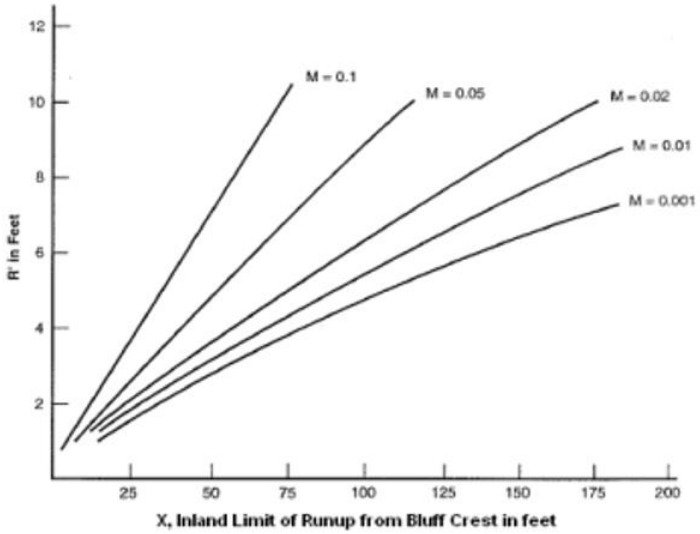
Figure E-18b Transect 10 located in the Morley Bay study area (with lake level rise)

Runup on Plateau

The FEMA guidelines for the Great Lakes (2014) provide guidance on reducing runup values on plateaux. The charts used in this method are presented below.



Treatment of Runup onto Plateau above Low Bluff



Curves for Computation of Runup Inland of Low Bluffs

Figure E-19 Treatment of excess runup on plateau (FEMA, 2014). Used for Transect 7 in the Teslin area.

Appendix F

Flood Hazard Maps

460000 470000 480000 490000 500000

670000 660000 650000 640000 630000 620000 610000

Johnson's Crossing

Brooks Brook

Alaska Highway

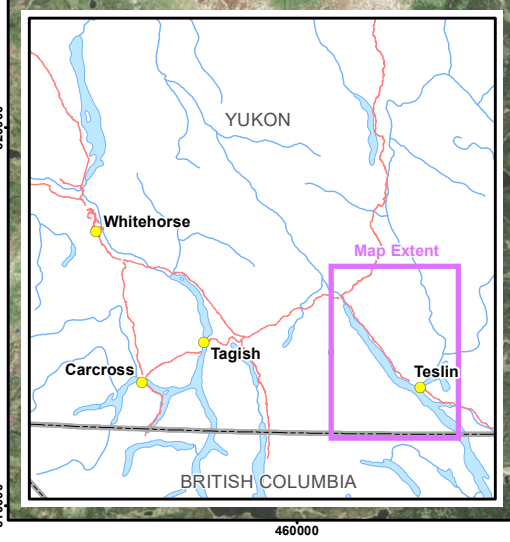
Deadman Creek

Teslin Lake

Teslin

Alaska Highway

Morley Bay



LEGEND

- Study Area
- Highway

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

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REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY © 2024 MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS SIO

Yukon Canada

Teslin Flood Mapping Study

Project Overview Map

2 0 2
Kilometres
1:200,000

N

September 2024

Figure 1.0

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

25mm
0

452000
454000
456000
458000
666000
664000
662000

TTC S-25B1
Model Domain Downstream Boundary
24
557
1208
1620
TTC S-24B1
Teslin River
2297
2764
3430
3857
TTC C-36B
4267.63
4306
4371
4530
TTC C-35B/D
TTC C-37B/D
5176
Sheet 3
Sheet 2
Sheet 1
6261
6891
7522
8211
8716
8921
Alaska Highway
Canol Road
TTC S-30B1
TTC R-5A
TTC R-11B
Model Domain Upstream Boundary
Teslin Lake

Johnson's Crossing Study Area
Teslin Lake
N
0 5 10 km

LEGEND

- Study Area
- Detailed Mapsheet Extent
- First Nation Settlement Lands - Surveyed
- 2023 LiDAR Extent *(Other areas in Model Domain covered by HRDEM)*
- Highway
- Local Road
- Cross-Section
- 7522 Cross-Section Number

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

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REFERENCE(S)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area

190 0 190
Metres
1:25,000

N

wsp

September 2024

Figure 2.0

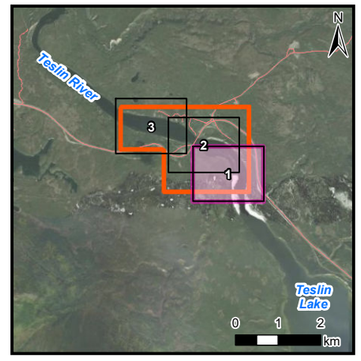
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Cross-Section
- Flow Direction

6261 / **685.74** — Cross-Section Number / Water Surface Elevation (m) Along Cross-Section



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.1-1

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

25mm

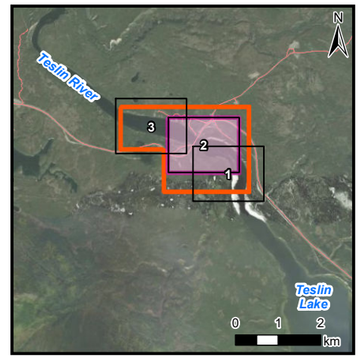
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Bridge
- Culvert

6261
685.74
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

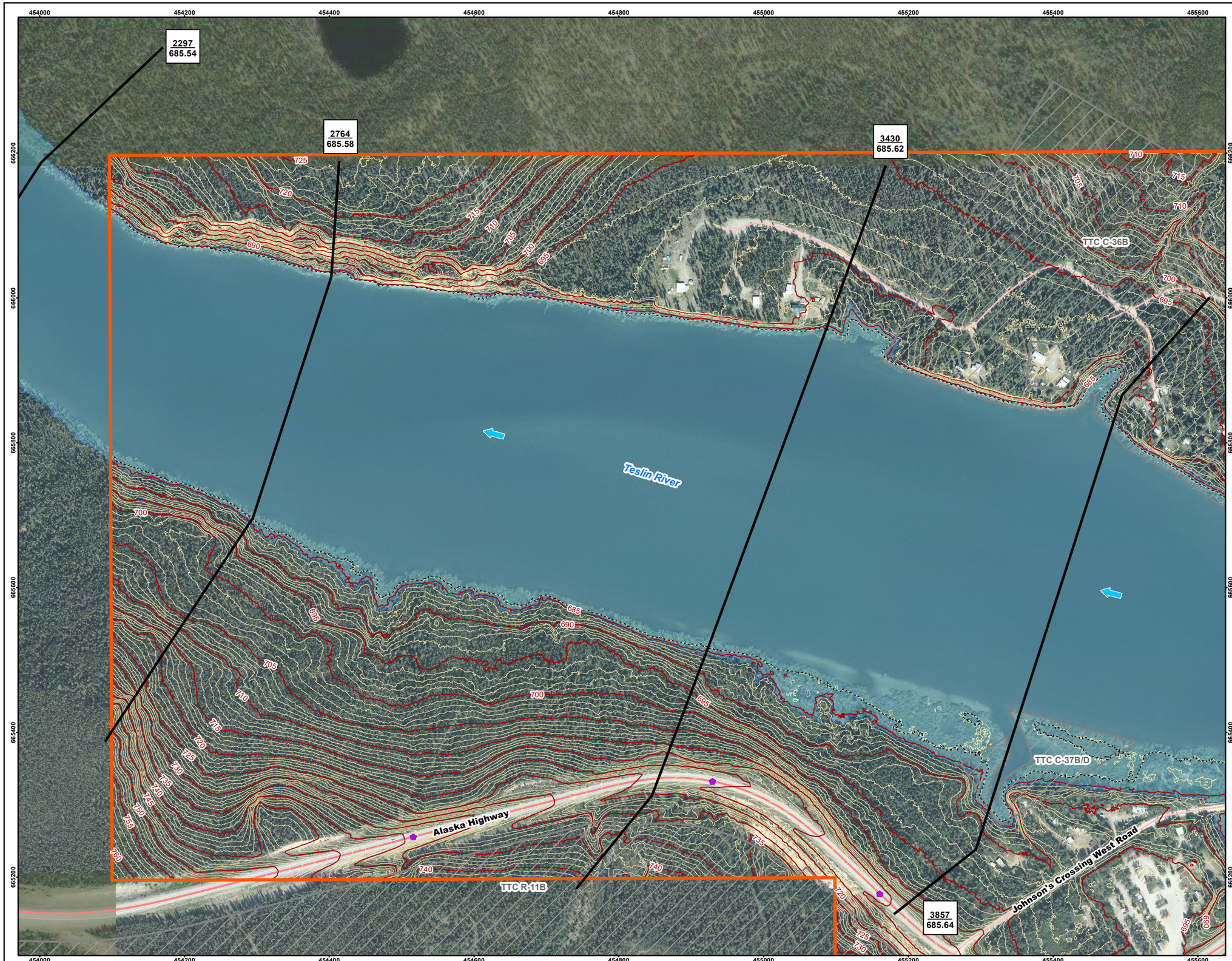
N

wsp

September 2024

Figure 2.1-2

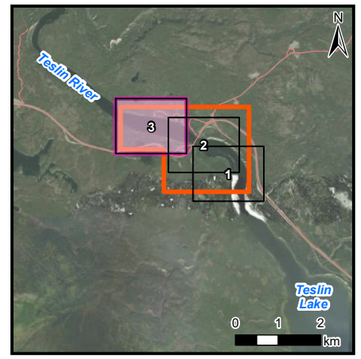
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Culvert

6261
685.74
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



NOTE(S)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.1-3

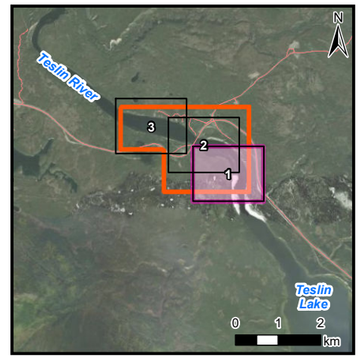
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Cross-Section
- Flow Direction

6261
686.63
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.2-1

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

25mm

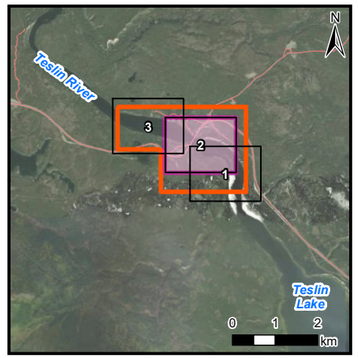
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Bridge
- Culvert

6261 / 686.63 — Cross-Section Number / Water Surface Elevation (m) Along Cross-Section



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

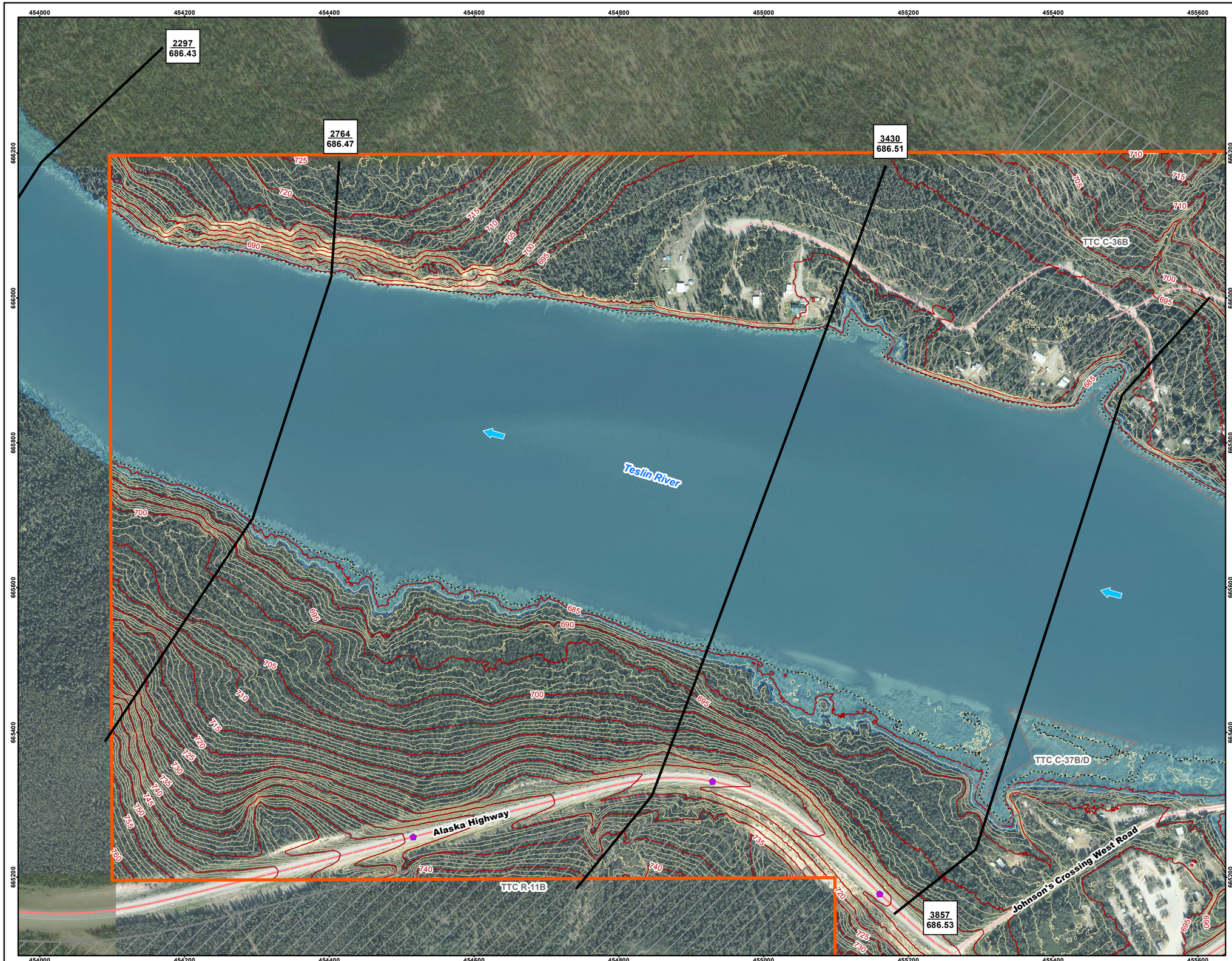
N

wsp

September 2024

Figure 2.2-2

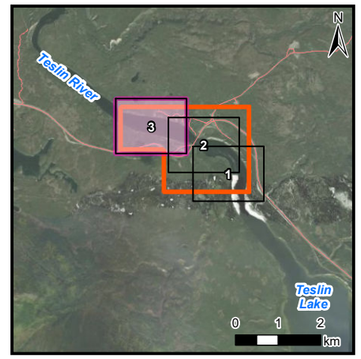
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Culvert

6261
686.63
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.2-3

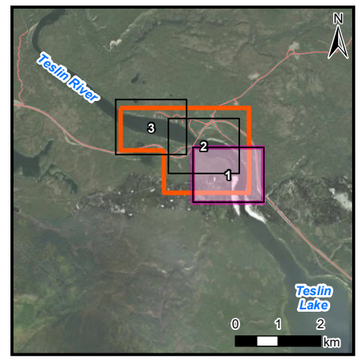
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Cross-Section
- Flow Direction

6261
686.97
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



NOTE(S)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.3-1

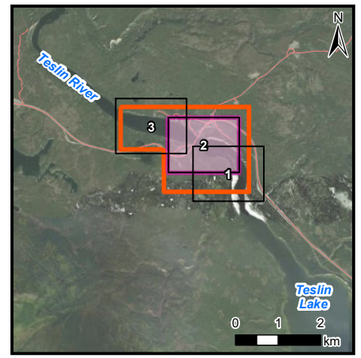
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Bridge
- Culvert

6261
686.97
Cross-Section Number
Water Surface Elevation (m) Along Cross-Section



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.3-2

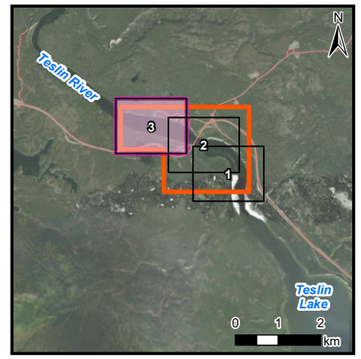
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Culvert

6261
686.97
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.3-3

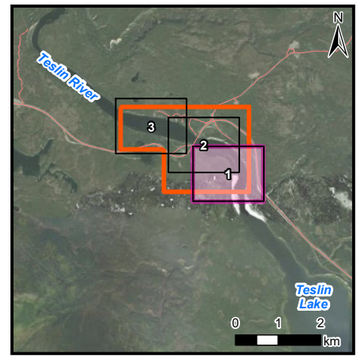
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Cross-Section
- Flow Direction

6261 / 686.22 — Cross-Section Number / Water Surface Elevation (m) Along Cross-Section



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

REV 0 - ISSUED AS FINAL (24/09/13)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.4-1

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

25mm

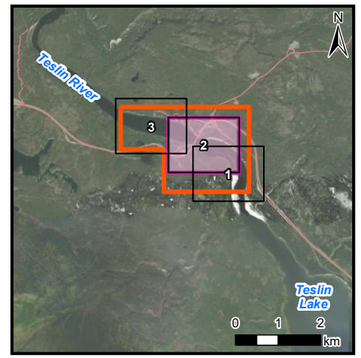
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Bridge
- Culvert

6261
686.22
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/13)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

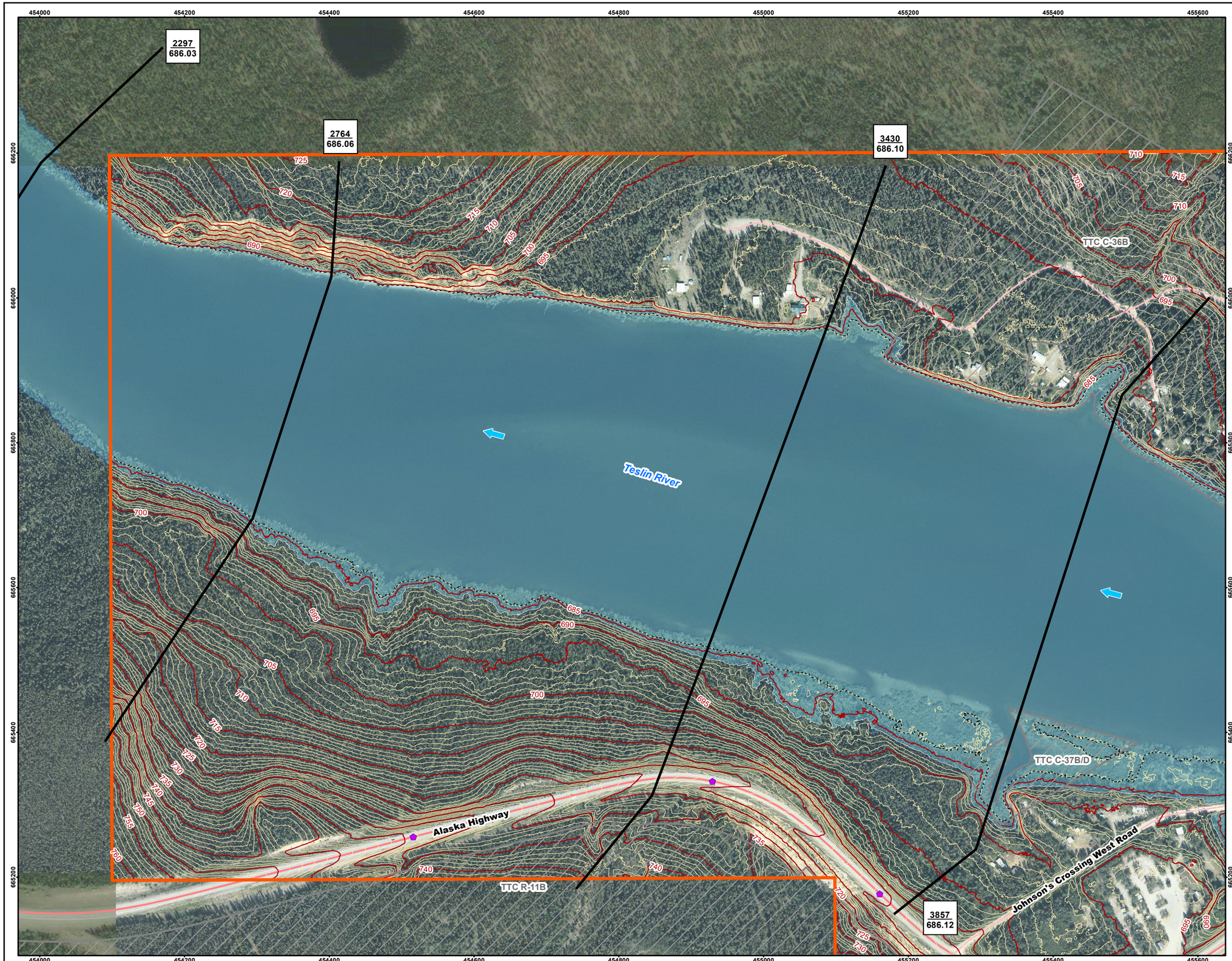
N

wsp

September 2024

Figure 2.4-2

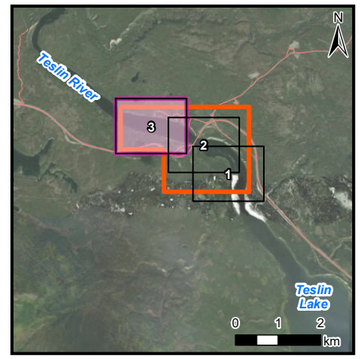
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Culvert

6261
686.22
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.4-3

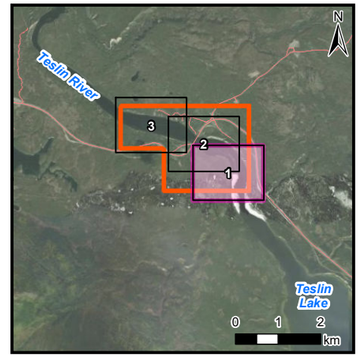
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Cross-Section
- Flow Direction

6261 Cross-Section Number
687.77 Water Surface Elevation (m) Along Cross-Section



NOTE(S)

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2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.5-1

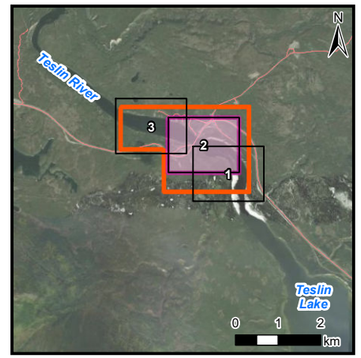
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Bridge
- Culvert

6261 / **687.77** — Cross-Section Number / Water Surface Elevation (m) Along Cross-Section



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

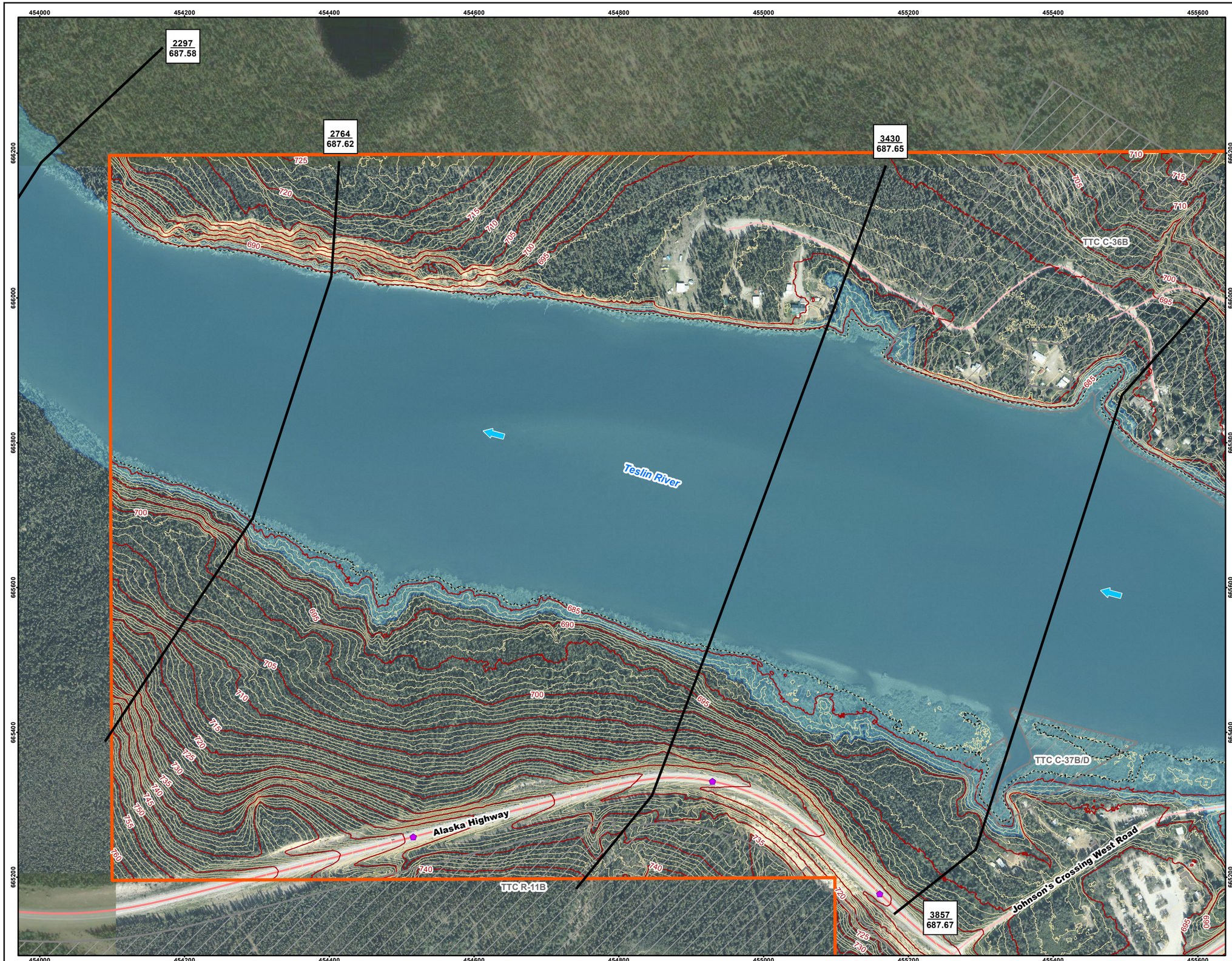
N

wsp

September 2024

Figure 2.5-2

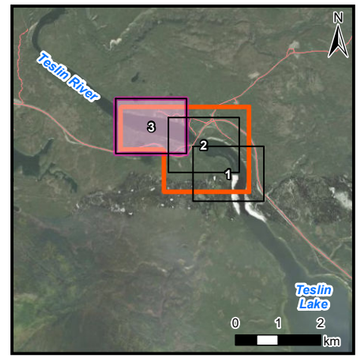
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Cross-Section
- Flow Direction
- Culvert

6261
687.77
Cross-Section Number
Water Surface Elevation (m)
Along Cross-Section



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Johnson's Crossing Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 2.5-3

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

25mm

0

460000
461000
462000
660000
659000
658000
657000
Alaska Highway
Sheet 1
Teslin Lake
TTC R-26B
Sheet 2
Alaska Highway
Brooks Brook
Study Area
N
Teslin
Lake
0 5 10
km

LEGEND

- Study Area
- Detailed Mapsheet Extent
- First Nation Settlement Lands - Surveyed
- Highway
- Local Road

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

REV 0 - ISSUED AS FINAL (24/09/13)

REFERENCE(S)

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2. IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. ADDITIONAL IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area

150 0 150
Metres
1:12,000

N

wsp

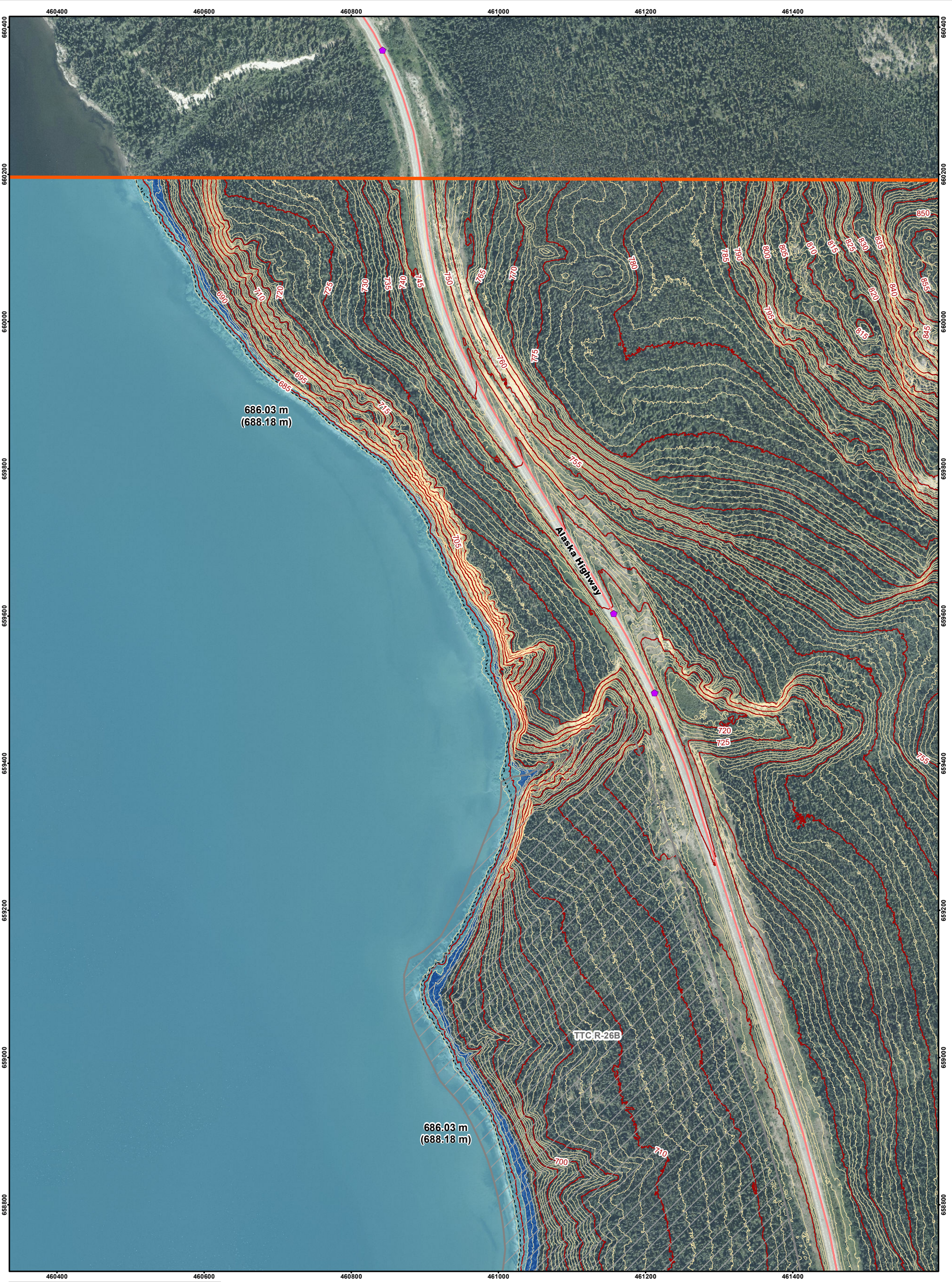
September 2024

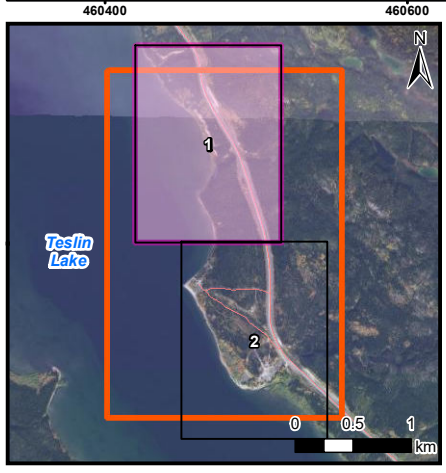
Figure 3.0

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

25mm

0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.03 m (688.18 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/19)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

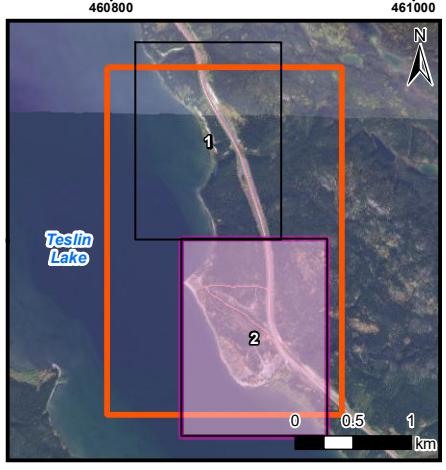
September 2024

Figure 3.1-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.03 m (688.18 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

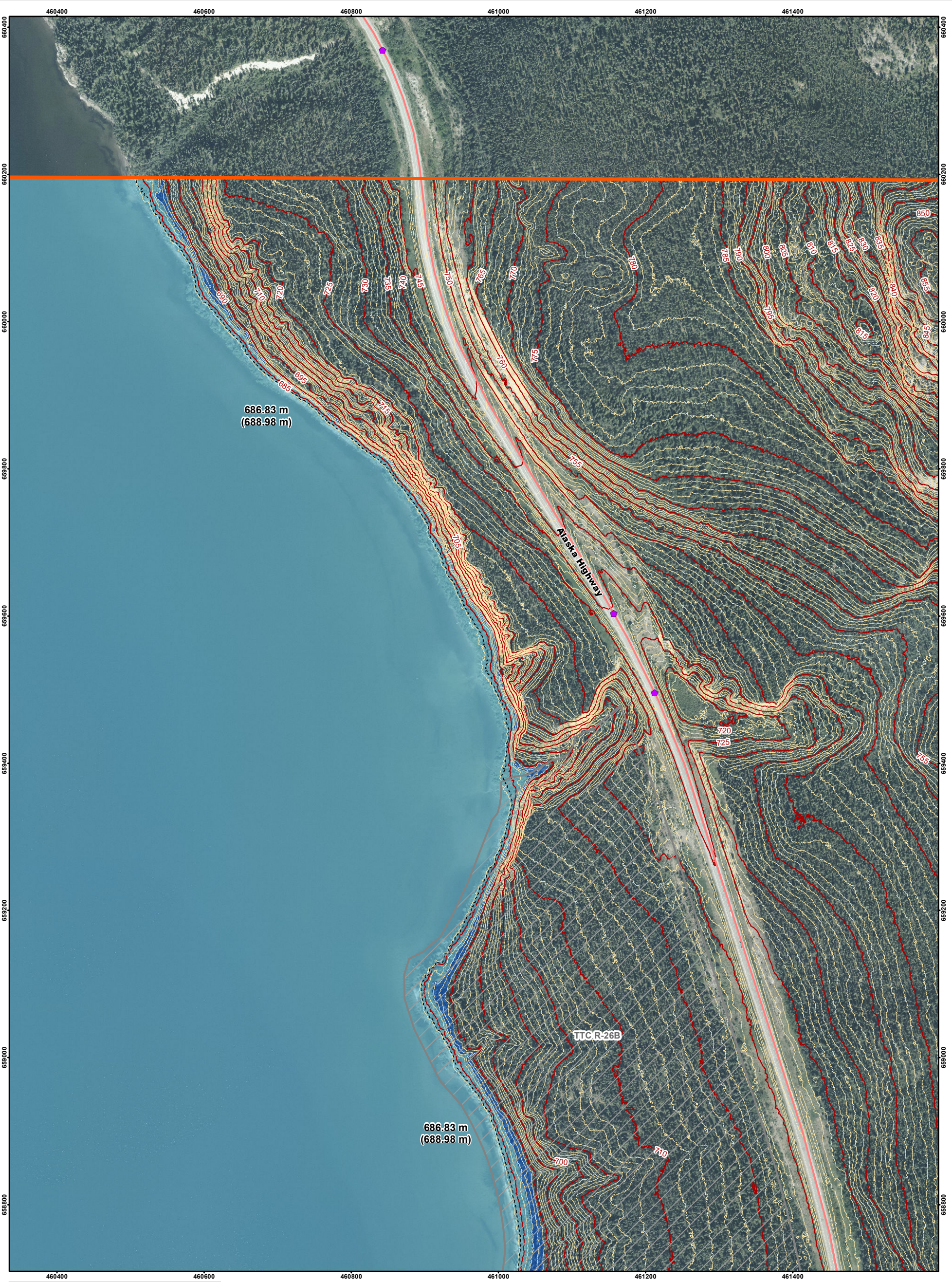
September 2024

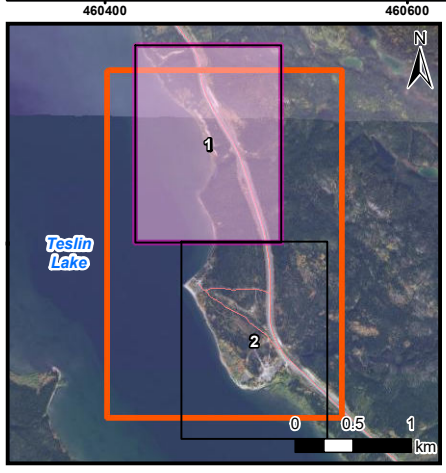
Figure 3.1-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.83 m (688.98 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/19)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

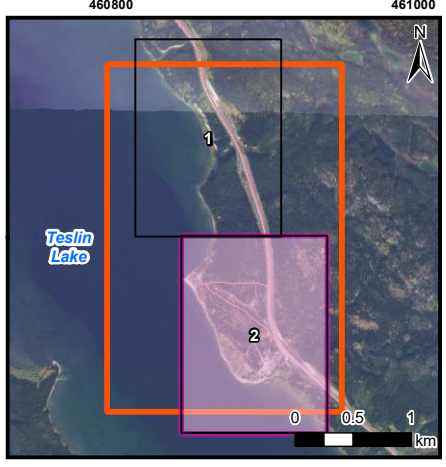
September 2024

Figure 3.2-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.83 m (688.98 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

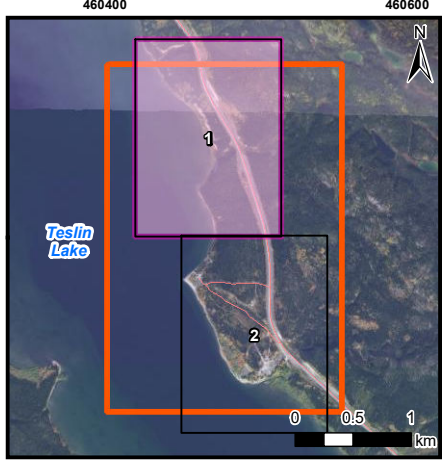
Figure 3.2-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.13 m (689.28 m) — Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

WSP

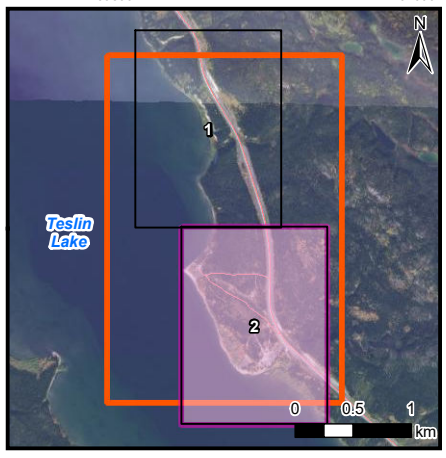
September 2024

Figure 3.3-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.13 m (689.28 m) Inundation Level with Wave Runup

NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

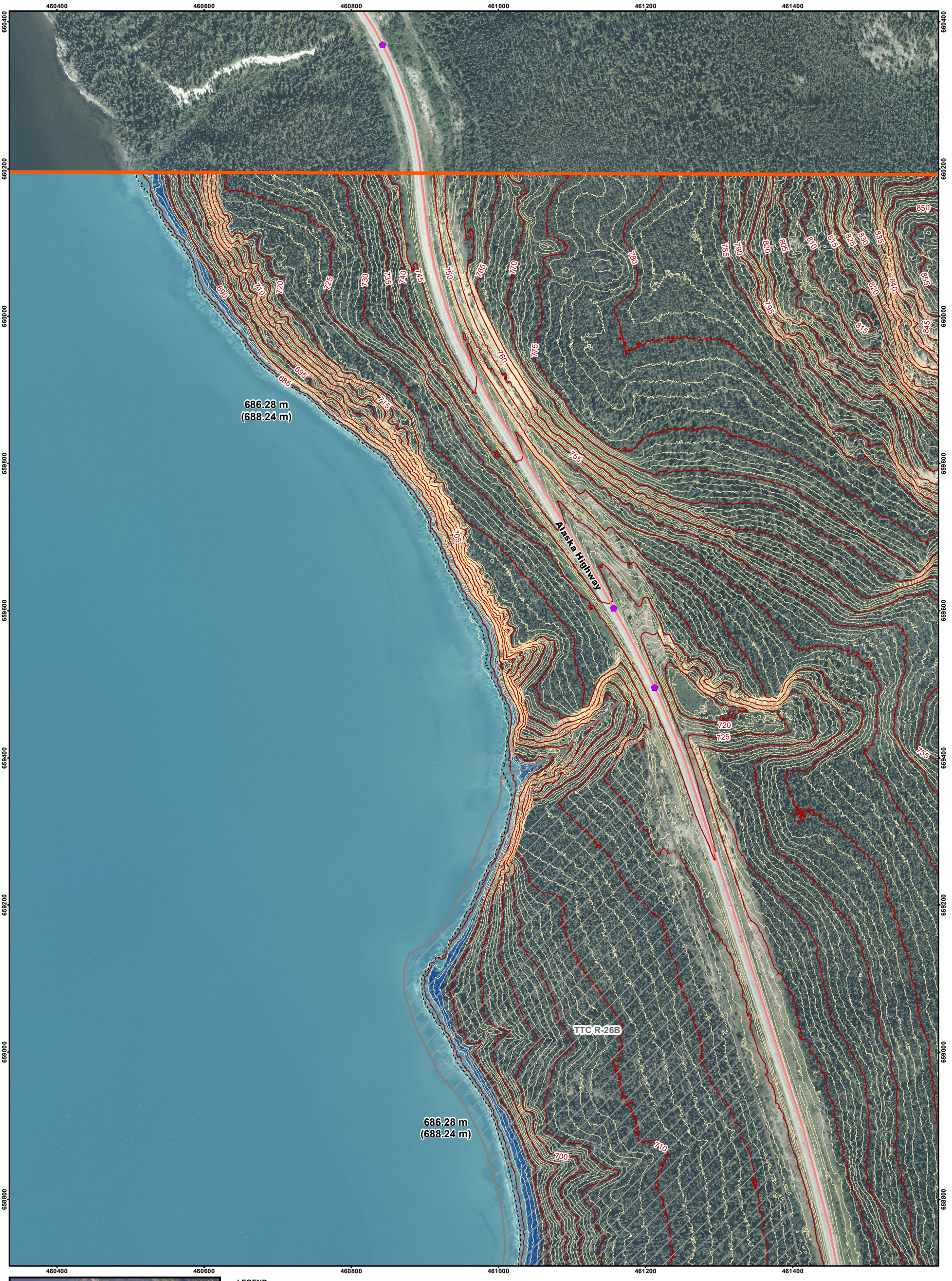
September 2024

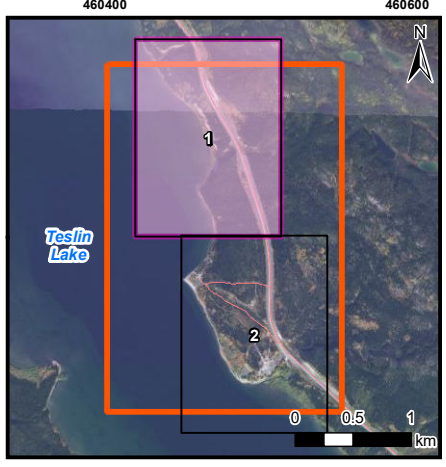
Figure 3.3-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.28 m (688.24 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

WSP

September 2024

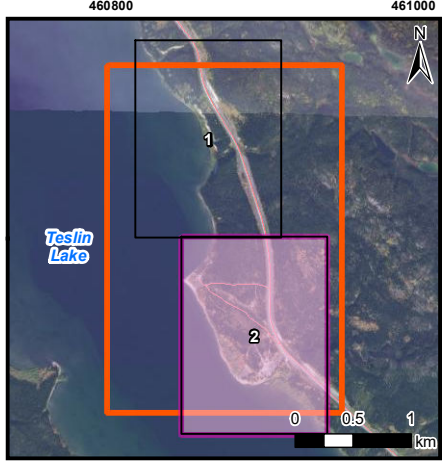
Figure 3.4-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.28 m (688.24 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

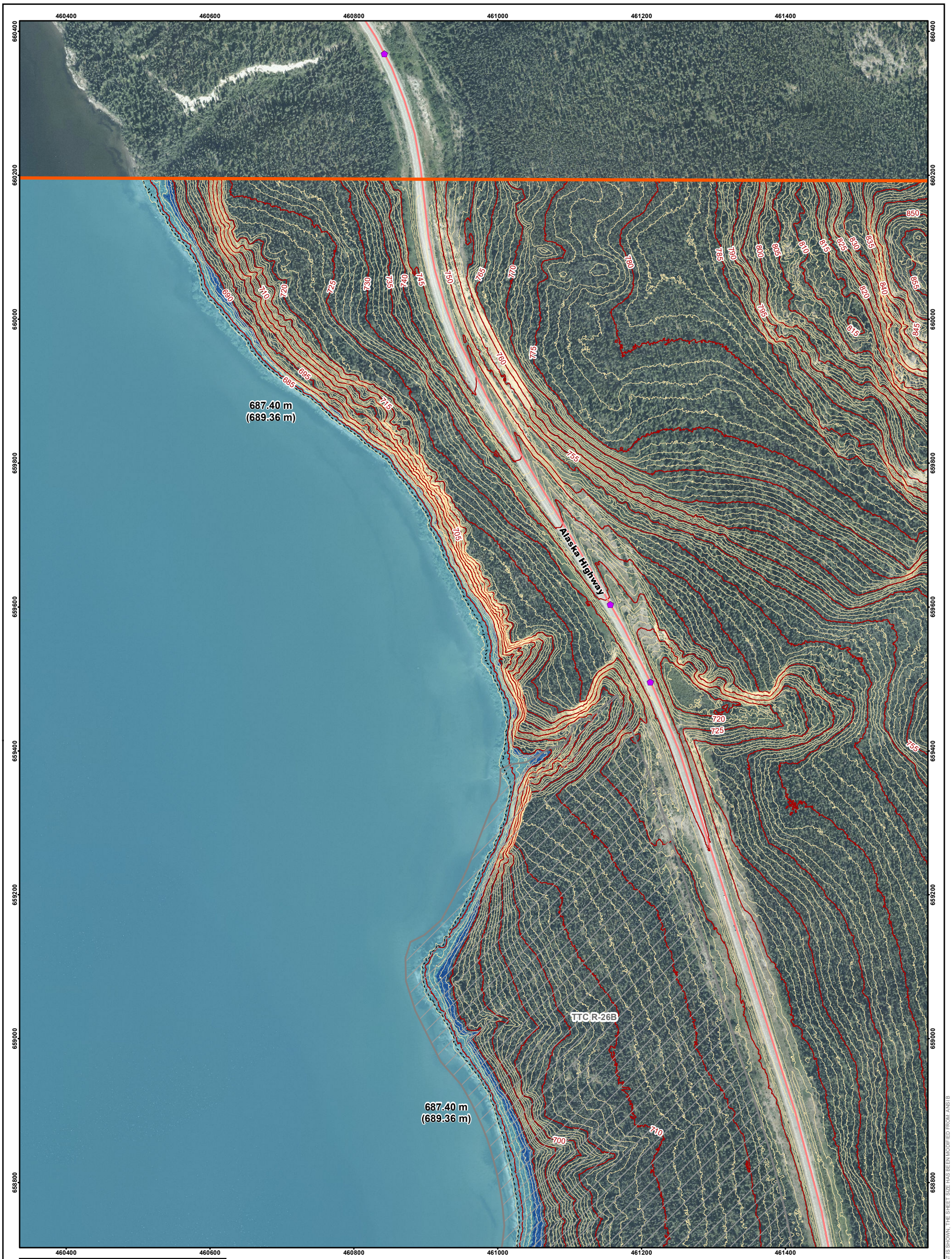
September 2024

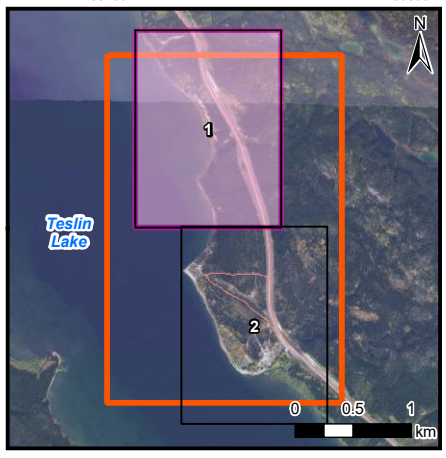
Figure 3.4-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 687.40 m (689.36 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

WSP

September 2024

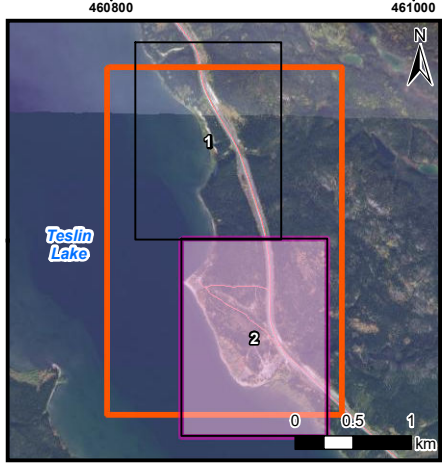
Figure 3.5-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study
- 0.5% AEP Climate Change Flood Inundation
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.40 m (689.36 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON

Yukon Canada

Teslin Flood Mapping Study

Brooks Brook Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

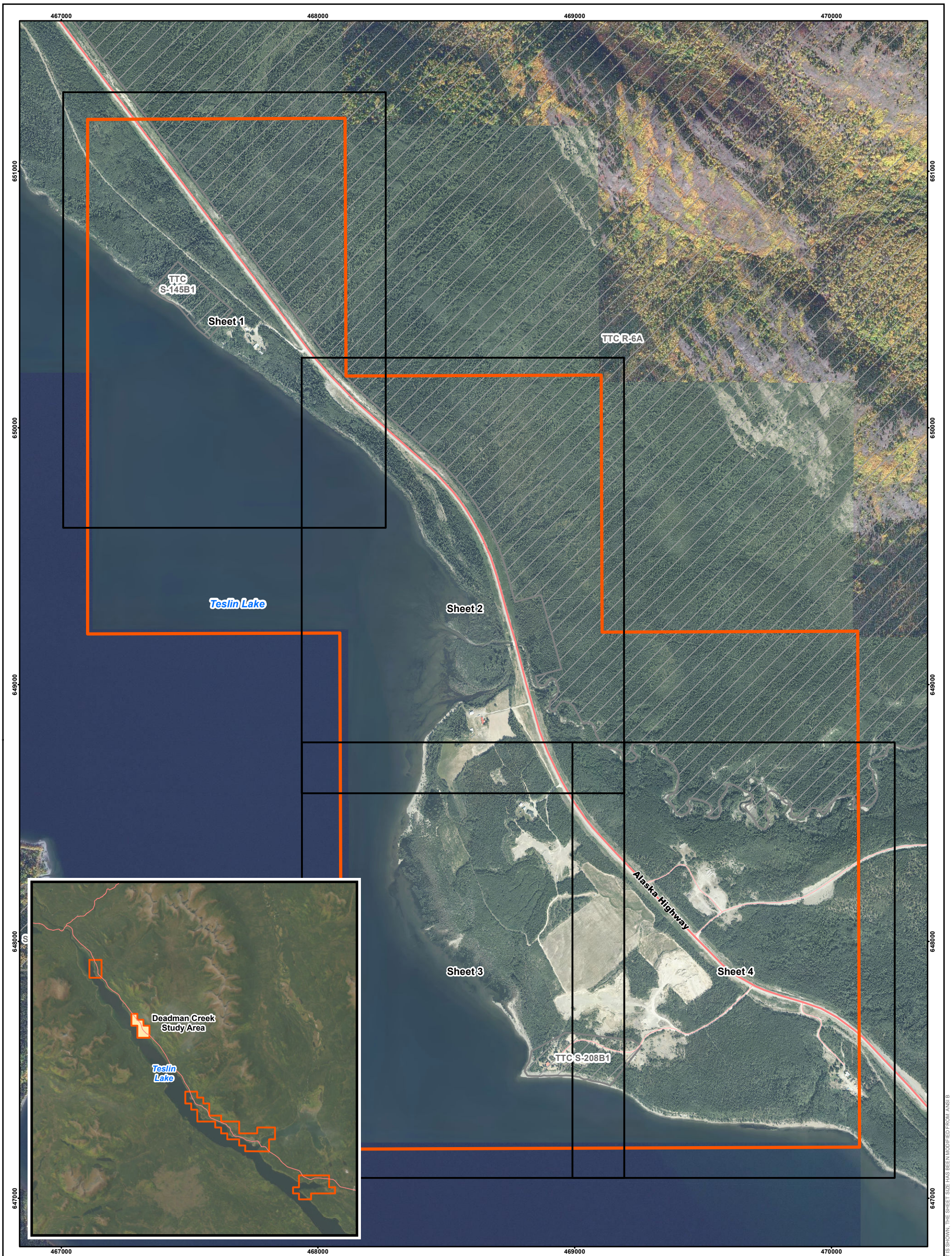
September 2024

Figure 3.5-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0



LEGEND

- Study Area
- Detailed Mapsheet Extent
- First Nation Settlement Lands - Surveyed
- Highway
- Local Road

NOTE(S)
1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

REV 0 - ISSUED AS FINAL (24/09/13)

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. ADDITIONAL IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area

150 0 150
Metres
1:14,000

N

wsp

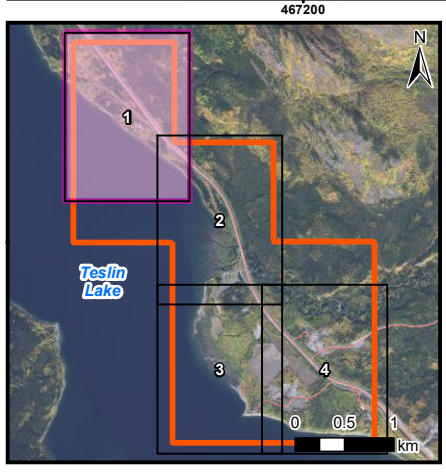
September 2024

Figure 4.0

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.03 m (688.44 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/19)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

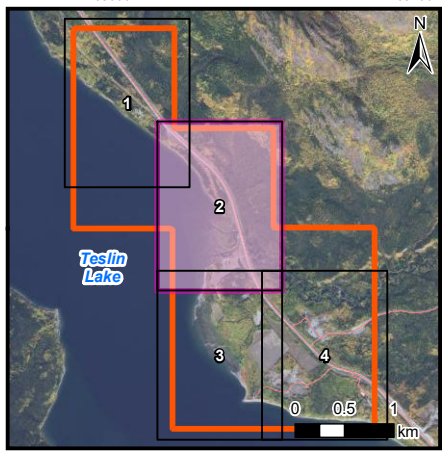
September 2024

Figure 4.1-1

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

25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.03 m (688.44 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

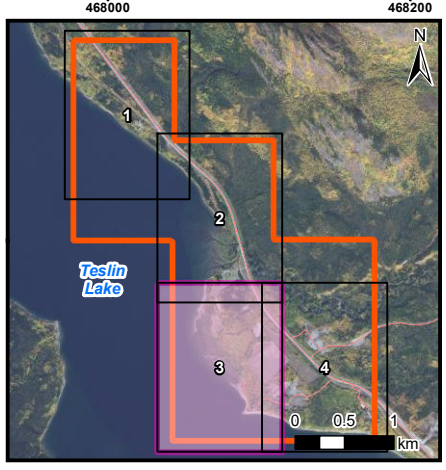
Figure 4.1-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

686.03 m (688.44 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

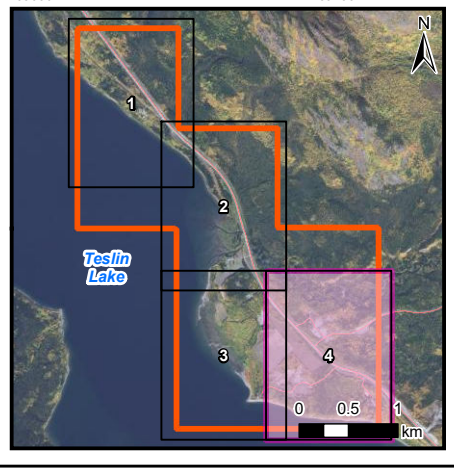
September 2024

Figure 4.1-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.03 m (688.44 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

September 2024

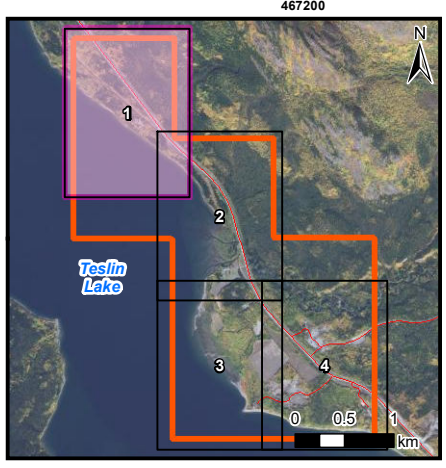
Figure 4.1-4

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

25mm

0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.83 m (689.24 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/19)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 4.2-1

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

25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.83 m (689.24 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/19)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

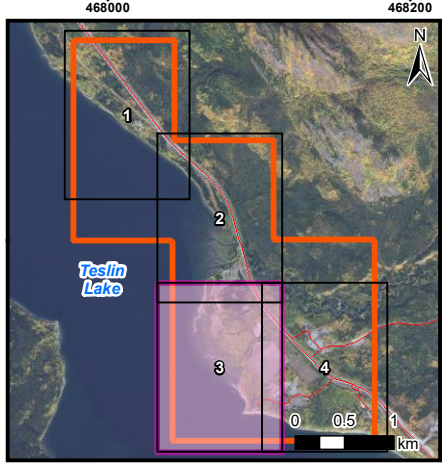
wsp

September 2024

Figure 4.2-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

686.83 m (689.24 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

WSP

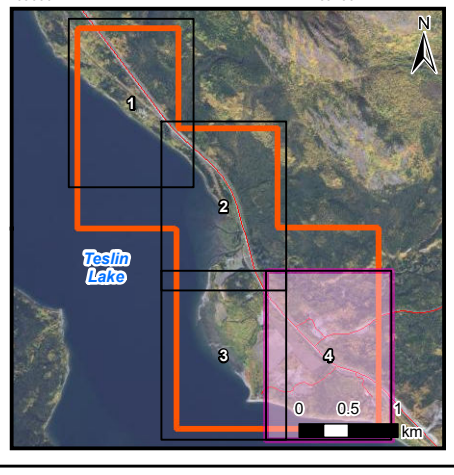
September 2024

Figure 4.2-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.83 m (689.24 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

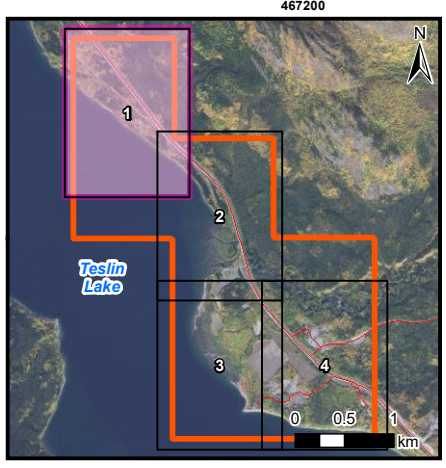
Figure 4.2-4

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

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 687.13 m (689.54 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

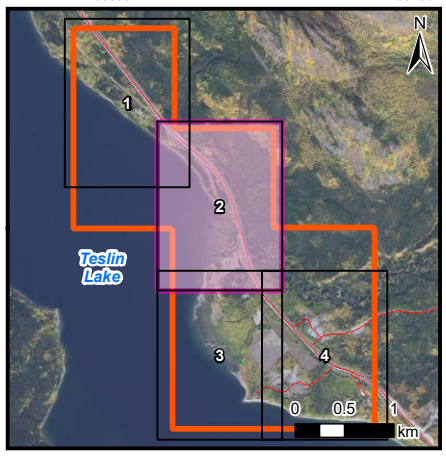
September 2024

Figure 4.3-1

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

25mm
0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.13 m (689.54 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/19)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

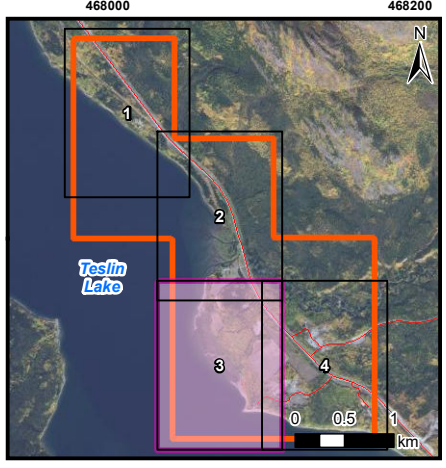
Figure 4.3-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

687.13 m (689.54 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

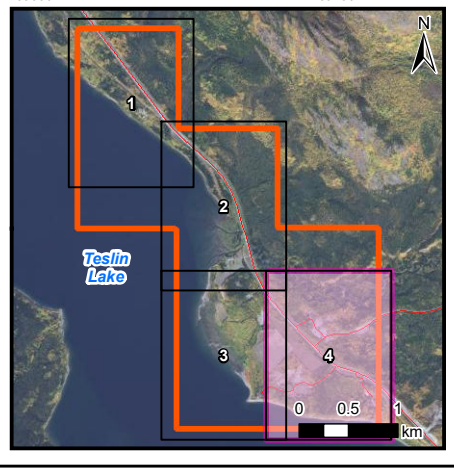
September 2024

Figure 4.3-3

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

25mm
0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.13 m (689.54 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

September 2024

Figure 4.3-4

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

25mm

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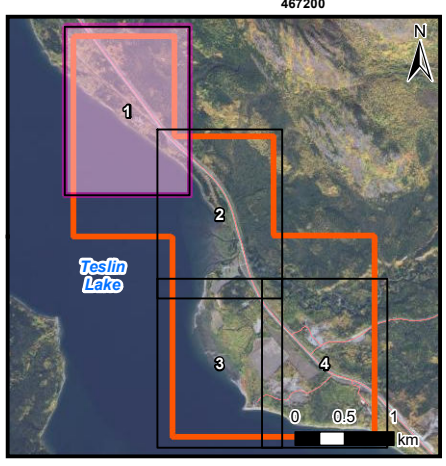

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.28 m (688.77 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

WSP

September 2024

Figure 4.4-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
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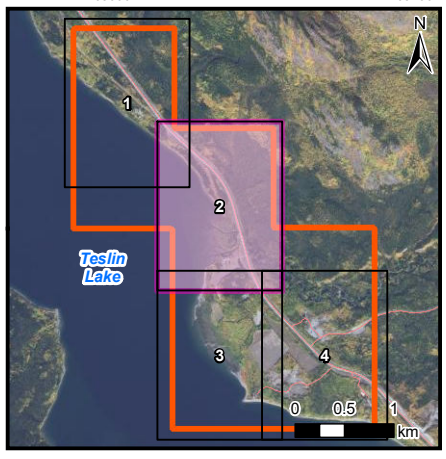

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 686.28 m (688.77 m) Inundation Level / Inundation Level with Wave Runup

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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

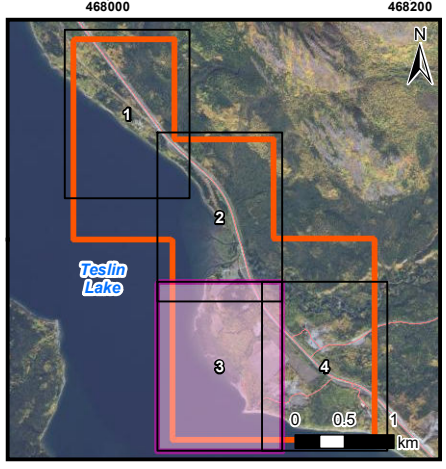
Figure 4.4-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- 686.28 m (688.77 m) Inundation Level / Inundation Level with Wave Runup

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Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 4.4-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
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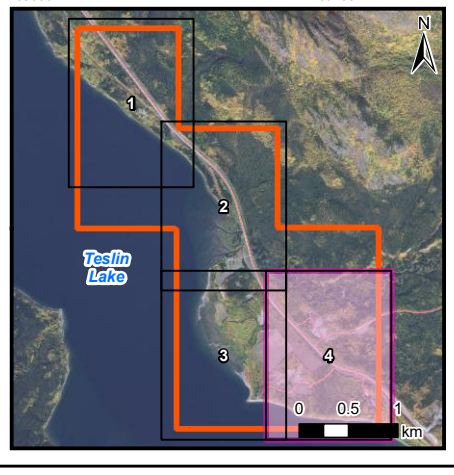

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
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Deadman Creek Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

September 2024

Figure 4.4-4

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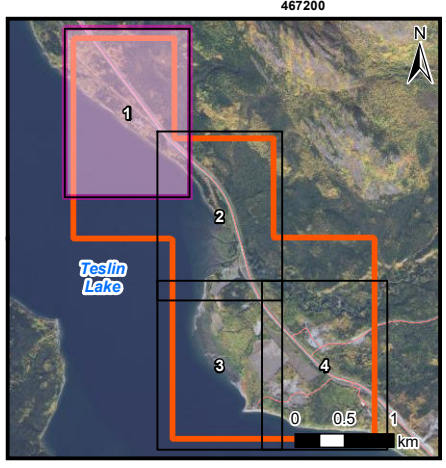

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 687.40 m (689.89 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 4.5-1

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

25mm

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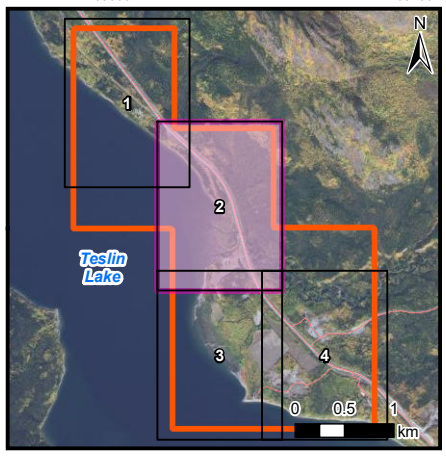

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 687.40 m (689.89 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 4.5-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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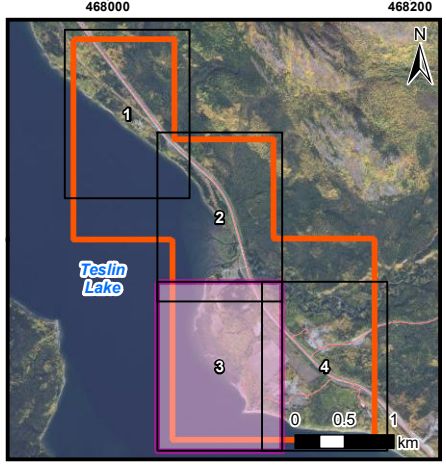

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- 687.40 m (689.89 m) Inundation Level / Inundation Level with Wave Runup

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Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

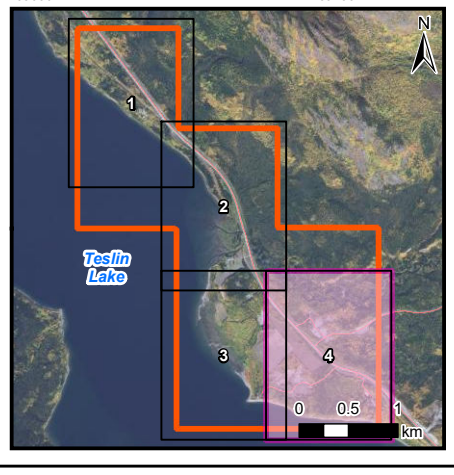
September 2024

Figure 4.5-3

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

25mm
0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.40 m (689.89 m) Inundation Level / Inundation Level with Wave Runup

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Yukon Canada

Teslin Flood Mapping Study

Deadman Creek Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

September 2024

Figure 4.5-4

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

25mm
0

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640000 635000 630000 625000

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Sheet 16
Sheet 17
Sheet 18

Teslin Lake
Teslin

Teslin Lake
Teslin Study Area

LEGEND

- Study Area
- Detailed Mapsheet Extent
- First Nation Settlement Lands - Surveyed
- Highway
- Local Road

NOTE(S)
1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

REV 0 - ISSUED AS FINAL (24/09/13)

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. ADDITIONAL IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area

600 0 600
Metres
1:60,000

N

wsp

September 2024

Figure 5.0

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm 0

476400 476600 476800 477000 477200 477400 477600 477800

638200 638000 637800 637600 637400 637200 637000

686.03 m
(686.33 m)

Alaska Highway

Ten Mile Point

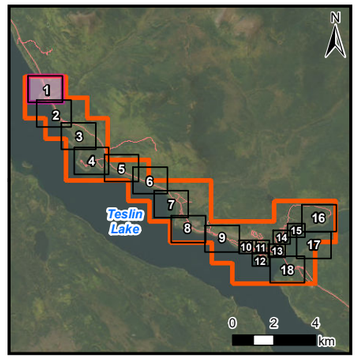
TTC S-44B1

TTC S-44B1

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

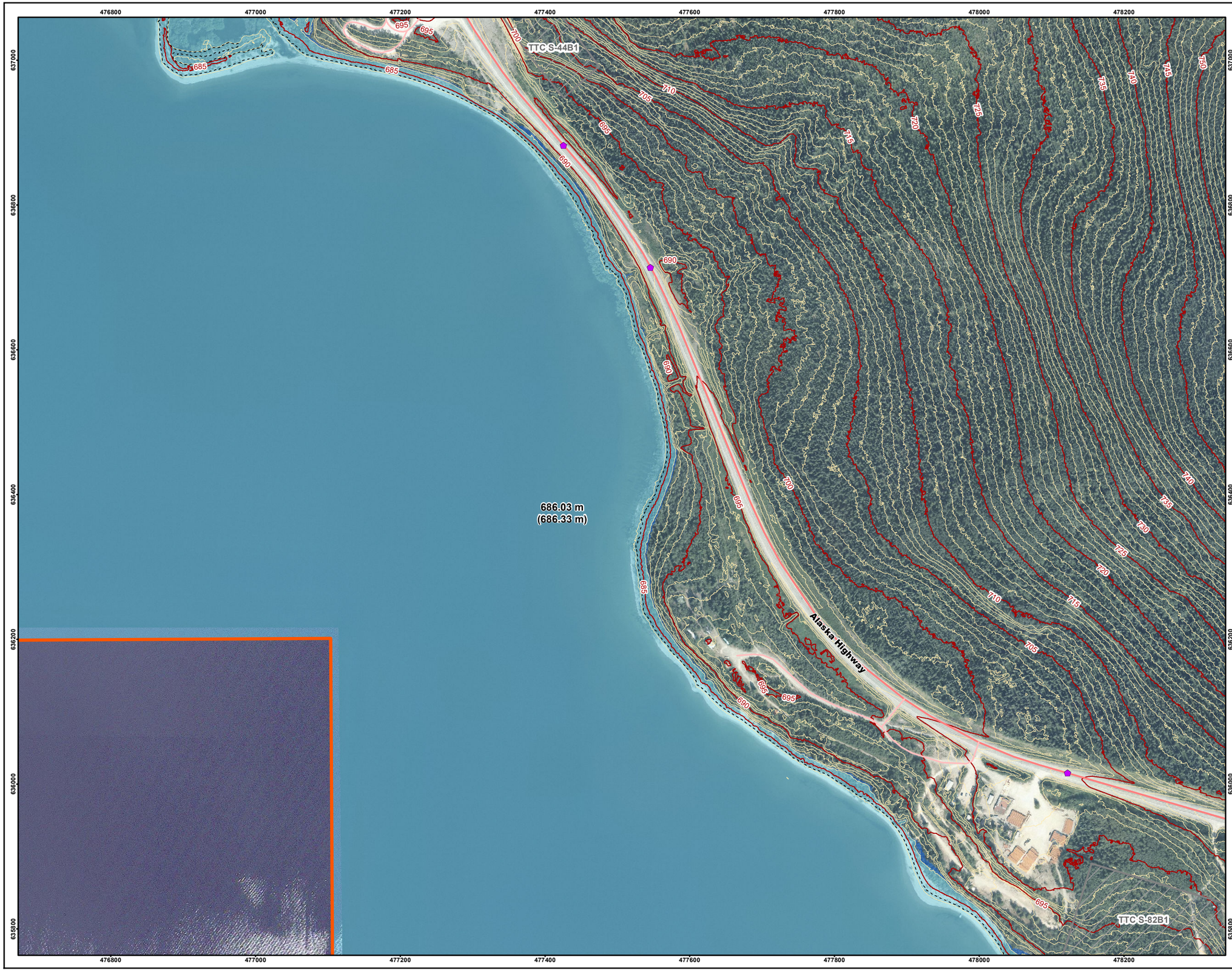
N

wsp

September 2024

Figure 5.1-1

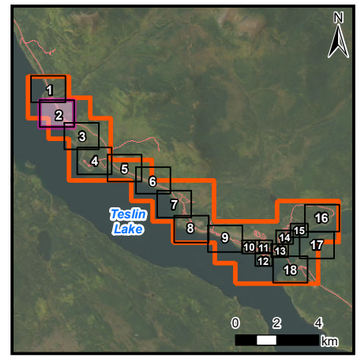
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

478000 478200 478400 478600 478800 479000 479200 479400

635800 635600 635400 635200 635000 634800

TTC S-82B1

Alaska Highway

Limit of LiDAR Data

686.03 m
(686.33 m)

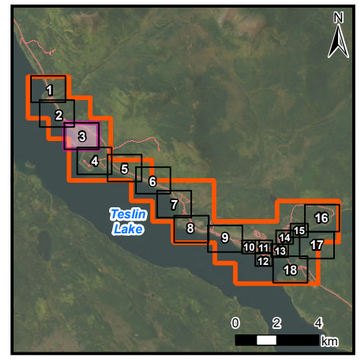
Ch'àl' X'àt' /
Willow Island

695 685 690 700 705 710 715 720 725 730 735 740 745 750 755 760 765

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



NOTE(S)

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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September
2024

Figure 5.1-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

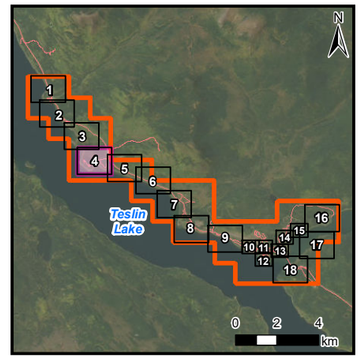
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m — Inundation Level
(686.33 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL), DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
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REV 0 - ISSUED AS FINAL (24/09/23)

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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON

SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-4

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

25mm

0

480000 480200 480400 480600 480800 481000 481200 481400 481600

634400 634200 634000 633800 633600 633400 633200

TTC S-39B1

TTC C-22B/D

TTC C-48B/D

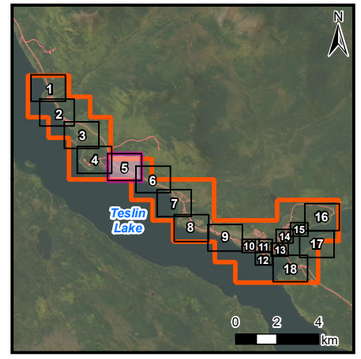
Alaska Highway

686.03 m
(686.93 m)

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



NOTE(S)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-5

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

25mm

0

481400 481600 481800 482000 482200 482400 482600 482800

633800 633600 633400 633200 633000 632800 632600

TTC R-14A

Alaska Highway

686.03 m
(686.93 m)

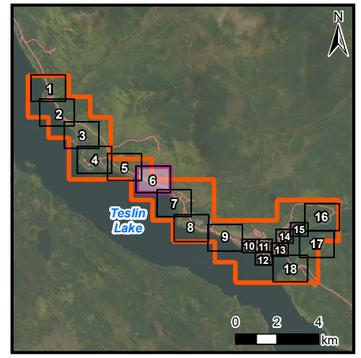
TTC C-50B/D

TTC C-49B/D

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-6

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

25mm

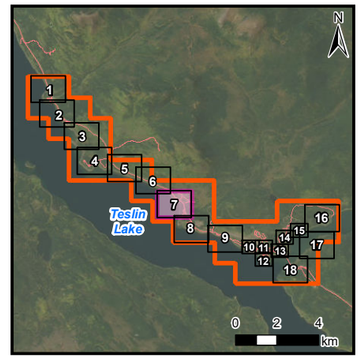
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



NOTE(S)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

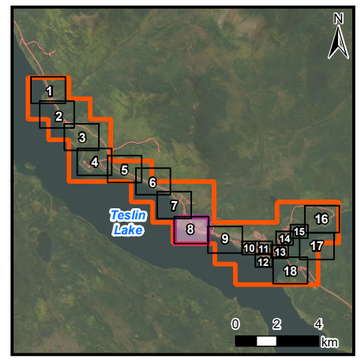
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m (686.33 m) Inundation Level with Wave Runup



NOTE(S)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-8

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

25mm

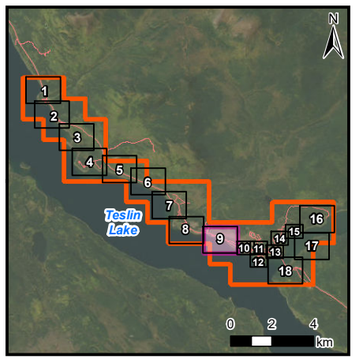
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m — Inundation Level
(686.33 m) — Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

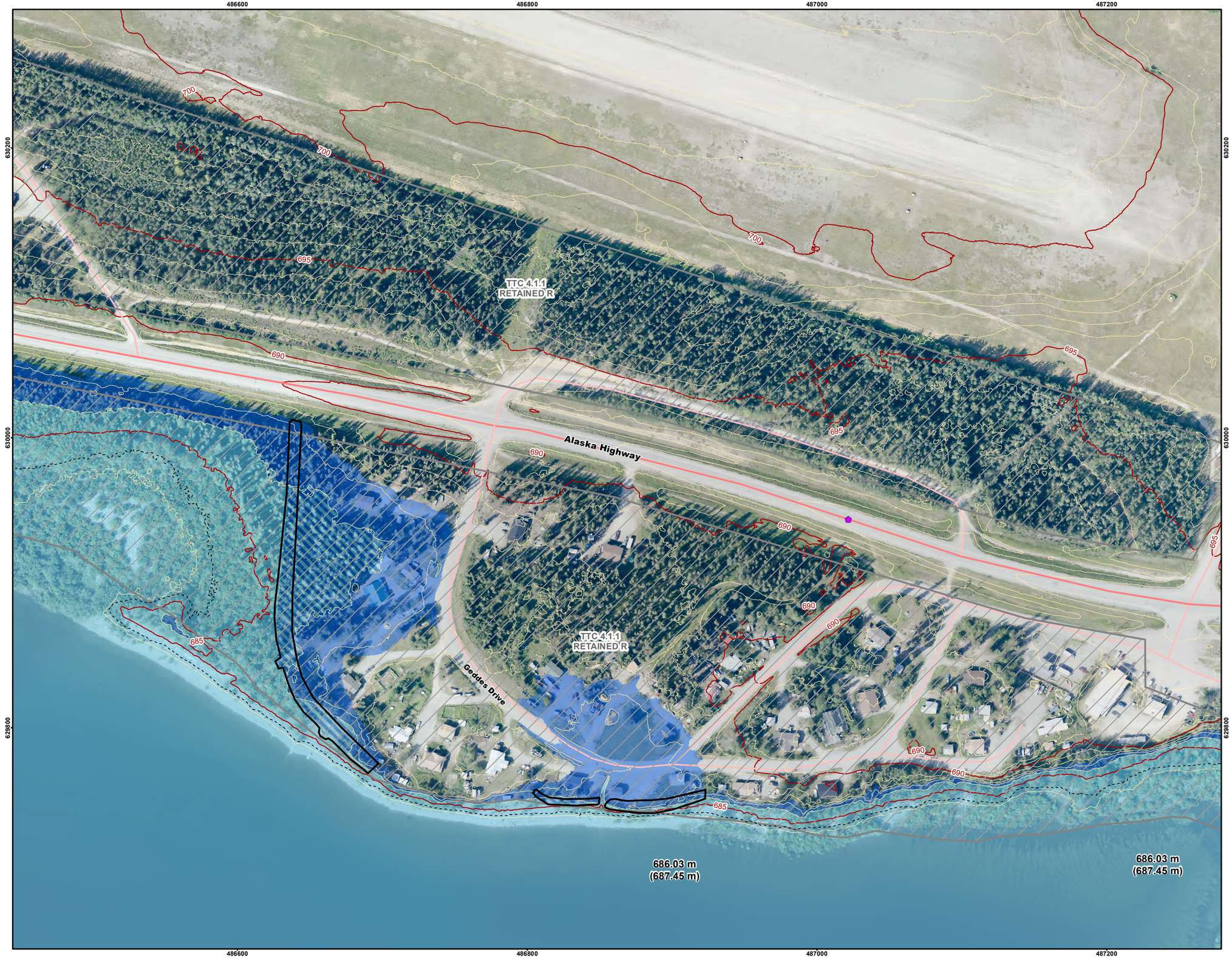
N

wsp

September 2024

Figure 5.1-9

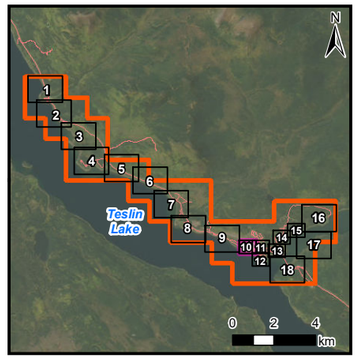
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- Flood Berm
- Protected by Flood Berm in Static Lake Conditions* (no wave runup)
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.03 m — Inundation Level
- (686.33 m) — Inundation Level with Wave Runup

* Hatching shows areas protected by flood berms for this AEP (static lake elevation only – not considering wave runup). Flood berms protect an area from flooding up to a design water level, and can be overtopped or bypassed if flood levels exceed the height of the berms at one or more locations.



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.1-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

487200 487400 487600 487800

630200 630000 629800

Airport Drive

Alaska Highway

Nisutlin Drive

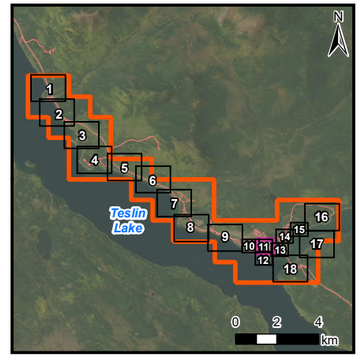
TTC 4.1.1 RETAINED R

686.03 m (687.45 m)

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.03 m Inundation Level
(686.33 m) Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.1-11

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

25mm

0

487200 487400 487600 487800

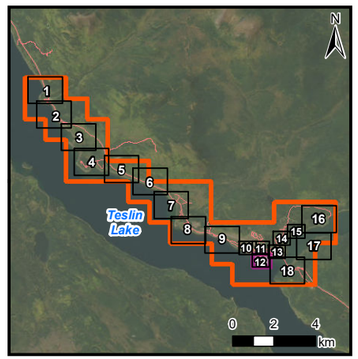
629600 629400 629200



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.03 m (686.33 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.1-12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

488000 488200 488400 488600

630000 629800 629600

Alaska Highway
Fox Street
Nisutlin Drive
Sawmill Road
TTC C-30B/D
Nisutlin Bay Bridge
686.03 m (687.45 m)
686.03 m (687.45 m)

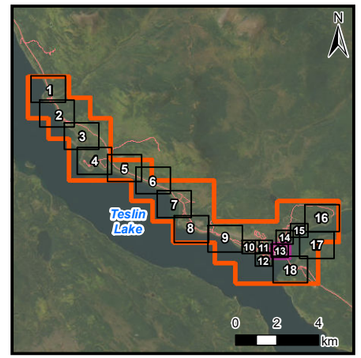
690 695 685

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- Flood Berm
- Protected by Flood Berm in Static Lake Conditions* (no wave runup)
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge

686.03 m — Inundation Level
(686.33 m) — Inundation Level with Wave Runup

* Hatching shows areas protected by flood berms for this AEP (static lake elevation only – not considering wave runup). Flood berms protect an area from flooding up to a design water level, and can be overtopped or bypassed if flood levels exceed the height of the berms at one or more locations.



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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.1-13

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

25mm

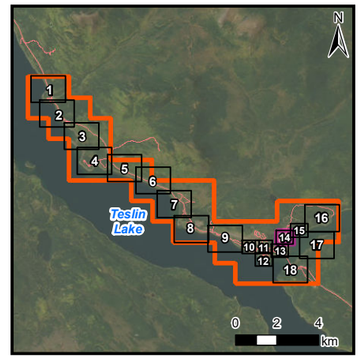
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.03 m (686.33 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL), DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.1-14

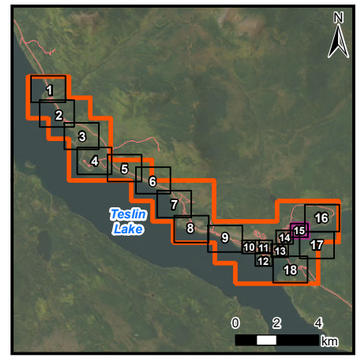
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.03 m — Inundation Level
(686.33 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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REV 0 - ISSUED AS FINAL (24/09/23)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.1-15

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

25mm

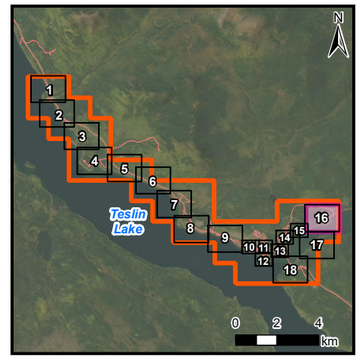
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.03 m (686.33 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

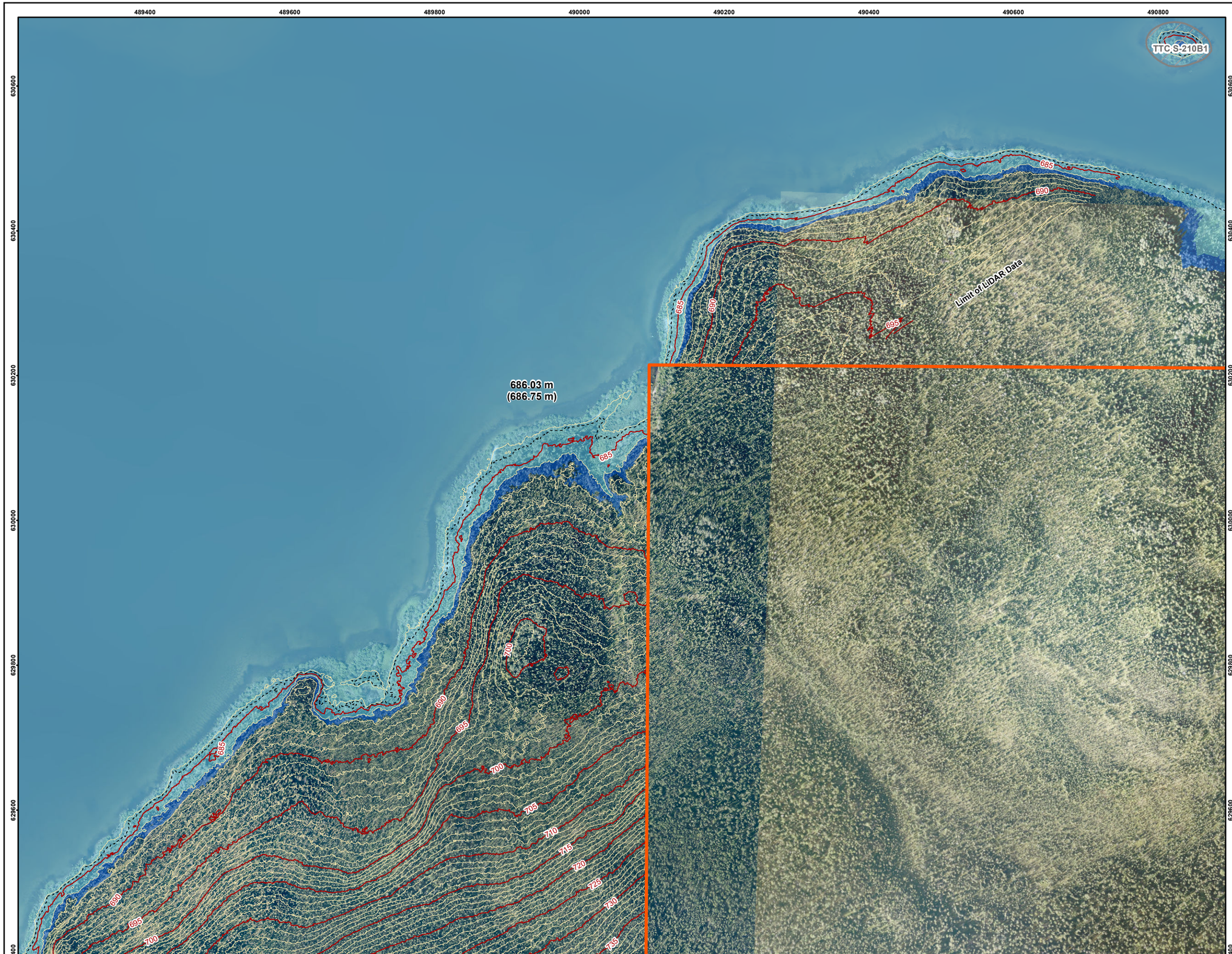
September 2024

Figure 5.1-16

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

25mm

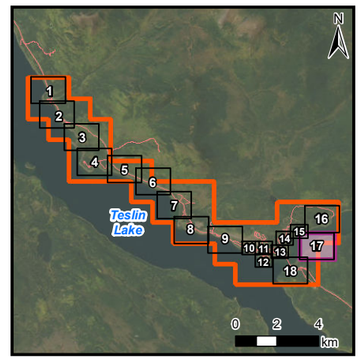
0



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.03 m (686.33 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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REV 0 - ISSUED AS FINAL (24/09/23)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-17

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

25mm

0

488000 488200 488400 488600 488800 489000 489200 489400 489600

629400 629200 629000 628800 628600 628400

Nisutlin Bay Bridge

686.03 m (686.75 m)

685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780

Alaska Highway

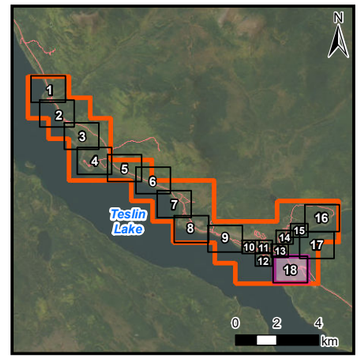
TTC C-8B

Limit of LiDAR Data

LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- Culvert

686.03 m (686.33 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.1-18

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

25mm

0

476400 476600 476800 477000 477200 477400 477600 477800

638200 638000 637800 637600 637400 637200 637000

686.83 m
(687.13 m)

Alaska Highway

Ten Mile Point

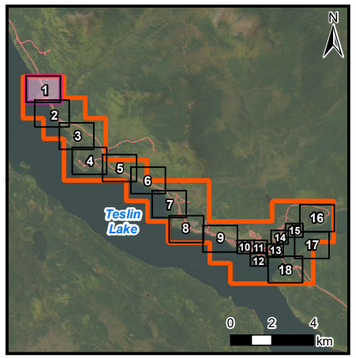
TTC S-44B1

TTC S-44B1

LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/24)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

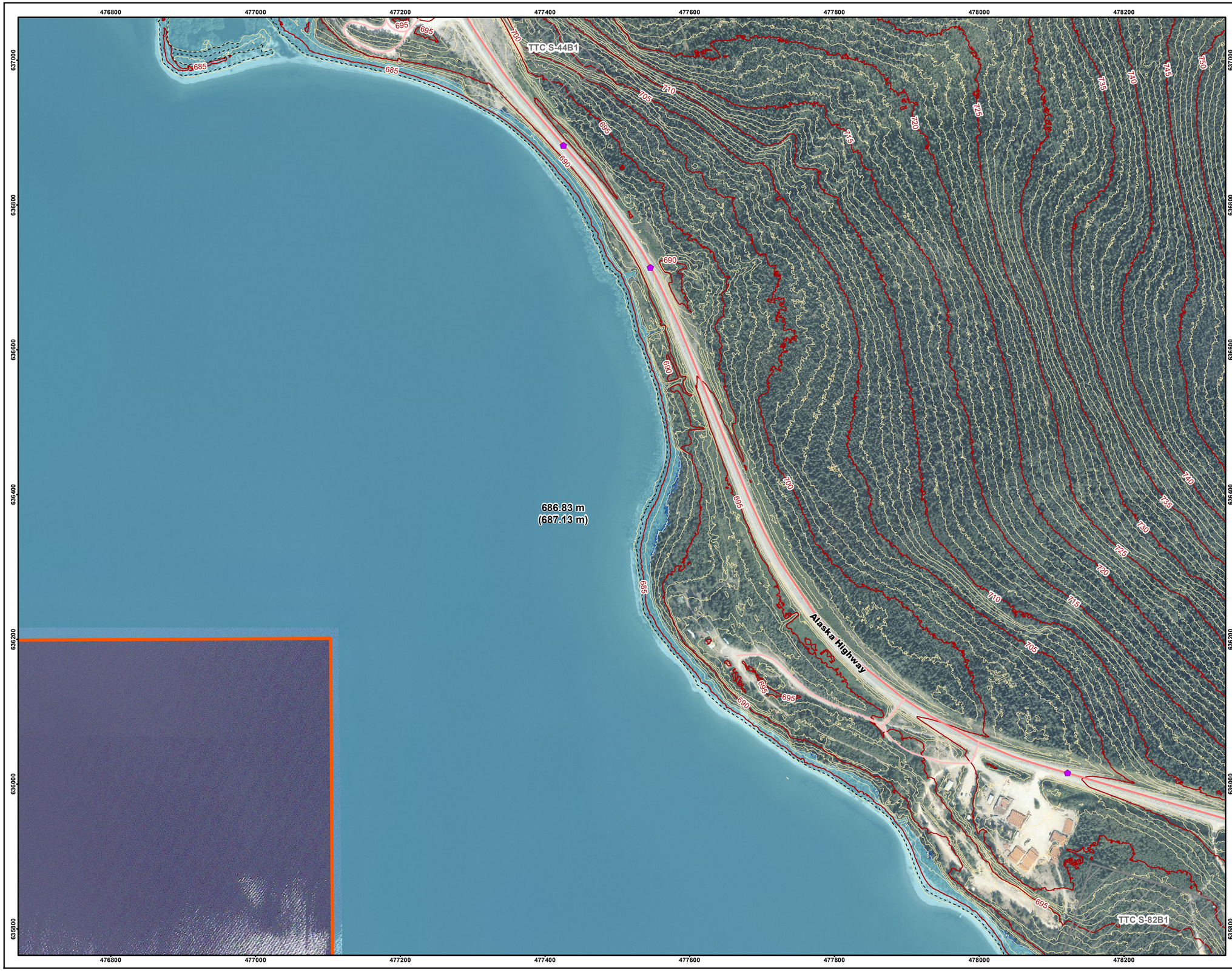
N

wsp

September 2024

Figure 5.2-1

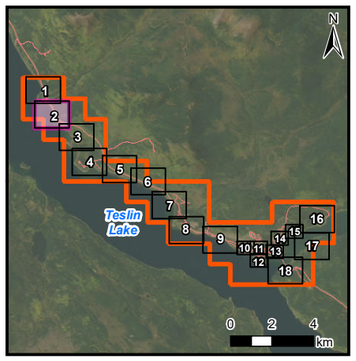
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.2-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

478000 478200 478400 478600 478800 479000 479200 479400

635800 635600 635400 635200 635000 634800

TTC S-82B1

Alaska Highway

Limit of LiDAR Data

686.83 m
(687.13 m)

Ch'àl' X'àt' /
Willow Island

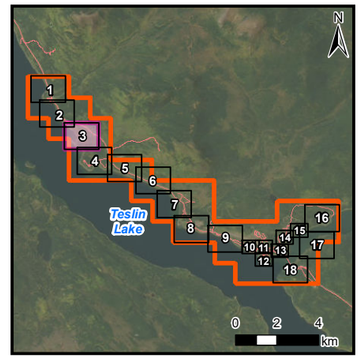
695 700 705 710 715 720 725 730 735 740 745 750 755 760 765

685 690

LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.85 m Inundation Level
(687.15 m) Inundation Level with Wave Runup



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/24)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

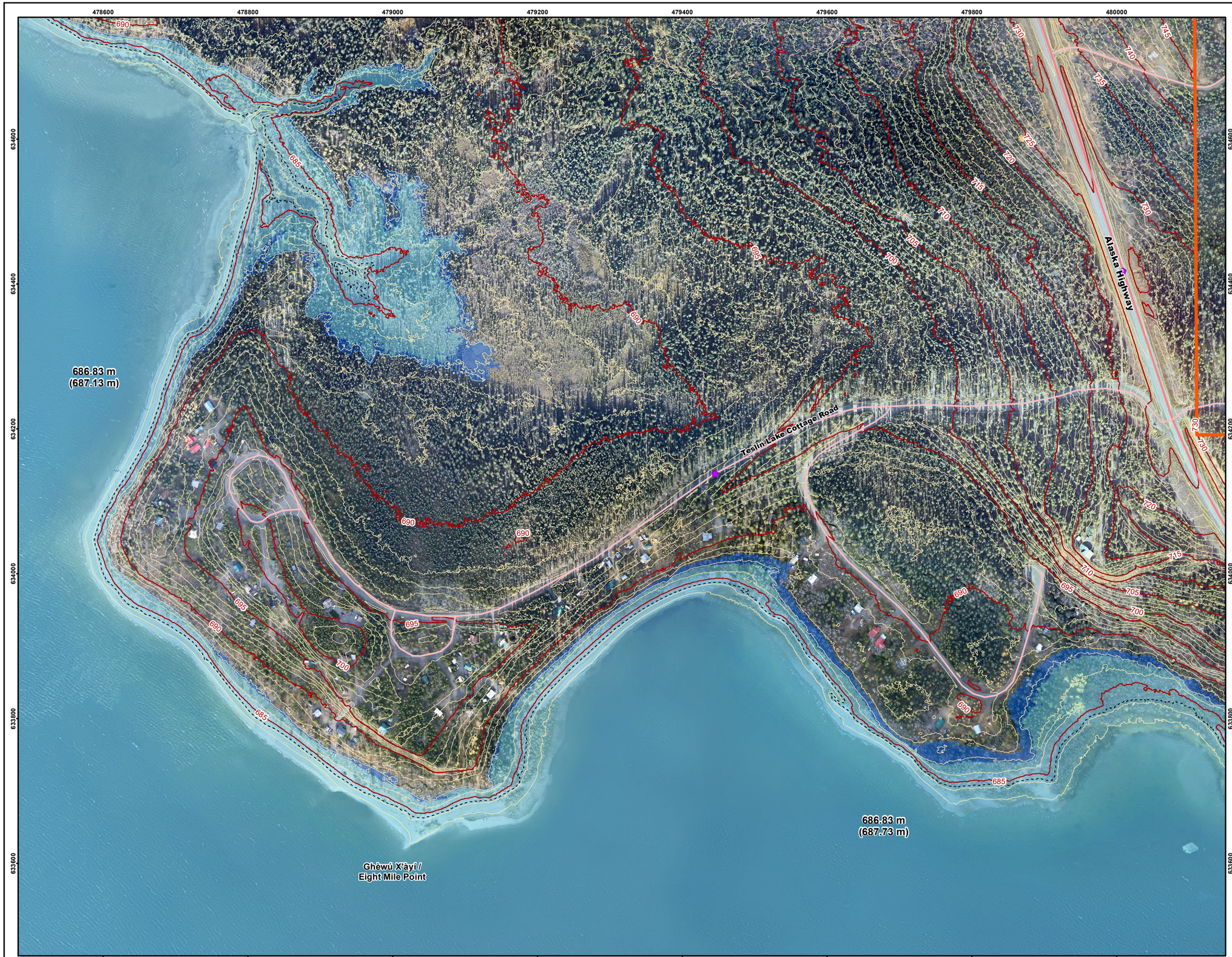
September
2024

Figure 5.2-3

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

25mm

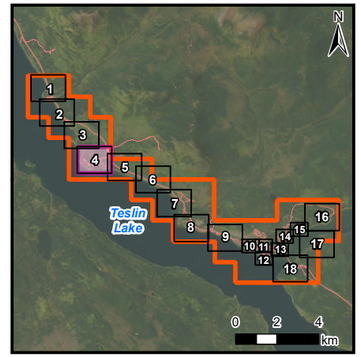
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.85 m (687.15 m) Inundation Level with Wave Runup



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REV 0 - ISSUED AS FINAL (24/09/24)

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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.2-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm

480000 480200 480400 480600 480800 481000 481200 481400 481600

634400 634200 634000 633800 633600 633400 633200

Highway

TTC S-39B1

TTC C-22B/D

TTC C-48B/D

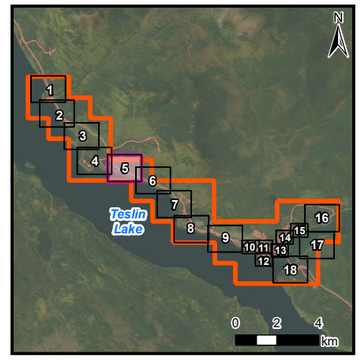
Alaska Highway

686.83 m
(687.73 m)

LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.85 m Inundation Level
(687.15 m) Inundation Level with Wave Runup



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/24)

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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

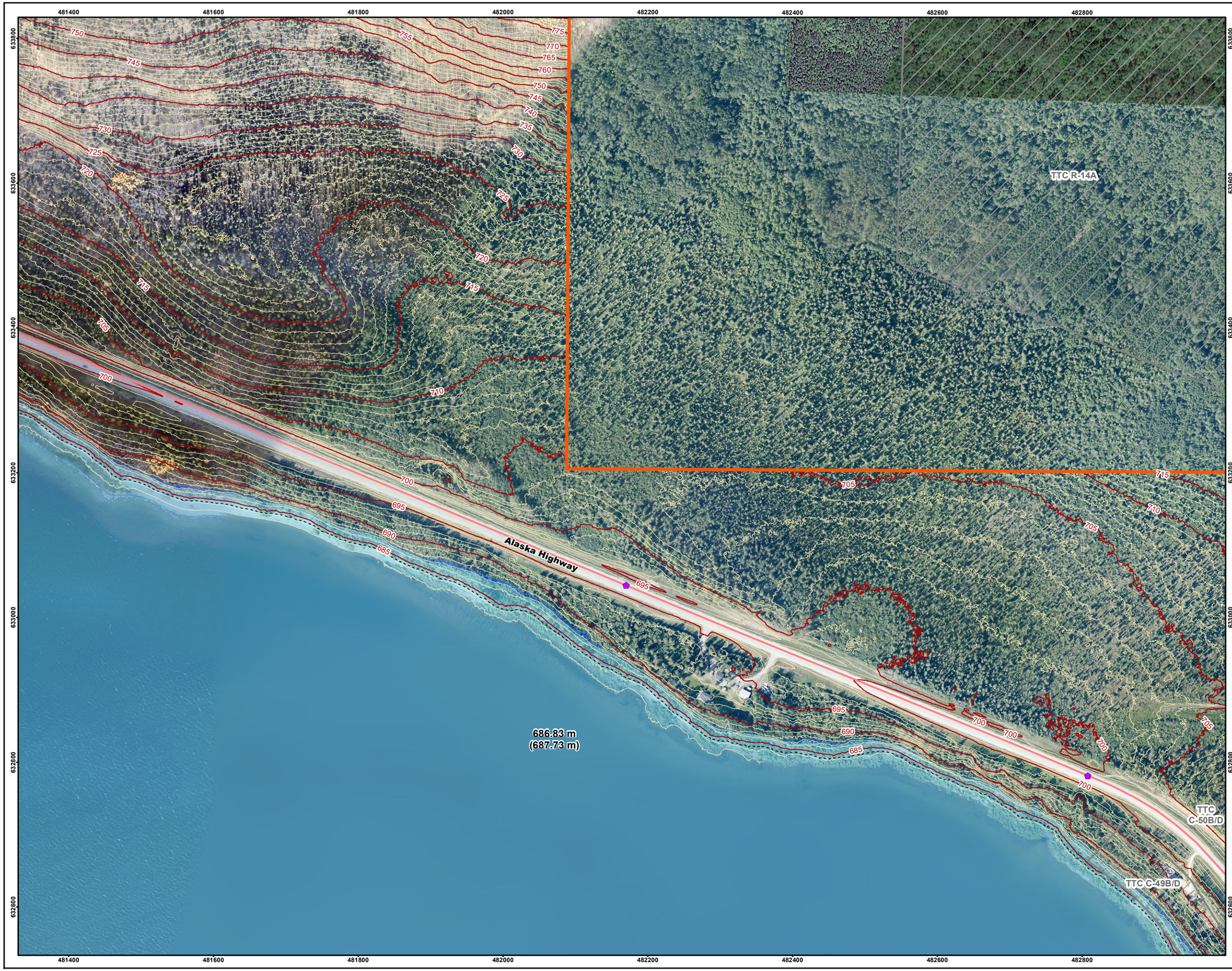
September 2024

Figure 5.2-5

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

25mm

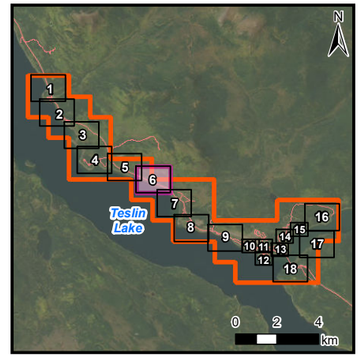
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.85 m — Inundation Level
(687.15 m) — Inundation Level with Wave Runup



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/24)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

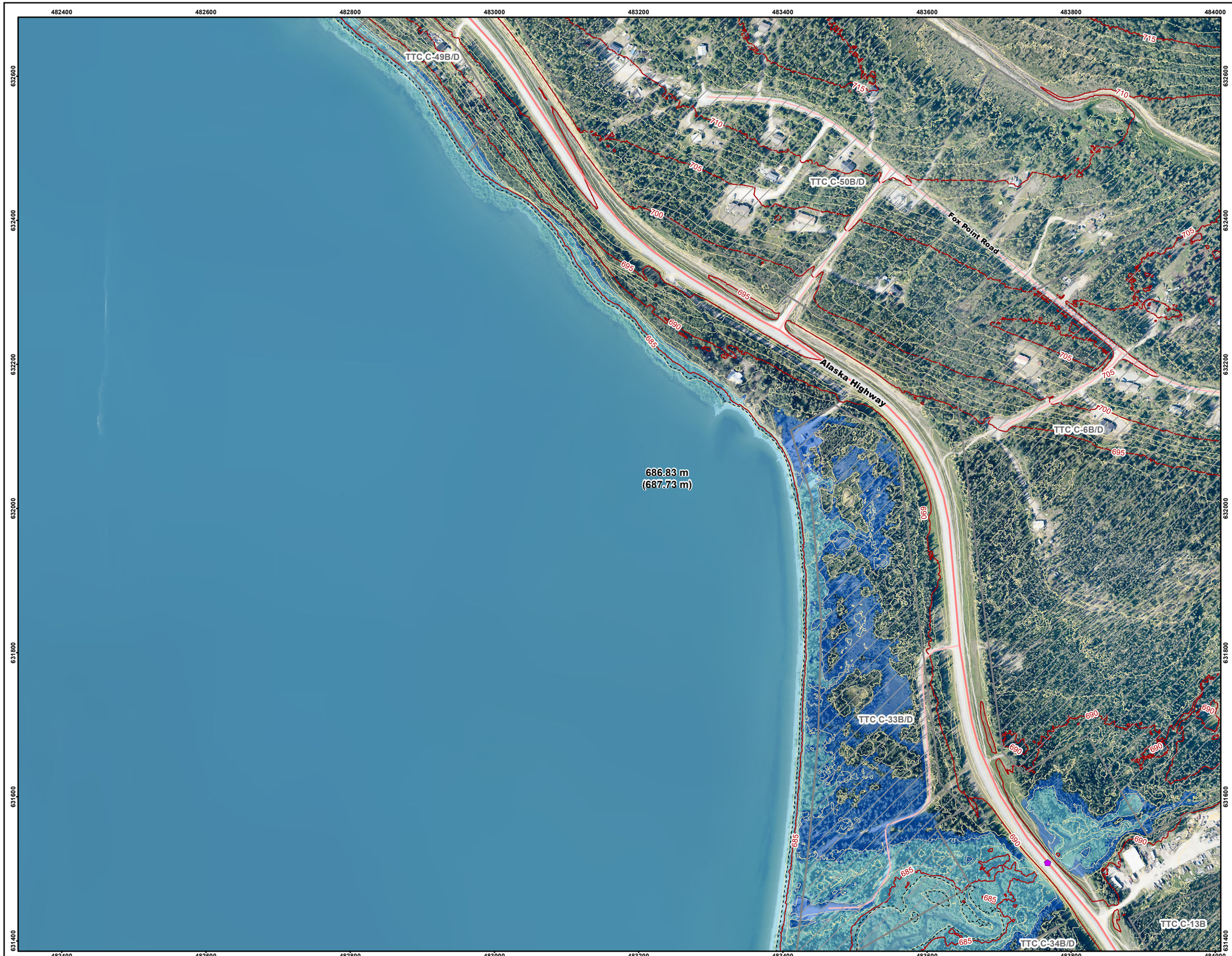
N

wsp

September 2024

Figure 5.2-6

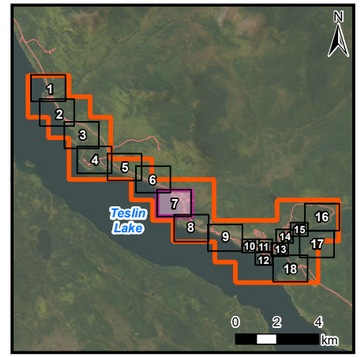
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

686.85 m Inundation Level
(687.15 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/24)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.2-7

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

25mm

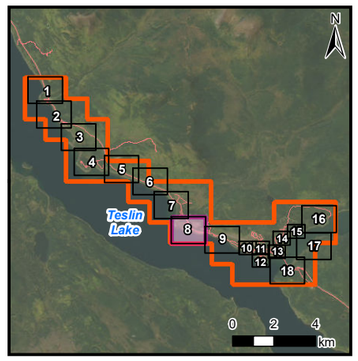
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.83 m — Inundation Level
(687.13 m) — Inundation Level with Wave Runup



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/24)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.2-8

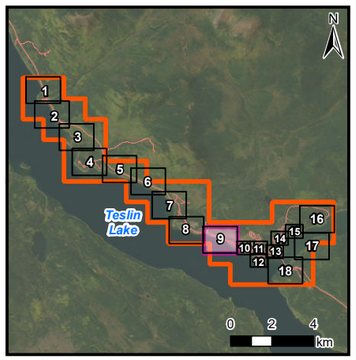
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.83 m — Inundation Level
(687.13 m) — Inundation Level with Wave Runup



NOTE(S)

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REV 0 - ISSUED AS FINAL (24/09/24)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

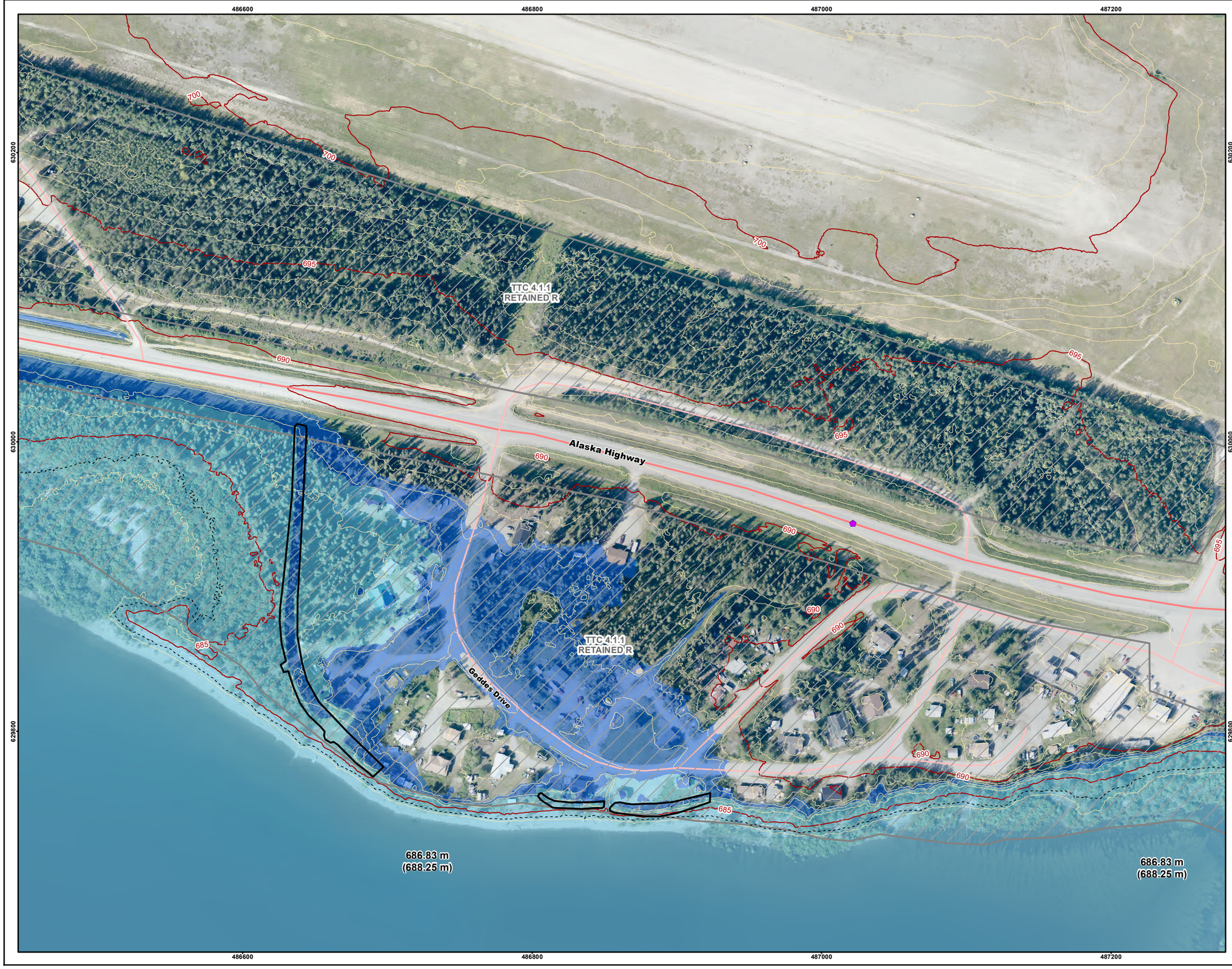
September 2024

Figure 5.2-9

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

25mm

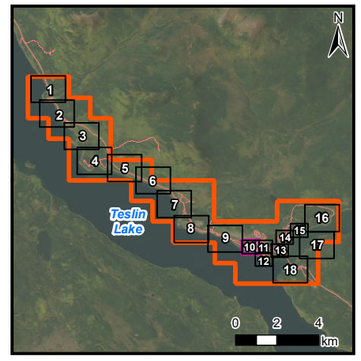
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- Flood Berm
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.2-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

487200 487400 487600 487800

630200 630000 629800

Airport Drive

Alaska Highway

Nisutlin Drive

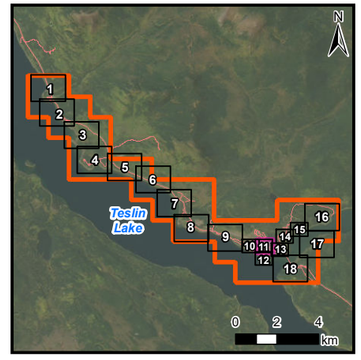
TTC 4.1.1 RETAINED R

686.83 m (688.25 m)

LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.83 m Inundation Level
(687.13 m) Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.2-11

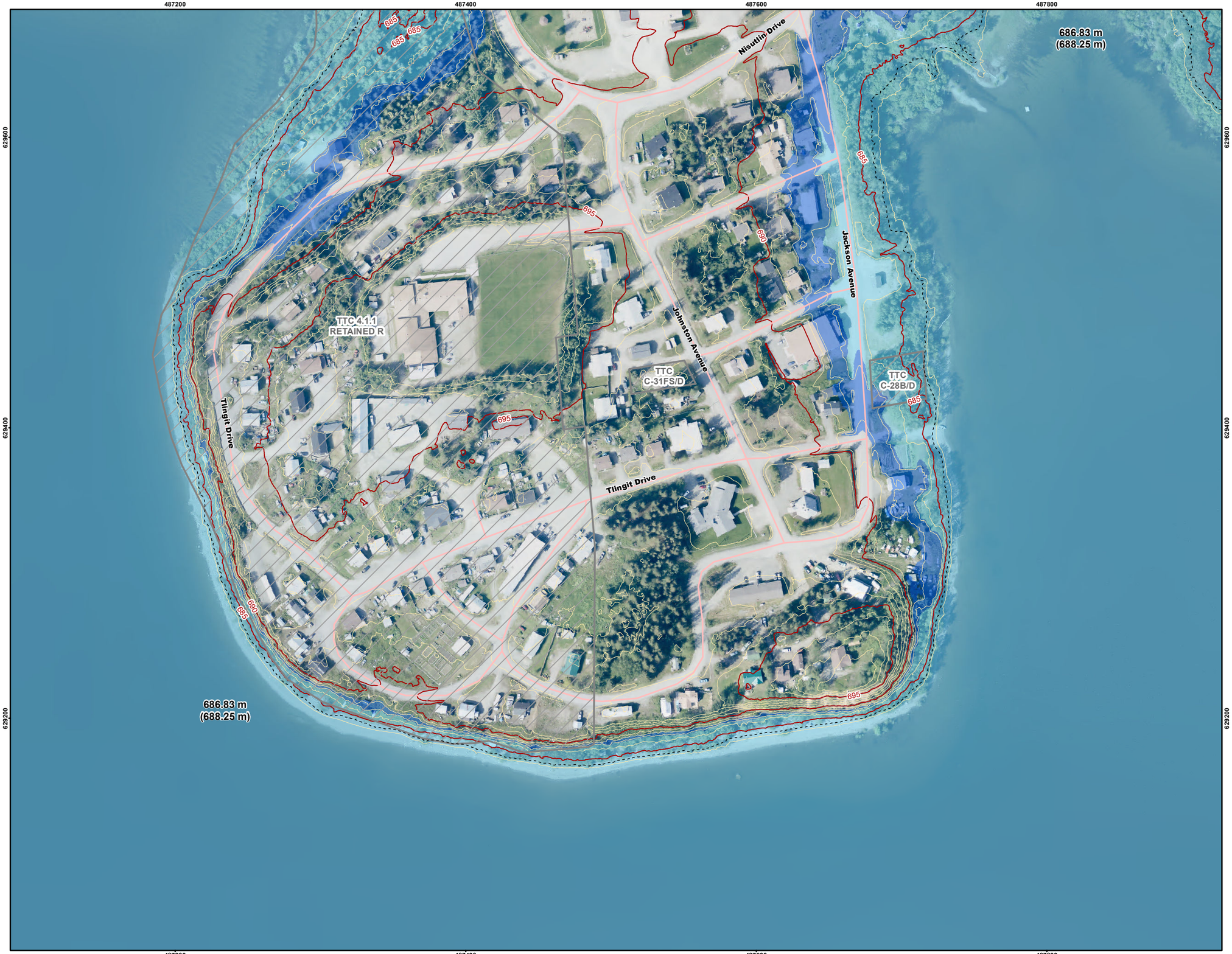
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

25mm

0

487200 487400 487600 487800

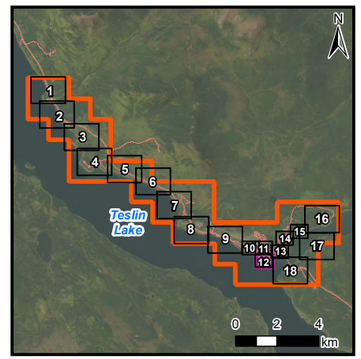
629600 629400 629200



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.2-12

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

25mm

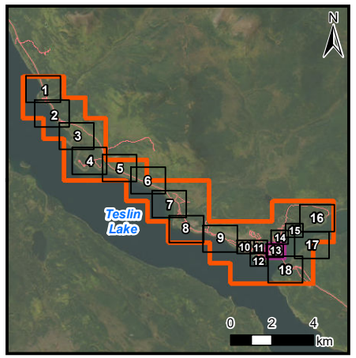
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- Flood Berm
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/24)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.2-13

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

25mm

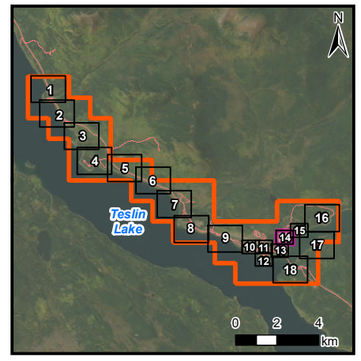
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.83 m (687.13 m) Inundation Level
Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

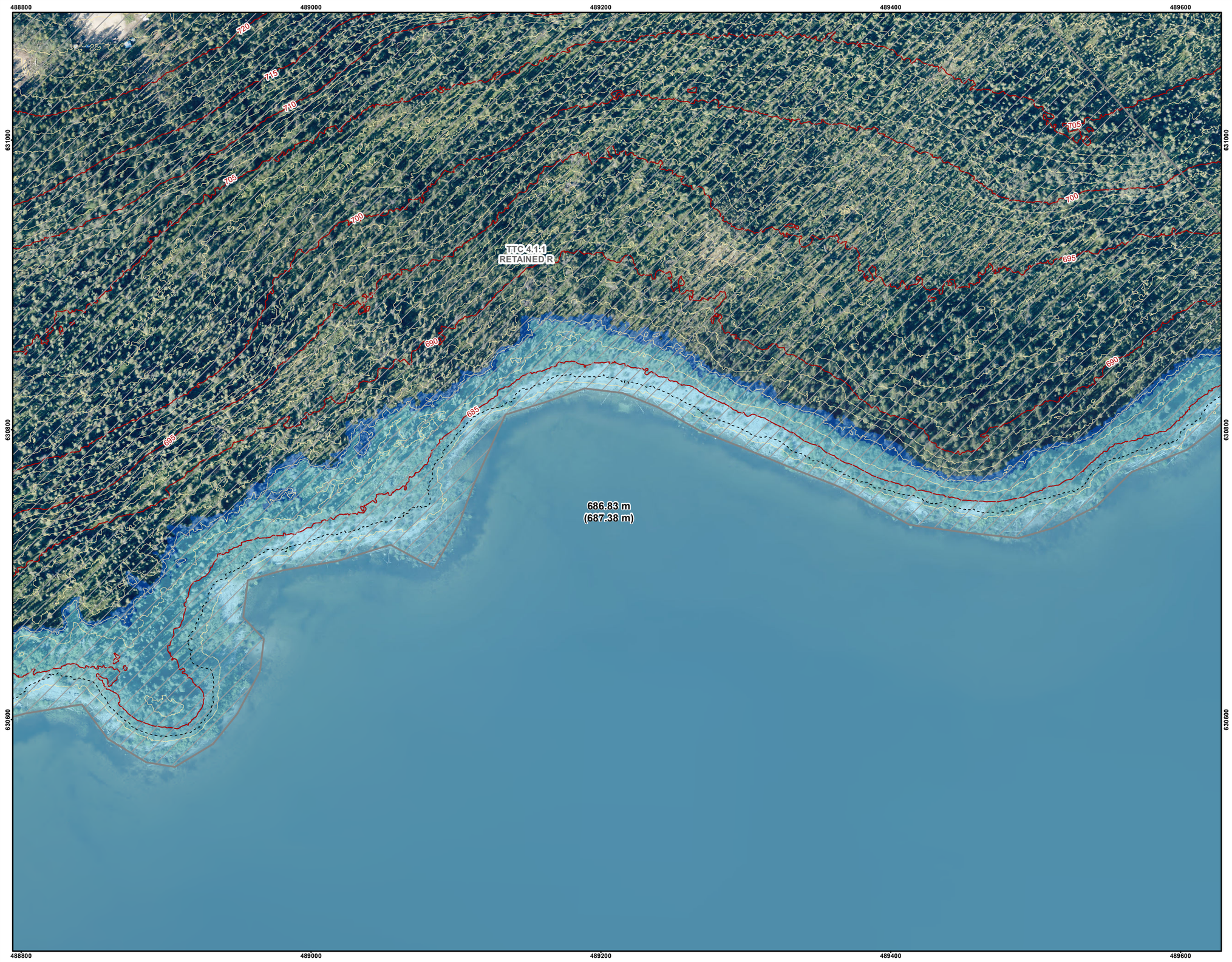
N

wsp

September 2024

Figure 5.2-14

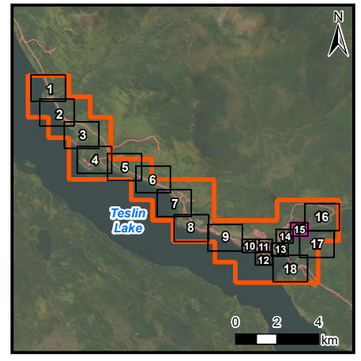
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.2-15

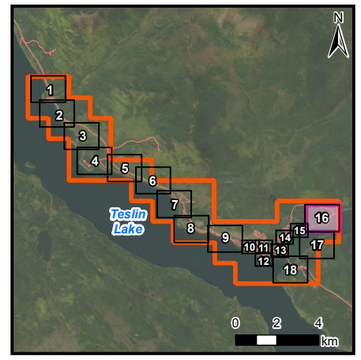
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.2-16

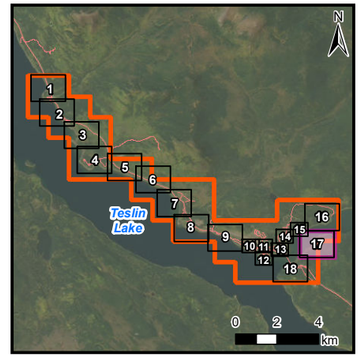
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.2-17

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

25mm

0

488000 488200 488400 488600 488800 489000 489200 489400 489600

629400 629200 629000 628800 628600 628400

Nisutlin Bay Bridge

686.83 m (687.55 m)

Alaska Highway

TTC C-8B

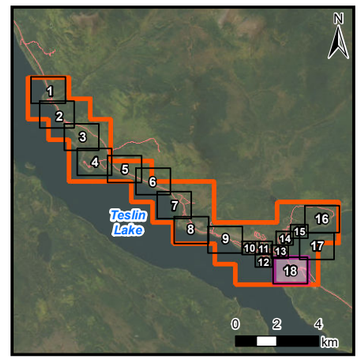
Limit of LiDAR Data

685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780

LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- Culvert

686.83 m (687.13 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

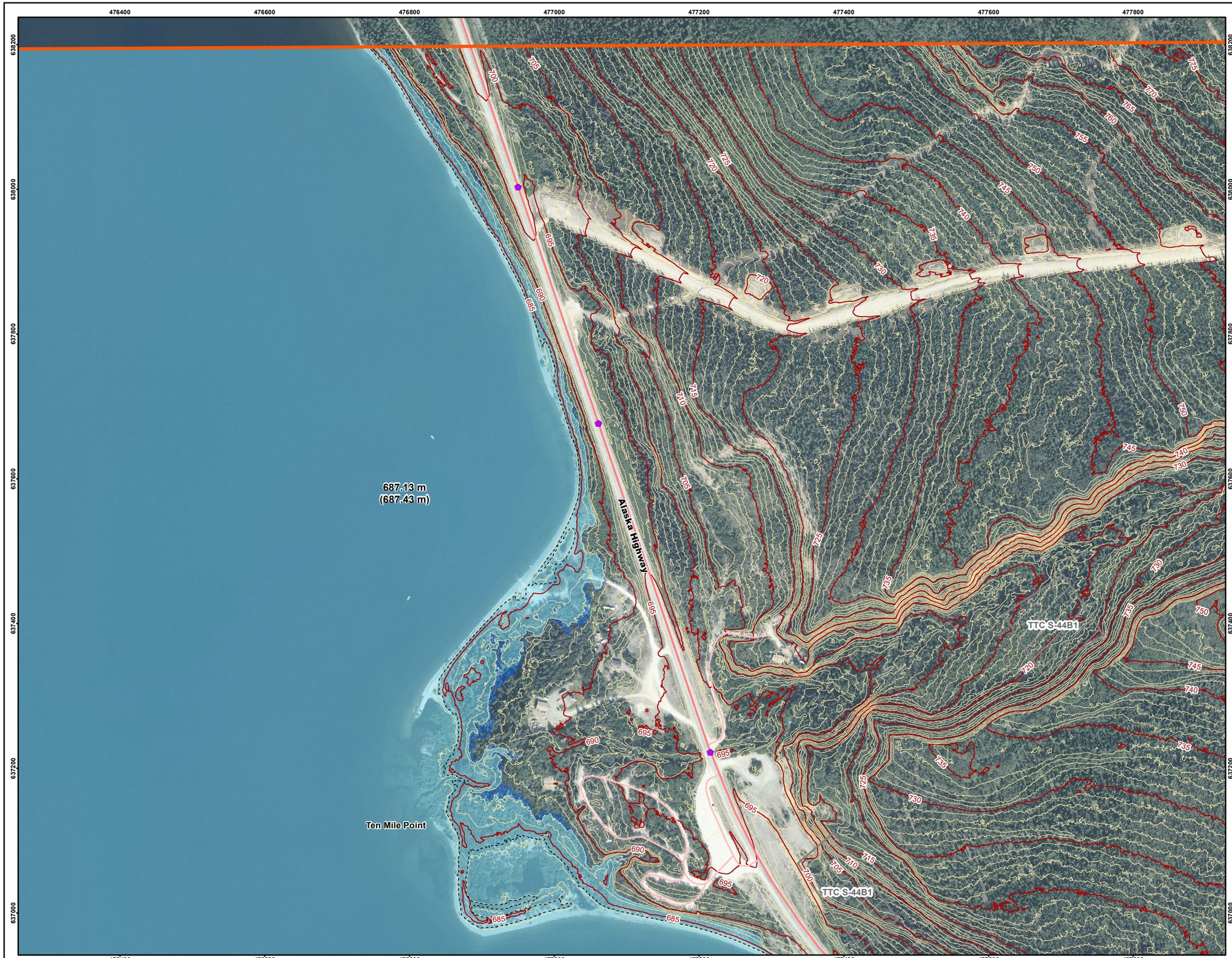
September 2024

Figure 5.2-18

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

25mm

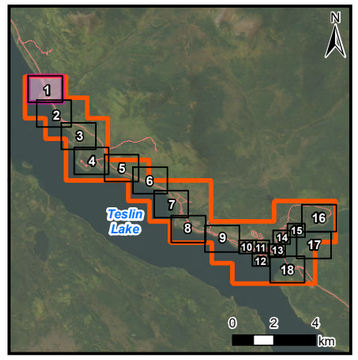
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m (687.43 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

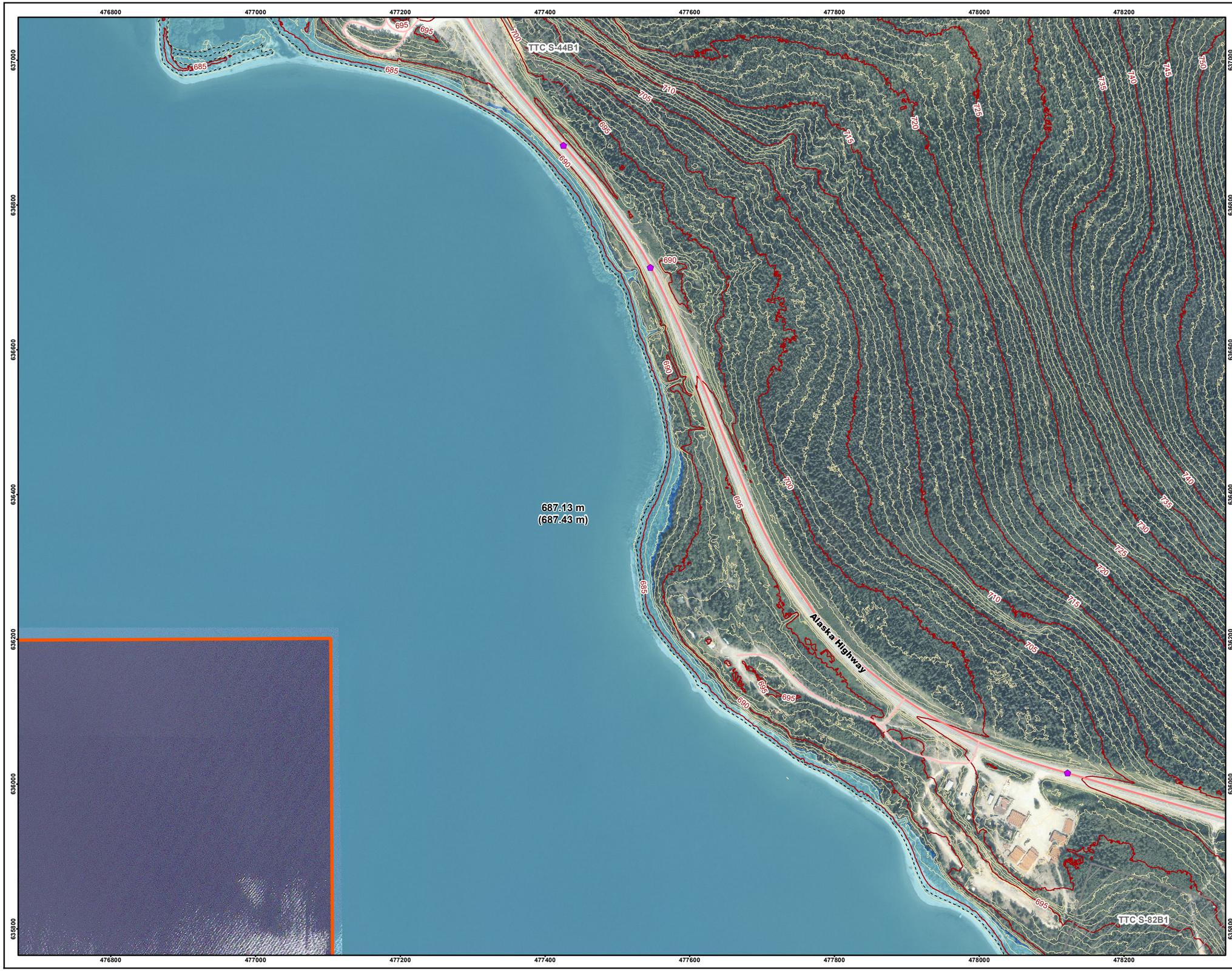
N

wsp

September 2024

Figure 5.3-1

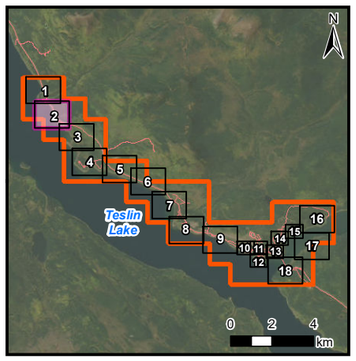
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m (687.43 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
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REV 0 - ISSUED AS FINAL (24/09/23)

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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

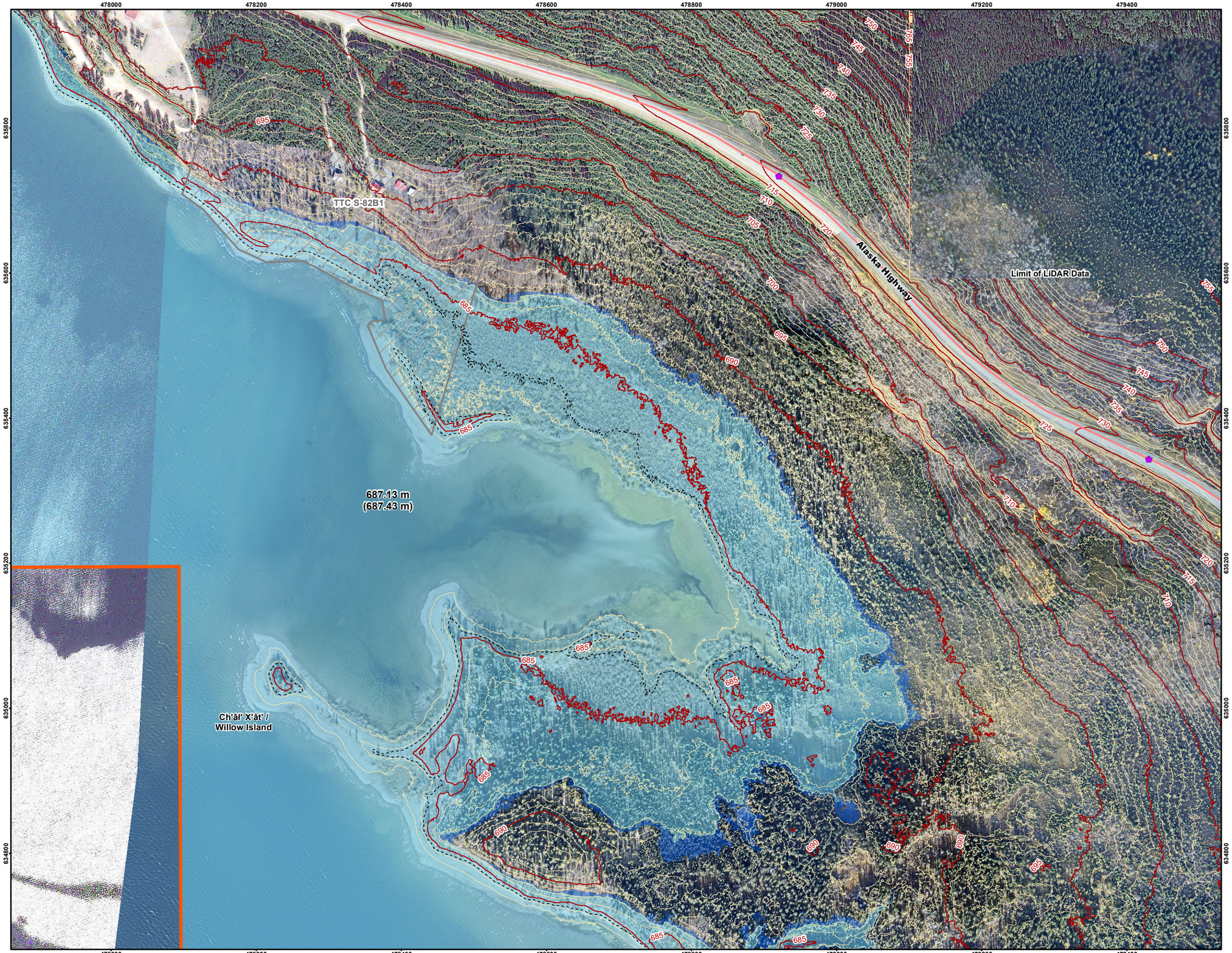
N

wsp

September 2024

Figure 5.3-2

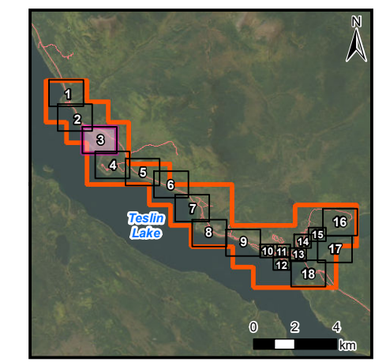
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.13 m Inundation Level
(687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/24)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON

SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

478600 478800 479000 479200 479400 479600 479800 480000

634600 634400 634200 634000 633800 633600

690 685 695 700 705 710 715 720 725 730 735 740 745

687.13 m
(687.43 m)

687.13 m
(688.03 m)

Alaska Highway

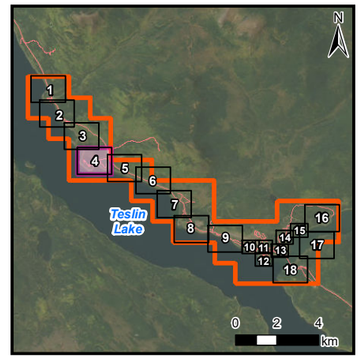
Teslin Lake Cottage Road

Ghèwú X'àyí /
Eight Mile Point

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m (687.43 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/24)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-4

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

25mm

0

480000 480200 480400 480600 480800 481000 481200 481400 481600

634400 634200 634000 633800 633600 633400 633200

Highway

TTC S-39B1

TTC C-22B/D

TTC C-48B/D

Alaska Highway

687.13 m
(688.03 m)

Teslin Lake

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m (687.43 m) Inundation Level with Wave Runup

0 2 4 km

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/24)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-5

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

25mm

0

481400 481600 481800 482000 482200 482400 482600 482800

633800 633600 633400 633200 633000 632800 632600

TTC R-14A

Alaska Highway

687.13 m
(688.03 m)

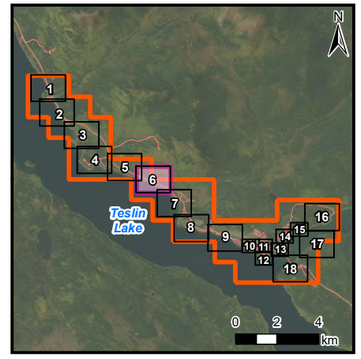
TTC C-50B/D

TTC C-49B/D

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.13 m (687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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REV 0 - ISSUED AS FINAL (24/09/24)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-6

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

25mm

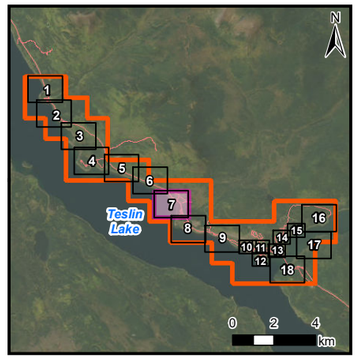
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

687.13 m (687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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REV 0 - ISSUED AS FINAL (24/09/24)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-7

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

25mm

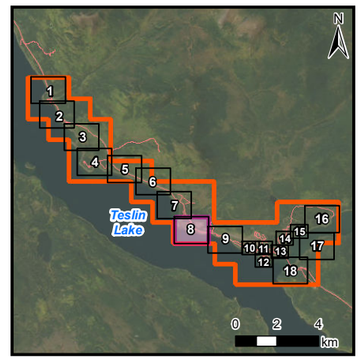
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m — Inundation Level
(687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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REV 0 - ISSUED AS FINAL (24/09/23)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

September 2024

Figure 5.3-8

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

25mm

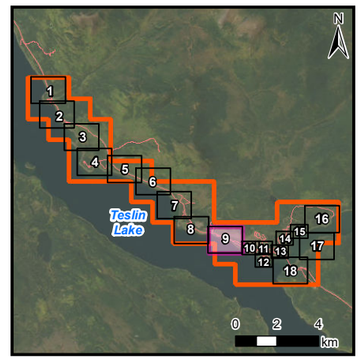
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m — Inundation Level
(687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

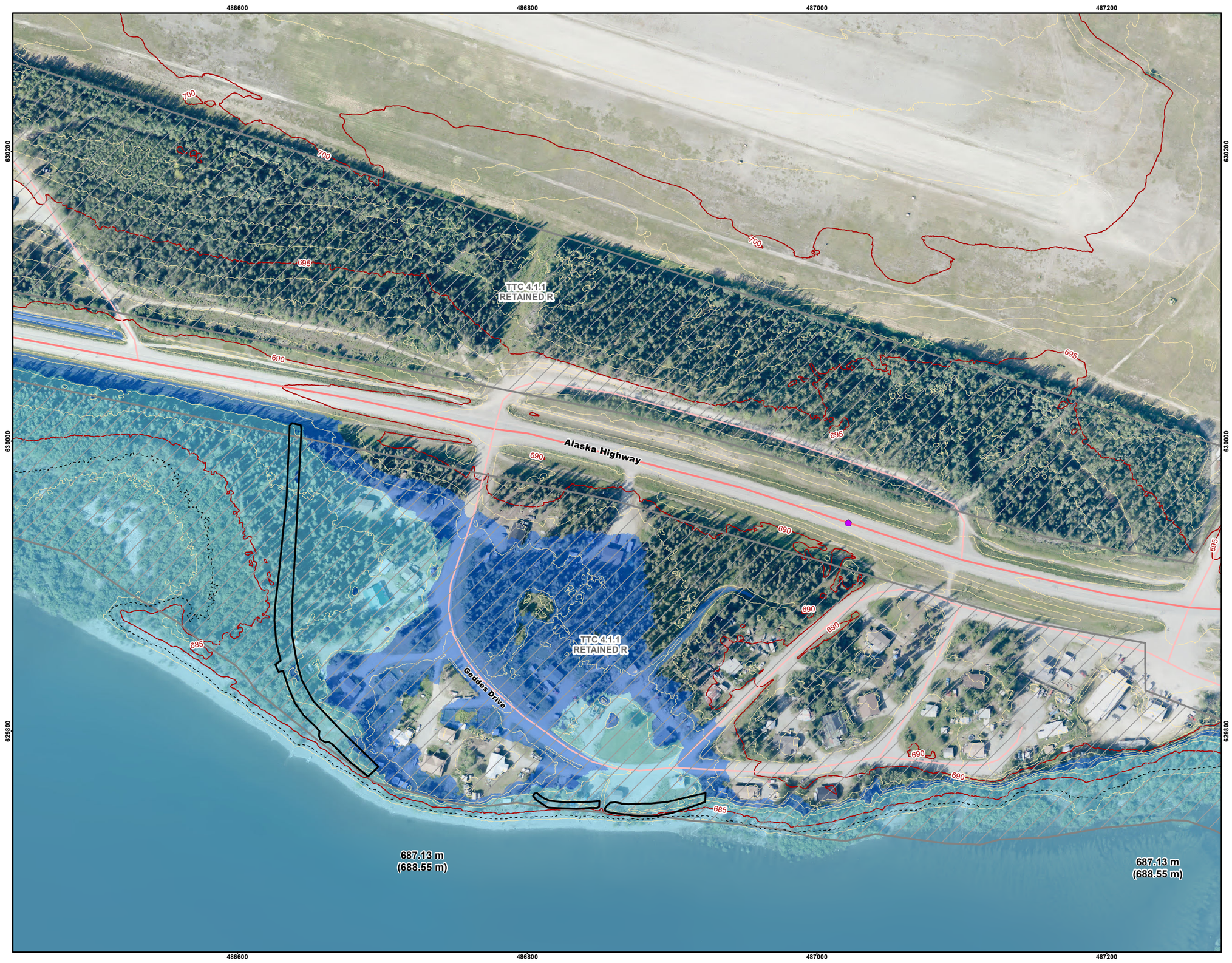
September 2024

Figure 5.3-9

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

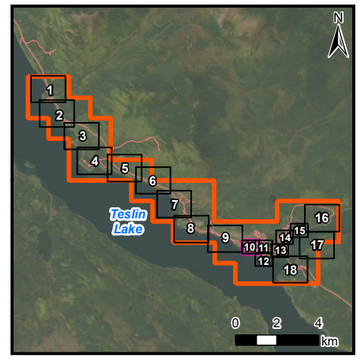
25mm

0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- Flood Berm
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.13 m — Inundation Level
- (687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL) DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

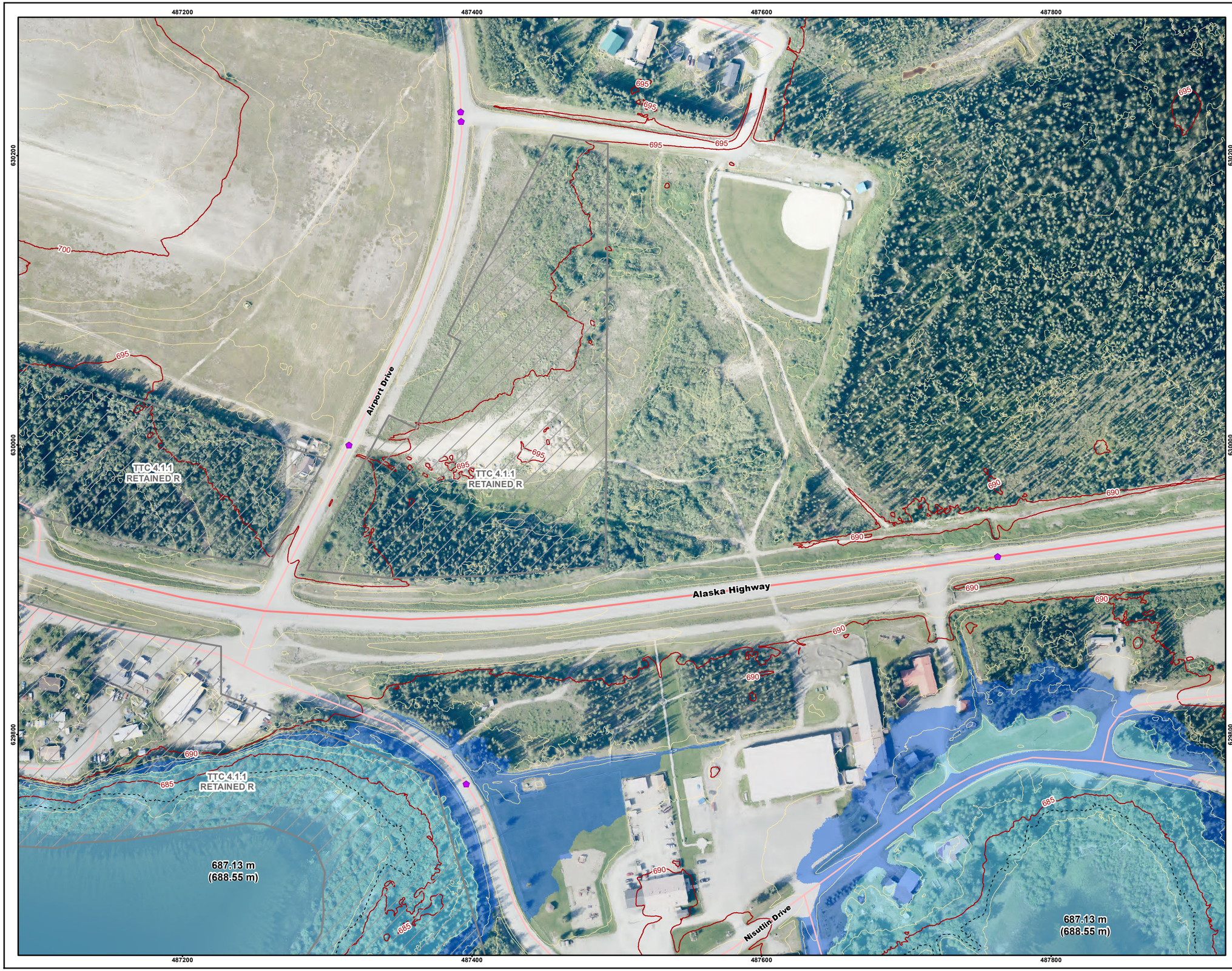
September 2024

Figure 5.3-10

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

25mm

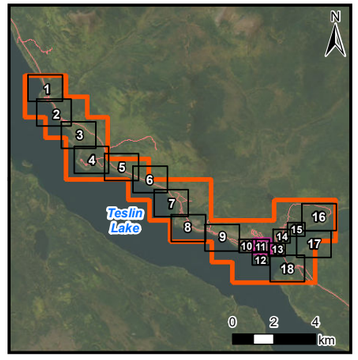
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.13 m — Inundation Level
(687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

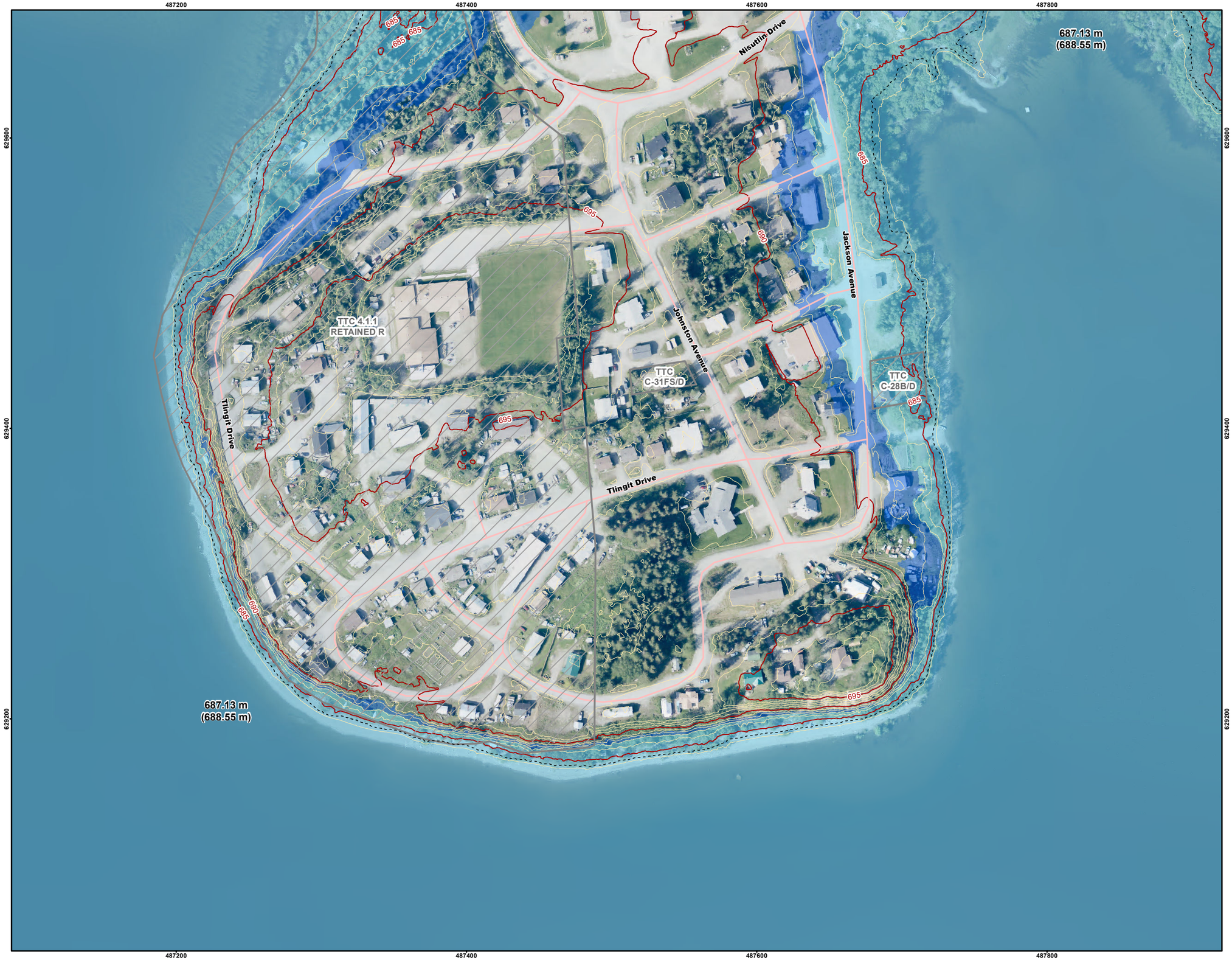
September 2024

Figure 5.3-11

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

25mm

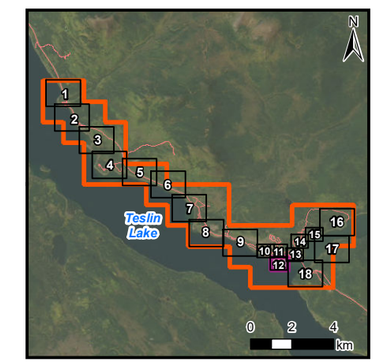
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.13 m Inundation Level
(687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.3-12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

488000 488200 488400 488600

630000 629800 629600

Alaska Highway
Fox Street
Nisutlin Drive
Sawmill Road
TTC C-30B/D
Nisutlin Bay Bridge

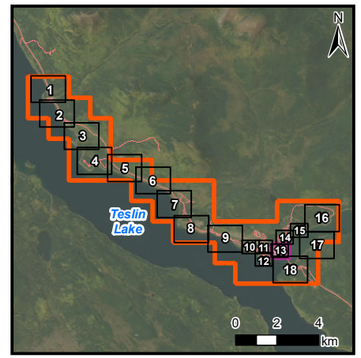
690 695 685

687.13 m
(688.55 m)

687.13 m
(688.55 m)

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- Flood Berm
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- 687.13 m — Inundation Level
- (687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.3-13

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

25mm

0

488200 488400 488600 488800

630600 630400 630200

Sawmill Road

TTC 4.1.1
RETAINED R

687.13 m
(687.68 m)

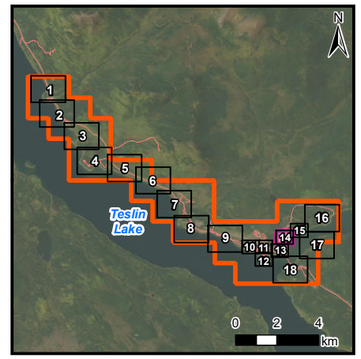
687.13 m
(688.55 m)

695 700 690 695 695 695 695 690 685 685 690 690 690 690

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.13 m Inundation Level
(687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL), DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.3-14

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

25mm

0

488800 489000 489200 489400 489600

631000 630800 630600

720 715 710 705 700 695 690 685 695 700 705 700 695 690

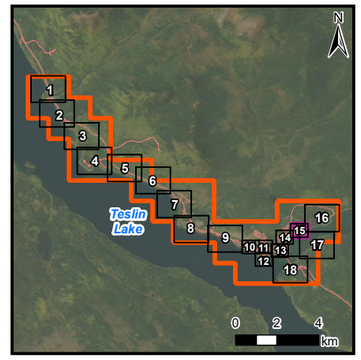
TTC 4.1.1
RETAINED R

687.13 m
(687.68 m)

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.13 m (687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL), DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

20 0 20
Metres
1:2,500

N

wsp

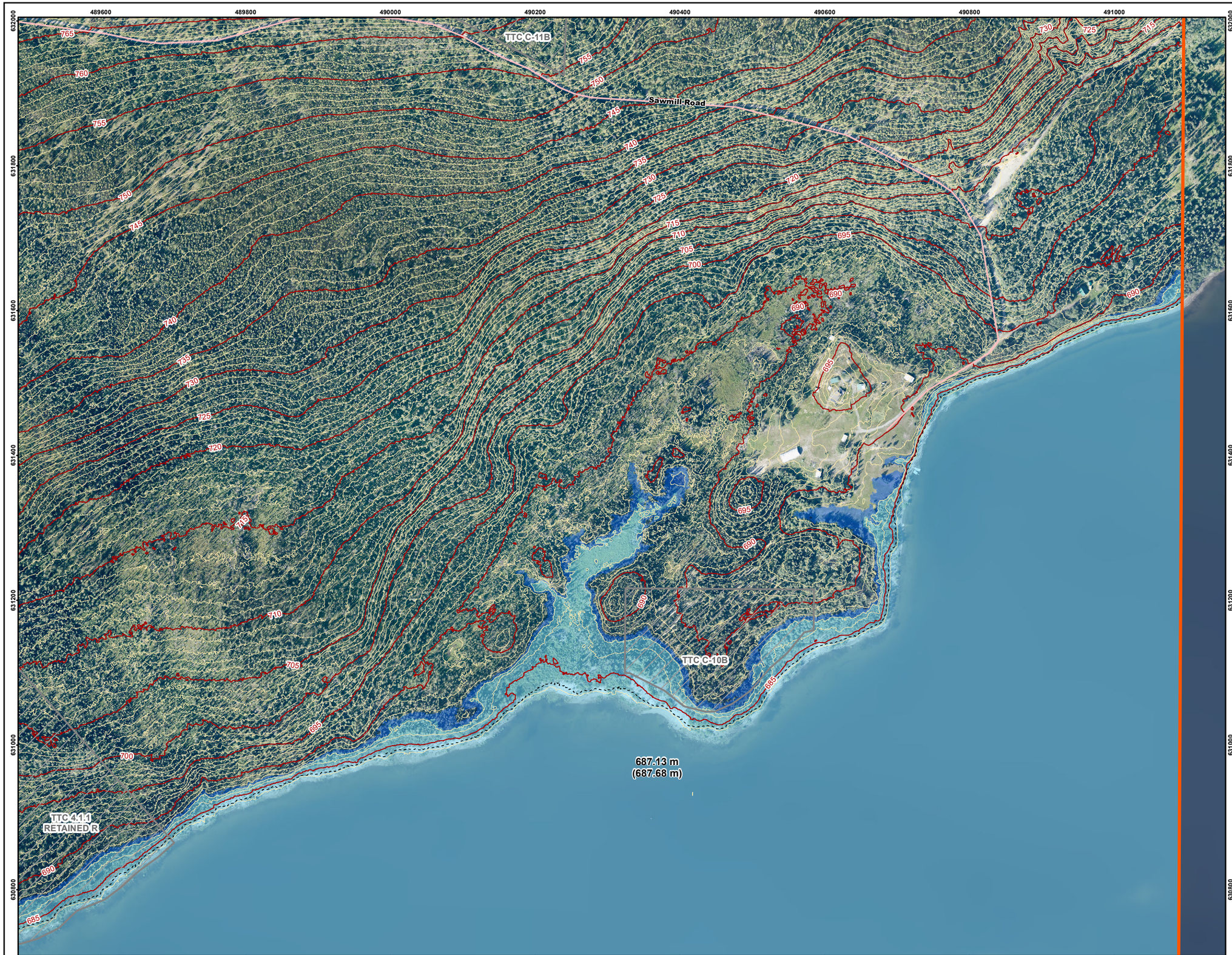
September 2024

Figure 5.3-15

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

25mm

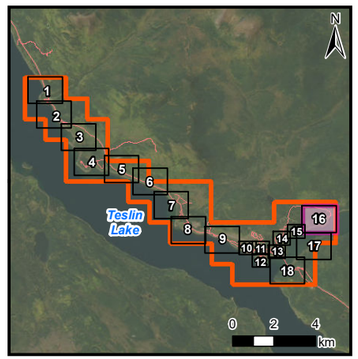
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.13 m (687.43 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL) DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-16

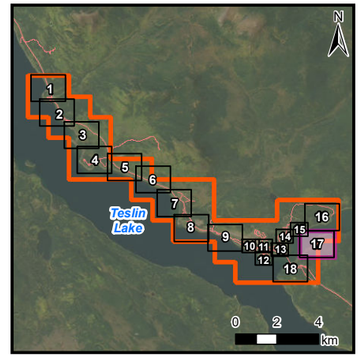
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

687.13 m — Inundation Level
(687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.3-17

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

25mm

0

488000 488200 488400 488600 488800 489000 489200 489400 489600

629400 629200 629000 628800 628600 628400

Nisutlin Bay Bridge

687.13 m (687.85 m)

685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780

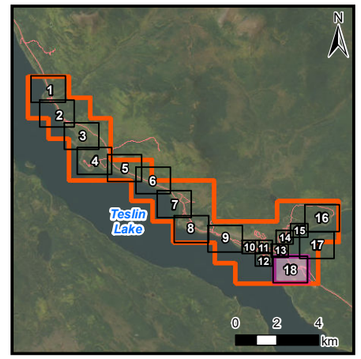
Alaska Highway

TTC C-8B

Limit of LiDAR Data

LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- Culvert
- 687.13 m — Inundation Level
- (687.43 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/23)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

40 0 40
Metres
1:5,000

N

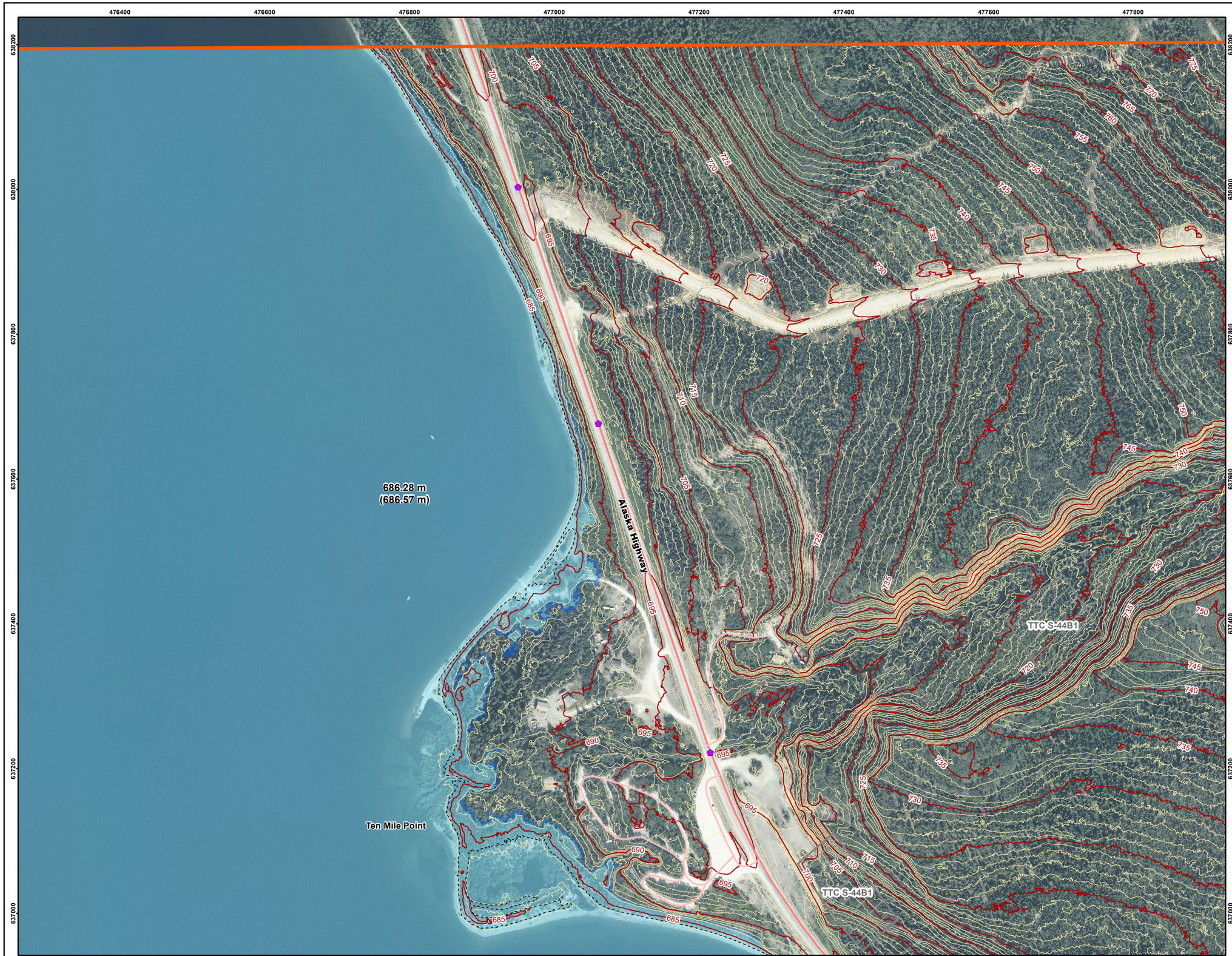
wsp

September 2024

Figure 5.3-18

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

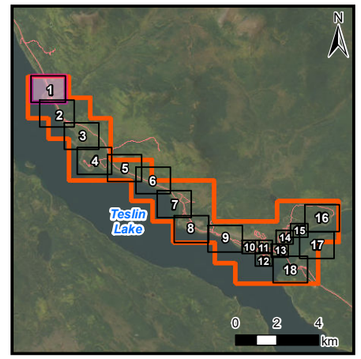
0 25mm



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.4-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm

476800 477000 477200 477400 477600 477800 478000 478200

637000 636800 636600 636400 636200 636000 635800

TTC S-44B1

TTC S-82B1

686.28 m
(686.57 m)

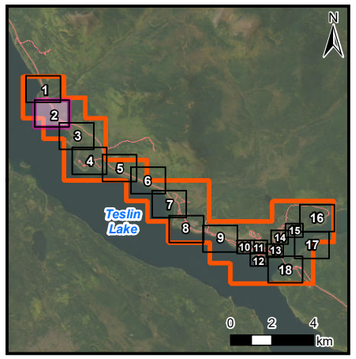
Alaska Highway

695 685 700 710 705 690 715 720 725 735 740 745 750 730

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup



NOTE(S)

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2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

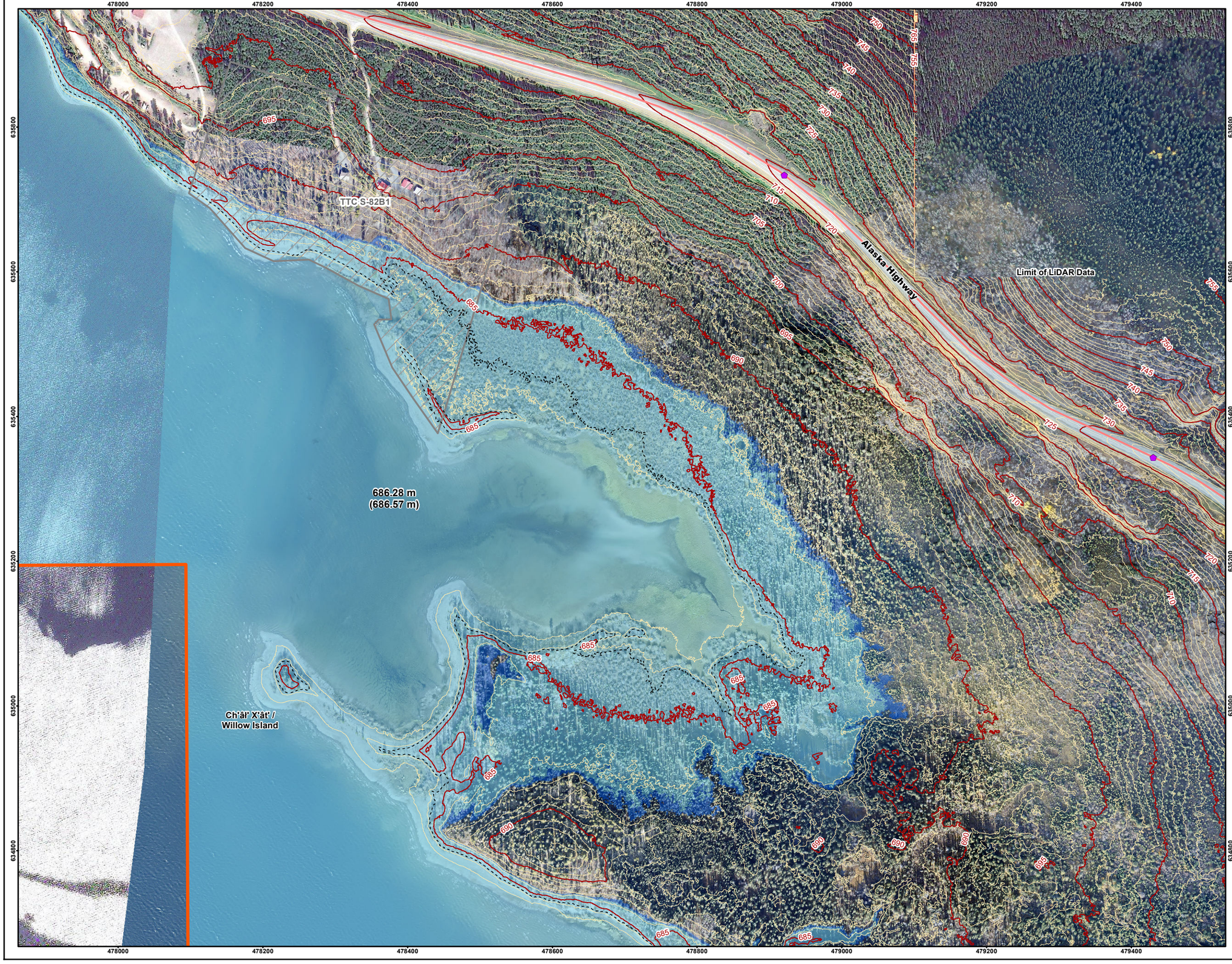
September 2024

Figure 5.4-2

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

25mm

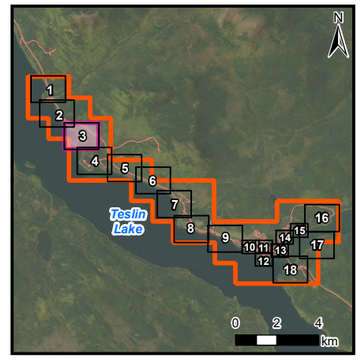
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.4-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

478600 478800 479000 479200 479400 479600 479800 480000

634600 634400 634200 634000 633800 633600

690 685 695 700 705 710 715 720 725 730 735 740 745

686.28 m
(686.57 m)

686.28 m
(687.02 m)

Alaska Highway

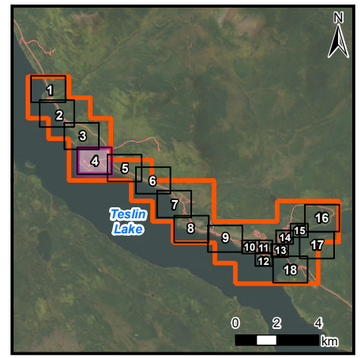
Teslin Lake Cottage Road

Ghèwú X'àyí /
Eight Mile Point

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL), DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON

SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.4-4

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

25mm

0

480000 480200 480400 480600 480800 481000 481200 481400 481600

634400 634200 634000 633800 633600 633400 633200

Highway

TTC S-39B1

TTC C-22B/D

TTC C-48B/D

Alaska Highway

686.28 m
(687.02 m)

Teslin Lake

0 2 4 km

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

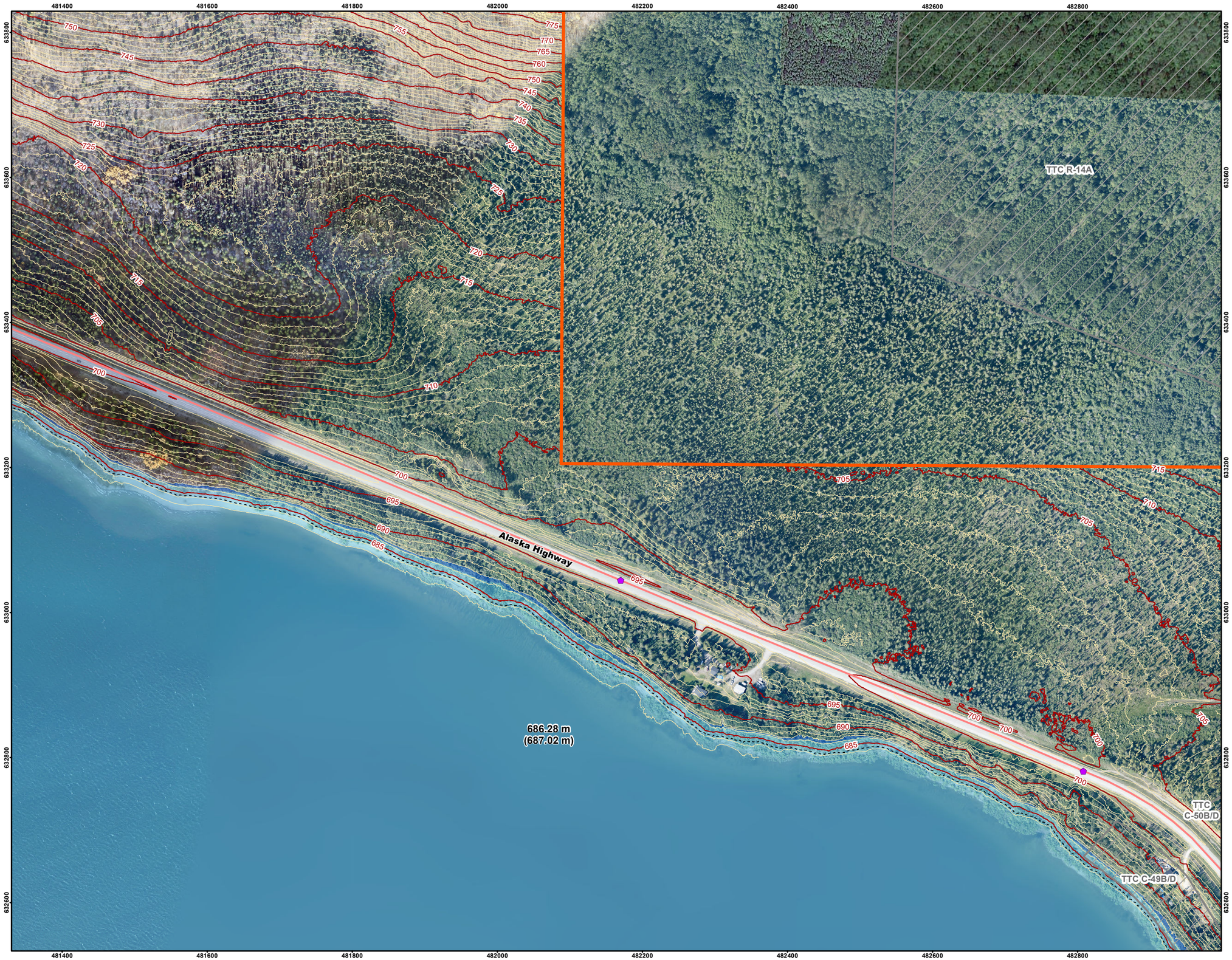
September 2024

Figure 5.4-5

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

25mm

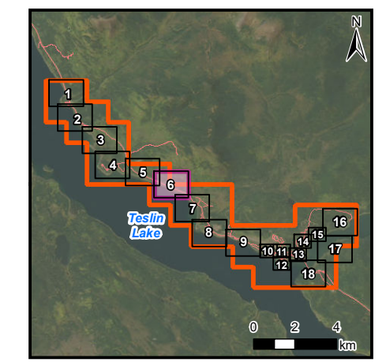
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.4-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

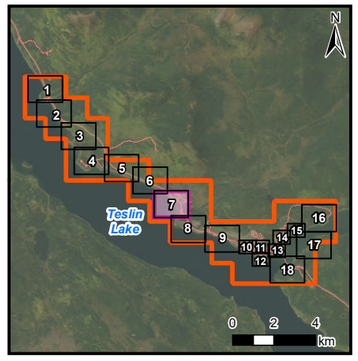
25mm



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

686.28 m Inundation Level
(686.57 m) Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.4-7

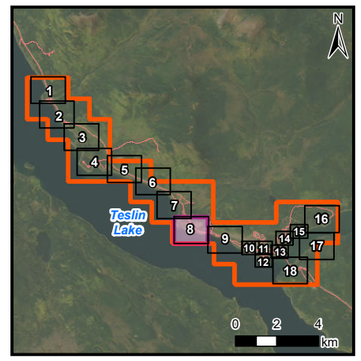
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m — Inundation Level
(686.57 m) — Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

November 2024

Figure 5.4-8

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

25mm

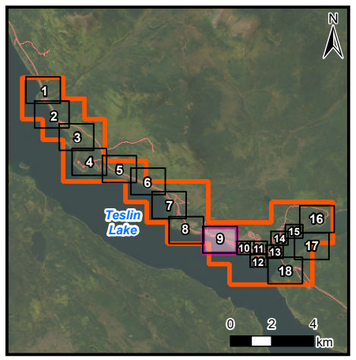
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m (686.57 m) Inundation Level
Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

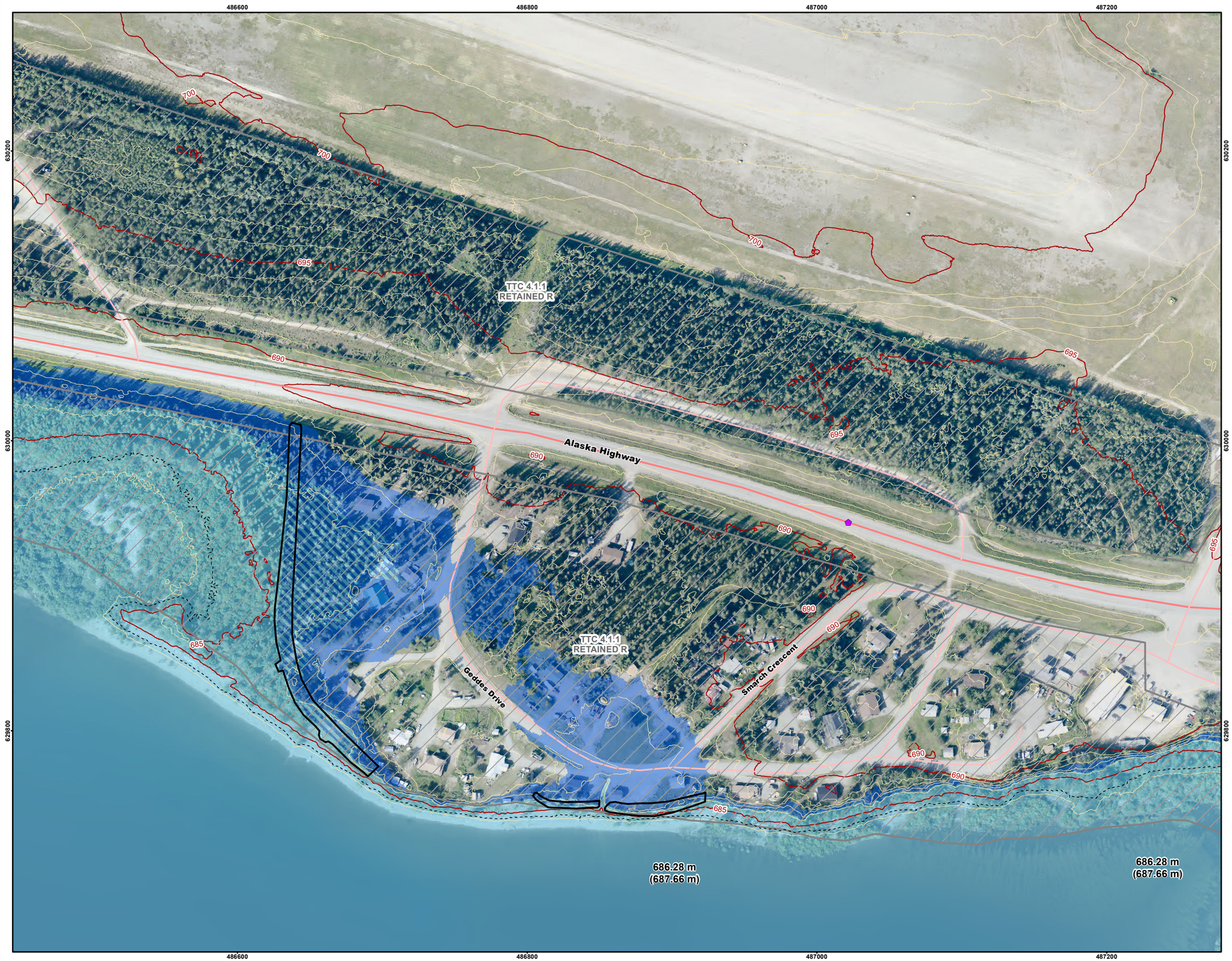
N

wsp

November 2024

Figure 5.4-9

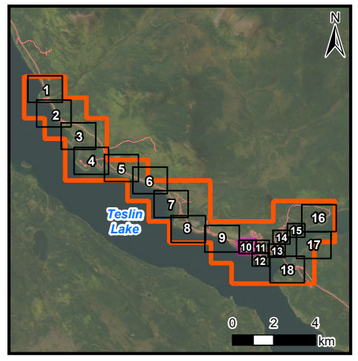
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- Flood Berm
- Protected by Flood Berm in Static Lake Conditions* (no wave runup)
- 50% AEP
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.28 m (686.57 m) Inundation Level / Inundation Level with Wave Runup

* Hatching shows areas protected by flood berms for this AEP (static lake elevation only – not considering wave runup). Flood berms protect an area from flooding up to a design water level, and can be overtopped or bypassed if flood levels exceed the height of the berms at one or more locations.



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.4-10

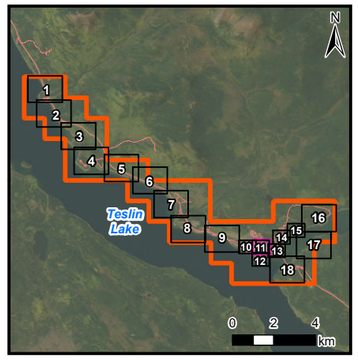
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

686.28 m (686.57 m) Inundation Level / Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

November 2024

Figure 5.4-11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

487200 487400 487600 487800

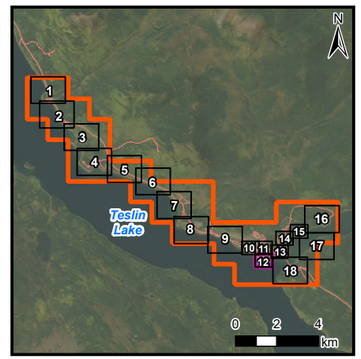
629600 629400 629200



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.28 m (686.57 m) Inundation Level
Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.4-12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

488000 488200 488400 488600

630000 629800 629600

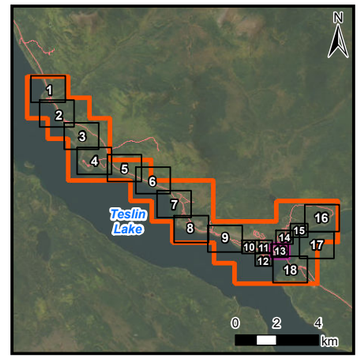
Alaska Highway
Sawmill Road
Fox Street
Nisutlin Drive
TTC C-30B/D
Nisutlin Bay Bridge
686.28 m (687.66 m)
686.28 m (687.66 m)

690 695 685

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- Flood Berm
- Protected by Flood Berm in Static Lake Conditions* (no wave runup)
- 50% AEP
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- 686.28 m (686.57 m) Inundation Level / Inundation Level with Wave Runup

* Hatching shows areas protected by flood berms for this AEP (static lake elevation only – not considering wave runup). Flood berms protect an area from flooding up to a design water level, and can be overtopped or bypassed if flood levels exceed the height of the berms at one or more locations.



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.4-13

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

25mm

0

488200 488400 488600 488800

630600 630400 630200

Sawmill Road

TTC 4.1.1
RETAINED R

686.28 m
(686.77 m)

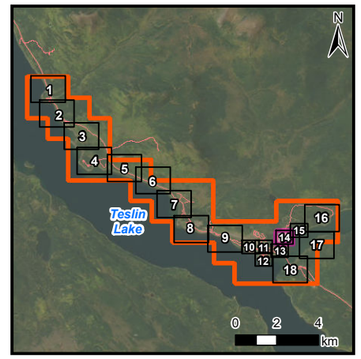
686.28 m
(687.66 m)

695 700 690 695 695 695 695 690 685 685 690 690 690 690

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.28 m (686.57 m) Inundation Level
Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.4-14

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

25mm

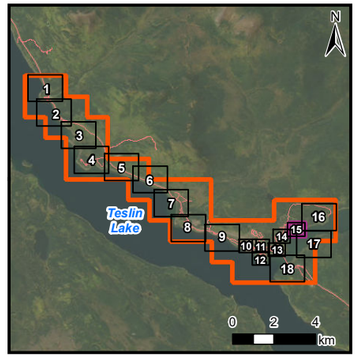
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.28 m (686.57 m) Inundation Level / Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

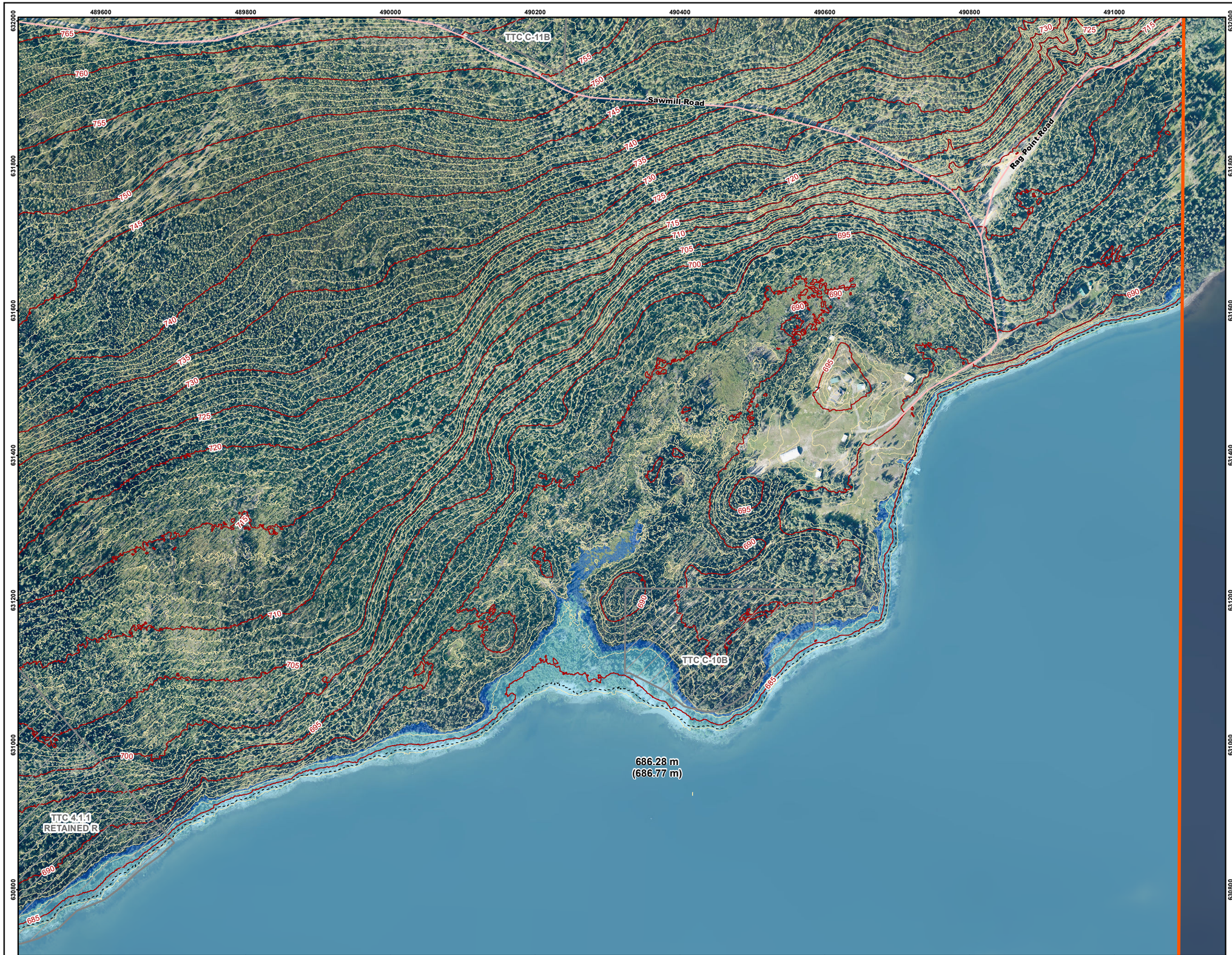
September 2024

Figure 5.4-15

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

25mm

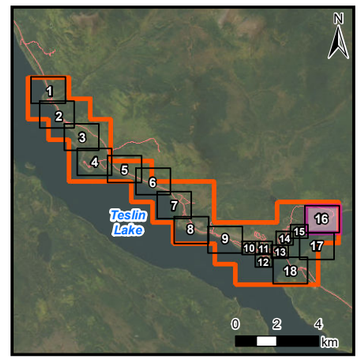
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

686.28 m — Inundation Level
(686.57 m) — Inundation Level with Wave Runup



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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

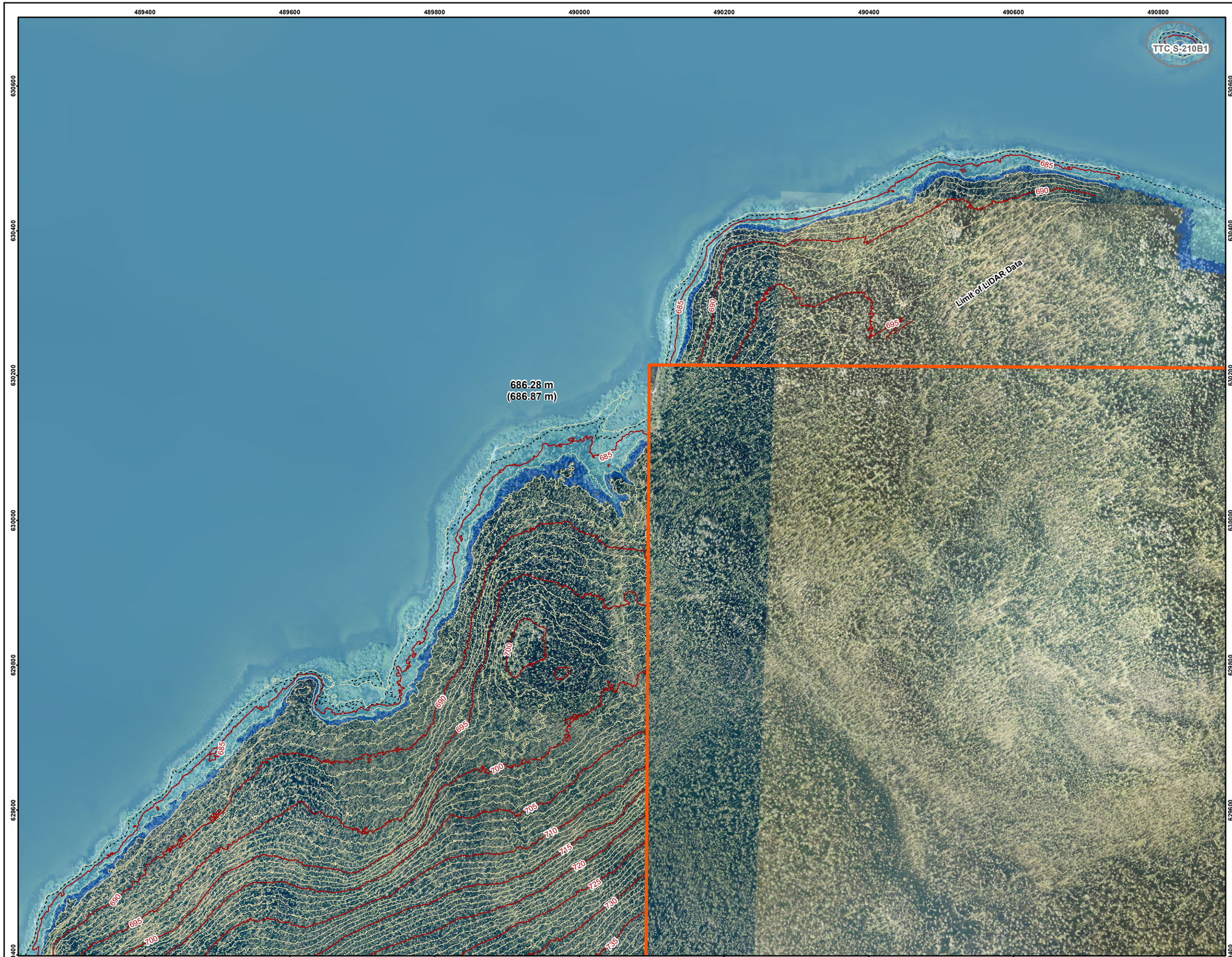
N

wsp

September 2024

Figure 5.4-16

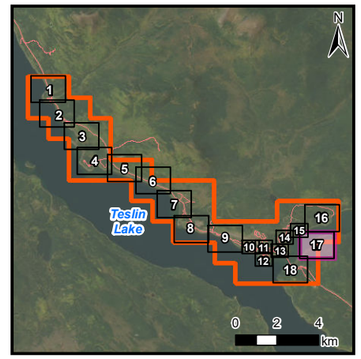
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.28 m (686.57 m) Inundation Level
Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.4-17

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm

488000 488200 488400 488600 488800 489000 489200 489400 489600

629400 629200 629000 628800 628600 628400

Nisutlin Bay Bridge

686.28 m
(686.87 m)

685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780

Alaska Highway

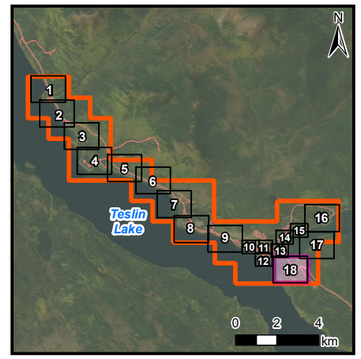
TTC C-8B

Limit of LiDAR Data

LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- Culvert

686.28 m (686.57 m) Inundation Level
Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

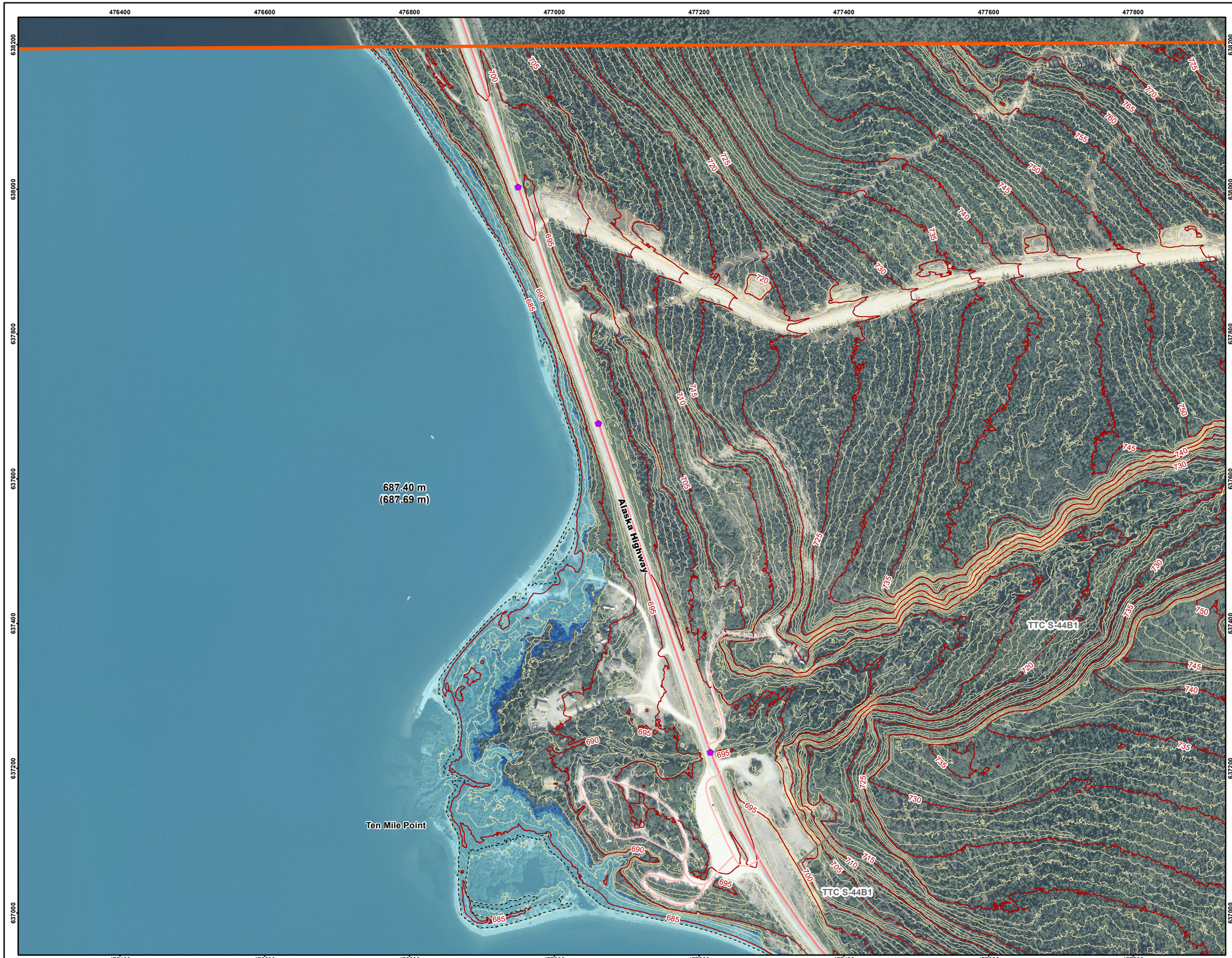
September 2024

Figure 5.4-18

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

25mm

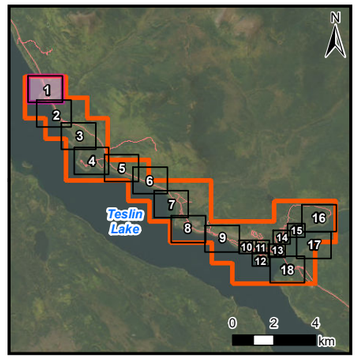
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m (687.69 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
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3. ADDITIONAL IMAGERY GOVERNMENT OF YUKON
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

September 2024

Figure 5.5-1

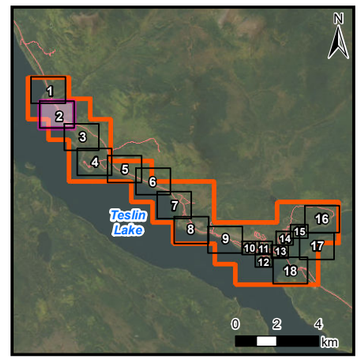
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.5-2

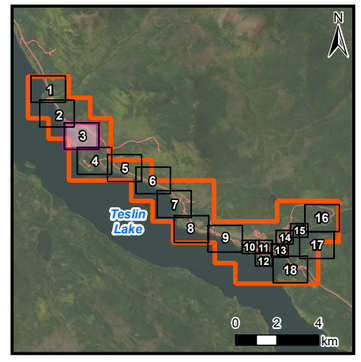
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

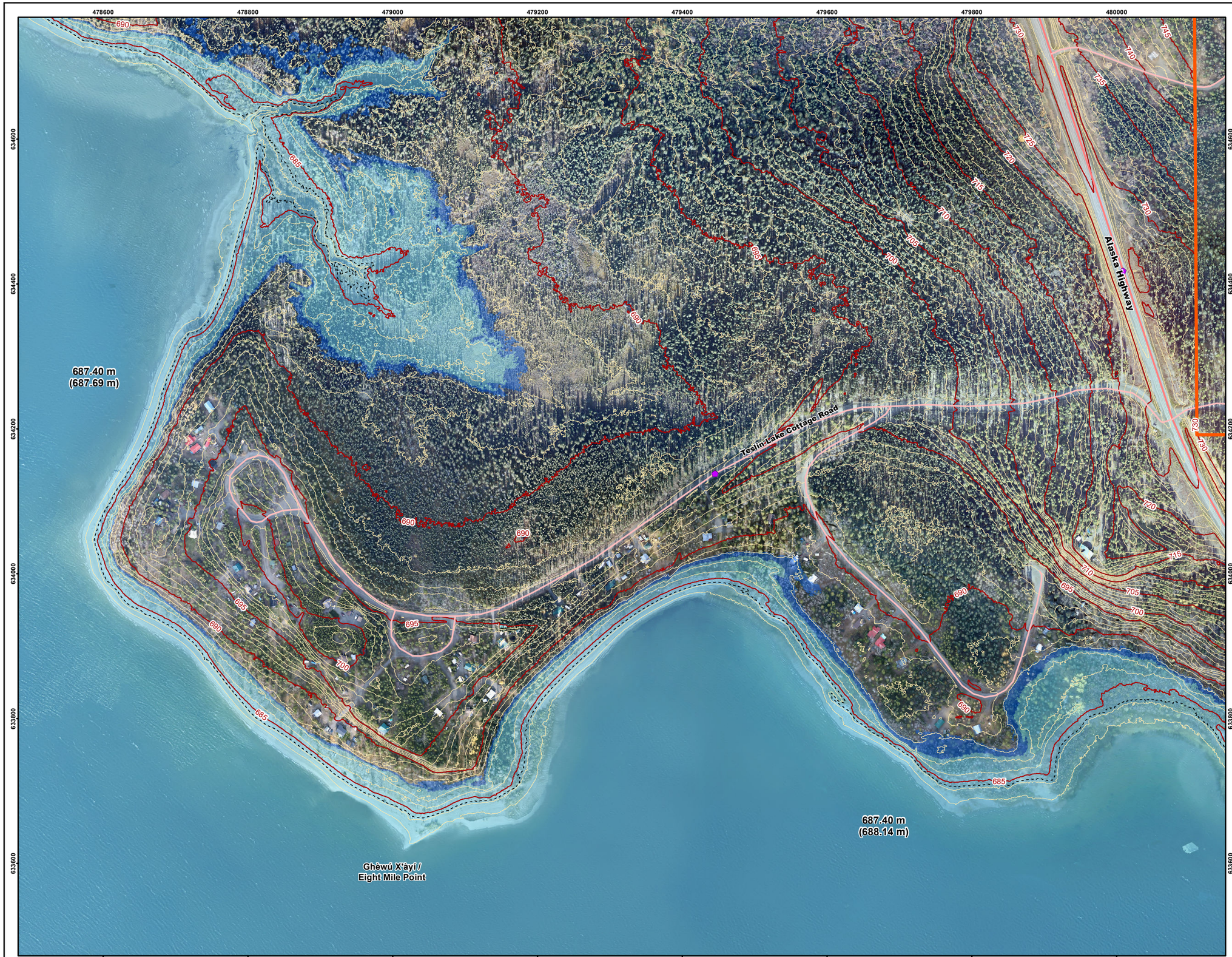
N

wsp

September 2024

Figure 5.5-3

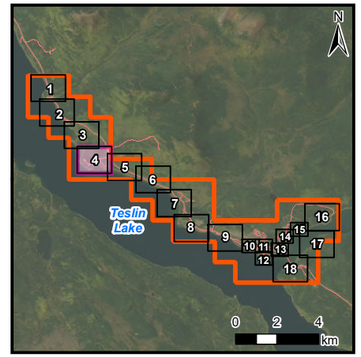
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m (687.69 m) Inundation Level with Wave Runup



NOTE(S)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.5-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

480000 480200 480400 480600 480800 481000 481200 481400 481600

634400 634200 634000 633800 633600 633400 633200

Highway

TTC S-39B1

TTC C-22B/D

Alaska Highway

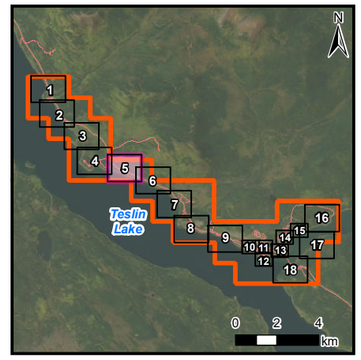
TTC C-48B/D

687.40 m
(688.14 m)

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.5-5

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

25mm

0

481400 481600 481800 482000 482200 482400 482600 482800

633800 633600 633400 633200 633000 632800 632600

TTC R-14A

TTC C-50B/D

TTC C-49B/D

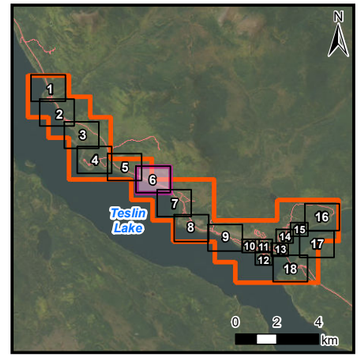
Alaska Highway

687.40 m
(688.14 m)

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.5-6

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

25mm

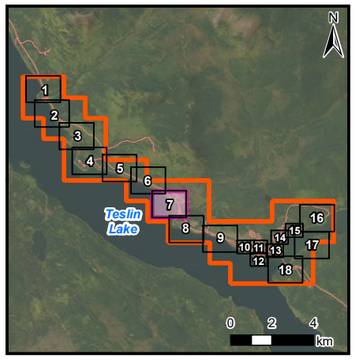
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road

687.40 m (687.69 m) Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.5-7

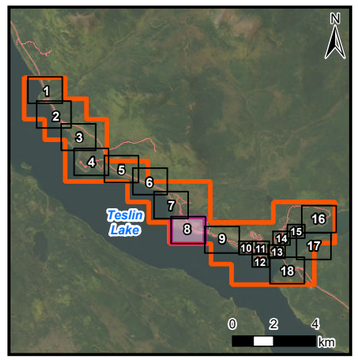
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

November 2024

Figure 5.5-8

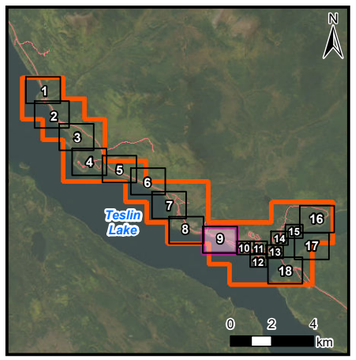
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

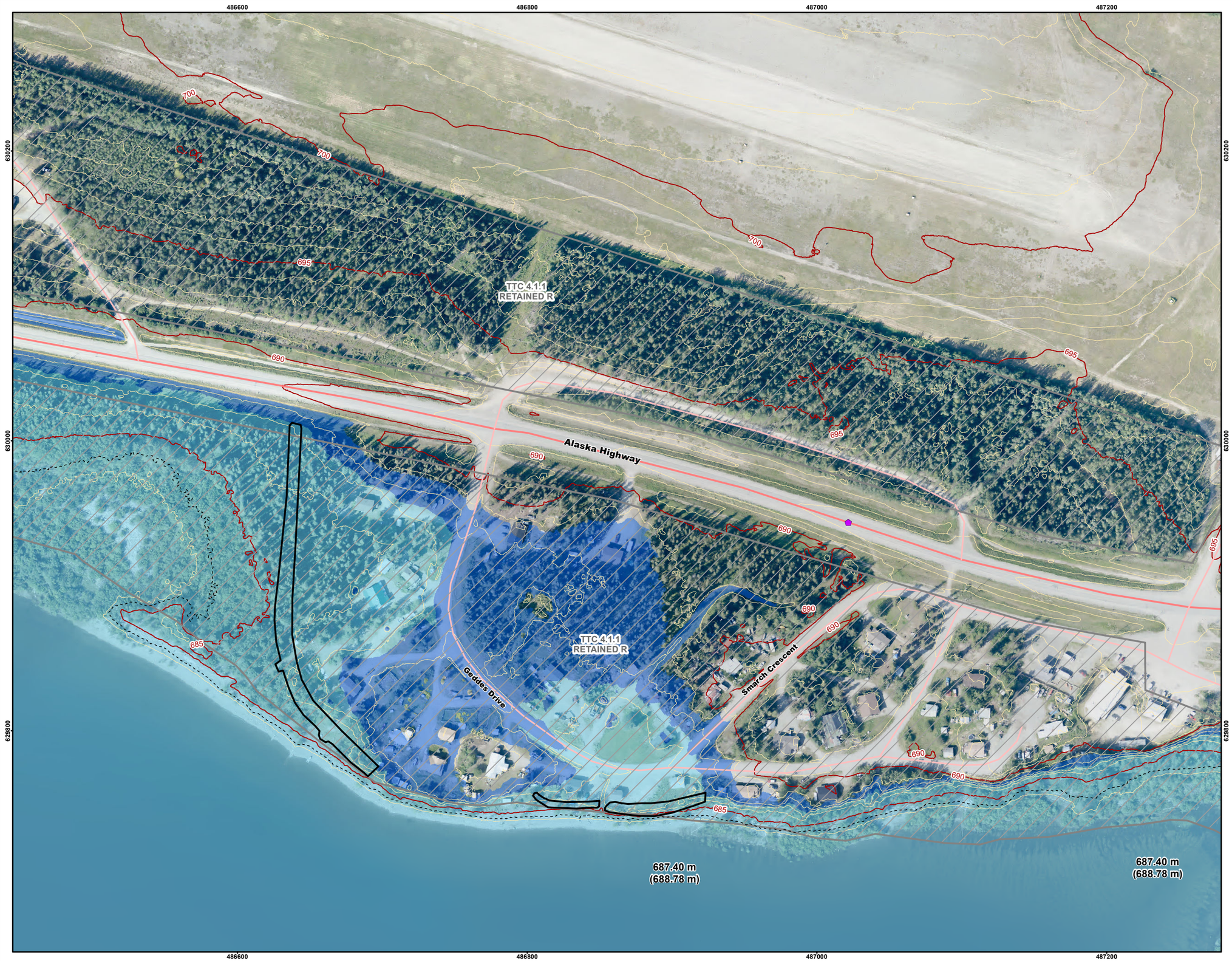
40 0 40
Metres
1:5,000

N

November 2024

Figure 5.5-9

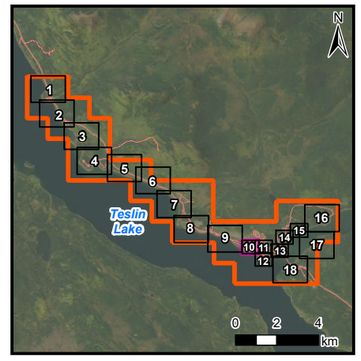
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- Flood Berm
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m — Inundation Level
(687.69 m) — Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.5-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

487200 487400 487600 487800

630200 630000 629800

Airport Drive

Alaska Highway

Nisutlin Drive

TTC 4.1.1 RETAINED R

TTC 4.1.1 RETAINED R

TTC 4.1.1 RETAINED R

687.40 m (688.78 m)

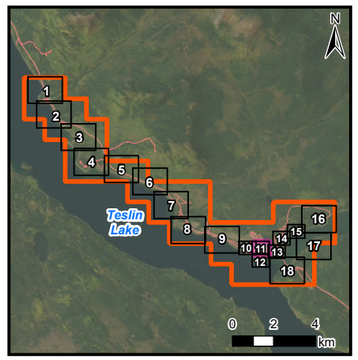
687.40 m (688.78 m)

700 695 690 685

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.5-11

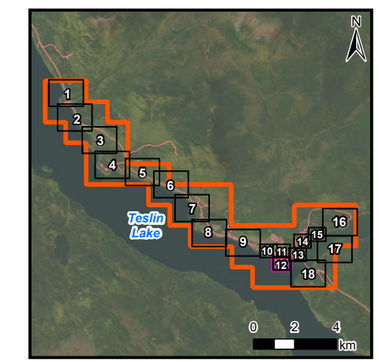
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area
Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

November 2024

Figure 5.5-12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

488000 488200 488400 488600

630000 629800 629600

Alaska Highway
Sawmill Road
Fox Street
Nisutlin Drive
TTC C-30B/D
Nisutlin Bay Bridge

690 695 685

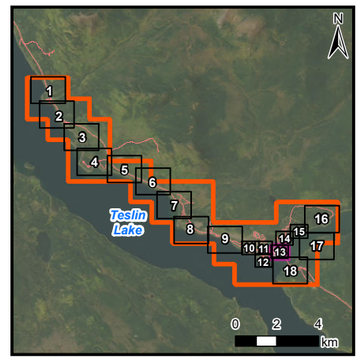
687.40 m
(688.78 m)

687.40 m
(688.78 m)

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- Flood Berm
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge

687.40 m Inundation Level
(687.69 m) Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

REFERENCE(S)

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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

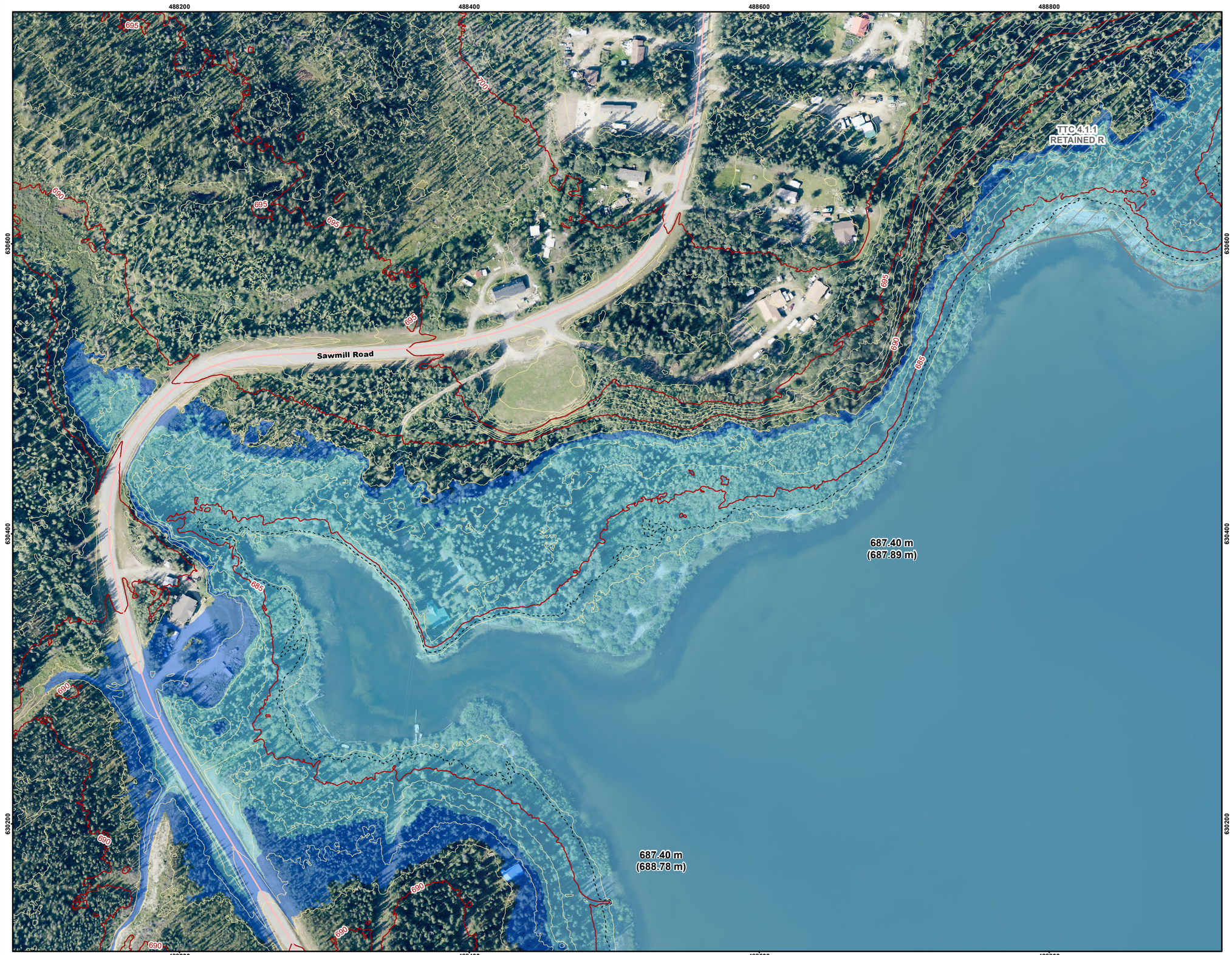
N

wsp

November 2024

Figure 5.5-13

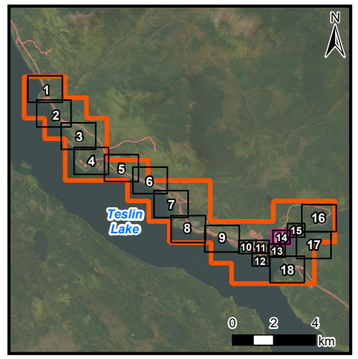
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

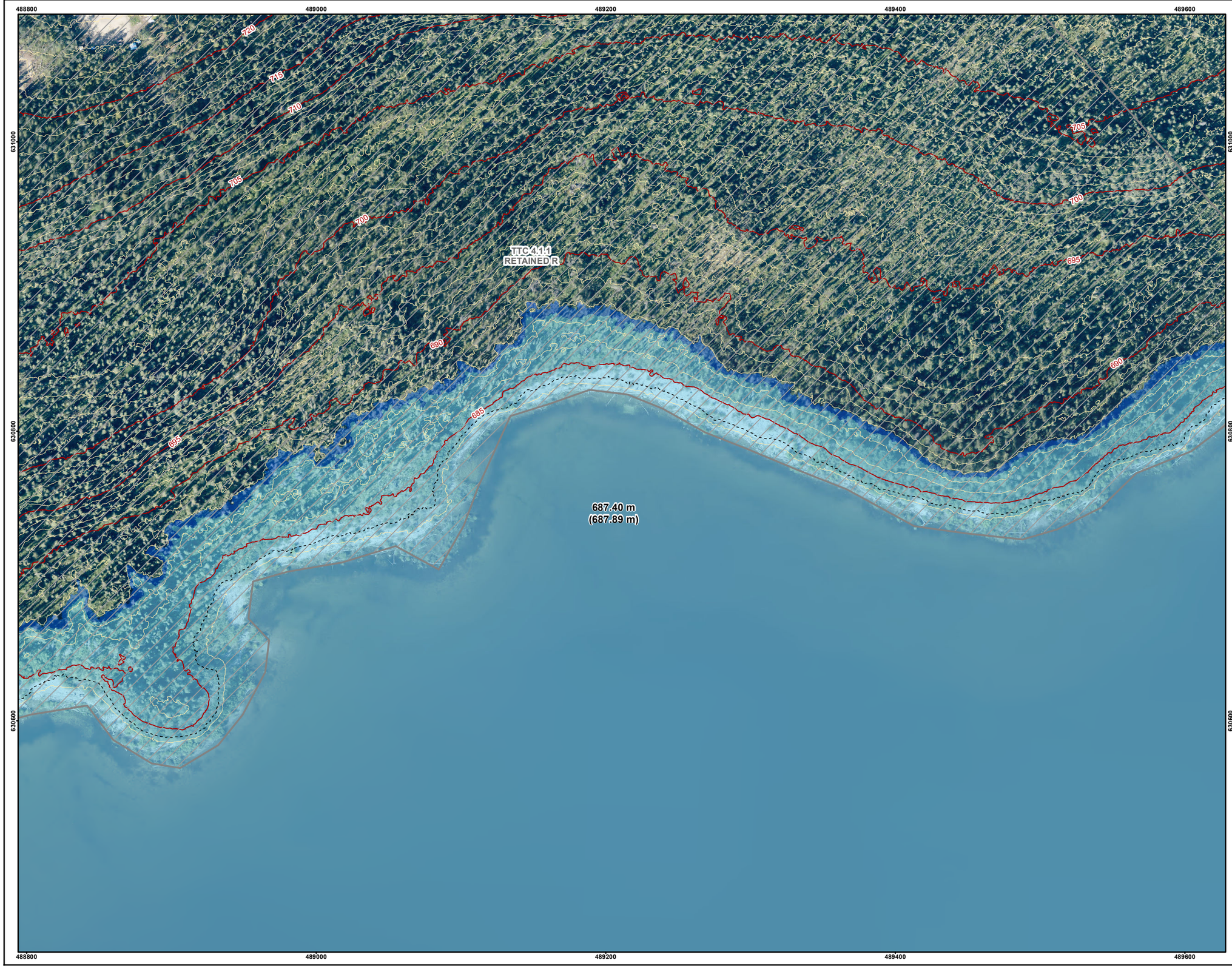
November 2024

Figure 5.5-14

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

25mm

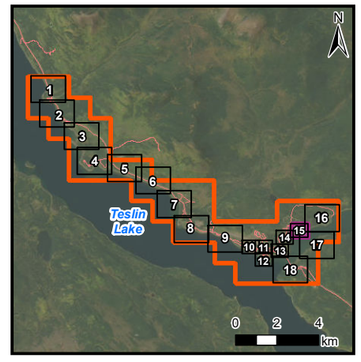
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL), DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
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3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

20 0 20
Metres
1:2,500

N

wsp

September 2024

Figure 5.5-15

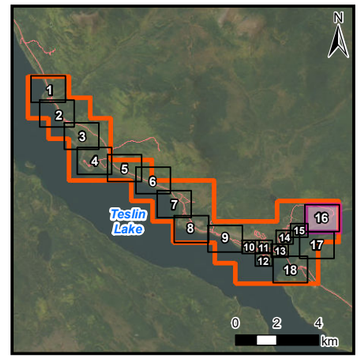
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Local Road

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

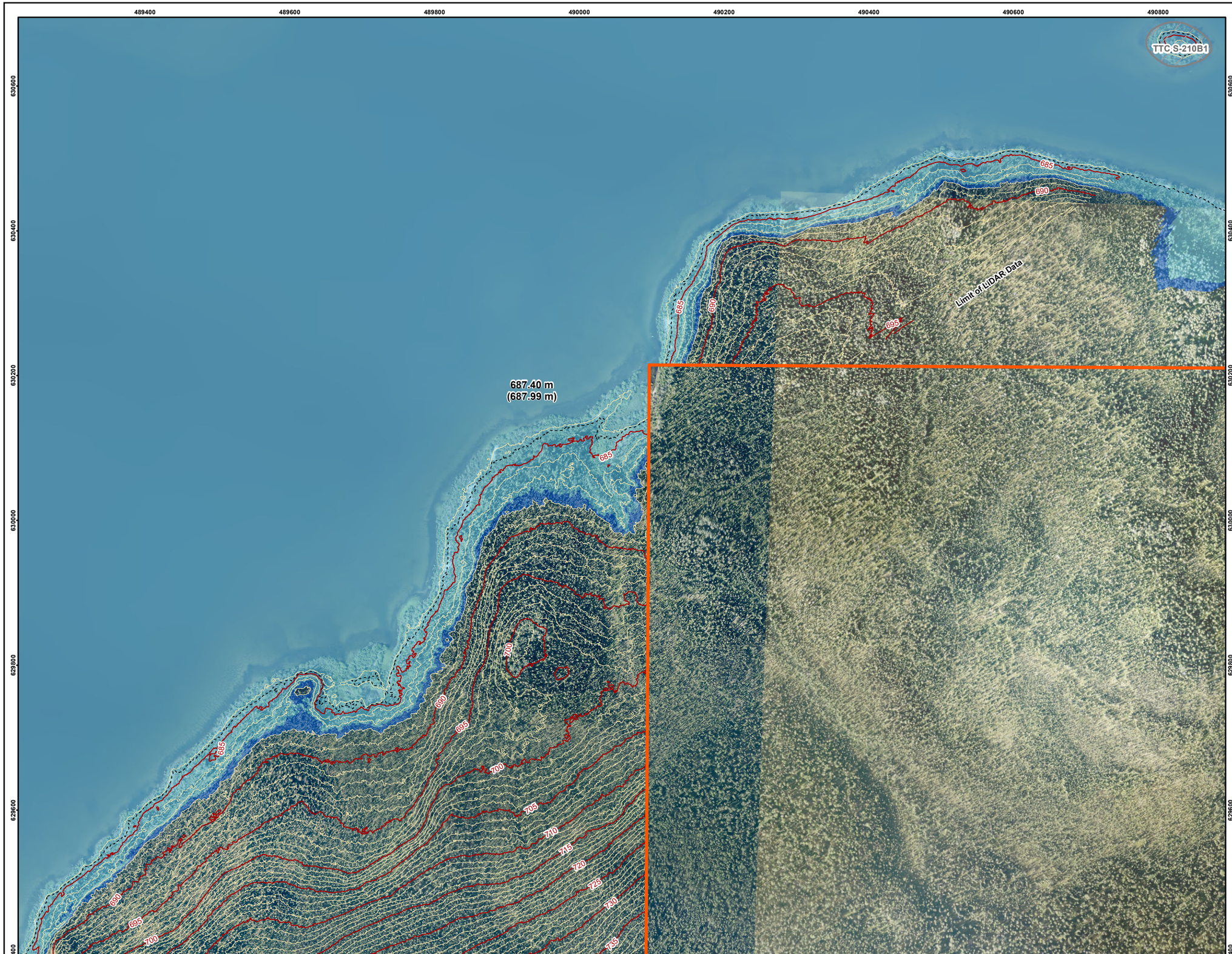
N

wsp

September 2024

Figure 5.5-16

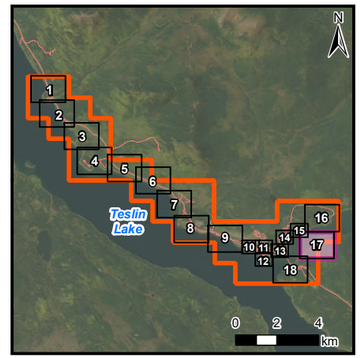
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

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Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

September 2024

Figure 5.5-17

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
0 25mm

488000 488200 488400 488600 488800 489000 489200 489400 489600

629400 629200 629000 628800 628600 628400

Nisutlin Bay Bridge

687.40 m
(687.99 m)

685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780

Alaska Highway

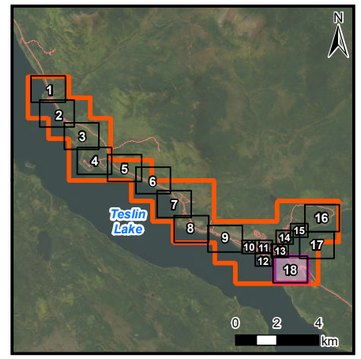
TTC C-8B

Limit of LiDAR Data

LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Bridge
- Culvert

687.40 m (687.69 m) Inundation Level / Inundation Level with Wave Runup



NOTE(S)

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2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/25)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)
3. ADDITIONAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Yukon Canada

Teslin Flood Mapping Study

Teslin Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

40 0 40
Metres
1:5,000

N

wsp

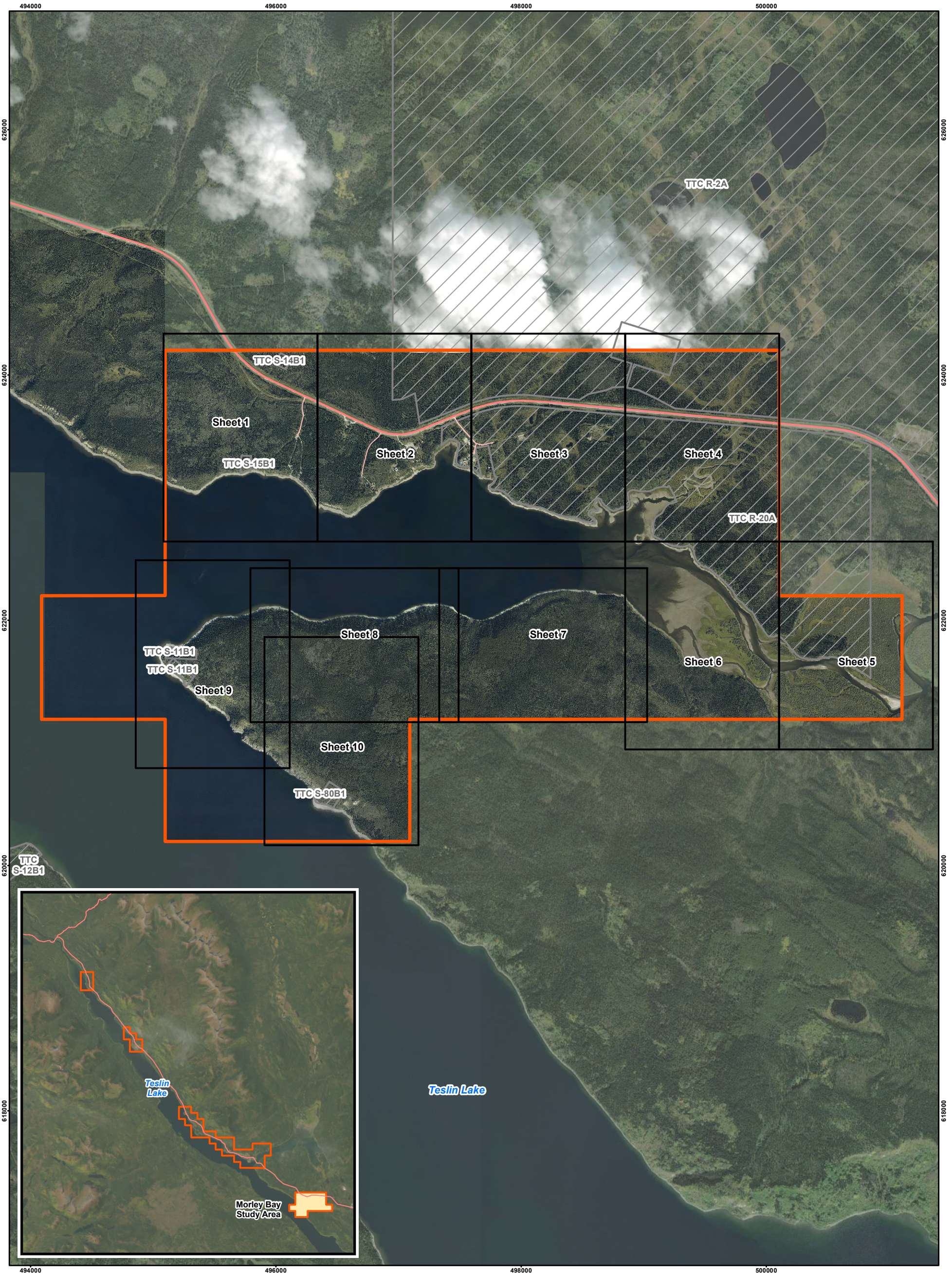
September 2024

Figure 5.5-18

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

25mm

0



LEGEND

- Study Area
- Detailed Mapsheet Extent
- First Nation Settlement Lands - Surveyed
- Highway
- Local Road

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS
2. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA

REV 0 - ISSUED AS FINAL (24/09/13)

REFERENCE(S)

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2. IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. ADDITIONAL IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area

300 0 300
Metres
1:30,000

N

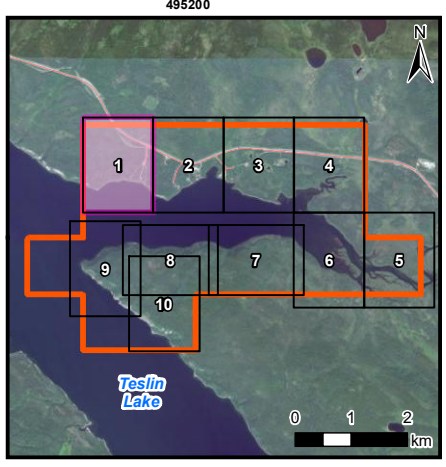
September 2024

Figure 6.0

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

25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.03 m (688.50 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

WSP

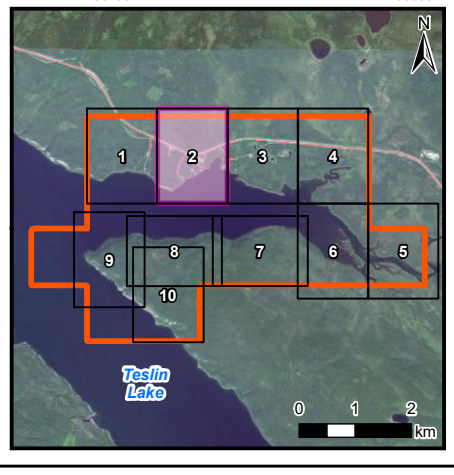
September 2024

Figure 6.1-1

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

25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.03 m (688.50 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

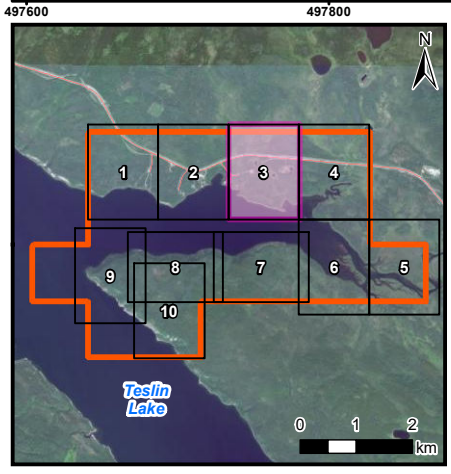
wsp

September 2024

Figure 6.1-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.03 m (688.50 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

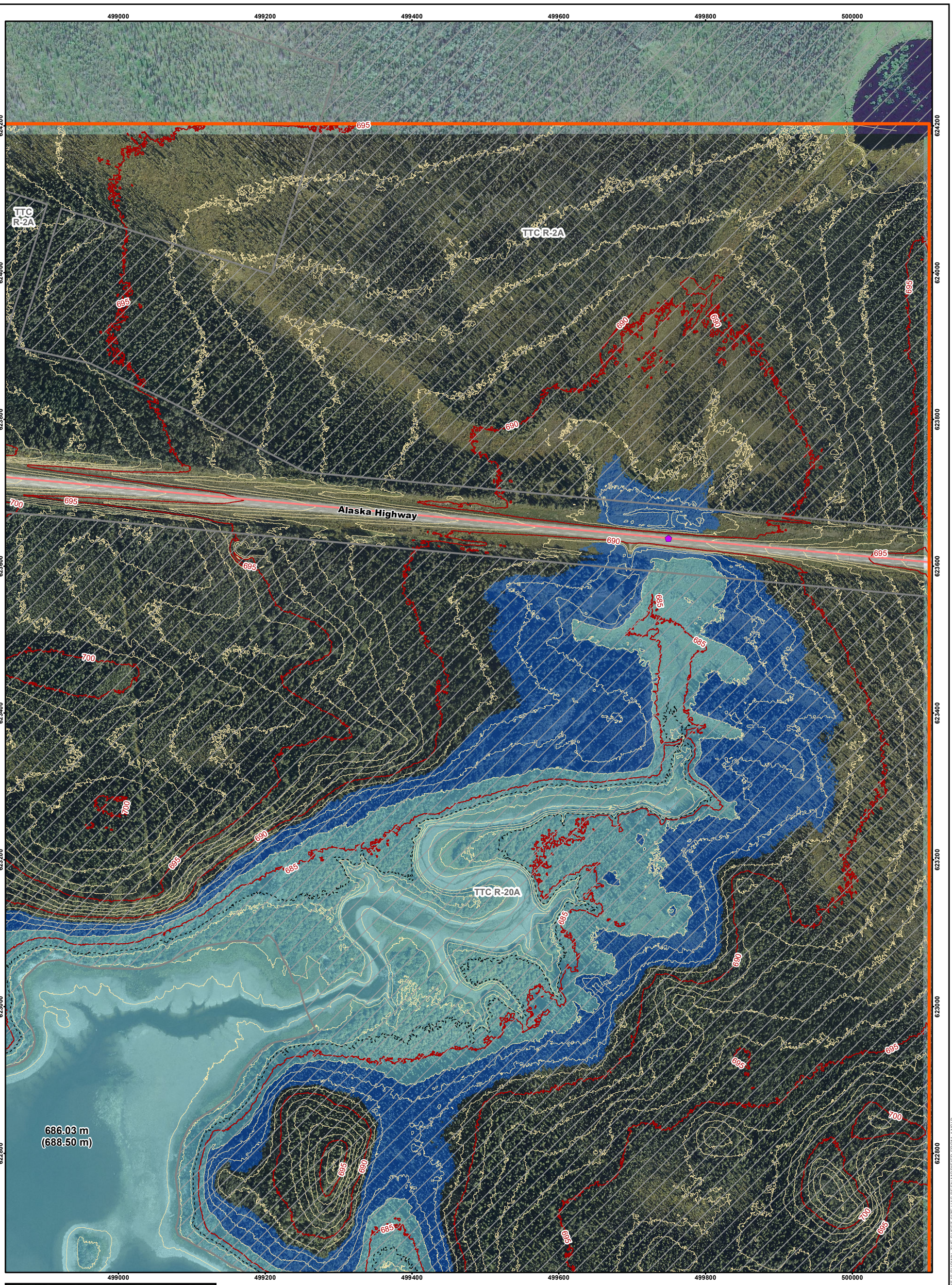
September 2024

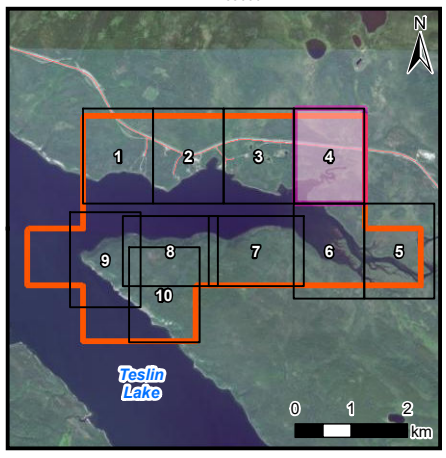
Figure 6.1-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.03 m (688.50 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

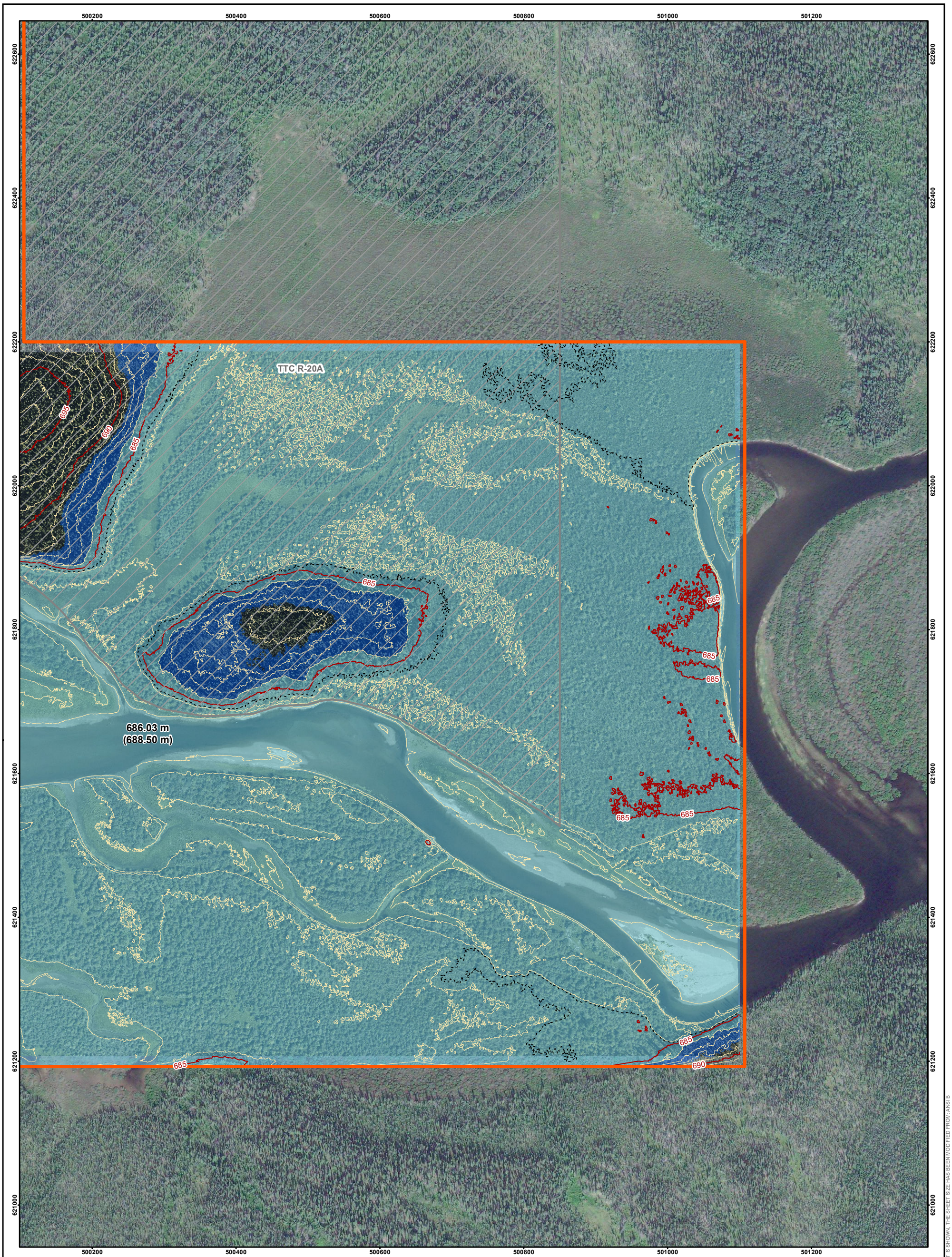
September 2024

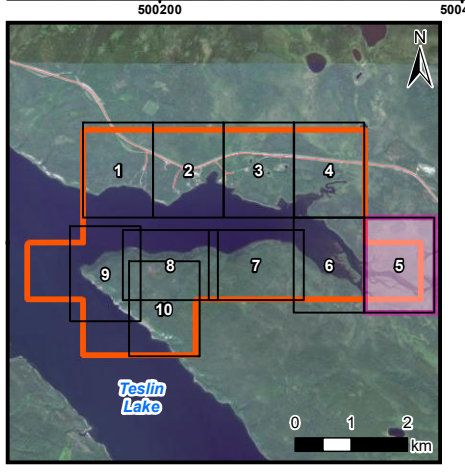
Figure 6.1-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.03 m (688.50 m) — Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.1-5

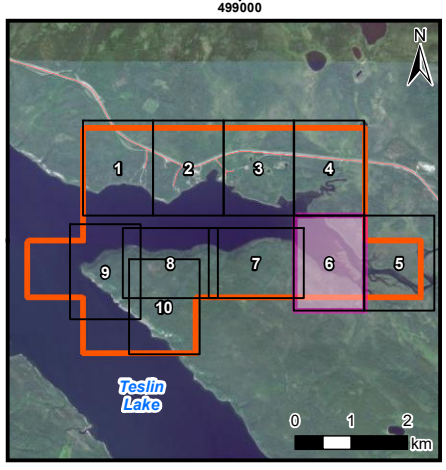
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0

686.03 m
(688.50 m)

686.03 m
(688.33 m)

TTC R-20A



LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.03 m Inundation Level
(688.50 m) Inundation Level with Wave Runup

NOTE(S)

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Teslin Flood Mapping Study

Morley Bay Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

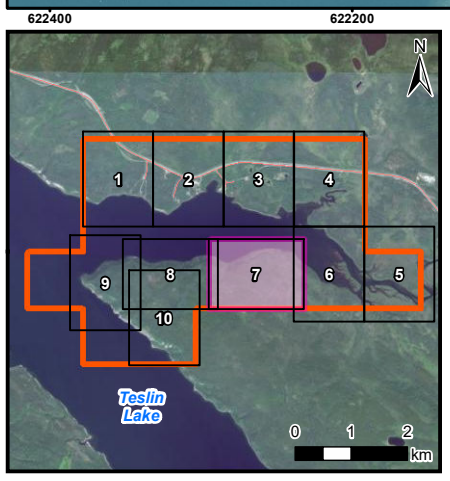
September 2024

Figure 6.1-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- 686.03 m — Inundation Level
- (688.50 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

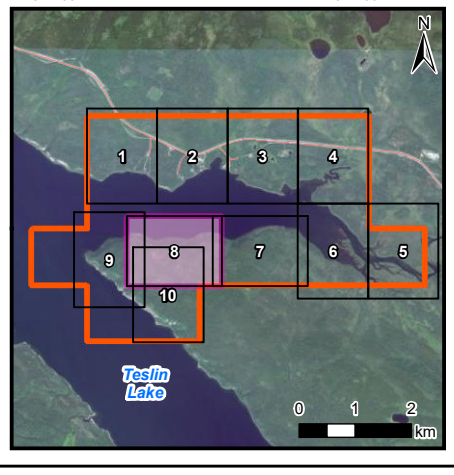
Figure 6.1-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.03 m (688.50 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

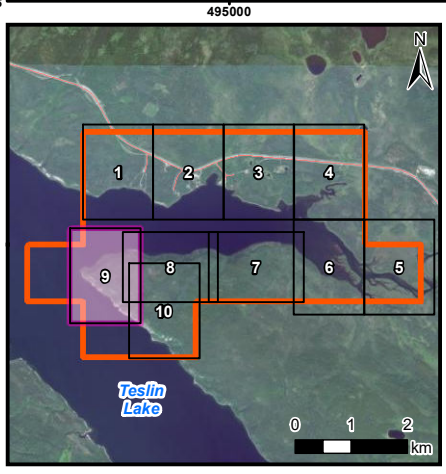
Figure 6.1-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.03 m — Inundation Level
(688.50 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

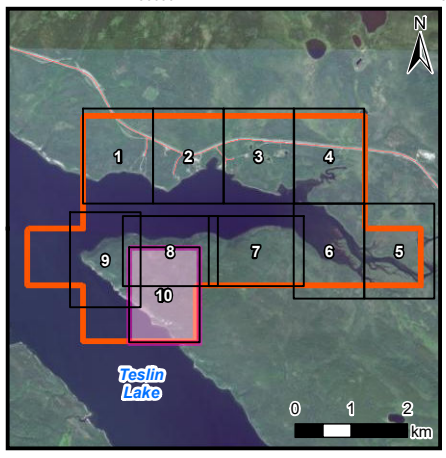
wsp

September 2024

Figure 6.1-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0





LEGEND

- Study Area
- 5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.03 m — Inundation Level
(688.50 m) — Inundation Level with Wave Runup

NOTE(S)

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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

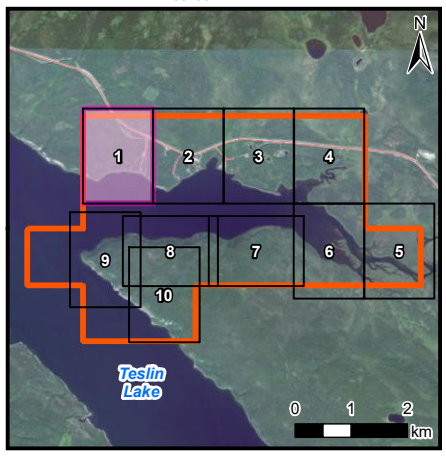
Figure 6.1-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.83 m (689.30 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

WSP

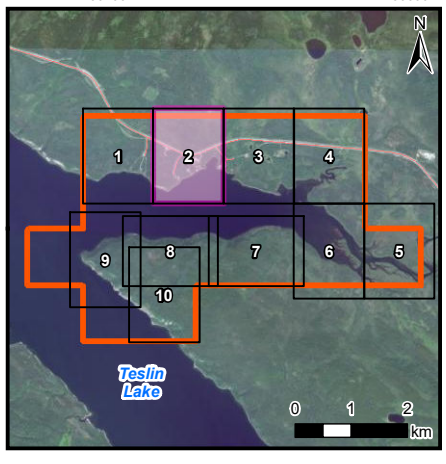
September 2024

Figure 6.2-1

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

25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
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50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.2-2

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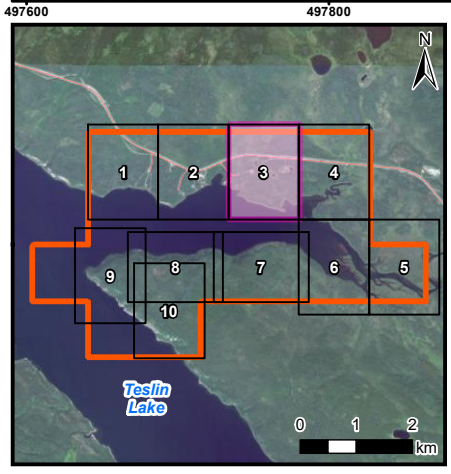
25mm

0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
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50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.2-3

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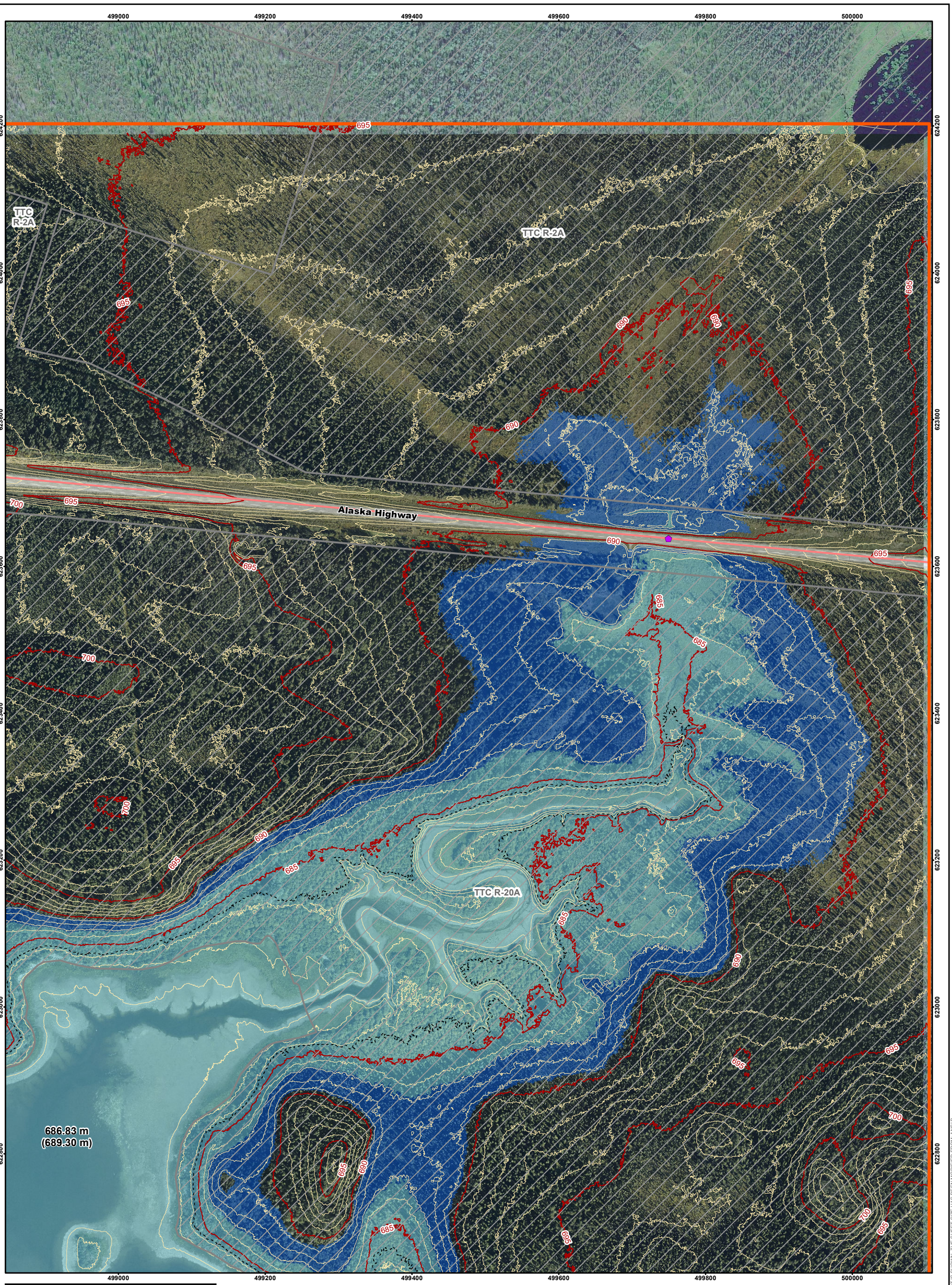
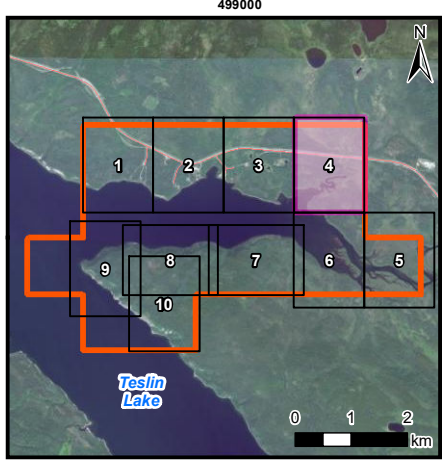
25mm
0





LEGEND

- Study Area
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- 50% AEP Extent
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- 1m LiDAR Contour
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686.83 m (689.30 m) — Inundation Level / Inundation Level with Wave Runup

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50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.2-4

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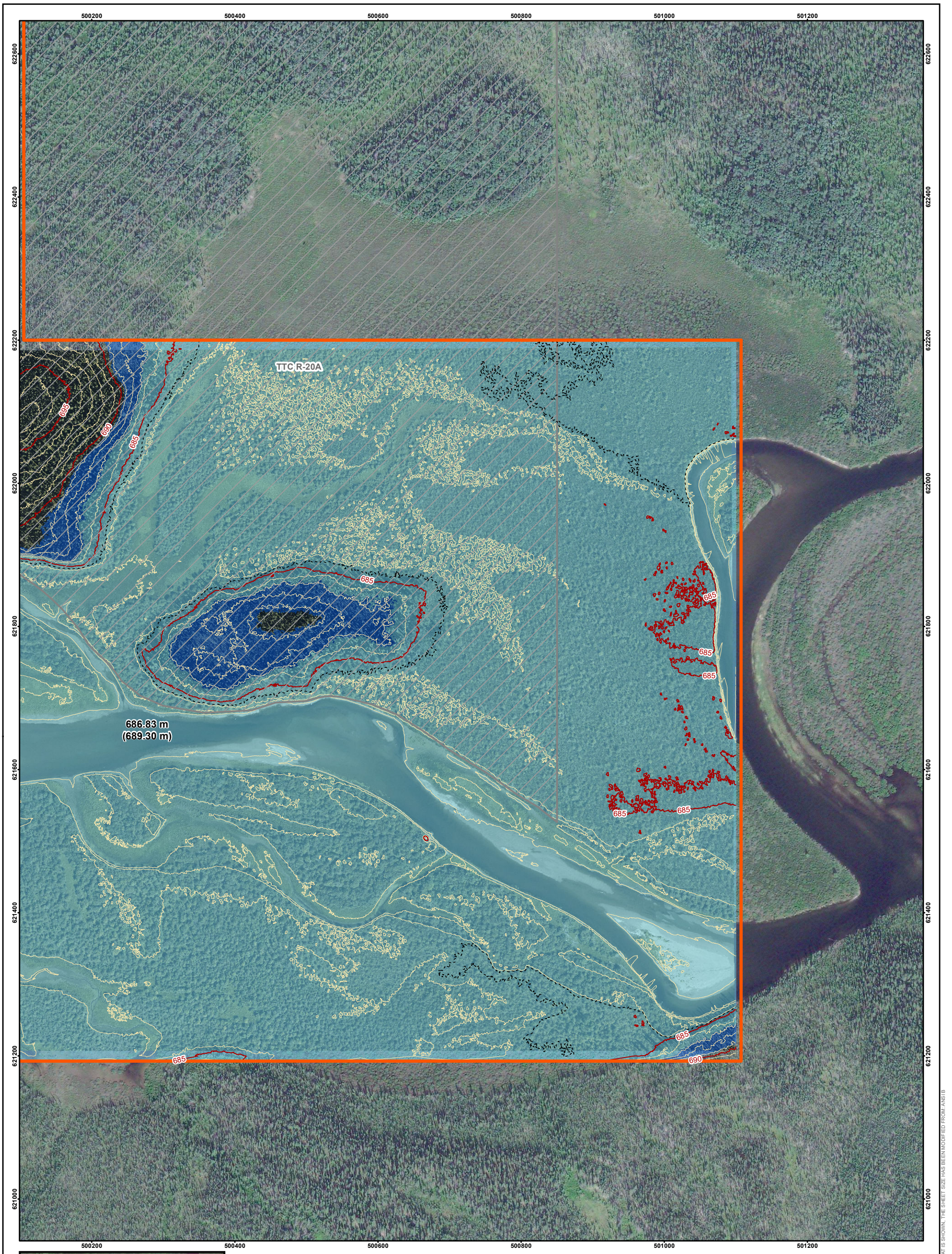
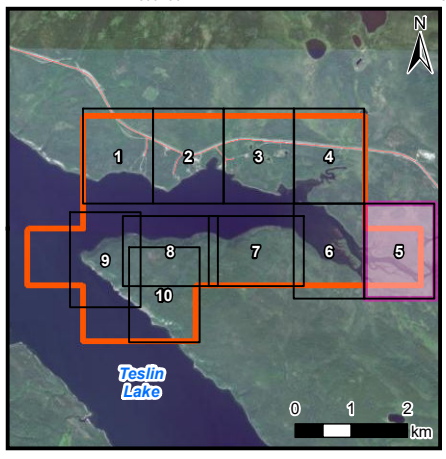
25mm

0





LEGEND

- Study Area
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- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
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- 1m LiDAR Contour
- Highway

686.83 m (689.30 m) Inundation Level / Inundation Level with Wave Runup

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Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

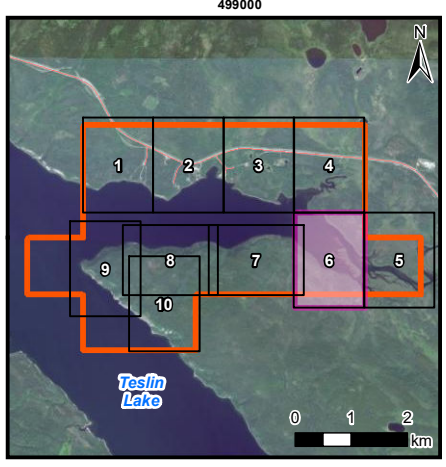
September 2024

Figure 6.2-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.83 m (689.30 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

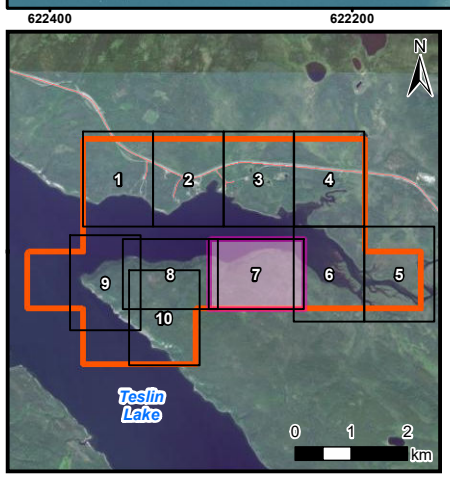
September 2024

Figure 6.2-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.83 m (689.30 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

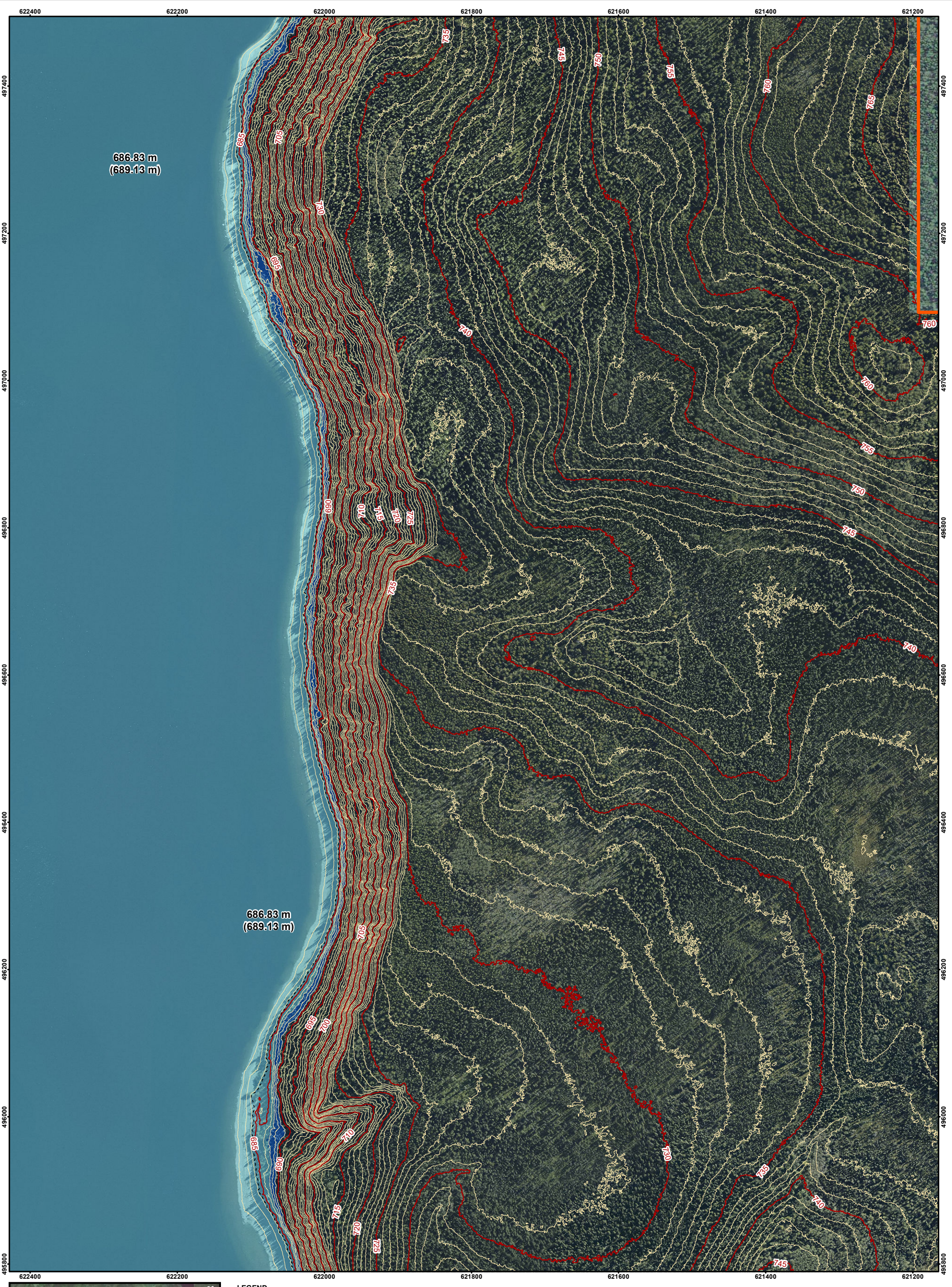
September 2024

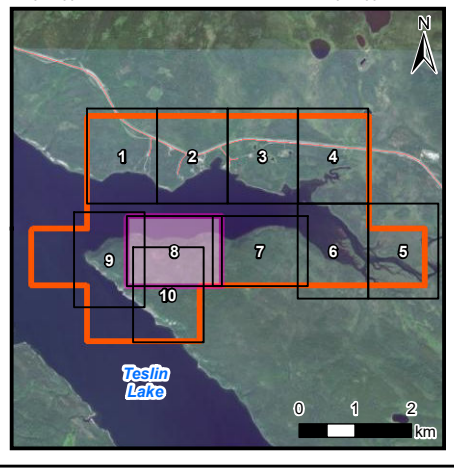
Figure 6.2-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.83 m Inundation Level
(689.30 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

WSP

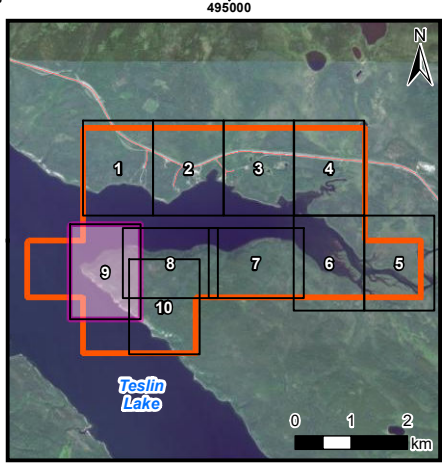
September 2024

Figure 6.2-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.83 m — Inundation Level
(689.30 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

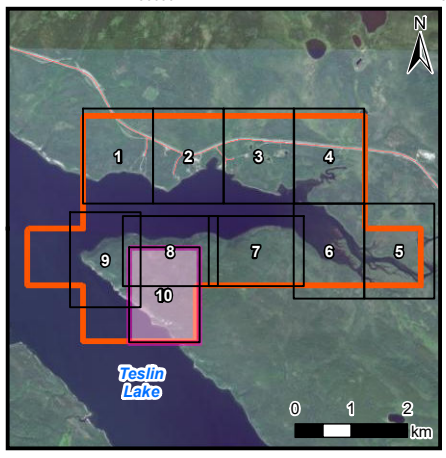
Figure 6.2-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 1% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 1% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.83 m — Inundation Level
(689.30 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 1% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

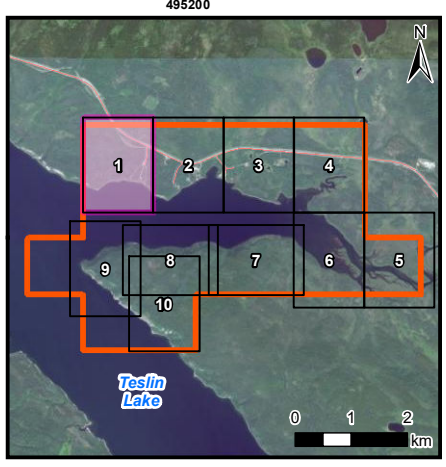
September 2024

Figure 6.2-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.13 m (689.60 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

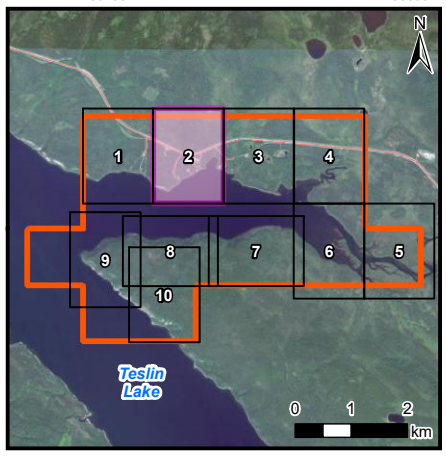
September 2024

Figure 6.3-1

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

25mm
0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.13 m (689.60 m) — Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

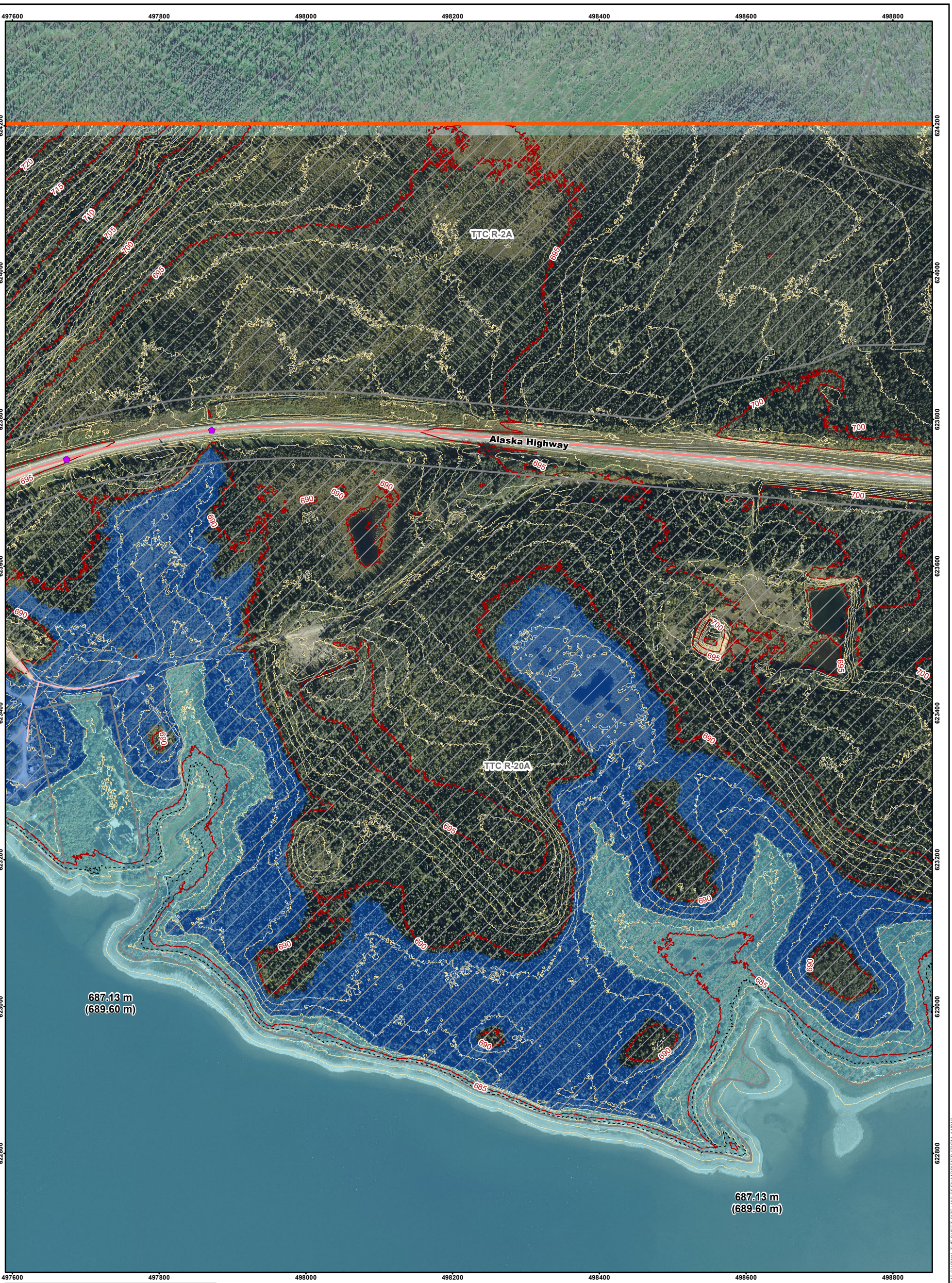
September 2024

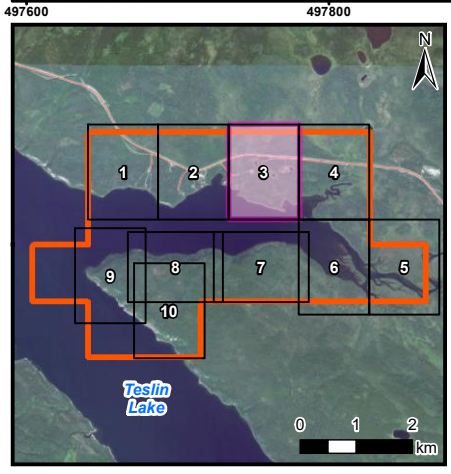
Figure 6.3-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.13 m (689.60 m) — Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

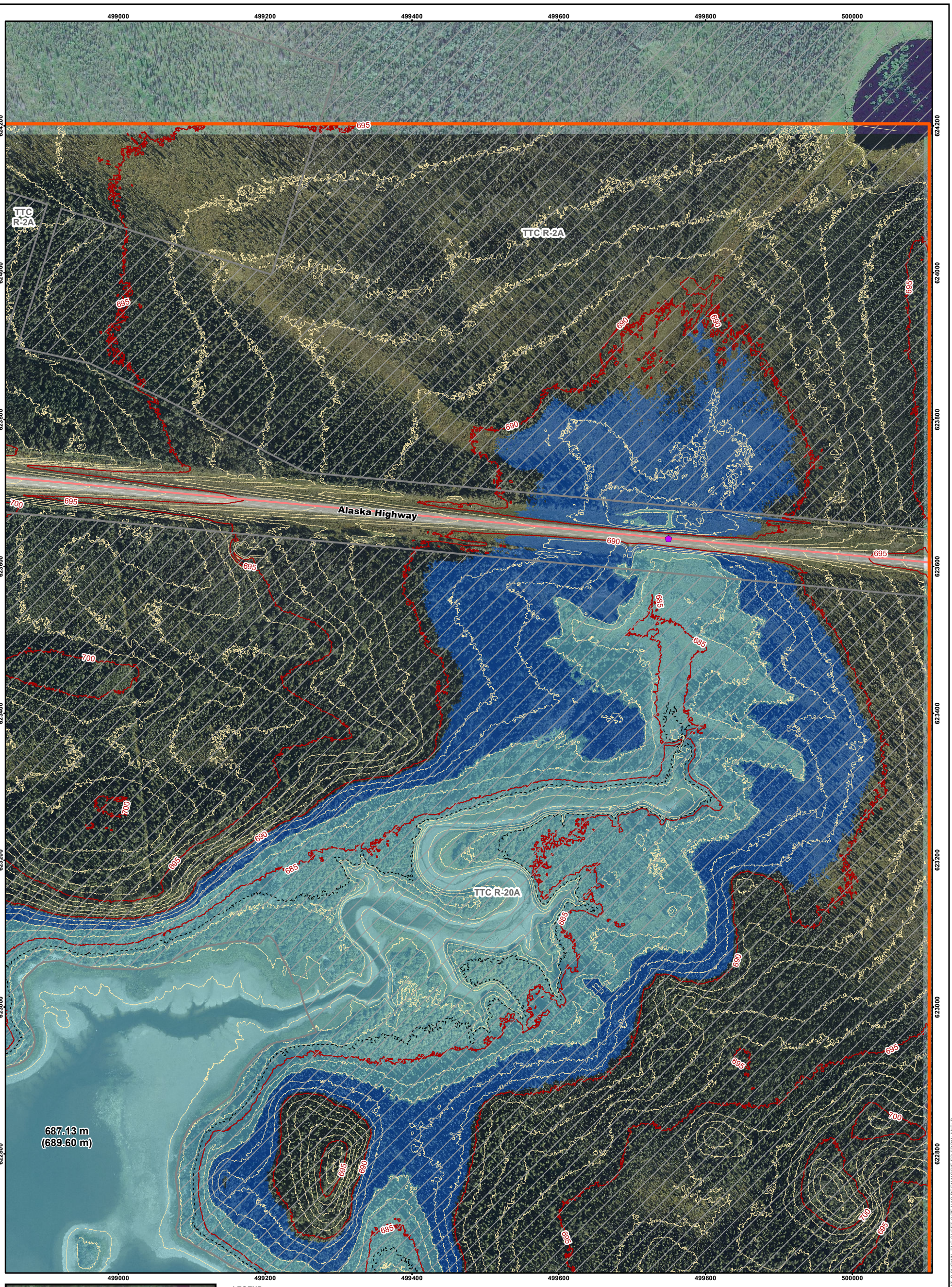
September 2024

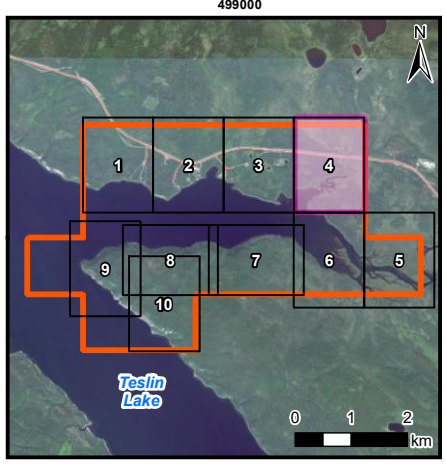
Figure 6.3-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

687.13 m (689.60 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

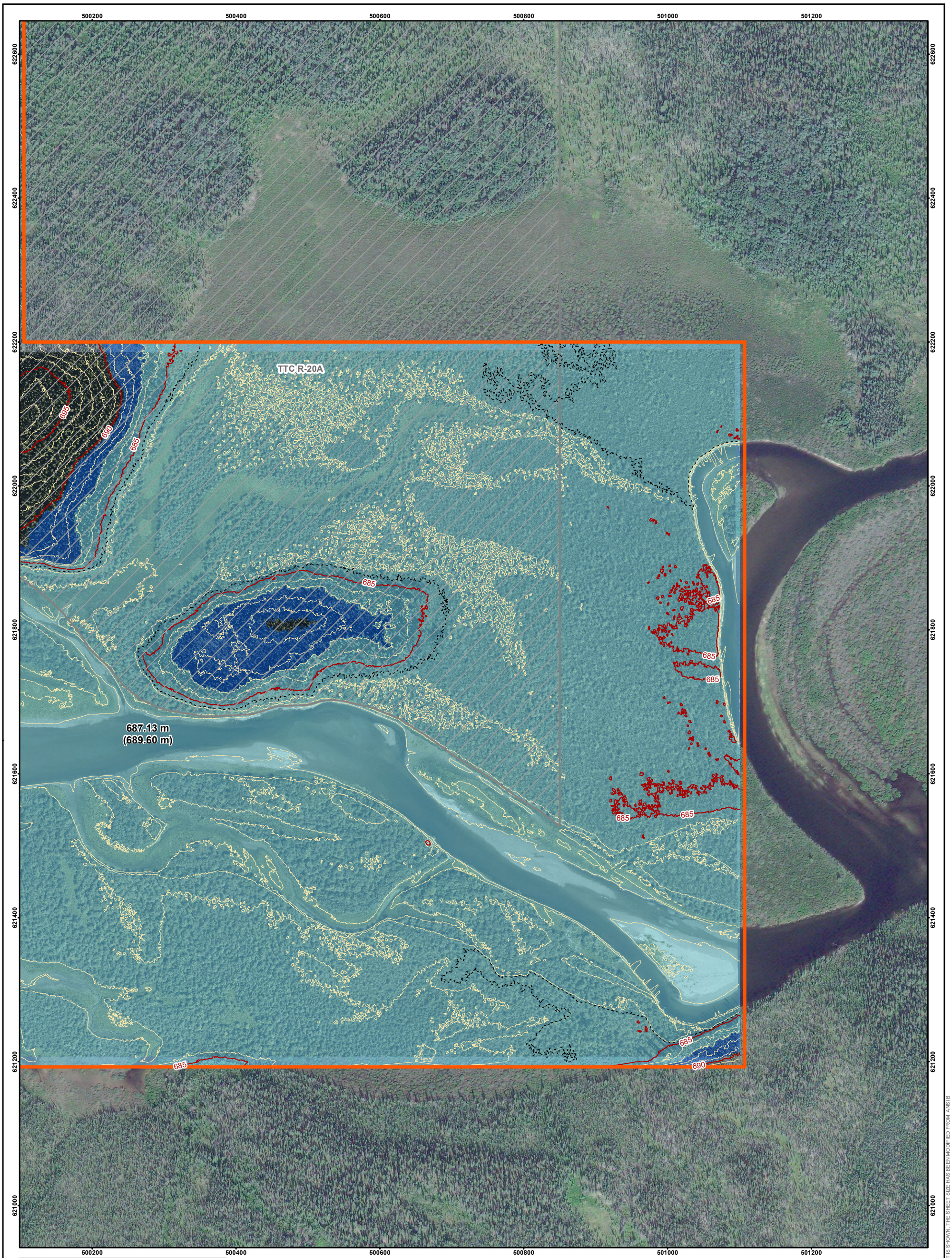
September 2024

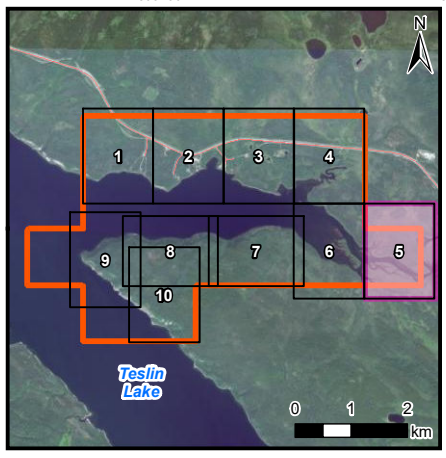
Figure 6.3-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

687.13 m (689.60 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.3-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0

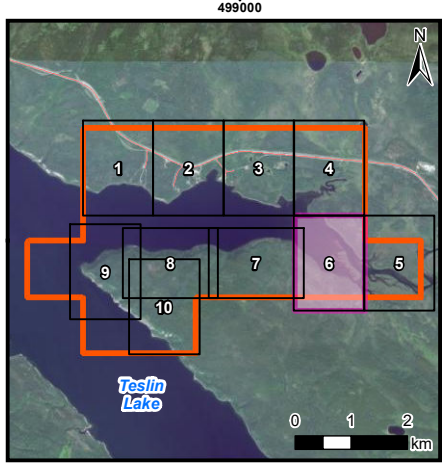
687.13 m
(689.60 m)

687.13 m
(689.43 m)

TTC R-20A

499000 499200 499400 499600 499800 500000

622600 622400 622200 622000 621800 621600 621400 621200 621000



LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

687.13 m (689.60 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

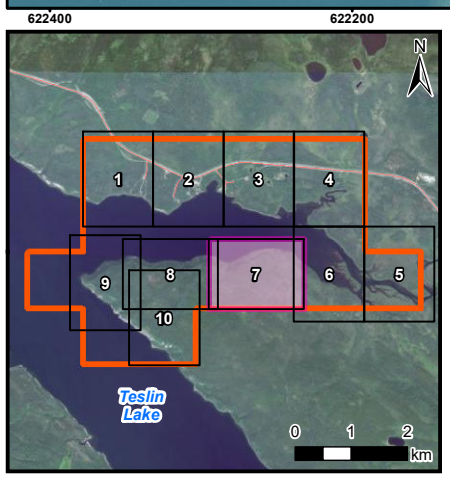
September 2024

Figure 6.3-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

687.13 m (689.60 m) Inundation Level with Wave Runup

NOTE(S)

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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

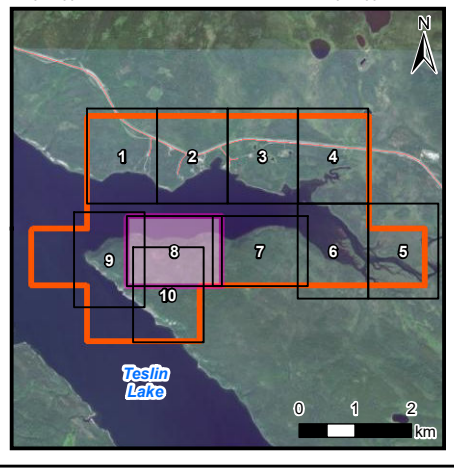
Figure 6.3-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

687.13 m (689.60 m) Inundation Level with Wave Runup

NOTE(S)

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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

WSP

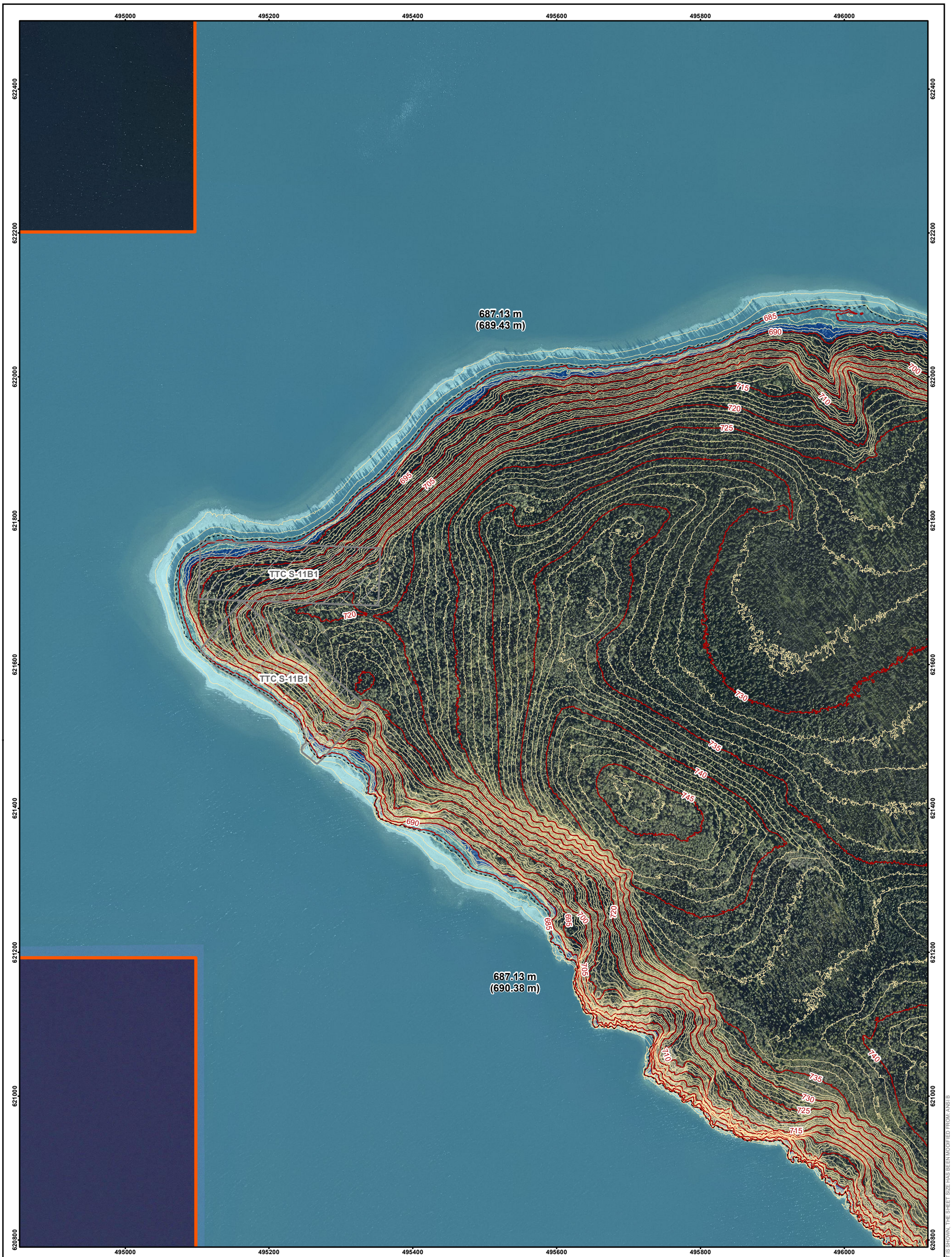
September 2024

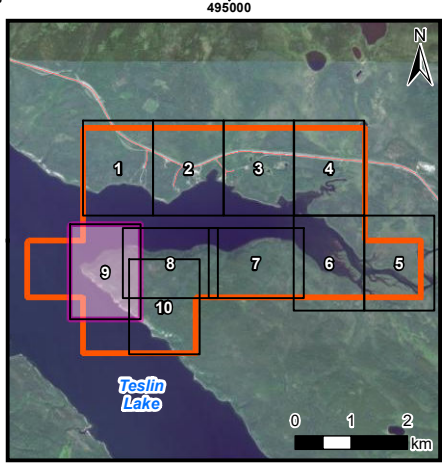
Figure 6.3-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

687.13 m — Inundation Level
(689.60 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – YUKON, CANADA.
2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

September 2024

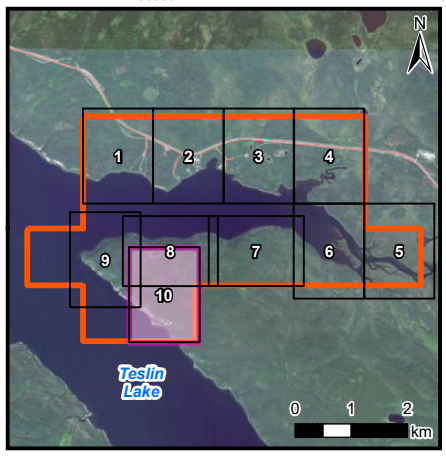
Figure 6.3-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

687.13 m — Inundation Level
(689.60 m) — Inundation Level with Wave Runup

NOTE(S)

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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event

50 0 50
Metres
1:5,000

N

wsp

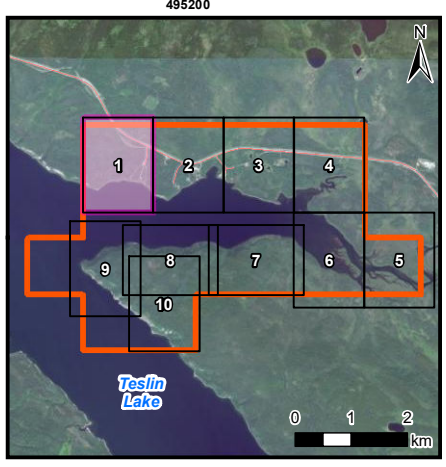
September 2024

Figure 6.3-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.28 m (689.21 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

WSP

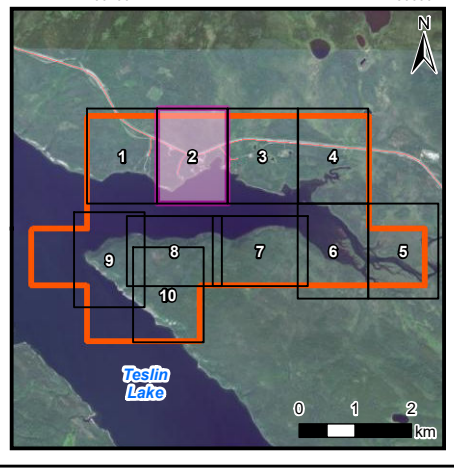
September 2024

Figure 6.4-1

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

25mm
0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.28 m — Inundation Level
- (689.21 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

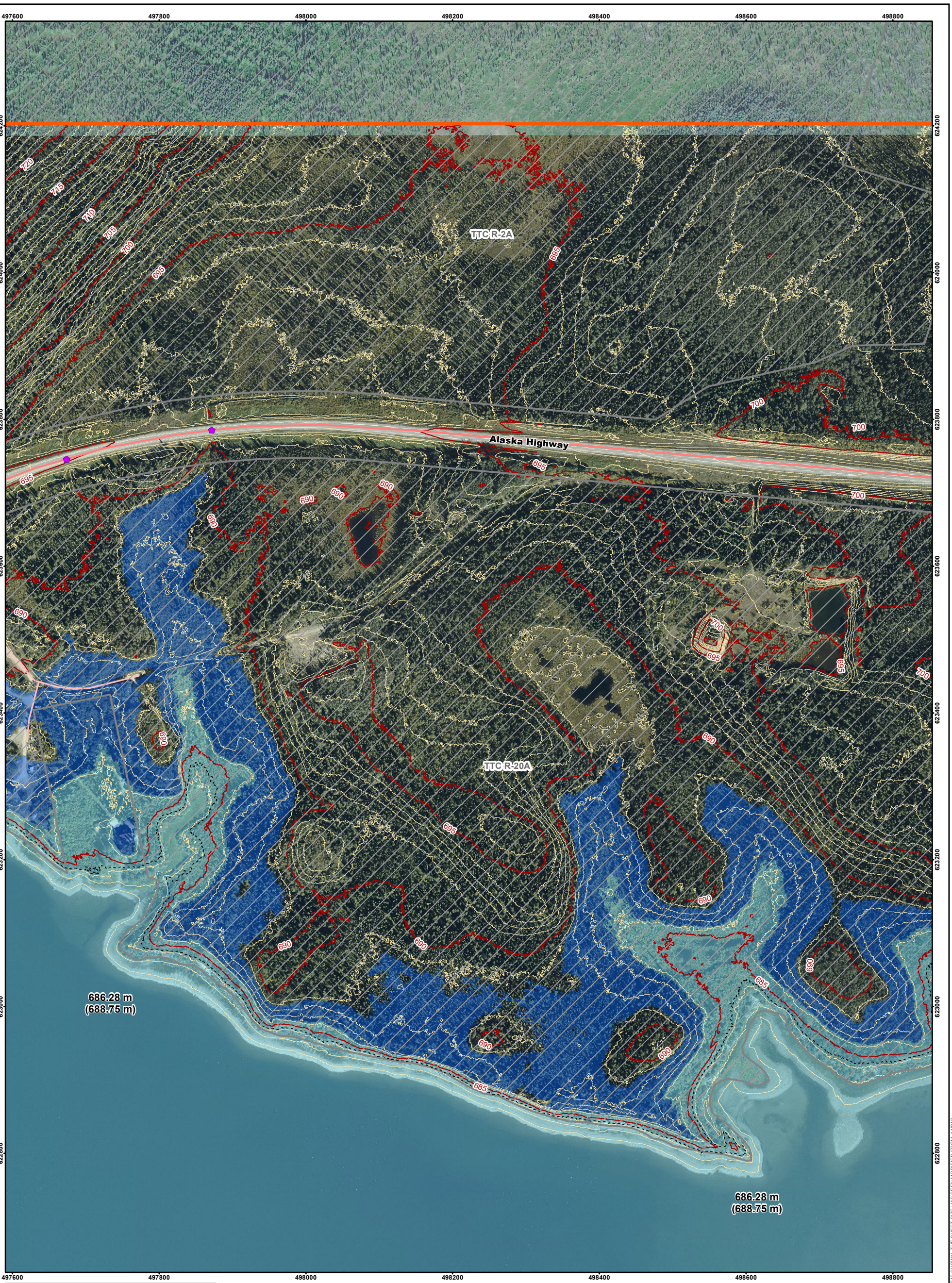
N

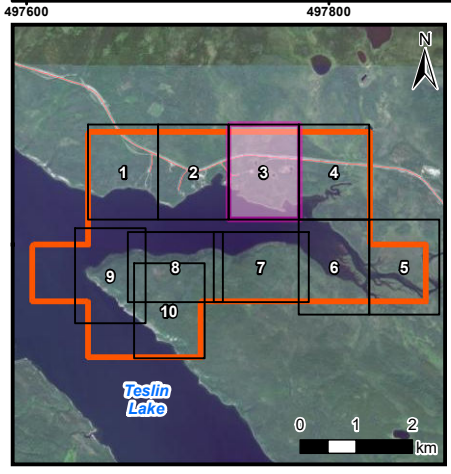
wsp

September 2024

Figure 6.4-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 686.28 m — Inundation Level
- (689.21 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Teslin Flood Mapping Study

Morley Bay Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event
Under Climate Change Conditions

50 0 50
Metres
1:5,000

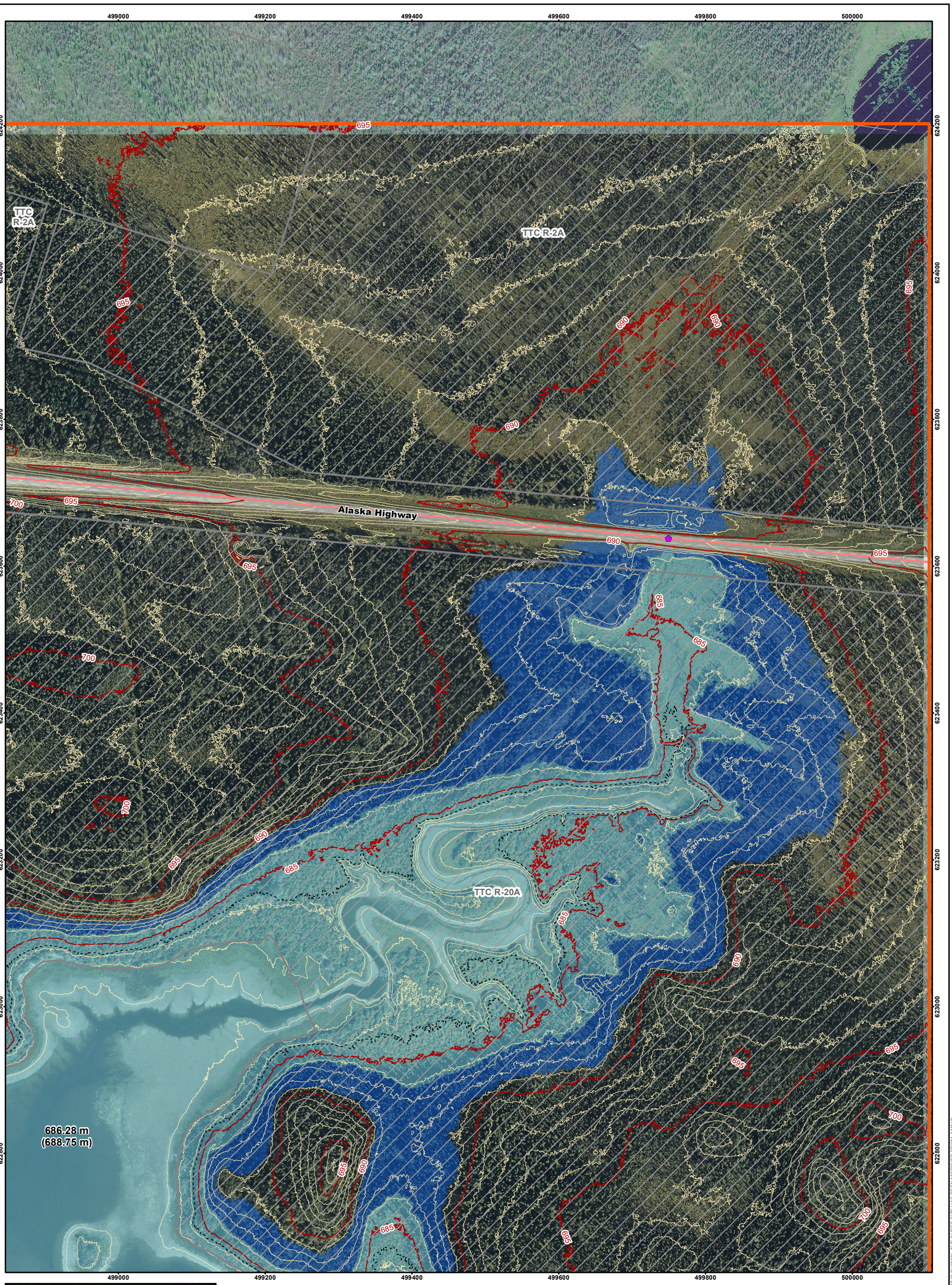
N

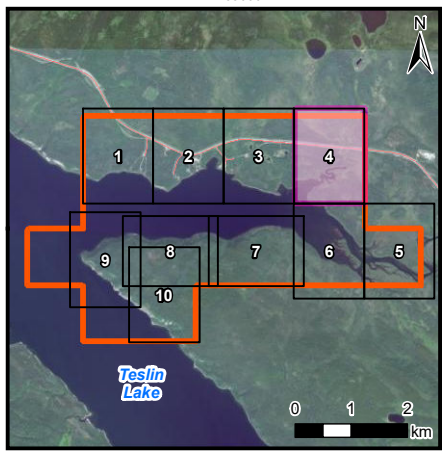
wsp

September 2024

Figure 6.4-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert

686.28 m (689.21 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

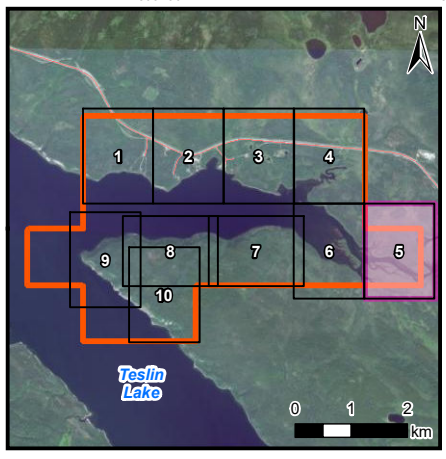
Figure 6.4-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0

TTC R-20A

686.28 m
(688.75 m)

685
690
695



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.28 m (689.21 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.4-5

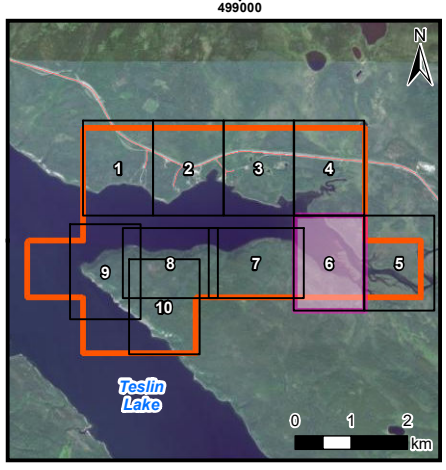
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0

686.28 m
(688.75 m)

686.28 m
(688.55 m)

TTC R-20A



LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- 686.28 m (689.21 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

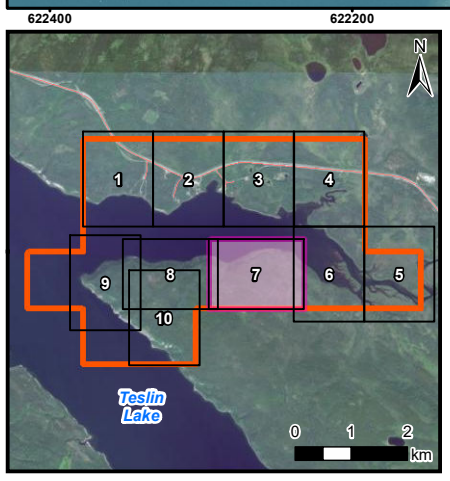
September 2024

Figure 6.4-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.28 m (689.21 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Teslin Flood Mapping Study

Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

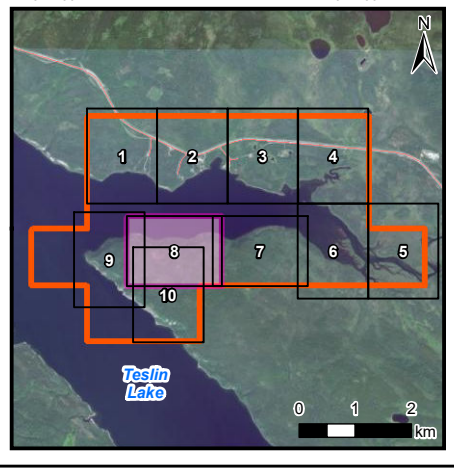
Figure 6.4-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

686.28 m (689.21 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

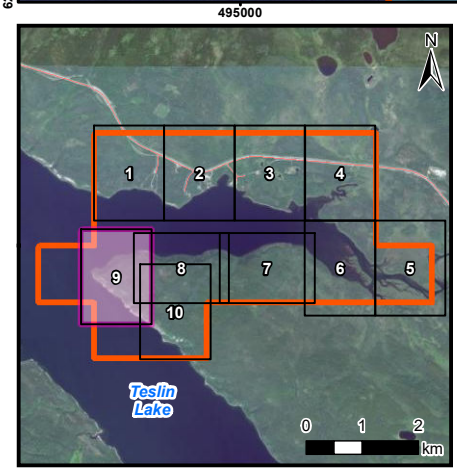
Figure 6.4-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.28 m — Inundation Level
(689.21 m) — Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
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Morley Bay Study Area
Estimated 5% Annual Exceedence Probability (AEP) Event
Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

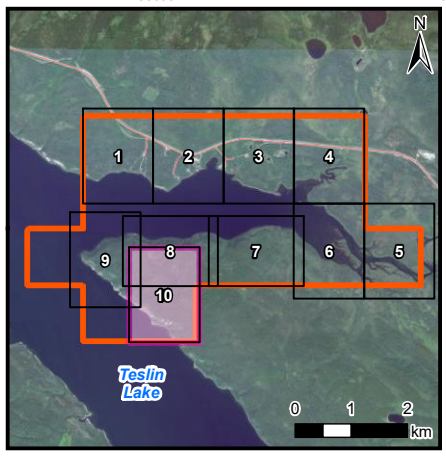
wsp

September 2024

Figure 6.4-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0





LEGEND

- Study Area
- 5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

686.28 m (689.21 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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Morley Bay Study Area Estimated 5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

WSP

September 2024

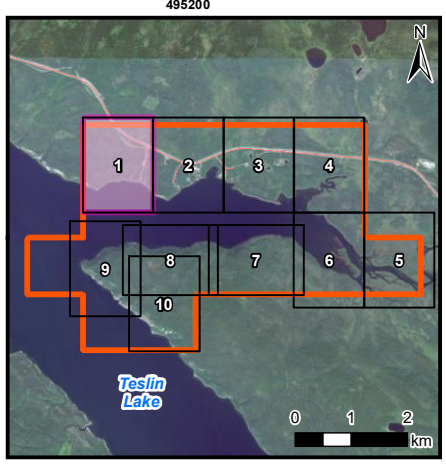
Figure 6.4-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.40 m (690.33 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
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Yukon Canada

Teslin Flood Mapping Study

Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

WSP

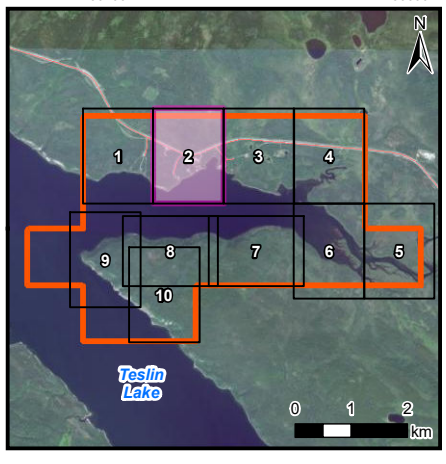
September 2024

Figure 6.5-1

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

25mm
0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.40 m (690.33 m) Inundation Level with Wave Runup

NOTE(S)

1. PROJECTION: NAD 1983 YUKON ALBERS; VERTICAL DATUM: CGVD2013
2. ELEVATIONS IN METRES ABOVE SEA LEVEL (MSL). DERIVED FROM 2023 LIDAR.
3. PROJECT PARTIALLY FUNDED BY THE GOVERNMENT OF CANADA
4. WAVE RUNUP EXTENTS BASED ON TYPICAL SHORELINE TRANSECTS. BERMS, OTHER STRUCTURES, OR VEGETATION THAT MAY INFLUENCE WAVE ACTION WERE NOT CONSIDERED.

REV 0 - ISSUED AS FINAL (24/09/20)

REFERENCE(S)

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2. IMAGERY PROVIDED BY GOVERNMENT OF YUKON (2023)

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Metres
1:5,000

N

wsp

September 2024

Figure 6.5-2

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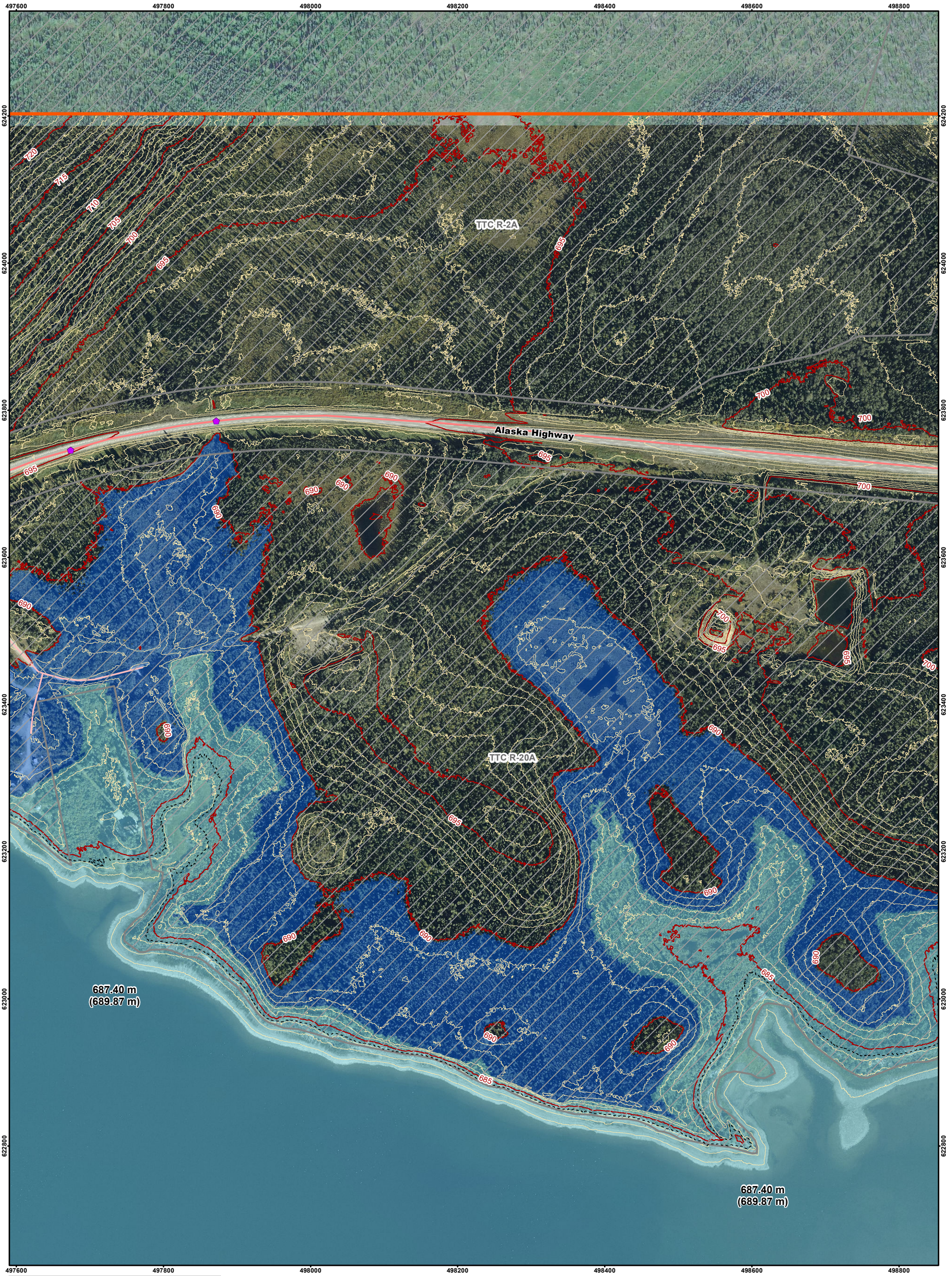
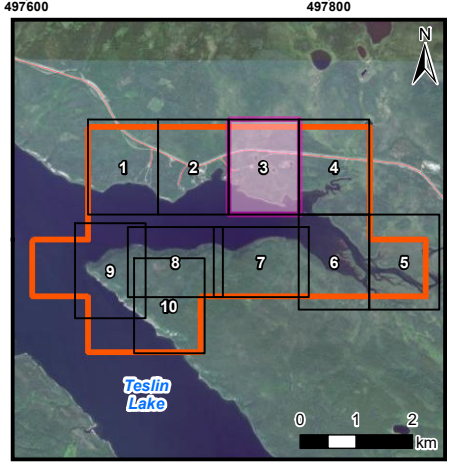
25mm

0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
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- 1m LiDAR Contour
- Highway
- Local Road
- Culvert
- 687.40 m (690.33 m) Inundation Level with Wave Runup

NOTE(S)

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50 0 50
Metres
1:5,000

N

wsp

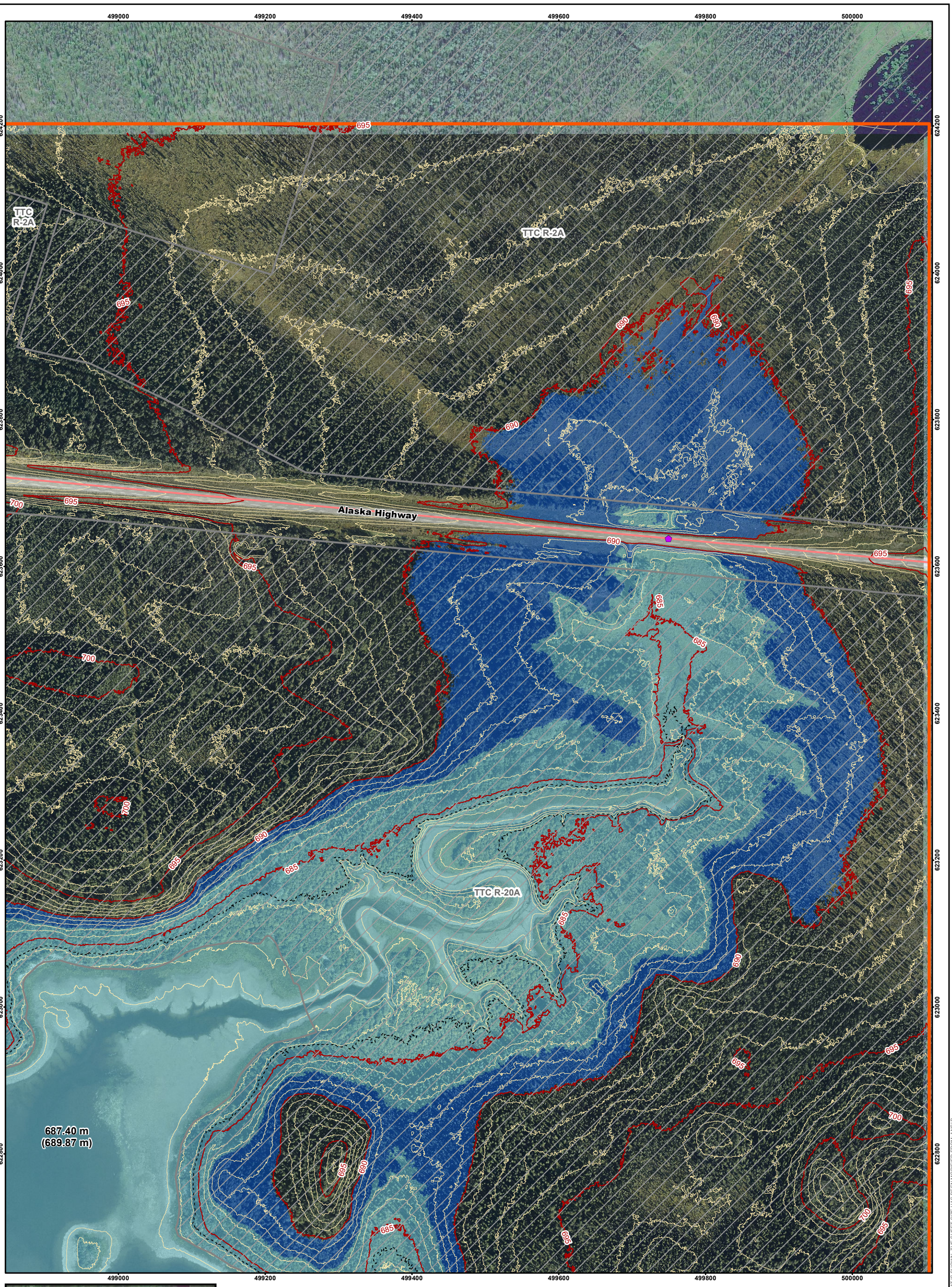
September 2024

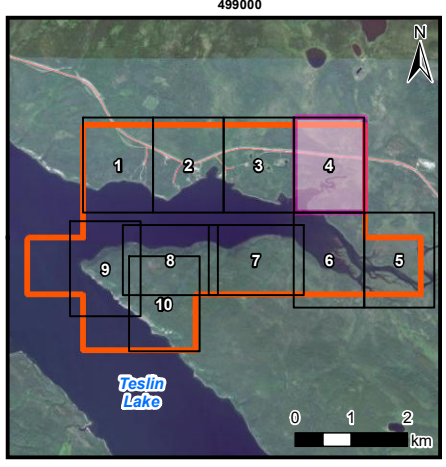
Figure 6.5-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- Culvert
- 687.40 m (690.33 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

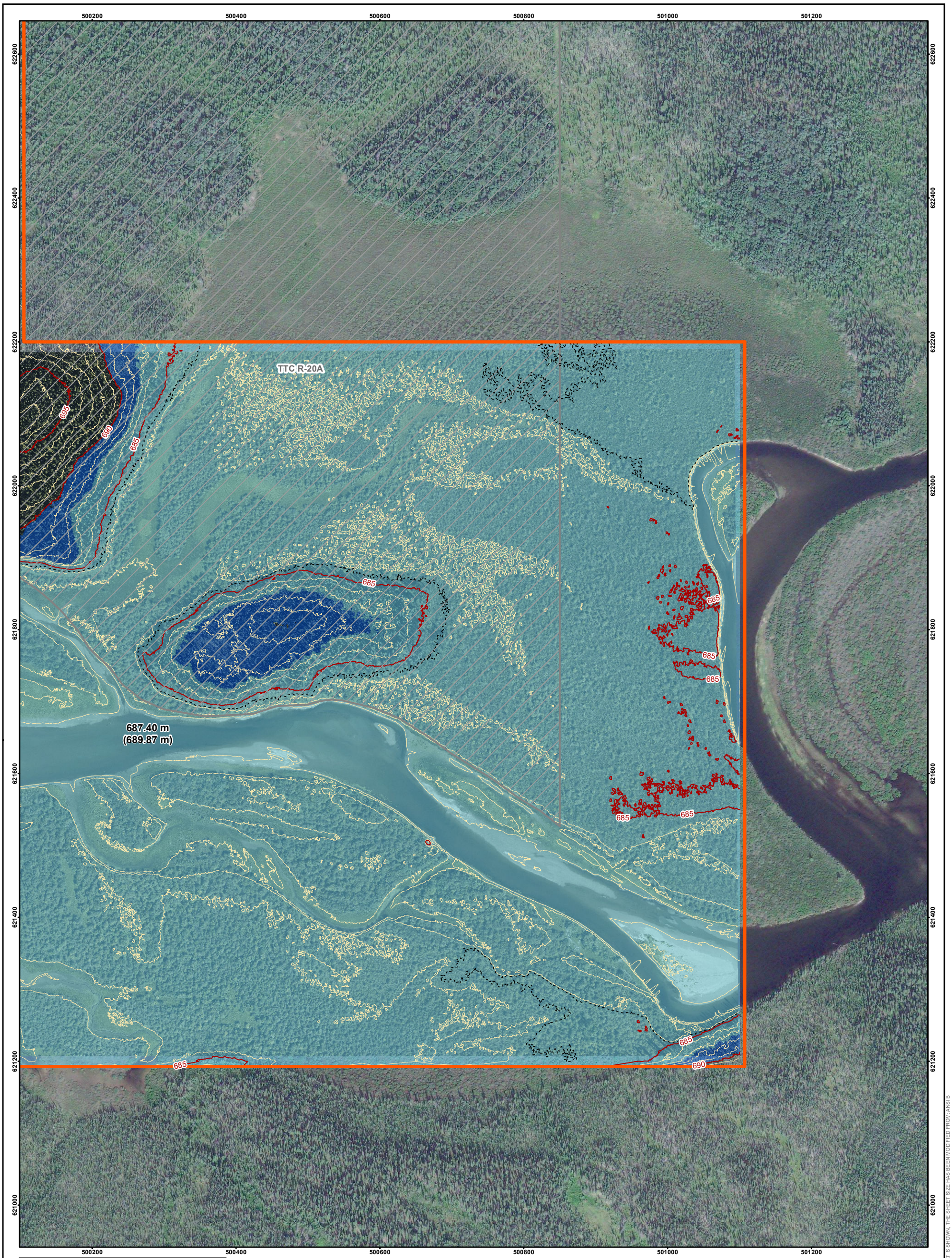
N

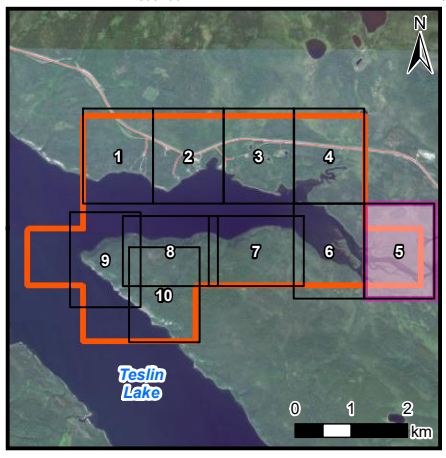
wsp

September 2024

Figure 6.5-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway
- 687.40 m (690.33 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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Morley Bay Study Area Estimated 0.5% Annual Exceedence Probability (AEP) Event Under Climate Change Conditions

50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.5-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

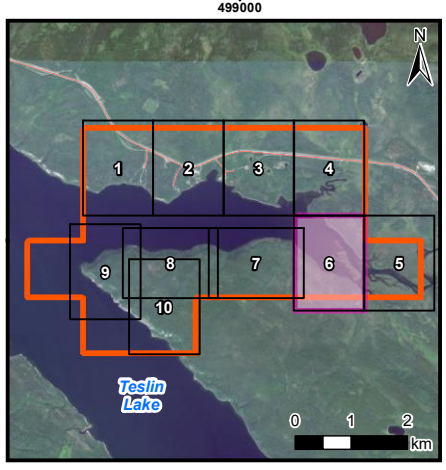
25mm

0

687.40 m
(689.87 m)

687.40 m
(689.67 m)

TTC R-20A



LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
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50 0 50
Metres
1:5,000

N

wsp

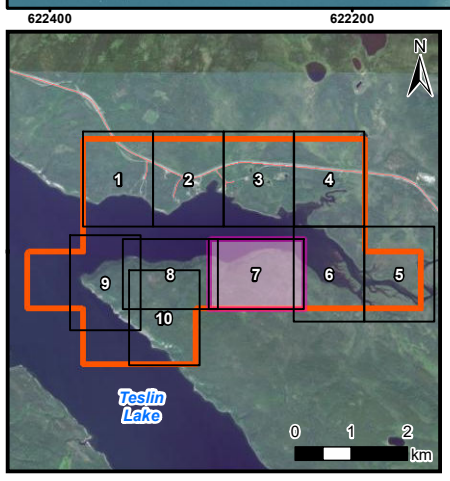
September 2024

Figure 6.5-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
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- 687.40 m (690.33 m) Inundation Level / Inundation Level with Wave Runup

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50 0 50
Metres
1:5,000

N

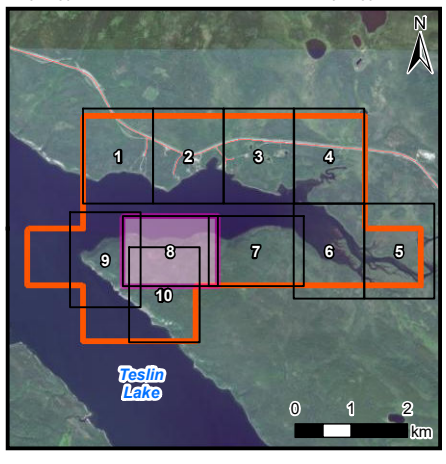
wsp

September 2024

Figure 6.5-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B
25mm
0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour
- Highway

687.40 m (690.33 m) Inundation Level / Inundation Level with Wave Runup

NOTE(S)

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50 0 50
Metres
1:5,000

N

wsp

September 2024

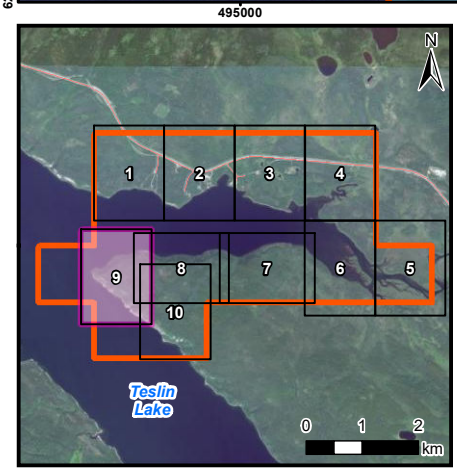
Figure 6.5-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0





LEGEND

- Study Area
- 0.5% AEP Climate Change Flood Inundation Extent
- Potential Additional Inundation Due to Wave Runup at 0.5% AEP with Climate Change
- First Nation Settlement Lands - Surveyed
- 50% AEP Extent
- 5m Index LiDAR Contour
- 1m LiDAR Contour

687.40 m (690.33 m) Inundation Level with Wave Runup

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50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.5-9

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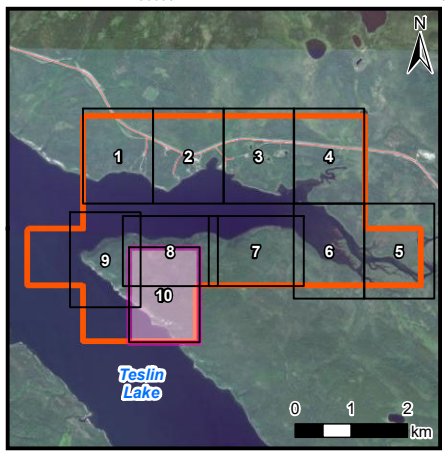
25mm

0





LEGEND

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687.40 m (690.33 m) Inundation Level with Wave Runup

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50 0 50
Metres
1:5,000

N

wsp

September 2024

Figure 6.5-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
0