1 KEY MESSAGES

1.1 New comprehensive floodplain mapping has been completed for Okanagan River and the Okanagan's valley-bottom (mainstem) lakes.

- The floodplain mapping covers the length of the Okanagan River and all mainstem lakes.
- Thanks to senior government funding, the updated floodplain mapping is state-of-the-art.
- The maps include the future impacts of climate change.
- Steps taken in this project:
    - Created a model of the land surface, river beds, and lake shorelines based on topographic data (using Light Detection and Ranging, or LiDAR).
    - Analyzed long term weather patterns (climate), including historical and future expectations, and used this to model the water cycle (or hydrology) of the Okanagan Valley. This includes changes in dam operations to manage higher future flows.
    - Simulated flow through the Okanagan River and its floodplain, identifying the potential for inundation in the floodplain area.
    - The model's accuracy was verified using past flood events.
    - A wave analysis was completed for the lakes to review expected wave height and wave runup on the shore (distance waves reach from the shore).
    - The above information was used to create floodplain maps showing the 20-year, 100-year, 200-year and 500-year events.
- While this modelling and mapping greatly improves the understanding of flood risk along Okanagan River and mainstem lakes, there are several limitations as discussed in the project report.
- This project includes updated maps, a detailed project report, and an interactive public website at www.OkanaganFloodStory.ca. The website introduces the public to the project and flood mapping through text and an explanatory video, and includes the updated floodplain maps, the history of flooding in the Okanagan valley, and numerous other resources about how to reduce flood risk. While the information provides a wealth of technical and non-technical information, it is not a replacement for the technical report.

1.1.1 Updated floodplain maps are the first step in reducing flood risk.

Understanding flood risk is a step towards the goals of the United Nations' Sendai Framework. This framework for disaster risk reduction, signed by 187 nations including Canada in Sendai, Japan in 2015, was adopted by the B.C. government in October 2018. The Sendai Framework identifies four priorities to prevent new disaster risk and reduce existing disaster risks, one of which is 'understanding disaster risk'. This project furthers the understanding of disaster risk as it pertains to flooding in the Okanagan and helps point the way towards building safer, more resilient communities.

1.2 This study shows that the potential for flooding in the Okanagan is increasing.

- We saw record flood levels throughout the Okanagan in 2017, followed by high flows in 2018. While flooding is not new to the Okanagan, these events prompted us to examine our understanding of flooding in the valley.
- The updated floodplain mapping shows a larger floodplain due to updated information and modelling techniques, and the inclusion of expected climate change impacts.
- The design floods recommended through this project are different from previous mapping. The 200-year Average Recurrence Interval (ARI) event was used to define the recommended design flow for Okanagan River and design still-water level for the mainstem lakes with two exceptions. As is typical in B.C., where the flood-of-record exceeds the 200-year ARI, the flood of record is used as the design flood. For Okanagan and Kalamalka lakes, the 2017 flood was exceeded the 200-year ARI, so the flood of record (2017) was used as the design level. For both types of design flood, climate change was included to the mid-century timeframe. At Osoyoos Lake, 200-year design flood is higher than the 1894 flood.
- The likelihood of flooding is expected to increase with climate change impacts, and by understanding how flooding may change, we can take action to reduce our risk.
- Through understanding the hazards they face, many communities in B.C. and around the world have developed and implemented strategies to enhance resilience to hazards such as flooding and fires.

1.3 Sharing the results of this project helps raise awareness about where the potential for flooding exists.

- Governments at all levels are moving towards open-data policies, which are considered a best practice for our organizations.
- Privacy concerns are not taken lightly and while this may be a shift for some organizations, not sharing this information puts people and property at unnecessary risk.
- In view of public safety, we are committed to sharing the most up-to-date information on potential hazards, including flooding. This empowers the public and, through community action, removes barriers to reducing flood risk.
- Progress in reducing flood risk is fostered by increasing awareness of flooding and prioritizing flood mitigation.

1.4 We must work together to develop flood resilient communities. It is all of our responsibility.

- This project is the first step in laying the groundwork for risk reduction plans and strategies.
- The floodplain mapping spans the Okanagan valley, providing consistent understanding and high-quality analysis across the valley.
- Developing flood-resilient communities is an opportunity for cooperation with our neighbours – both next-door neighbours, and neighbouring local governments. This project makes possible a valley-wide approach to flood risk reduction and collaboration across jurisdictional boundaries.

- The information developed here supports long-term planning and solutions to flooding in our communities. This project is a step towards flood risk reduction strategies such as: community planning and land use, flood-proof construction techniques, enhancement of habitat, recreation and cultural values through shoreline naturalization, structural improvements to dikes, and enlargement of water crossings such as bridges and culverts.
- The people of the Okanagan valley are closely connected to water, and floods are one of those connections. We can work together to balance valley-wide priorities to shape our relationship with flooding.

2 FAQS

2.1 General Questions About the Project & Flooding

Question: Who paid for this project and who completed the work?

Answer: This project was made possible with funding for LiDAR (Light Detection and Ranging) from Emergency Management BC. Additional funding for flood mapping was provided by Emergency Management BC, Public Safety Canada under the National Disaster Mitigation Program, and from the Province of B.C. administered by the Union of B.C. Municipalities under the Community Emergency Preparedness Fund. The project was undertaken by Northwest Hydraulic Consultants Ltd. (NHC). The project was managed by the Okanagan Basin Water Board (OBWB) and supported by the Regional District of North Okanagan, Regional District of Central Okanagan, Regional District of Okanagan-Similkameen and the Government of B.C.. Numerous local and First Nations governments also supported the project: Okanagan Nation Alliance, City of Armstrong, Township of Spallumcheen, City of Vernon, District of Coldstream, District of Lake Country, City of Kelowna, City of West Kelowna, District of Peachland, District of Summerland, City of Penticton, Town of Oliver, Town of Osoyoos, Splatsin First Nation, Okanagan Indian Band, Westbank First Nation, Penticton Indian Band and Osoyoos Indian Band.

Question: What are local governments doing to reduce flood risk?

Answer: This project is a key piece in understanding potential flood hazard and planning for flood risk reduction for local governments in the Okanagan valley. Many local governments may use this project to develop a flood risk reduction plan, or to update existing bylaw, zoning and official community plans. Many local governments have completed or are planning flood mitigation projects such as creek crossing enhancements or shoreline infrastructure. Contact your local government for more information.

Next steps after this project for local governments include:

- Assessment of existing flood risk reduction systems and infrastructure
- A risk assessment to identify priorities for mitigation
- Development and implementation of a comprehensive mitigation plan including both non-structural mitigations such as land use planning and structural mitigation measures such as dike improvements

Question: Who is responsible for regulations related to the floodplain?

Answer: Regulations about land use or construction within the floodplain are the responsibility of local governments. Check out the 'Responsibility' tab on this website for more information and contact your local government if you have questions.

Question: Can I get insurance for flooding from lakes, rivers and creeks?

Answer: Possibly. Contact your insurance provider for details. Traditionally, overland flood insurance has not been available in Canada, however this is changing with the increased availability of improved information on potential flooding. See page 24 of the **Building Climate Resilience in the Okanagan** brochure for more information. Information about how flood insurance relates to disaster financial assistance is also provided on the 'Responsibility' tab of this website, and at the following link: **Provincial Government Explanation**, **Disaster Financial Assistance**.

Question: What can be done to mitigate flooding at a community level?

Answer: Communities can engage in mitigation measures such as land-use management, flood-proofing assets, flood prediction and warning, flood emergency response and recovery plans, river naturalization projects, flood barriers, flood flow reduction, erosion protection, and monitoring and maintenance of infrastructure.

Question: Who can I contact if I have questions?

Answer: You can contact your local government for any questions related to flood regulations, local hazards, or mitigation in your area. If you have any questions about this website, please contact the Okanagan Basin Water Board-Okanagan WaterWise at OkWaterWise@OBWB.ca.

Question: Where can I get information about forecasted floods?

Answer: If you want to know if a flood is forecasted in your area, check the **B.C. River Forecast Centre**. For information about Emergency Alerts and Orders, you can check the map from the provincial government **here** or text information **here**. All of this information, as well as contact details for local Emergency Operations Centres, is also found on the 'Response' tab of this website.

Question: What should I do to prepare for a flood?

Answer: Long before a flood is forecasted, you can prepare by reducing your flood risk through measures suggested on the 'Reducing Risk' tab of this website.

For assistance in the event of an immediate threat to safety, please call 9-1-1. If a flood is forecasted, for enquiries about emergency conditions and resources related to flooding, contact your local Emergency Operation Centre. The 'How to Prepare' tab of this website includes more information about what you can do before a flood.

Question: If I live in a floodplain, what can I do to reduce my risk?

Answer: There are several strategies for property flood risk reduction identified on the 'Reducing Risk' tab of this website. Strategies range from temporary measures to implement in advance of a flood, to long-term risk reduction strategies that should be considered prior to new construction or as part of building renovations.

Question: How do dams and their operation affect flooding?

Answer: Dams help reduce flooding in the valley. They 'attenuate' (store and slowly release) river flows by providing storage during large inflows and reducing the amount of water which flows downstream. The dams all have a maximum water level they can reach before they must release flows and convey water downstream without storage. When inflows exceed the attenuation that dams can provide, flooding may occur.

Question: Are lakefront properties being sacrificed to protect downstream properties?

Answer: Water management along the Okanagan valley-bottom (mainstem) lakes balances the needs of many stakeholders including lakefront property owners and downstream property owners. Dam operations (storage and releases) in the Okanagan are managed by a set of criteria which have been developed to balance First Nations, fishery, agricultural, and recreational interests.

2.2 Using the New Flood Maps

Question: How are these maps different than previous maps?

Answer: These new maps differ from previous ones due to current mapping guidelines modern science and engineering approaches, and inclusion of climate change. Please refer to the project report for details.

Question: How does the new floodplain mapping compare to areas flooded in the 2017 flood?

Answer: The 2017 freshet resulted in historic peak lake levels in Kalamalka and Okanagan lakes which were higher than the old floodplain mapping 200-year average recurrence interval (ARI). The lakes were at their highest level since the lake's dams were built.

Question: How is climate change predicted to impact flooding?

Answer: The "Changing Climate" tab on the *Okanagan Flood Story* website provides information about expected changes to flooding due to climate change. The project report also provides technical chapters on climate and the valley's water cycle (hydrology), and impacts on flooding. These changes include:

- Freshet may be a month or more earlier;
- The highest water levels may no longer be due to snow melt, but due to heavy rainstorms; and

- The ability to forecast water flows will decrease. This means that the ability to regulate water flow, such as dam operations, will become more difficult and perhaps less effective.

Question: How do land use changes like logging, further development or forest fires impact flooding?

Answer: Changes to land use can affect the speed of runoff and the amount of runoff. These changes can result in less water being absorbed by the soil and an increase in the potential for flooding. Development that increases the impermeable surface of an area (e.g. roads, paved parking lots, houses) also decreases the amount of water that can be absorbed by the soil and can increase flooding potential.

Question: What is the difference between the different map layers (Flood Construction Level (FCL), extents, depths, and hazards)?

Answer: The different map layers all represent a different modelling scenario or different modelling output information. For more information, watch the flood mapping video on the "Flood Maps" page of this website, or read more details in the project report.

Question: Why is flooding shown behind (on the land-side of) the dikes?

Answer: Flooding is identified behind dikes because, while dikes reduce the risk of flooding, they do not eliminate risk since there could be dike failure, water seepage through dikes, or ponding behind dikes. Areas behind dikes are still within the floodplain and are identified as such in this mapping.

Question: How do these maps reflect water use and flow regulation by dams?

Answer: These maps incorporate Okanagan Lake Regulation System (OLRS) operations using current guidelines and also preliminary modifications to the guidelines to manage future expectation of high flows.

2.2.1 My property is in the floodway. Now what?

Question: My property is in the new floodplain. What does that mean?

Answer: It means that there is a chance your property could flood. Using the information provided, you can review the likelihood of flooding, the depth of flooding possible and infrastructure, such as dikes, that may reduce the flood's impact. You can contact your local government about their flood management plans. If you're planning renovations or other changes on your property and want to reduce flood risk, consider options like flood proofing and a site-specific engineering analysis to assess flood hazard and mitigation options.

Question: I want to develop in an area identified on one of the maps as within a floodplain. Is that okay?

Answer: Are you prepared to accept potential flood risk on your property? If so, you should check with your local government about any floodplain management plans they have or on-going

mitigation projects. Many local governments in the Okanagan have floodplain management plans and guidelines for developments. Depending on the site, options like flood-proofing or raising buildings may be feasible. A site-specific engineering assessment should be considered in your development plans.

Question: My property is in the mapped floodplain but I have never seen flooding. Why?

Answer: The mapped floodplain identifies areas where flooding may occur, which means there's a possibility of flooding on your property. The required conditions may not have occurred to flood your property in the past, however they could in the future.

Question: My property is in the new floodplain. How does this affect my property values?

Answer: Many towns in B.C. are built on floodplains near lakes, rivers and oceans. Potential flooding is a hazard on many properties across the province and an accepted risk for many homeowners. You may want to talk to your real estate agent about property value considerations related to the potential flood hazard, and what you can do to reduce flood risk and enhance your property value.

Question: My property is in the new floodplain. How does this affect my insurance?

Answer: You should contact your insurance provider for details related to your insurance policy. Overland flood insurance is a relatively new product in Canada, and is different from the typical home insurance coverage related to flooding from sewer or sump pump backup (which does not cover overland flooding). Updated flood mapping can help insurance companies assess risks when offering overland flood insurance and may lead to increased availability of flood insurance. See page 24 of the **Building Climate Resilience in the Okanagan** guidebook for more information. Additional information about how flood insurance relates to disaster financial assistance is provided on the "Responsibility" tab of this website and at the following link: **Provincial Government Explanation**, **Disaster Financial Assistance**.

2.3 Understanding Flood Lingo

Question: What is freeboard?

Answer: A 0.6 metre vertical distance added to represent local variations in water level and uncertainty in estimates from the science and engineering analysis.

Question: What does 'recommended design flood' mean and how should it be used?

Answer: 'Recommended design flood' is the flood level used for planning, construction and development in a floodplain. This design flood has a likelihood that matches society's tolerance for risk.

Question: How was the 'recommended design flood' selected?

Answer: In B.C., 'design floods' are generally adopted from either the 1-in-200 year Average Recurrence Interval (ARI) flood or the highest recorded flood. For Okanagan and Kalamalka lakes, the

2017 flood is the highest recorded flood and, with adjustment for climate change, is used as the recommended design event. For other Okanagan water bodies, the 1-in-200 year flood with climate change was used.

Question: What is the likelihood of the 'recommended design flood' happening?

> **Answer:** The likelihood of the 'recommended design flood' is based on the event used to develop it. For areas where the 'recommended design flood' is the 1-in-200 year flood, the likelihood of that flood is approximately 0.5% each year. For areas where the 'recommended design flood' is the 2017 flood, the likelihood of that flood is 0.2%. Generally, for all areas, the likelihood of flooding is increasing due to climate change. These likelihoods are expected to increase over the next 50-80 years.

Question: How do you use the Flood Construction Level (FCL) zones?

Answer: FCL zones are used by local governments and property owners to regulate, plan, and design communities to increase flood resilience.

Question: Is flooding in the Okanagan a recent phenomenon?

Answer: See the 'History' tab on this website for a timeline of some past flooding events and mitigation projects in the valley. The Okanagan valley has experienced flooding numerous times in the past, which is part of the reason for the dikes, dams, and straightened channels we see today. Flood risk reduction efforts have been ongoing in the area for nearly 100 years and will continue.

Question: What does a shift in vertical datum mean?

Answer: A shift in the vertical datum means that the way elevations are measured and recorded have changed, but it does not mean that the physical elevations have changed. The vertical datum used across Canada was changed from Canadian Geodetic Vertical Datum 1928 (CGVD28) to Canadian Geodetic Vertical Datum 2013 (CGVD2013) to improve accuracy and facilitate GPS measurements. An adjustment or shift can be applied to elevations in the old datum to convert them to the new datum. This shift is not constant throughout the Okanagan valley. For example, the difference between the older datum (CVD28) and the newer datum (CGVD2013) at Kelowna General Hospital is 24 cm, and in Oliver at the Highway 97 bridge, the difference between the datums is 29cm.

Flood Construction Levels (FCLs) and lake levels commonly referenced prior to this project used the old datum (CVD28). While the FCLs increased due to the new mapping, some of this increase is due to their reporting in a new datum. See the project report for more details and sample conversions.

Question: Is flooding from creeks included in this mapping?

Answer: Flooding from creeks is not included in the new floodplain maps. However, take a look at the 'Complementary Flood Maps' that are part of the 'Flood Maps' tab on this website for a few creek flood hazard assessments completed for tributaries to the Okanagan mainstem (valley-bottom lakes).

Several other studies are ongoing. You can also contact your local government for more information about local creek flooding studies that may have been undertaken in your area.

2.4 Let's Get Technical - Modelling Questions

Question: What model was used and how does it work?

Answer: The hydrology was modelled using the 'Raven hydrologic modelling framework.' Raven is an open-source platform that is under active development, with a focus on mathematically stable and computationally efficient integration of a wide variety of hydrologic model options. Raven is currently being used by multiple organizations within Canada for reservoir management and flood forecasting.

To simulate the flood conditions and calculate the flood profile, the River Analysis System software (HEC-RAS) developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center was used. For this project, a 1D-2D coupled unsteady flow model was used to determine the flood extents for the Okanagan Basin, with 1D used in the main channel and 2D for the floodplain areas behind the dikes.

Question: Why are there isolated areas mapped as if in the floodplain?

Answer: Low-lying areas that may not be visibly connected to the remainder of the floodplain are identified as within the floodplain using a filtering approach. The filtering was used to remove isolated areas smaller than 100 m^2. Holes in the inundation extent with areas less than 100 m^2 were also removed. Isolated areas larger than 100 m^2 were retained for mapping if they were within 40 metres of direct inundation or within 40 metres of other retained polygons. This is to account for high water tables and potential water movement through culverts and channels, and also seepage through permeable material such as soil, road beds, and railway beds.

Question: What determines the width of the wave effect polygons?

Answer: The width of the wave effect polygons depend on the slope of the shoreline. During the wave modelling, the 200-year lake level was used and a wave height boundary of 0.3 m was generated. The landward side of the wave effect polygon was created by offsetting from the 0.3m wave height boundary inland 40m. In areas where the landward slope is shallow, the inundation can go further inland than where there are steep slopes, and the associated wave effects can be further inland.

Question: Is flow control by the dams considered?

Answer: Yes, flow control from the dams is considered in the analysis. As described in the project report and based on guidelines, the Gates Open Scenario under normal operation was included in the development of the design event to represent the potential for upstream reservoir inoperability.

Question: How is climate change incorporated?

Answer: Potential climate change effects are incorporated into the hydrologic modelling as detailed in the project report. Large climate models with predicted changes to regional weather patterns were downscaled to the Okanagan basin. Many simulations of dam operations were run with inputs adjusted for climate changes to develop data for a frequency analysis.

Question: How accurate are these maps?

Answer: These maps and the underlying analysis are comprehensive and based on state of the art modelling and analysis, however they are subject to limitations as described in the project report. The maps meet all applicable professional standards and were developed based on provincial guidelines. The mapped recommended design flood includes freeboard – a 0.6 metre vertical distance added to represent local variations in water level and uncertainty in estimates from the science and engineering analysis. Site specific analysis is recommended to allow for refinement and application of modelling results prior to property specific applications.