Old Crow flood hazard mapping

Areas of interest to be mapped
(outlined in blue) – these areas were identified with input from Government of Yukon departments and Vuntut Gwitchin First Nation.

What are flood maps and why are they useful?

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

The information produced through flood mapping studies can be used in the assessment of flood risks, design of mitigation measures, emergency preparation, and community development planning. Final flood maps are publicly available for use by community members and all levels of government.

Mandate & funding

Mapping for communities at risk of flooding was established as an action in *Our Clean Future: A Yukon strategy for climate change, energy and a green economy*. Natural Resources Canada is supporting this work through the *Flood Hazard Identification and Mapping Program*.

Study timeline

Planning for flood mapping in Old Crow began with study scoping in June 2023. The Government of Yukon hired Northwest Hydraulic Consultants Ltd. (NHC) to complete the study, with input from the community of Old Crow and the Vuntut Gwitchin First Nation.

Below is the timeline for the study:

- **April 2024:** start of consultant contract
- **June 2024:** site visit, bathymetric and topographic surveys, high water mark surveys
- **Summer 2024:** hydrologic, geomorphic and river ice analysis
- **Fall-Winter 2024**: modelling and mapping
- **February 2025:** engagement on draft maps.
- **May 2025:** final maps and reporting completed and shared with the public

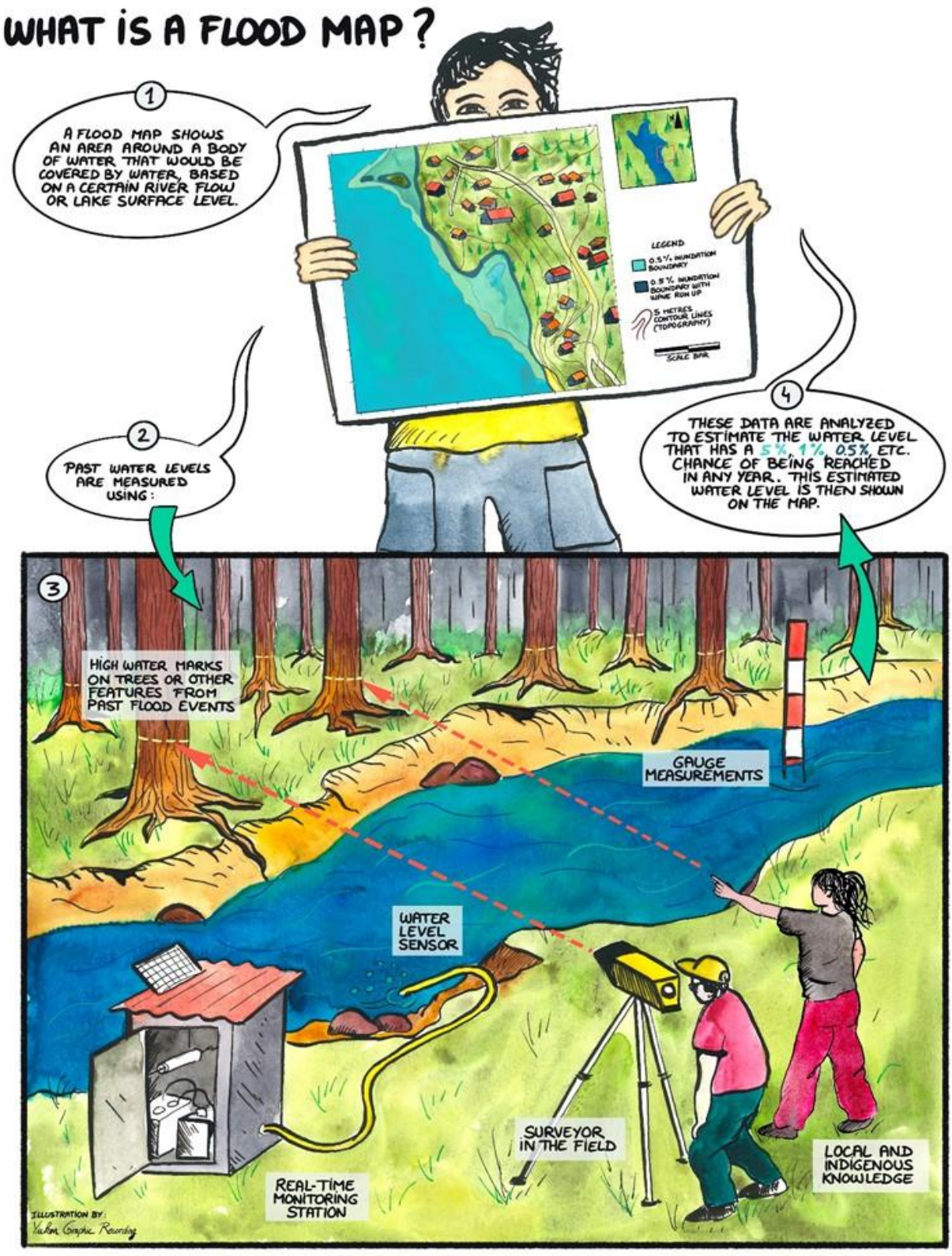
Community involvement

Community members and Vuntut Gwitchin First Nation (VGFN) were involved in the study at various stages:

- VGFN provided input on the boundaries of areas to be mapped.
- Indigenous Knowledge holders described their experiences with past and recent flooding – this input informed NHC's flood history and high-water mark documentation.
- Community members and VGFN staff provided comments on the draft maps to validate the results and inform revisions for the final maps.

FOR MORE INFORMATION:
floodmapping@yukon.ca

WHAT IS A FLOOD MAP?



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Study methods

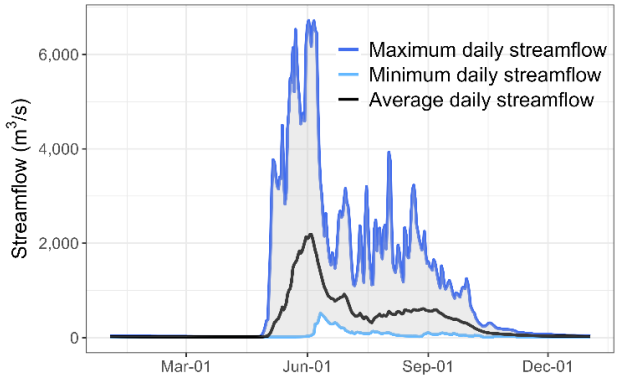
Site visits & field surveys

Representatives from the Government of Yukon, NHC, Underhill Geomatics and Kermode Consulting visited Old Crow in June 2024. This visit provided the opportunity for the project team to become familiar with the study area. The project team documented areas that were previously flooded and gathered information on high-water marks.

Elevation data was gathered using aerial LiDAR in September 2019. In June 2024, Underhill Geomatics conducted topographic surveys and measured high-water marks. Riverbed surveys were also carried out by boat in parts of the Old Crow and Porcupine Rivers.

Water Survey of Canada station in Old Crow

Hydrograph for Porcupine River at Old Crow



Hydrologic assessment

An analysis of past floods in open water and ice jam conditions was done to identify the most likely cause of flooding. Statistical methods were used to estimate the size of extreme flood events using data from the Water Survey of Canada for both the Old Crow and Porcupine Rivers.

Geomorphic assessment

A basic study of the land and water shape was done. This looked at past maps of riverbanks and studied how the rivers move and carry sediment. The goal was to find areas along the riverbank that are at risk of eroding. The study also identified important processes and possible dangers, and considered how these might change in the future due to climate and environmental factors.

Possible meander cutoff location upstream of Old Crow on the Porcupine River

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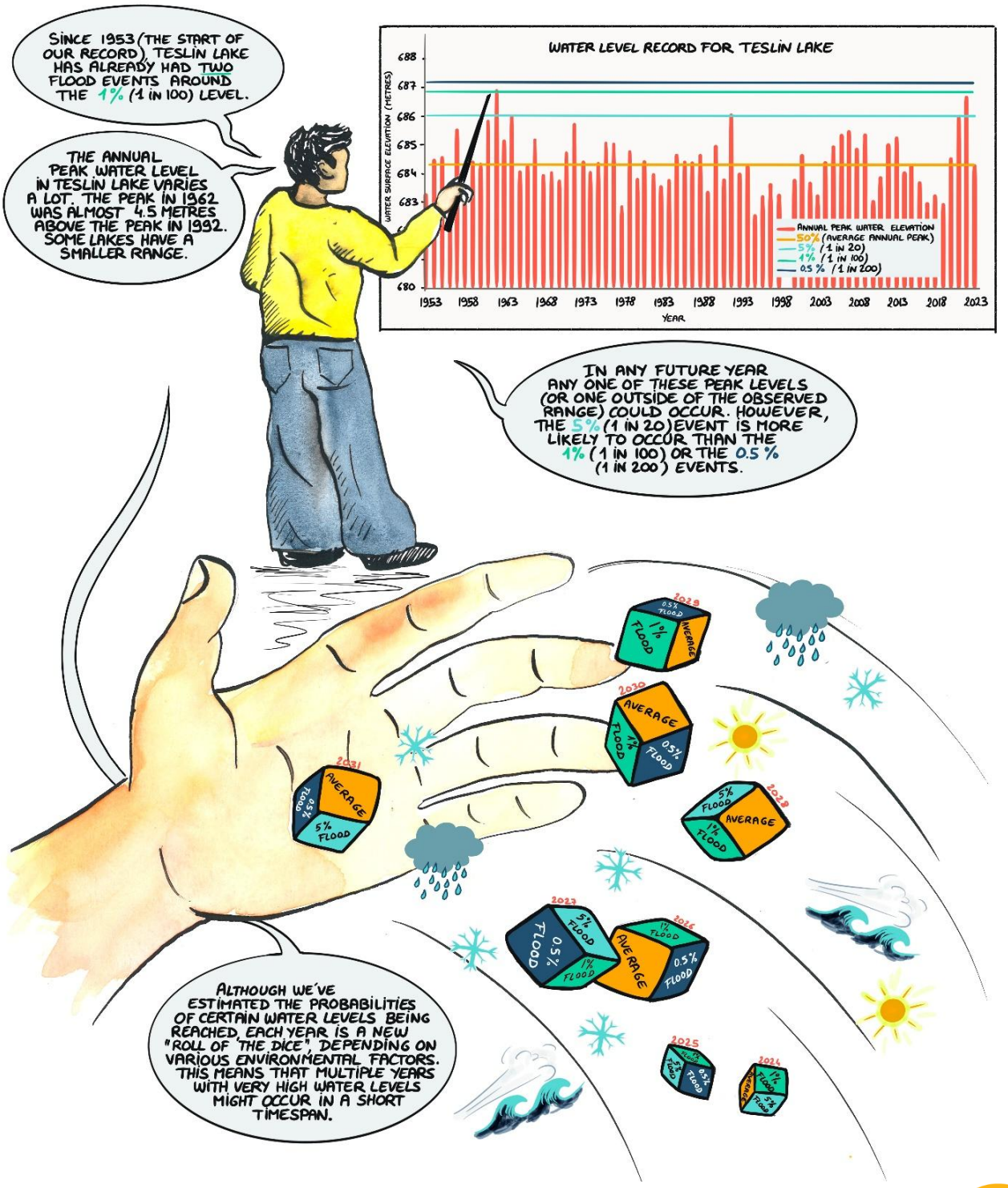
UNDERSTANDING FLOOD PROBABILITIES

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.



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Flooding processes

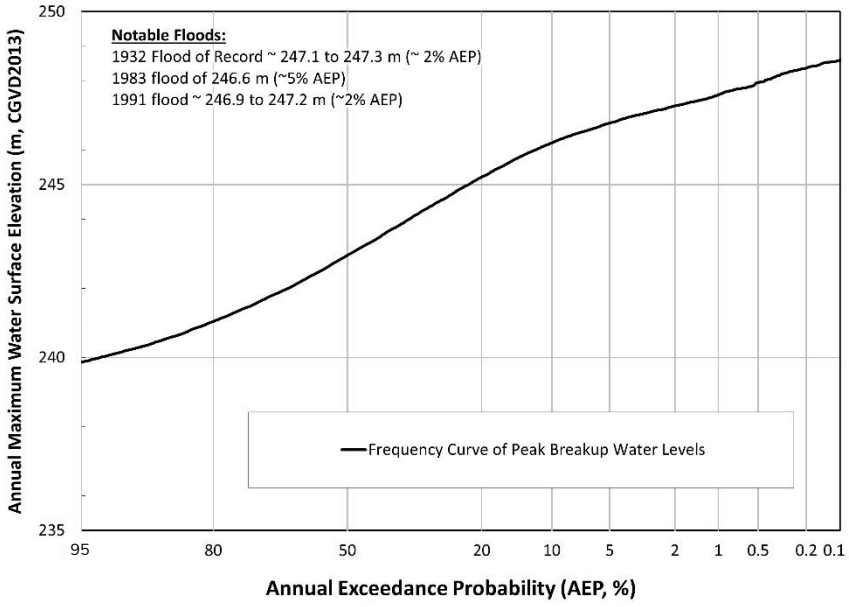
Ice pushed up onto the banks of the Porcupine River during breakup

The most significant flood events in Old Crow have been caused by ice jams during river ice breakup. Open water flooding on the Porcupine River at Old Crow has been limited. Ice on the Porcupine River can break up due to thermal factors (like warmer air or water temperatures) or mechanical factors (like rising water levels or flow). Mechanical factors usually cause the ice to break up faster, which increases the risk of severe ice jam flooding.

Hydraulic modelling & estimation of flood levels

Hydraulic modeling was done to understand how water flows in the river and floodplain, providing an estimate of water levels during both normal and ice jam conditions. The model used survey and water flow data to recreate past floods and predict different flood situations. A method called Monte Carlo simulation was used to figure out the highest possible water levels from different ice cover scenarios. To estimate the size of rare, extreme floods caused by ice cover in Old Crow, statistical analysis was done on the model results.

Breakup levels and probabilities for the Porcupine River at Old Crow



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Climate change considerations

A review of climate change data and research was conducted to understand how future climate and land-cover changes could impact flooding in Old Crow. The factors that cause flooding in Old Crow are complex and the science on how future flooding in northern rivers may change is still unclear. Changes in future temperatures and precipitation could affect how river ice breaks up, but it's uncertain whether this will lead to higher or lower flood levels. However, the following combination of events could result in higher flood levels:

- More mid-winter breakups, followed by ice re-freezing, could increase the amount of ice produced in the watershed.
- Higher winter snow accumulation might make the ice cover stronger and more resistant to breakup, while also increasing the amount of water flowing in the spring.
- Larger temperature differences between the headwaters and outlet areas could lead to higher spring runoff that encounters resistant ice in the cooler areas.
- Warming temperatures may affect the permafrost, which could change how water runs off or soaks into the ground in different ways.

The Porcupine River downstream of Old Crow

Flood mapping

Flood maps were created by overlaying the estimated flood levels onto a digital elevation model of the study area. The flood boundary shows an estimate of where flooding could happen for the following flood scenarios:

- 5% AEP (20-year return period)
- 1% AEP (100-year return period)
- 0.5% AEP (200-year return period)

Draft flood maps were published in February 2025. Input from community members and VGFN staff helped validate the flood extents and suggested improvements to how information is presented. Final flood maps were published in May 2025. The maps, technical report and engagement summary are available on the Government of Yukon's Flood Hub: https://floods.service.yukon.ca/

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