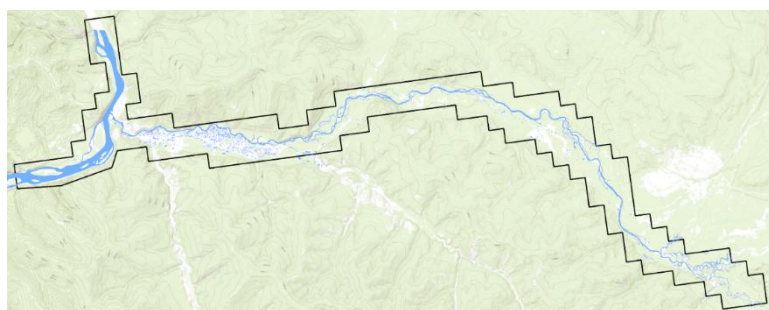


Dawson City & Klondike Valley flood hazard mapping

What are flood maps and why make them? Flood maps show an area that may be covered by water or show where the water reached during a past flood event. They are prepared by engineers. These maps describe the level of flood hazard in different areas of a community.

How will the maps be used? The information produced in this work can be used in the design of mitigation measures, emergency preparation and community development planning.

Final maps will be publicly available.



Area of Interest (outlined in black): includes 16 km of the Yukon River and 60 km of the Klondike River, based on input from the Government of Yukon and Tr'ondëk Hwëch'in.

Mandate & funding. The Government of Yukon is developing flood maps for communities at risk to support resilience in the face of climate change. Natural Resources Canada is financially supporting this work through the Flood Hazard Identification and Mapping Program.

Study details

Project scoping began in spring 2023. The Government of Yukon hired Stantec to complete the study, with input from the community, Tr'ondëk Hwëch'in and the City of Dawson.

Below is the timeline for the study:

- **Spring 2024:** start of consultant contract, site visit, review of previous work.
- **Summer 2024:** shoreline and bathymetric (river bottom) surveying, highwater mark surveying.
- **Fall 2024 - Summer 2025:** data analysis, modelling and mapping.
- **Fall 2025:** open house and online engagement on draft maps, preparing final maps.
- **Spring 2026:** Release of final maps and report.

Community involvement

Community members and staff from the City of Dawson and Tr'ondëk Hwëch'in (TH) Government have been involved in the study at various stages:

- TH provided input on the boundaries of areas to be mapped.
- Local and Indigenous Knowledge Holders described their experiences with past and recent flooding – this input informed Stantec's flood history and highwater mark documentation.
- Klondike H2O supported the flood documentation and field surveys.
- Community member input on the draft maps validated the results.

FOR MORE INFORMATION:

floodmapping@yukon.ca / floods.service.yukon.ca

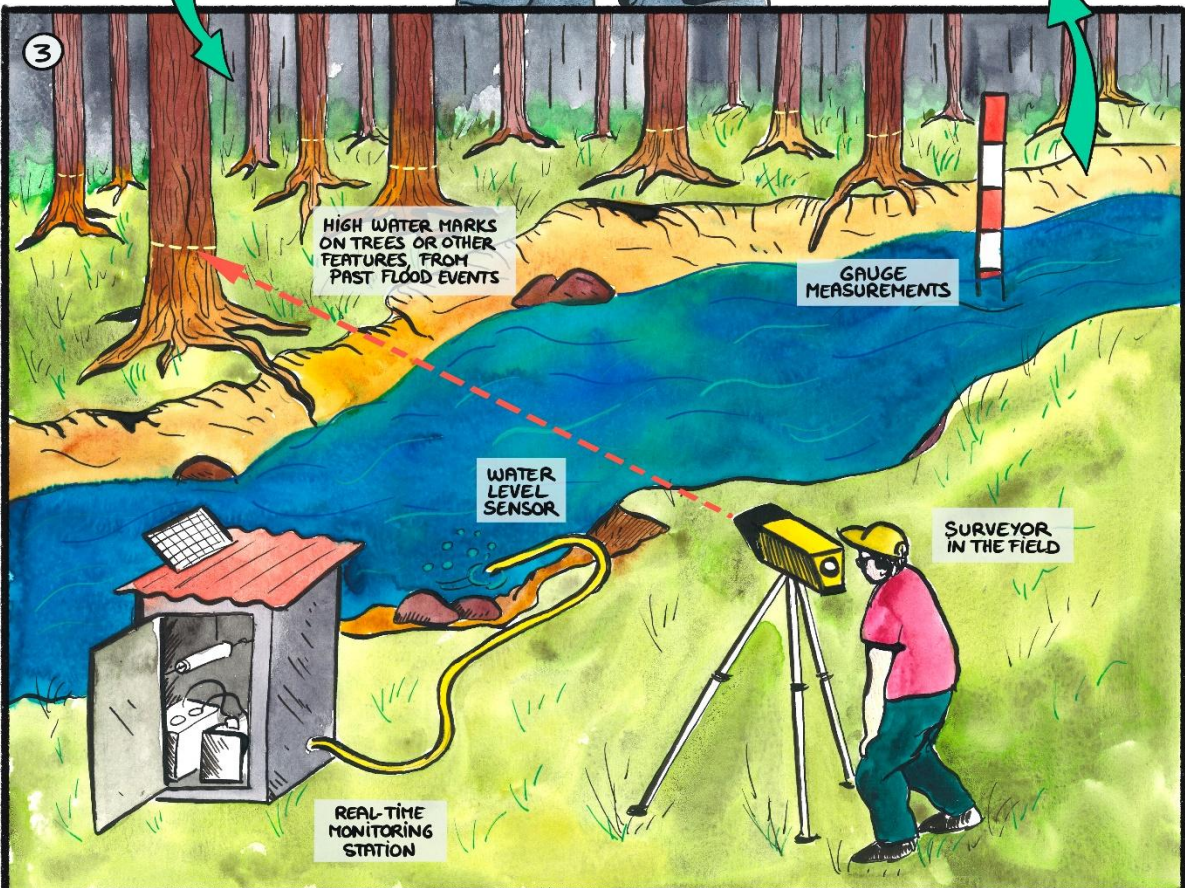
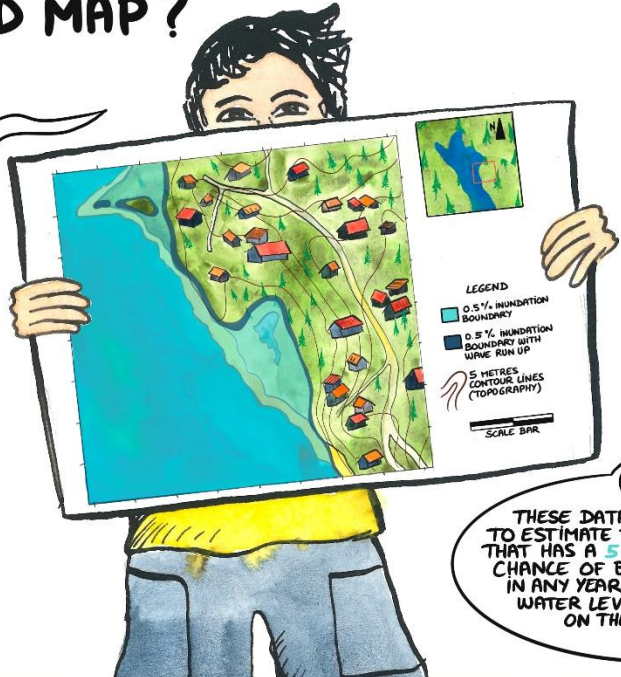


WHAT IS A FLOOD MAP ?

1
A FLOOD MAP SHOWS AN AREA AROUND A BODY OF WATER THAT WOULD BE COVERED BY WATER, BASED ON A CERTAIN RIVER FLOW OR LAKE SURFACE LEVEL.

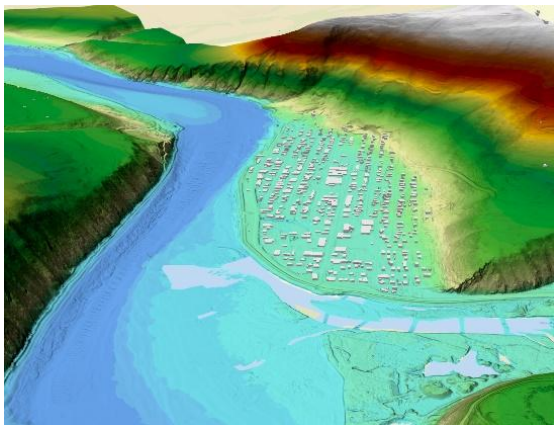
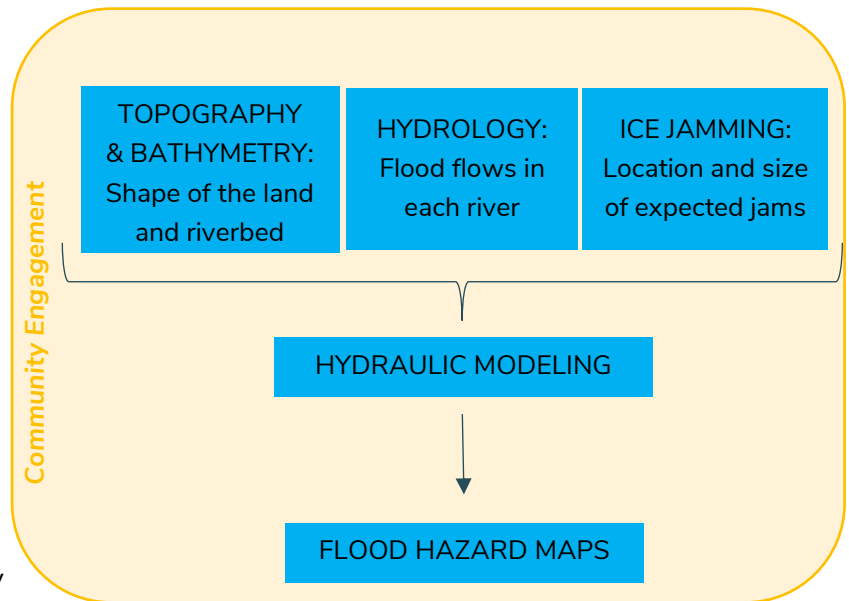
2
PAST WATER LEVELS ARE MEASURED USING:

4
THESE DATA ARE ANALYZED TO ESTIMATE THE WATER LEVEL THAT HAS A 5%, 1%, 0.5%, ETC. CHANCE OF BEING REACHED IN ANY YEAR. THIS ESTIMATED WATER LEVEL IS THEN SHOWN ON THE MAP.



The mapping process

To make a flood map, topographic and bathymetric data (shape of the land and riverbed) are combined with hydrology data (flows in the river) and ice jams (where applicable) in hydraulic modelling. The hydraulic modelling produces estimates of water levels and inundation extents for different river flows and ice jam scenarios. Those water levels and inundation extents are illustrated on the flood maps. Engagement with the community is crucial throughout the study to produce well-informed flood maps.



Integrated bathymetry & topography through Dawson City.

Topography and bathymetry

Elevation data for the topography (areas above water) in the study area was obtained in 2019 (Yukon River) and 2024 (Klondike River). Bathymetry (areas below water) was surveyed in 2024. The bathymetry surveys consisted of continuous bathymetry survey in select areas and cross-sections throughout the study area.

The surveyed bathymetry and cross-sections were integrated with the elevation data, providing the terrain input for the hydraulic modelling.

Hydrology

Statistical analysis was completed to estimate the magnitude of flood events on both the Yukon River and the Klondike River using river flow and level data from Water Survey of Canada stations in the area. Flooding can happen from both breakup ice jams and open water (ice-free) conditions in the study area. Using this information, we calculated how likely certain river flow levels are to happen each year during two times of the year: the breakup period (late April to early May) and the open water period (late May to October). These are called “annual exceedance probability” (AEP) flows. An AEP tells us the chance that a certain flow or water level will be reached or passed in any given year.

FOR MORE INFORMATION:

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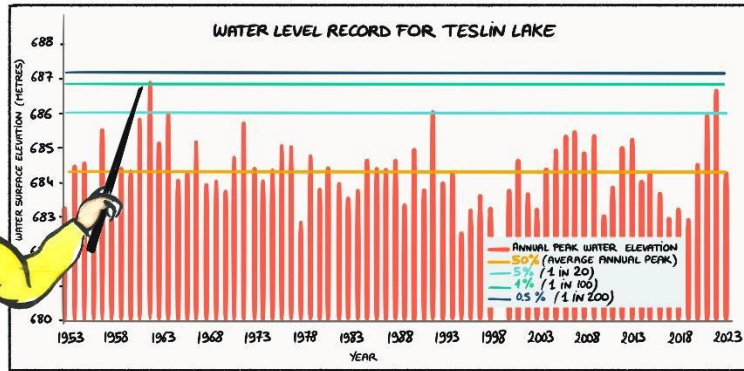


UNDERSTANDING FLOOD PROBABILITIES

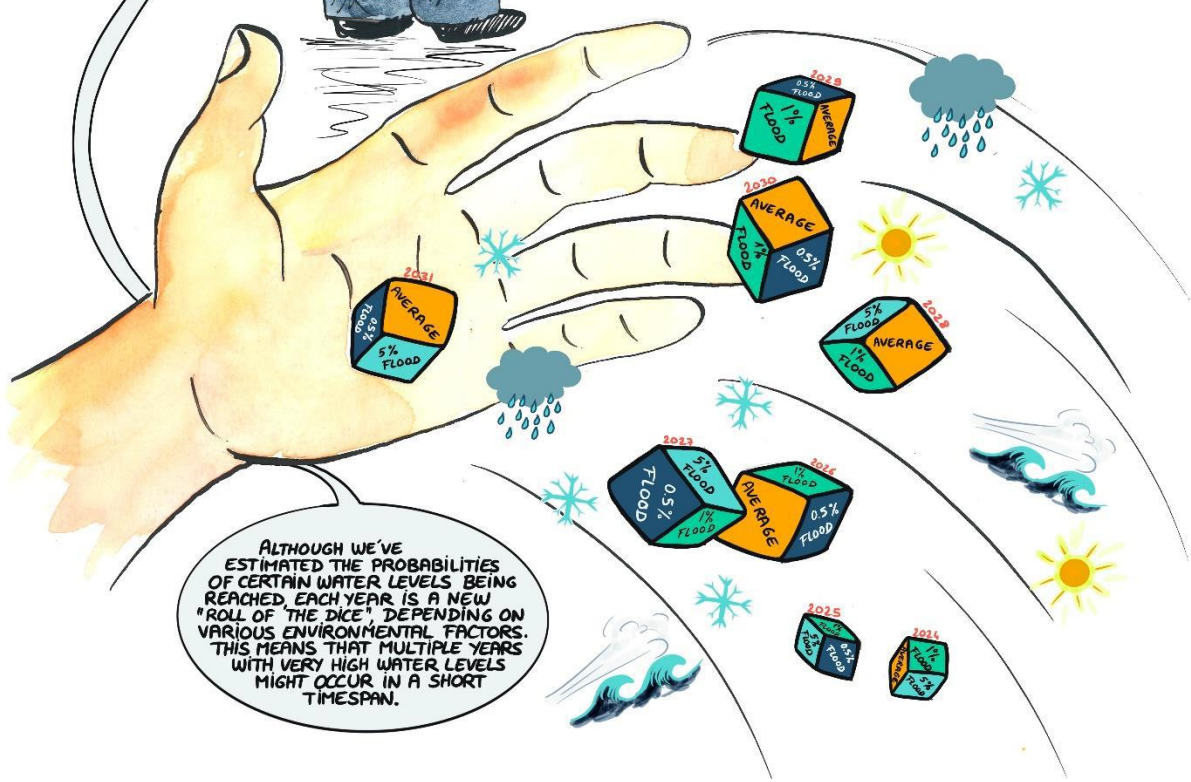
THE LIKELIHOOD OF THE WATER REACHING OR EXCEEDING A CERTAIN LEVEL IN ANY YEAR CAN BE DESCRIBED AS A PERCENT PROBABILITY. THESE PROBABILITIES ARE CALCULATED BASED ON RECORDS OF THE PEAK LEVEL REACHED IN PAST YEARS. LEARN MORE ABOUT FLOOD PROBABILITIES BELOW THROUGH THE EXAMPLE OF PAST FLOODING IN TESLIN.

SINCE 1953 (THE START OF OUR RECORD) TESLIN LAKE HAS ALREADY HAD TWO FLOOD EVENTS AROUND THE 1% (1 IN 100) LEVEL.

THE ANNUAL PEAK WATER LEVEL IN TESLIN LAKE VARIES A LOT. THE PEAK IN 1962 WAS ALMOST 4.5 METRES ABOVE THE PEAK IN 1992. SOME LAKES HAVE A SMALLER RANGE.



IN ANY FUTURE YEAR ANY ONE OF THESE PEAK LEVELS (OR ONE OUTSIDE OF THE OBSERVED RANGE) COULD OCCUR. HOWEVER, THE 5% (1 IN 20) EVENT IS MORE LIKELY TO OCCUR THAN THE 1% (1 IN 100) OR THE 0.5% (1 IN 200) EVENTS.



ALTHOUGH WE'VE ESTIMATED THE PROBABILITIES OF CERTAIN WATER LEVELS BEING REACHED, EACH YEAR IS A NEW "ROLL OF THE DICE" DEPENDING ON VARIOUS ENVIRONMENTAL FACTORS. THIS MEANS THAT MULTIPLE YEARS WITH VERY HIGH WATER LEVELS MIGHT OCCUR IN A SHORT TIMESPAN.

FOR MORE INFORMATION:

floodmapping@yukon.ca / floods.service.yukon.ca



Ice jamming

Flooding in Dawson City and the Klondike Valley from ice jamming is well documented – most recently on the Klondike River in 2023. This study reviewed ice jamming locations that have consistently occurred in the past and resulted in flooding, identifying the “dominant” ice jam locations for flood mapping purposes. These ice jams were simulated in hydraulic modelling software with the estimated breakup period flows.



Klondike River breakup ice jam (1986)

Hydraulic modelling

Hydraulic modelling software was used to simulate water levels during various flood events. The foundation of the model was the terrain (topography and bathymetry). The open water AEP flows were used to estimate open water flood extents. Breakup AEP flows were used in combination with the ice jams to estimate breakup jam flood extents. Hydraulic modelling was completed for the 5% AEP, 1% AEP, 0.5% AEP, and 0.5% AEP + climate change scenarios.

Flood hazard maps

For each flood event of interest, the breakup jam and open water flooding extents were mapped together throughout the study area. As a result, the maps show the overall flood extent associated with a given probability, whether that flooding is caused by ice jamming or open water floods.

The flood maps are available online as layers on the Government of Yukon’s Flood Hub site

<https://floods.service.yukon.ca/pages/final-flood-maps>



Composite flood map for the 0.5% AEP

How is flooding changing over time?

The project looked at changes to land cover – including changes to vegetation type and forest fires – and determined that it was unlikely that these changes would increase flood flows in the study area.

Climate change effects in the catchments (warmer temperatures, increased precipitation) are anticipated to increase flood flows between now and 2100. An additional set of AEP flows were modelled to account for potential future climate conditions. The climate change scenario considered a 30% increase to the Yukon River flows and a 40% increase to the Klondike River flows. These increases were based on a review of the hydrologic patterns of each river, the projected changes to temperature, precipitation and snowpack, and approaches to accounting for climate change used in other jurisdictions.

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