



Syilx Okanagan Flood and Debris Flow Risk Assessment Map Book

Map Series 1 of 7: Flood and Debris Flow Hazards

31 December 2019



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Acknowledgement

The *Syilx* Okanagan Flood and Debris Flow Risk Assessment is made possible by the many *Syilx* Okanagan Nation members from across the territory who generously contributed their input, knowledge, and lived experience – all of which form the foundations of this Assessment. Special recognition is given to the *Syilx* Okanagan traditional knowledge keepers and Elders who led the watershed tours and were a guiding force in rooting the assessment in traditional *Syilx* Okanagan perspectives.

This Assessment is a testament to the power of collaboration and partnership between *Syilx* and non-*Syilx* organizations, including the project team at Ebbwater Consulting Inc. (Ebbwater), and exhibits a shared concern for how water is managed and recognized in the territory.

Support for this project came from Emergency Management British Columbia (EMBC) and Public Safety Canada (PSC) as part of the National Disaster Mitigation Program (NDMP), First Nation Adapt Program and the Real Estate Foundation of B.C. through successful applications submitted by the Okanagan Nation Alliance (ONA).

Okanagan Nation Alliance would like to acknowledge Ebbwater for the production of this Map Book, which was completed by Dickon Wells, M. Eng, with support from Silja Hund, Ph.D., Nikoletta Stamatatou, M.Sc., and Robert Larson, M.Sc. Qualitative input for the Map Book is owed to project participants, as well as Erica Crawford (SHIFT Collaborative) and Kelly Terbasket (indigenEYEZ) for leading the workshops. Cory McGregor, GIT and Derek Cronmiller, P.Geo (both of Palmer Environmental Consulting Group Ltd.) provided the information to quantitatively map debris flow hazard. The Map Book contains significant input from ONA team members Tessa Terbasket, Kathy Holland, and Skyeler Folks. The Map Book was reviewed by Tamsin Lyle, P.Eng of Ebbwater.

The team is grateful to *Syilx* Okanagan community staff who contributed to and supported the process; Colleen Marchand (OKIB), Brody Armstrong (PIB), Stephanie Paul (WFN), Jonathan Ford (WFN), Wendy Hawkes (LSIB), Trudy Peterson (LSIB), Mike Allison (USIB) and Robin Irwin (USIB). Finally, the team would like to thank the *Syilx* Okanagan Flood Adaptation Initiative Steering Committee members who will continue to work together and provide direction to co-build flood resilience in the region.

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Introduction

The ONA was a successful Stream 1 applicant to the National Disaster Mitigation Program (NDMP) to study flood and debris flow hazard risk in the Okanagan-Similkameen region. This project is the initial phase of a multi-year flood and debris flow adaptation initiative. This project's goal is to **understand the risk due to flood and debris flows within the project area, to support priority-setting of future work.**

This Map Book is one of four outputs that form the risk assessment component of this project (Figure 1). The Map Book may also be used as the main visual reference to the Synthesis and Recommendations report, for readers to obtain a summary understanding of the project. The Qualitative, Quantitative, and Basis of, studies contain more detailed information. The Map Book summarizes the spatial results following the methods described in the Qualitative and Quantitative studies.

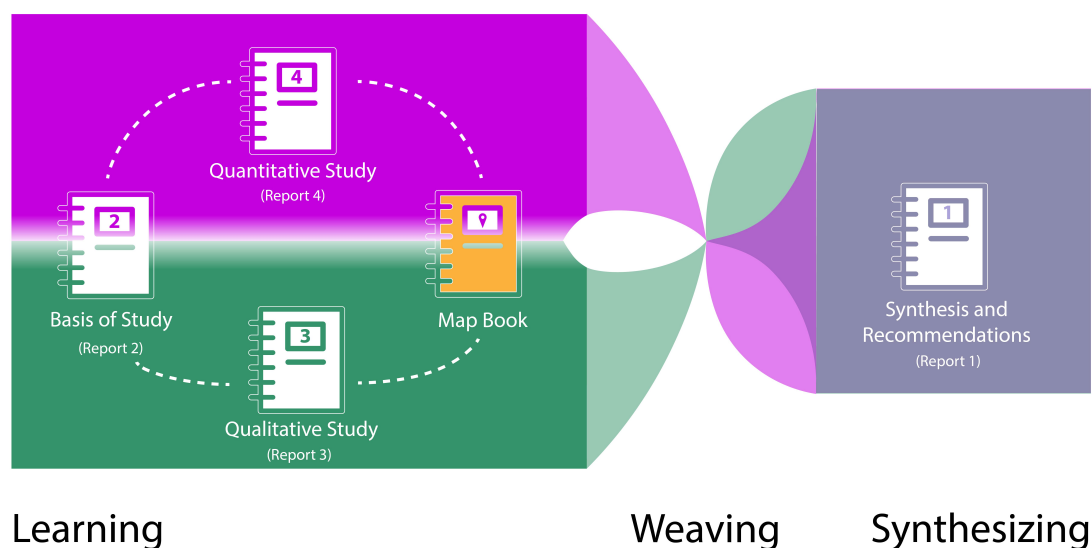


Figure 1: Project reporting diagram, with the Risk Assessment's four distinct outputs (i.e., Map Book, Basis of Study, and the complementary Qualitative and Quantitative studies).

Overview of Maps

Ebbwater assessed the impacts from both flood and debris flow in the Okanagan-Similkameen watersheds. This assessment was done quantitatively and qualitatively. This map series is one out of a series of 7 that together form the Map Book. In aggregate, the 7 series cover the 2 hazards assessed and 6 exposure indicators. The table below lists the 7 series, and highlights the series contained herein. The qualitative maps combine impacts from both flood and debris flow hazards. The quantitative maps show consequences from flood and debris flow hazards separately. In the quantitative maps, the consequences for flood hazard are shown for the moderate magnitude scenario only.

Series	Map Book Title	Information Shown
Series 1	Flood and Debris Flow Hazard	<ul style="list-style-type: none">• Debris Flow• Low, Moderate, and High Magnitude Flood
Series 2	Environment Indicator	<ul style="list-style-type: none">• Qualitative (Impacts)• Quantitative (Consequences)
Series 3	Culture Indicator	<ul style="list-style-type: none">• Qualitative (Impacts)• Quantitative (Consequences)
Series 4	Mortality Indicator	<ul style="list-style-type: none">• Quantitative (Consequences)
Series 5	Affected People Indicator	<ul style="list-style-type: none">• Qualitative (Impacts)• Quantitative (Consequences)
Series 6	Economy Indicator	<ul style="list-style-type: none">• Qualitative (Impacts)• Quantitative (Consequences)
Series 7	Disruption Indicator	<ul style="list-style-type: none">• Qualitative (Impacts)• Quantitative (Consequences)

Printing and Document Navigation

All maps are designed and scaled to be printed in 'ANSI D' format. Maps are linked and can be navigated through by clicking within the following:

- Index line items on page 3.
- Blue tiles, watersheds or text, located in the top right-hand corner of the maps, where present.
- Hyperlinked Map index on page 6.

Notes to User

1. The debris flow hazard layer was produced by Palmer Environmental Consulting Group Inc. and the flood hazard layers by Ebbwater Consulting Inc. The method used to produce the hazard layers is described in the Quantitative Study.

Quantitative Data Sources

1. Lakes and Watercourses, Roads, Dikes, and Reserves: BC Data Catalogue.
2. Dam Failure Consequence: BC Ministry of forests, lands and natural resource operations
3. Building Footprints: Regional districts, municipalities, WFN and hand digitized using Bing Satellite Imagery.
4. *Sylix* Place Names: Okanagan Nation Alliance.
5. Base Layer: OpenStreetMap data – openstreetmap.org (© OpenStreetMap contributors; cartography licence CC BY-SA) and hill shade created using CDEM and USGM GMTED2010.

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Hazard Maps

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Sylix Okanagan Flood and Debris Flow Risk Assessment

Map Book

Map Series 1 of 7: Flood and Debris Flow Hazard

Hazard Maps



Project Area Map



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THOUGHTFUL FLOOD MANAGEMENT

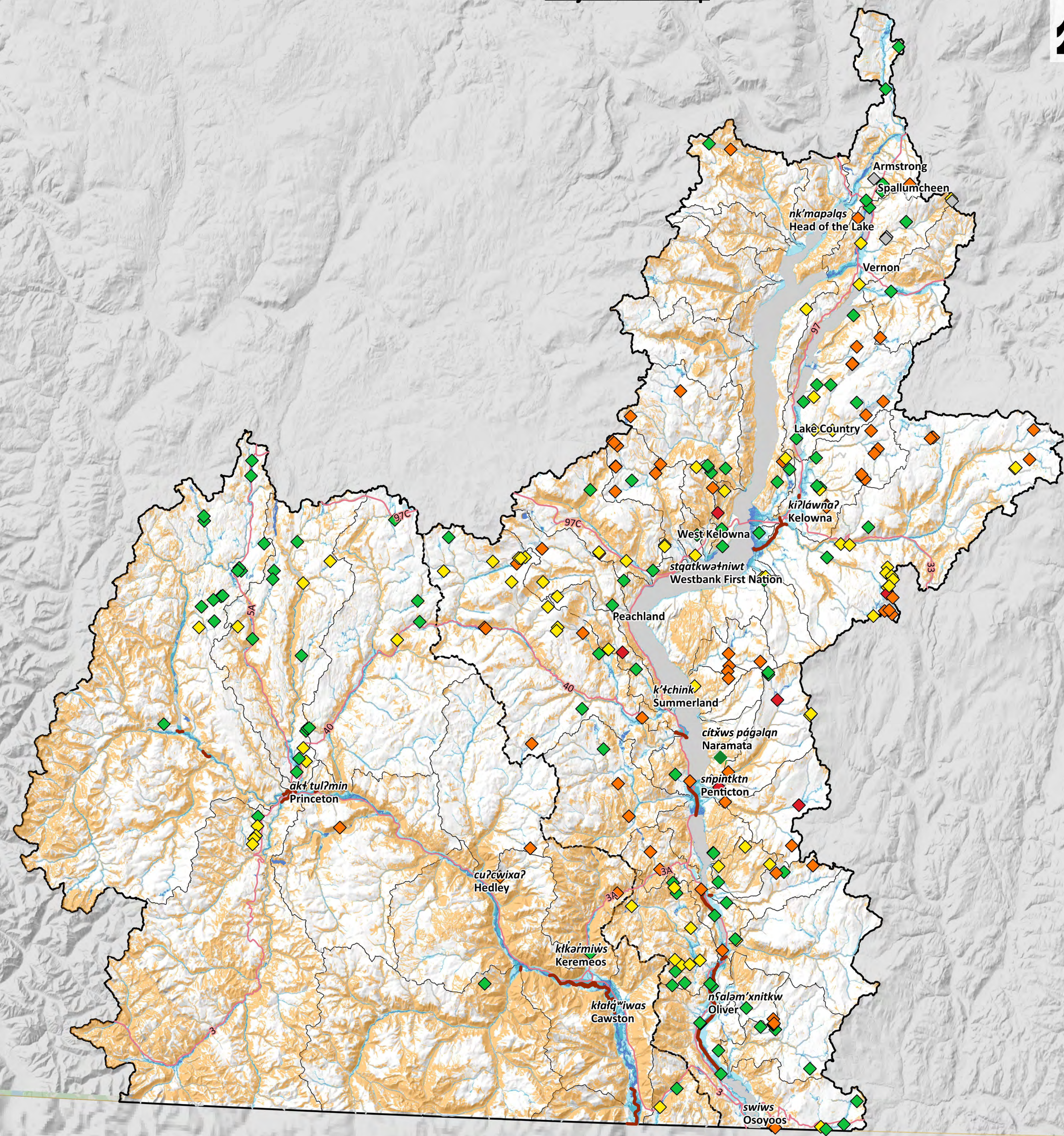
Palmer Environmental Consulting Group Inc.

Sylix Okanagan Nation Alliance

Index Map

0 50 100 km

[Click above map tile for Zoom-In map](#)

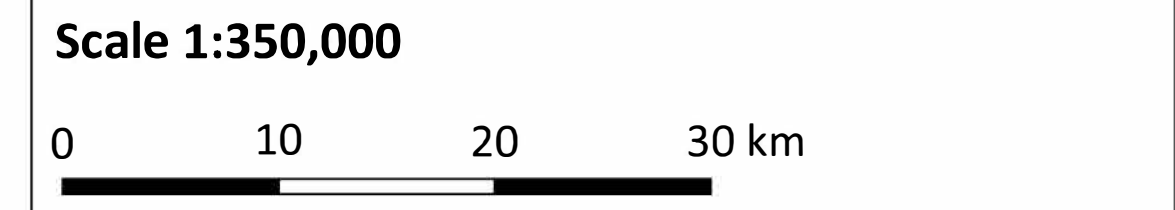


Map Notes

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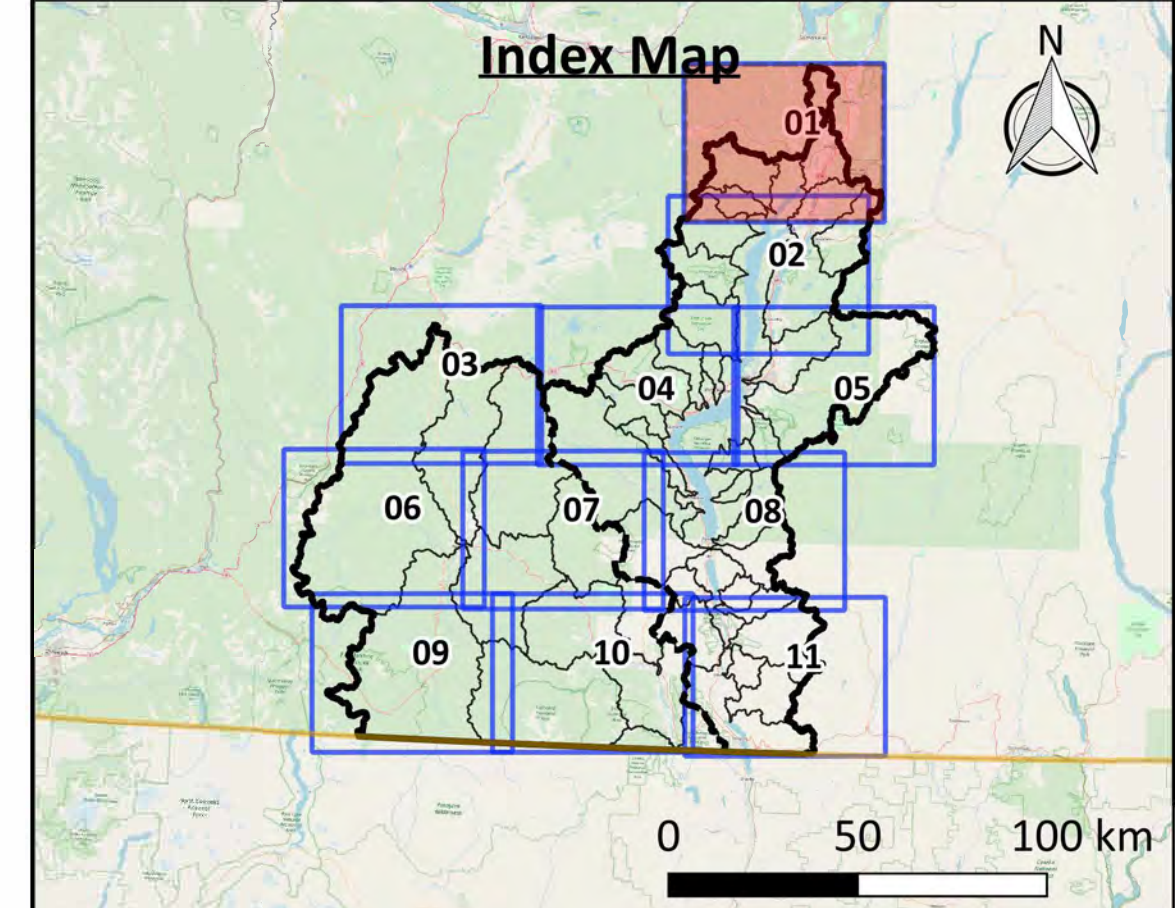
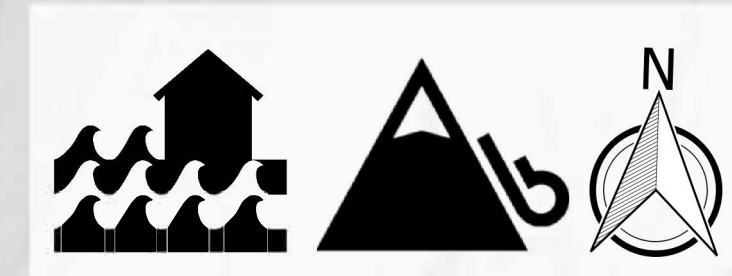


Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
□ Lakes	Moderate Magnitude
— Watercourses	High Magnitude
— Dikes	Dam Failure Consequence
— Highway	Extreme
--- Okanagan-Similkameen Boundary	High
	Significant
	Low
	Not Available

Date: 31 December 2019
Produced by: Ebbwater Consulting Inc.

Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Project Area Map



[Click above map tile for Zoom-In map](#)
[Click here for Project Area Map](#)

Map Notes
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Data Sources
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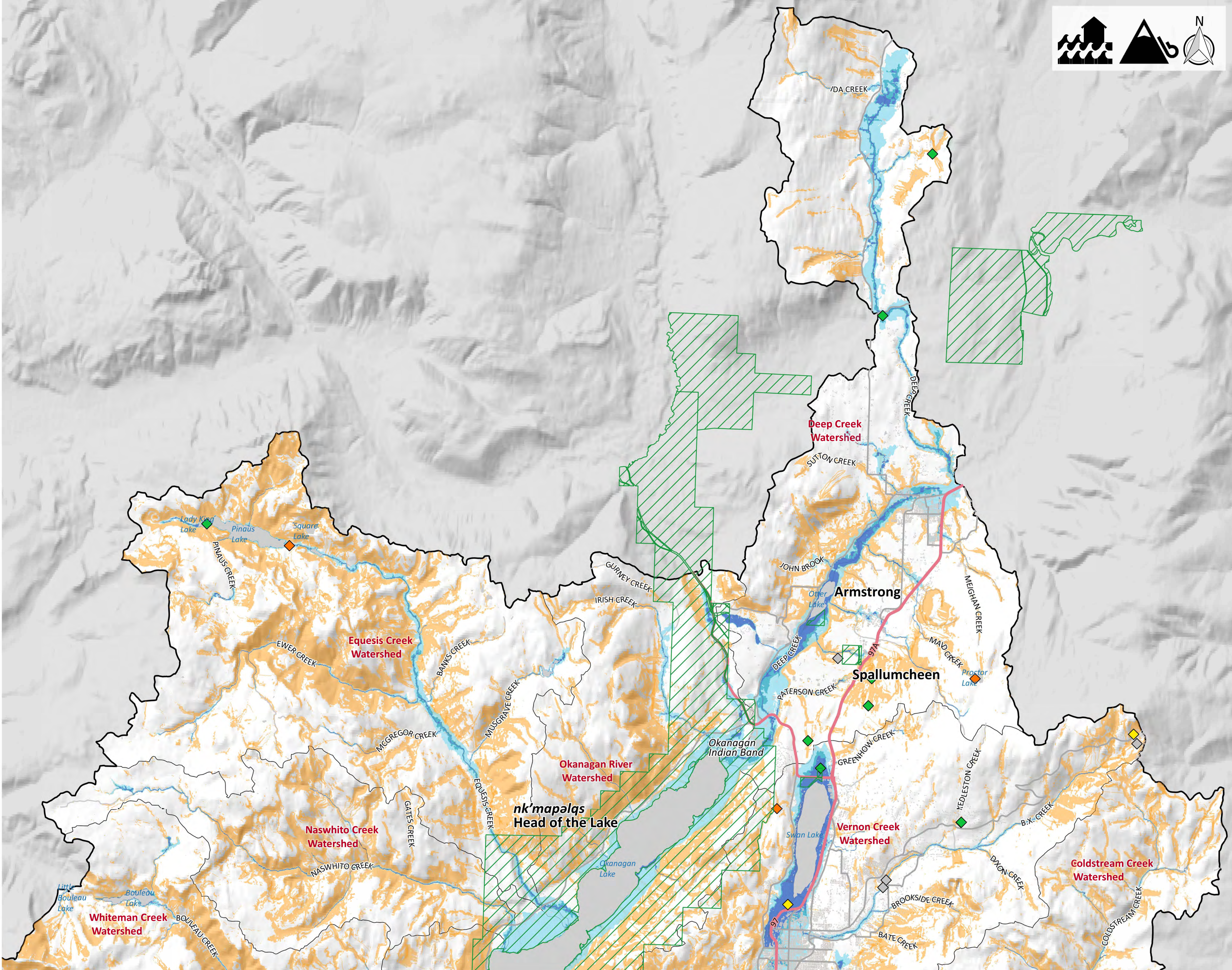
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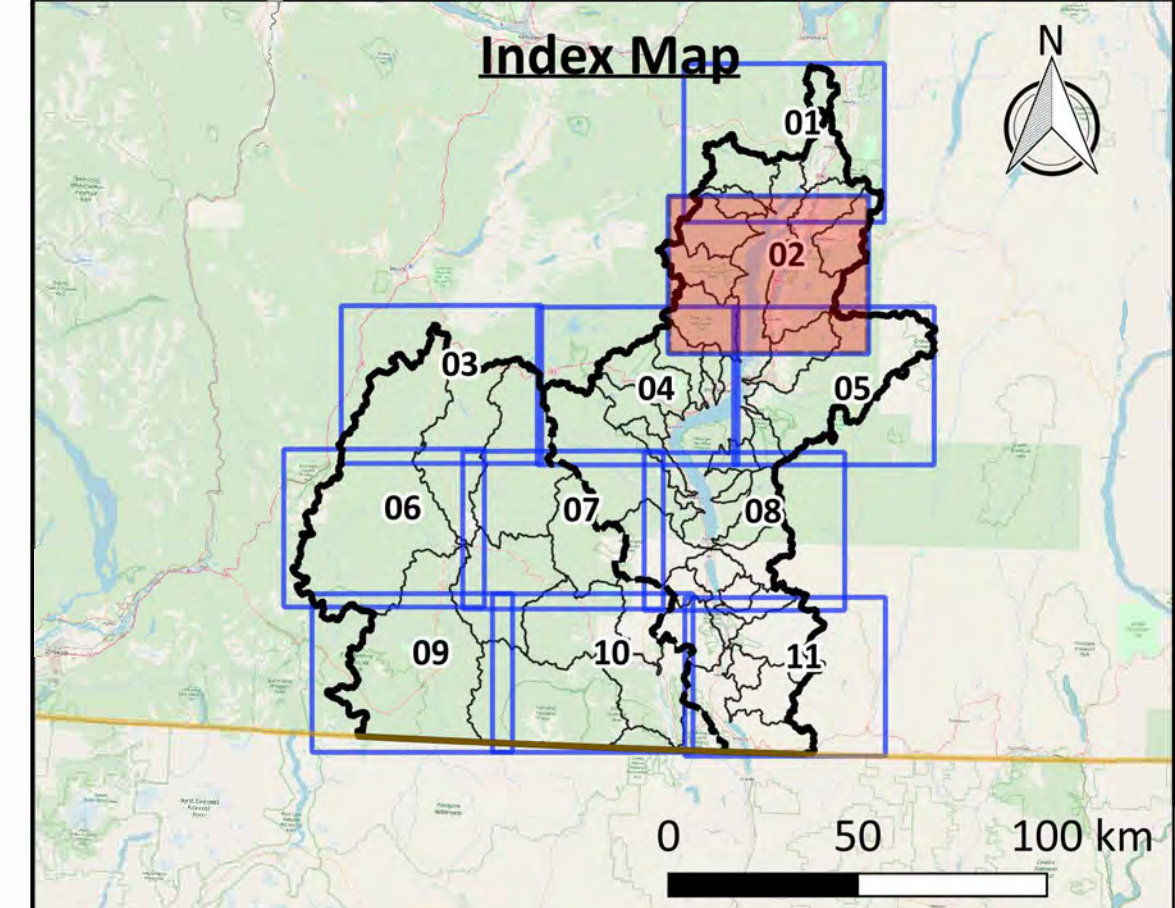
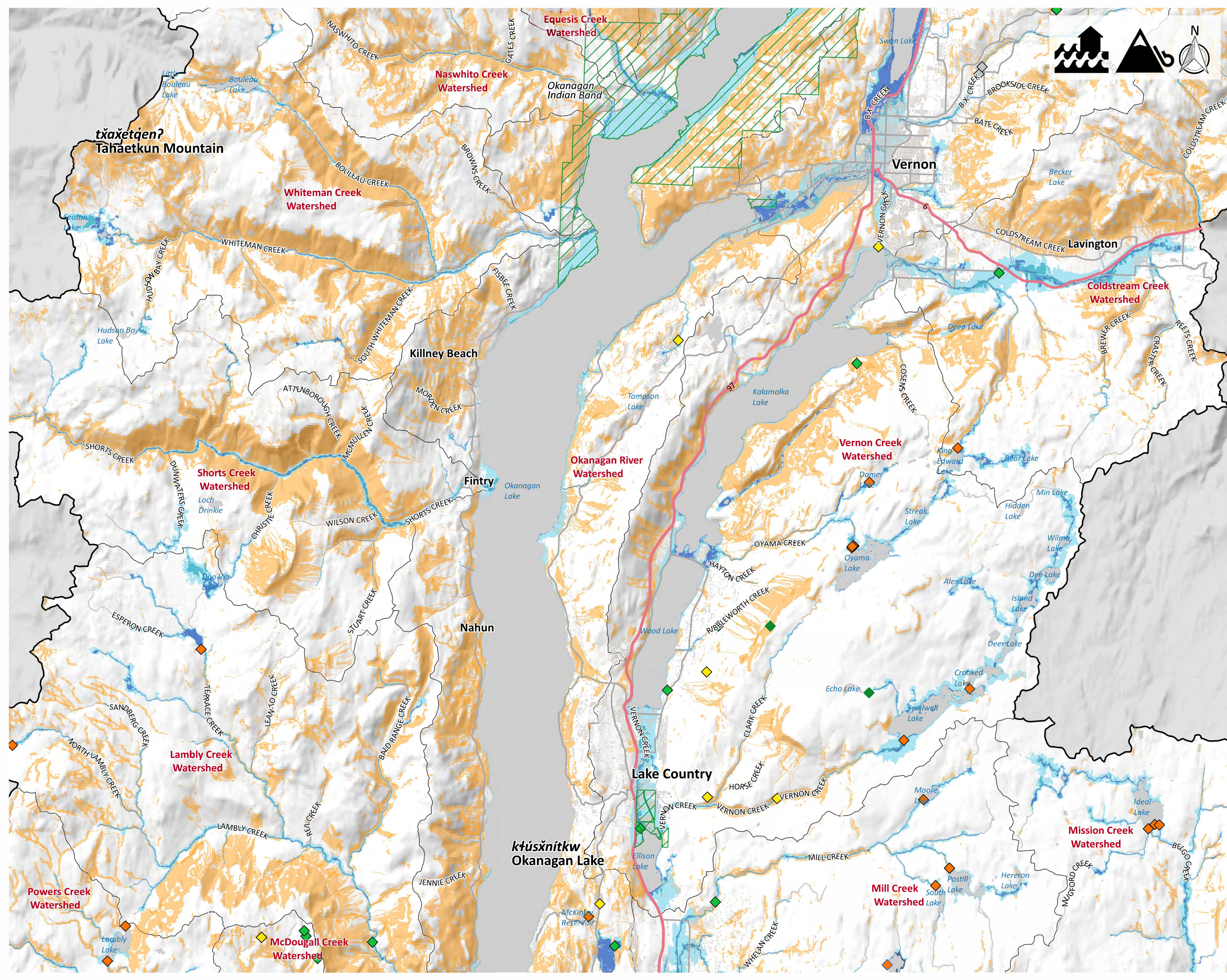
Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
▭ Reserves	Moderate Magnitude
— Lakes	High Magnitude
— Watercourses	Dam Failure Consequence
— Dikes	Extreme
— Highway	High
— Major Road	Significant
▭ Building Footprints	Low
— Okanagan-Similkameen Boundary	Not Available

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Produced by: Ebbwater Consulting Inc.

Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 01 of 11





[Click above map tile for Zoom-In map](#)
[Click here for Project Area Map](#)

Map Notes

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Data Sources

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Scale 1:75,000

0 1 2 3 4 5 km

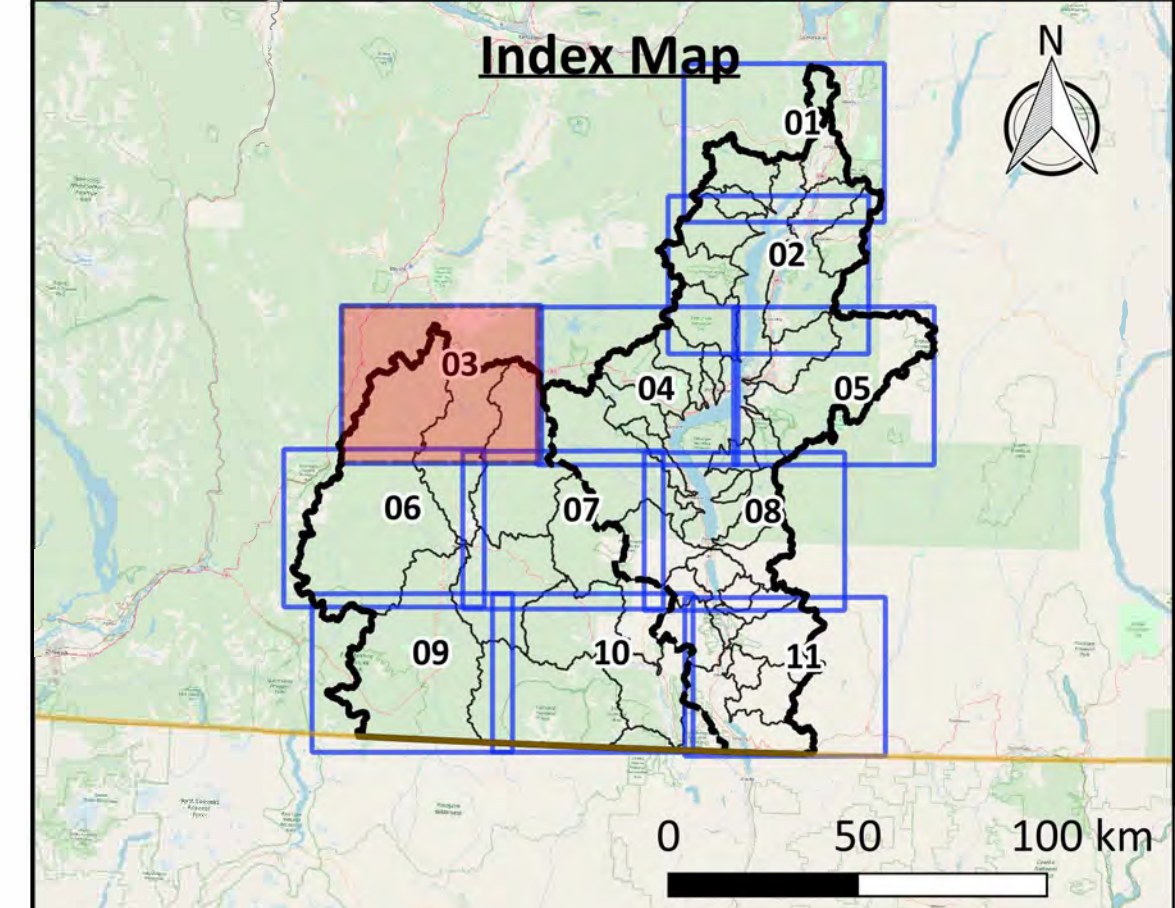
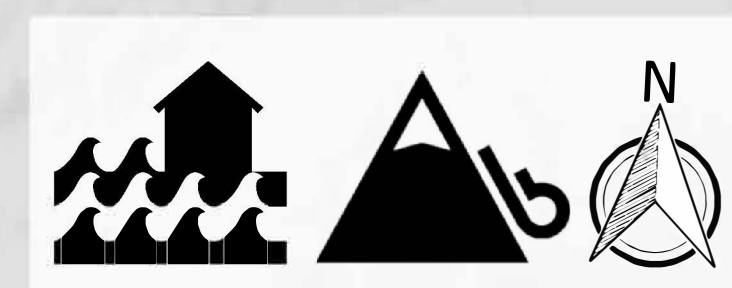
Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
▭ Reserves	Moderate Magnitude
— Lakes	High Magnitude
— Watercourses	Dam Failure Consequence
— Dikes	Extreme
— Highway	High
— Major Road	Significant
▭ Building Footprints	Low
— Okanagan-Similkameen Boundary	Not Available

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Siylx (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 02 of 11

ANSI D - Map No. HA-002-002

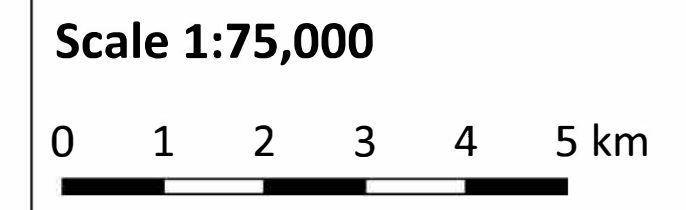


[Click above map tile for Zoom-In map](#)

[Click here for Project Area Map](#)

Map Notes
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 2. The debris flow hazard layer was produced by Palmer Environmental Consulting Group Inc. and the flood hazard layers by Ebbwater Consulting Inc. The method used to produce the hazard layers is described in the Quantitative Study.

Data Sources
 1. Lakes and Watercourses, Roads, Dikes, and Reserves: BC Data Catalogue.
 2. Dam Failure Consequence: BC Ministry of forests, lands and natural resource operations
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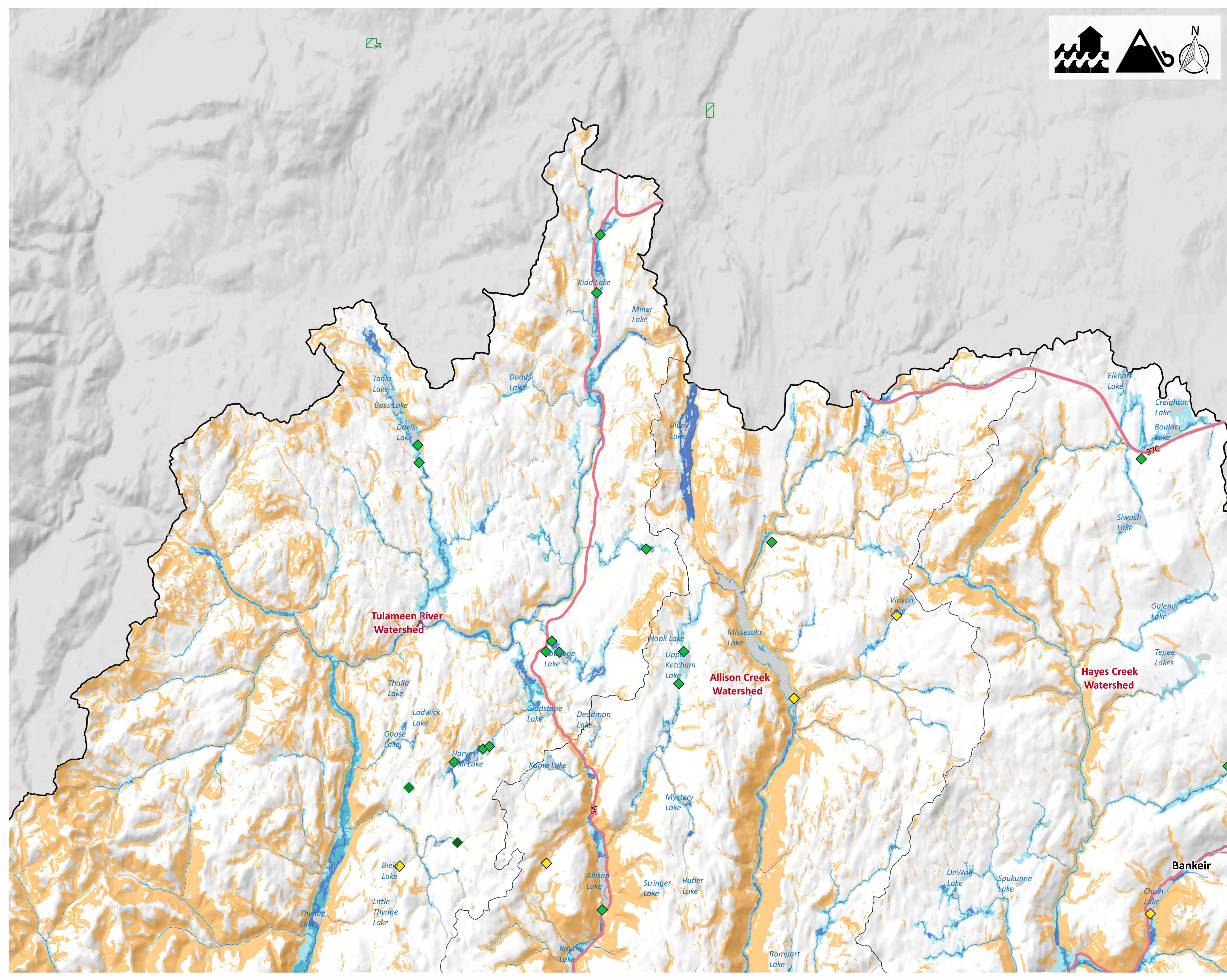
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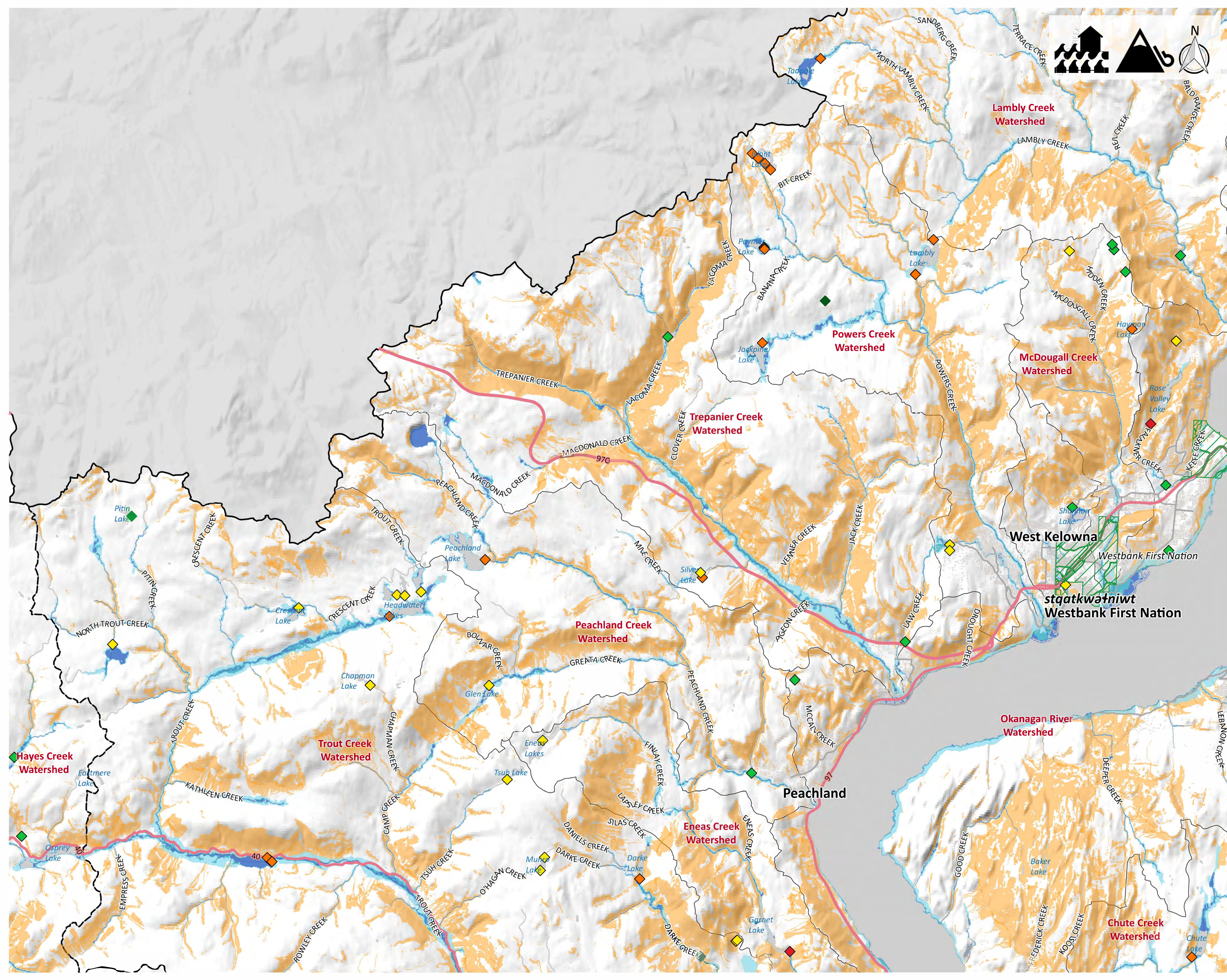
Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
□ Reserves	Moderate Magnitude
□ Lakes	High Magnitude
— Watercourses	Dam Failure Consequence
— Dikes	Extreme
— Highway	High
— Major Road	Significant
□ Building Footprints	Low
— Okanagan-Similkameen Boundary	Not Available

Date: 31 December 2019
Produced by: Ebbwater Consulting Inc.

Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 03 of 11

ANSI D - Map No. HA-002-003





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Sylix Okanagan Nation Alliance

Index Map

0 50 100 km

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Map Notes

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Data Sources

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Scale 1:75,000

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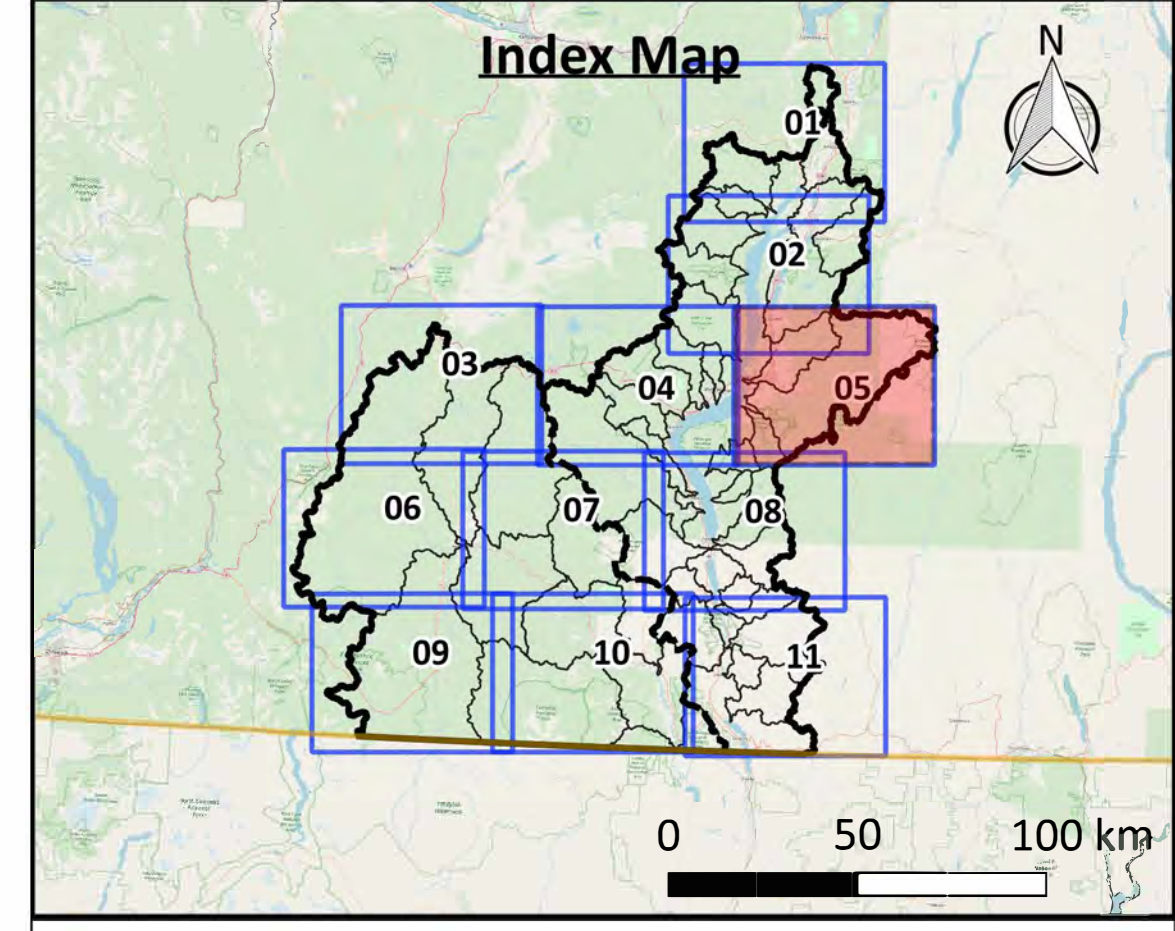
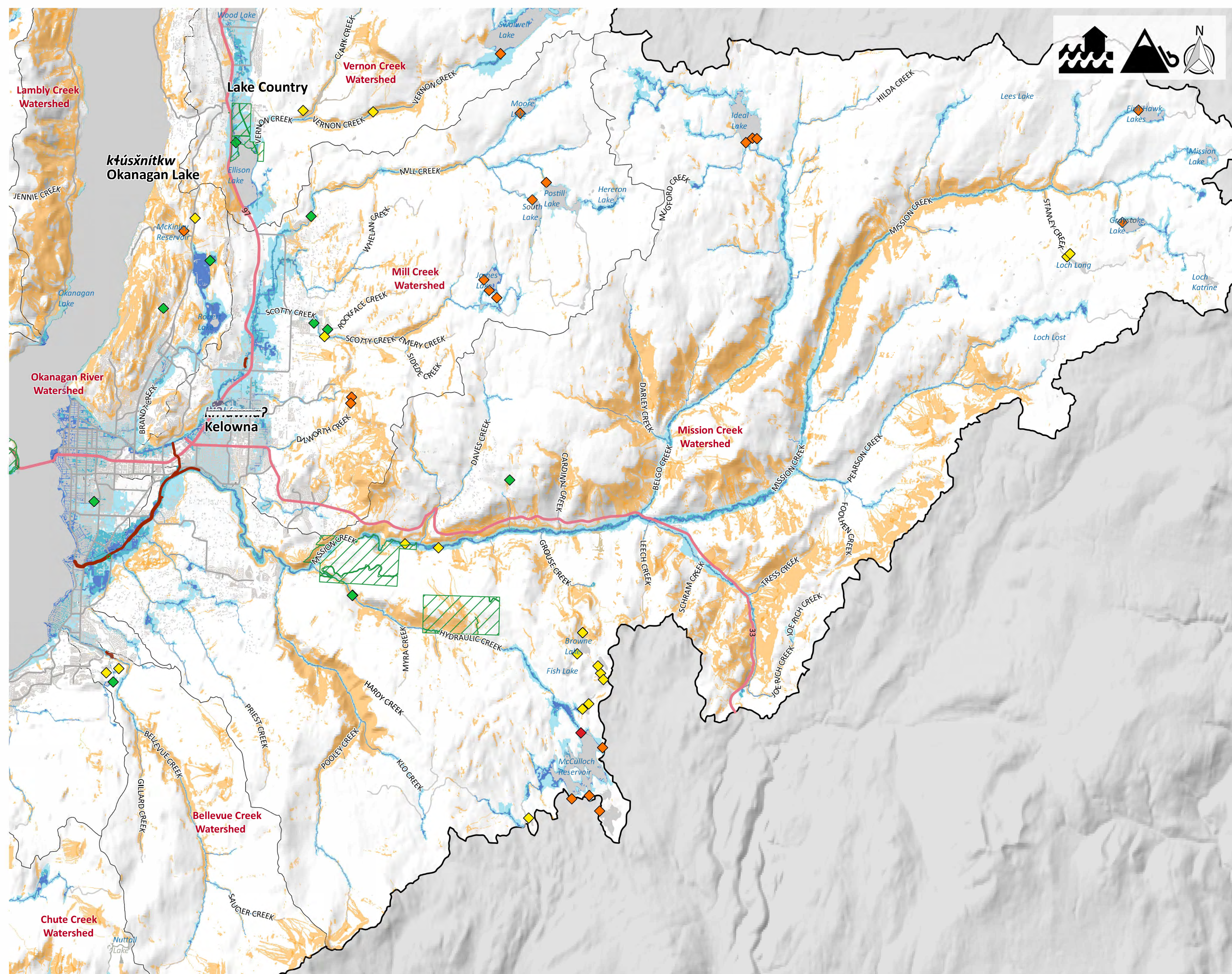
Legend

Background	Hazard
Watershed Boundary	Debris Flow Hazard Area
Named Subwatersheds	Flood Hazard Area
Canada - US Border	Low Magnitude
Reserves	Moderate Magnitude
Lakes	High Magnitude
Watercourses	Dam Failure Consequence
Dikes	Extreme
Highway	High
Major Road	Significant
Building Footprints	Low
Okanagan-Similkameen Boundary	Not Available

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Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 04 of 11

ANSI D - Map No. HA-002-004



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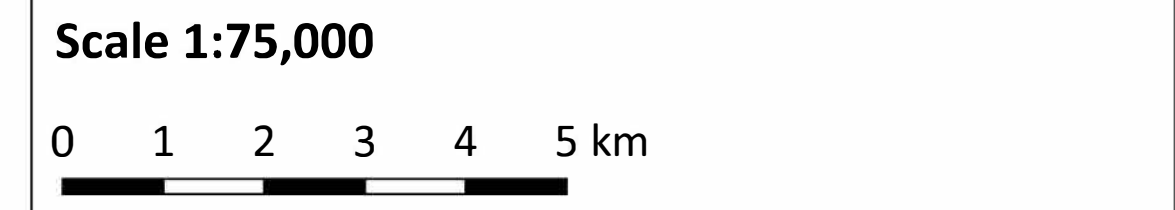
[Click here for Project Area Map](#)

Map Notes

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Data Sources

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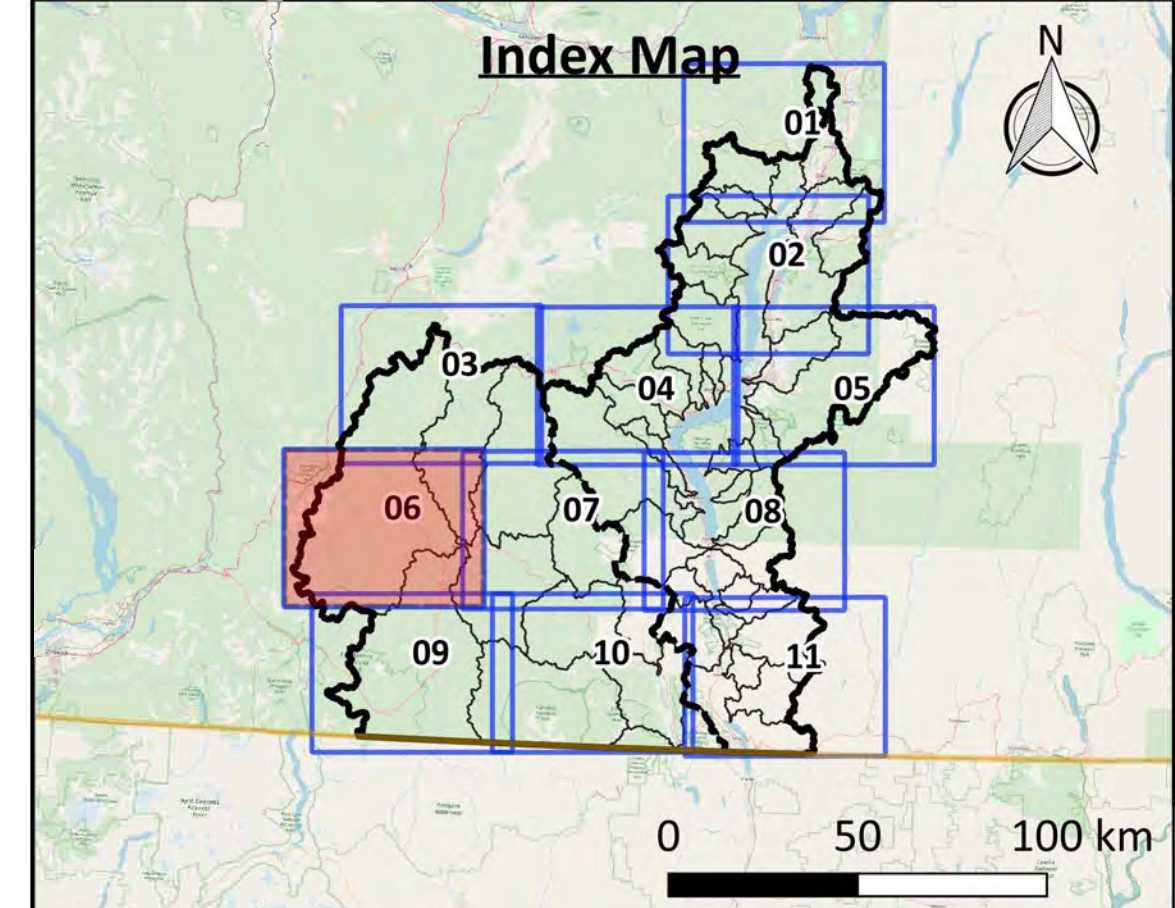
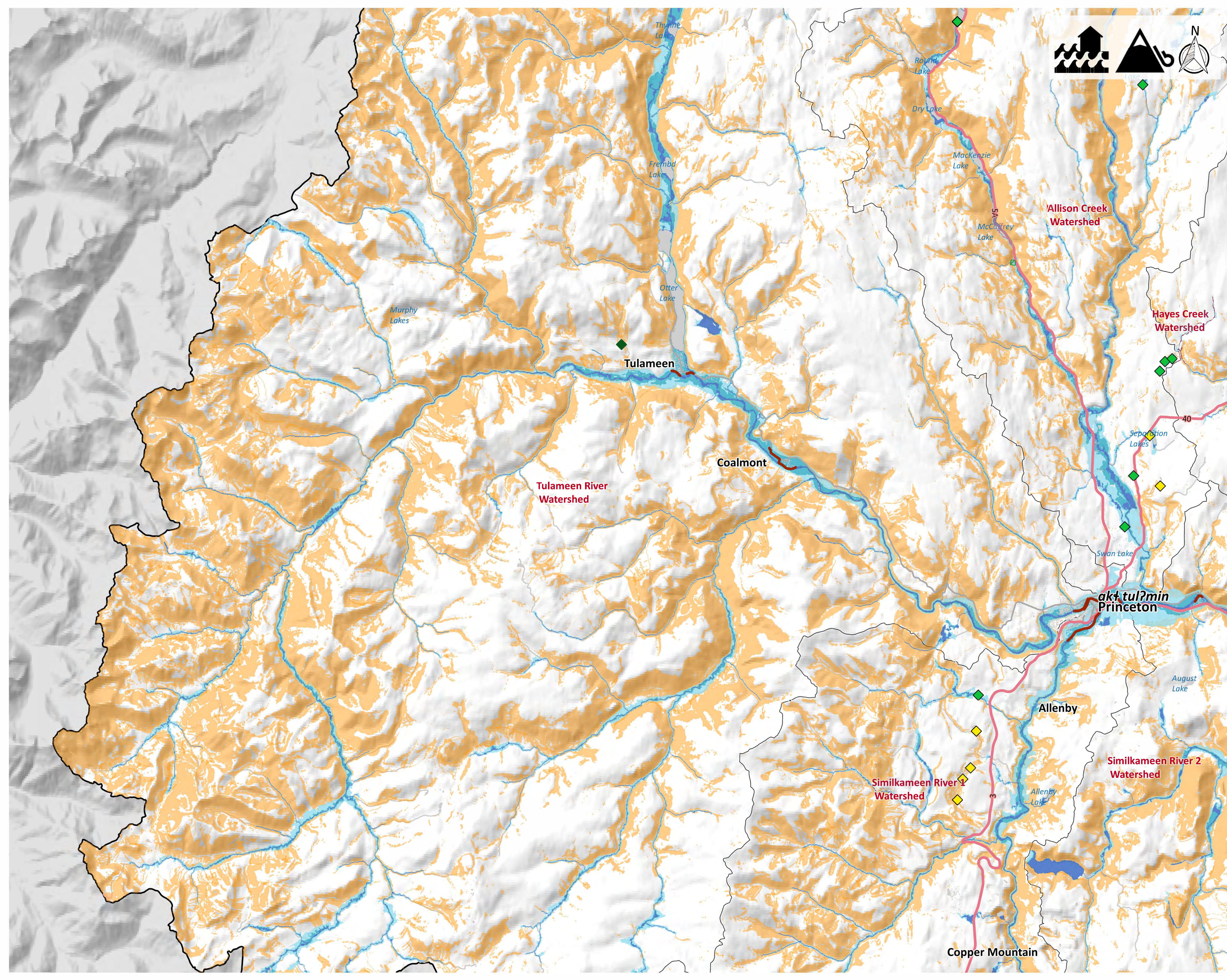


Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
▭ Reserves	Moderate Magnitude
— Lakes	High Magnitude
— Watercourses	Dam Failure Consequence
— Dikes	Extreme
— Highway	High
— Major Road	Significant
— Okanagan-Similkameen Boundary	Low
	◇ Not Available

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Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 05 of 11



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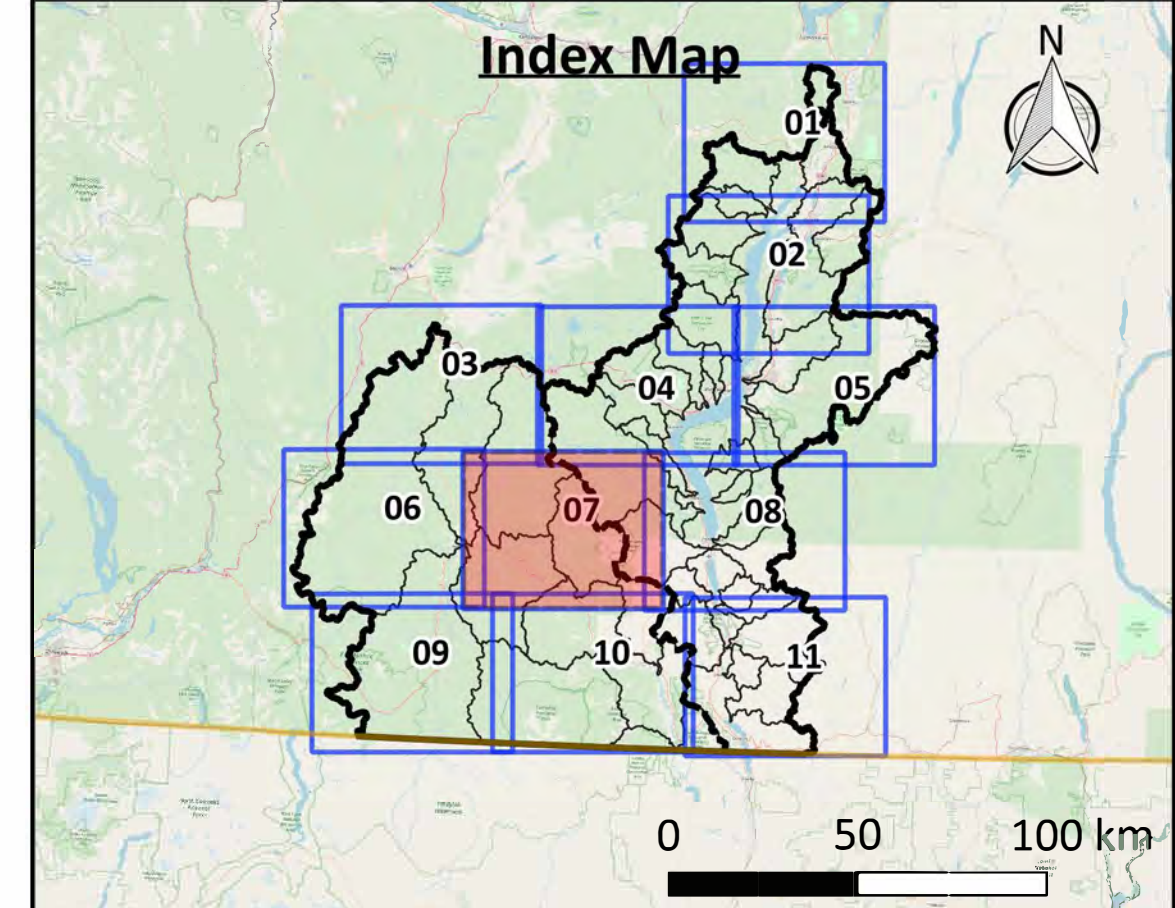
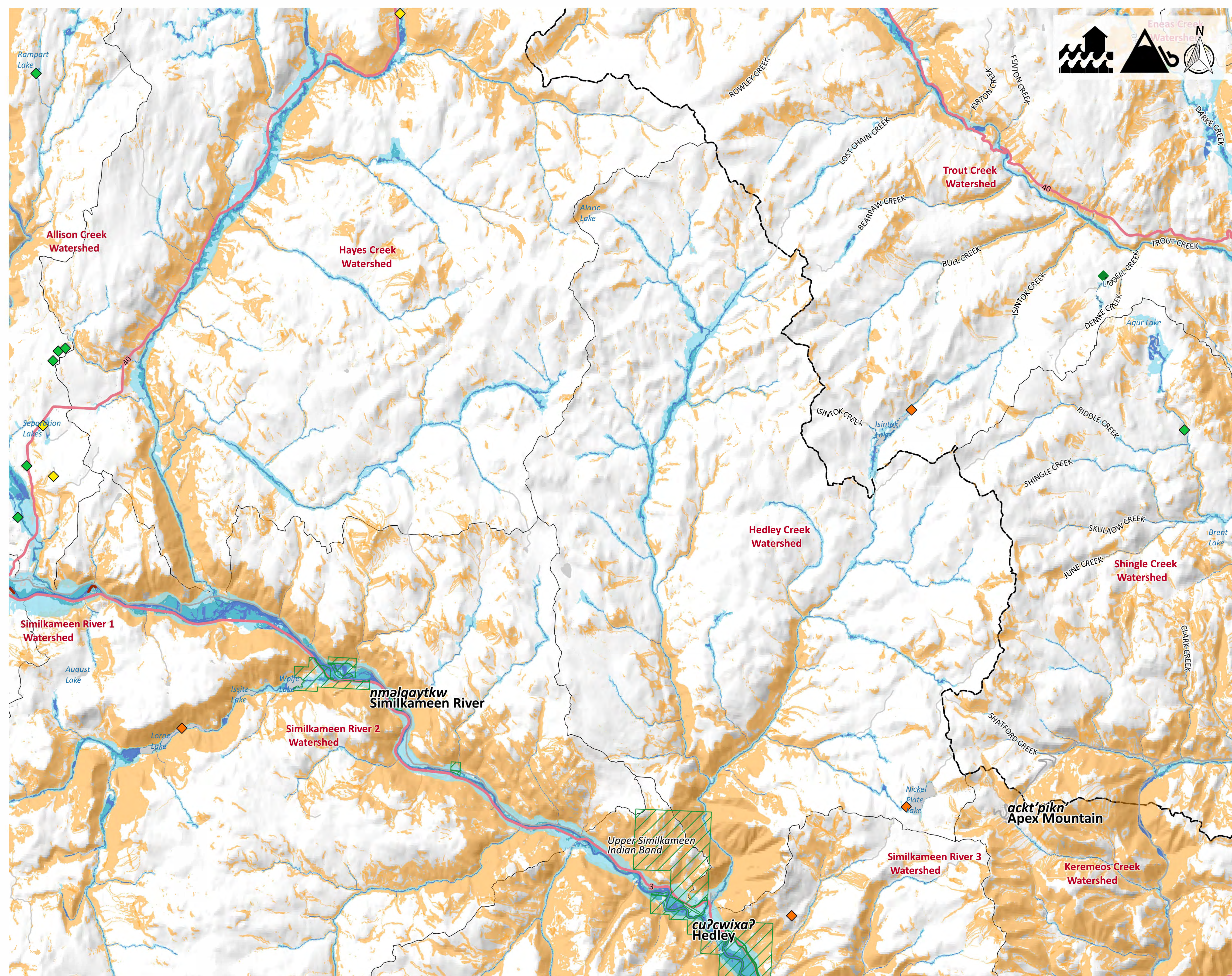
Scale 1:75,000
 0 1 2 3 4 5 km

Legend	
Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
□ Reserves	Moderate Magnitude
□ Lakes	High Magnitude
— Watercourses	Dam Failure Consequence
— Dikes	Extreme
— Highway	High
— Major Road	Significant
□ Building Footprints	Low
— Okanagan-Similkameen Boundary	Not Available

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Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 06 of 11

ANSI D - Map No. HA-002-006



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Scale 1:75,000
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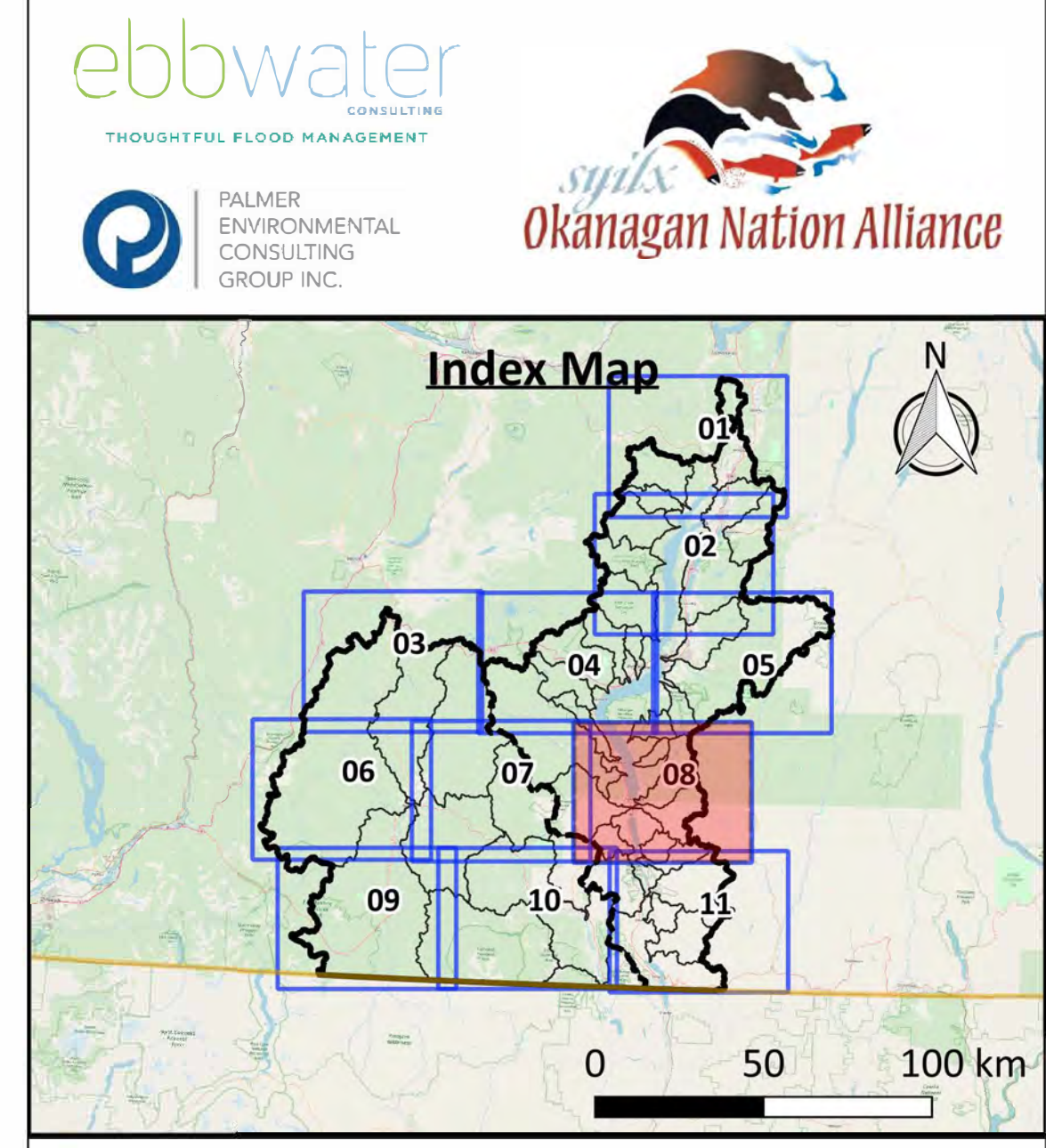
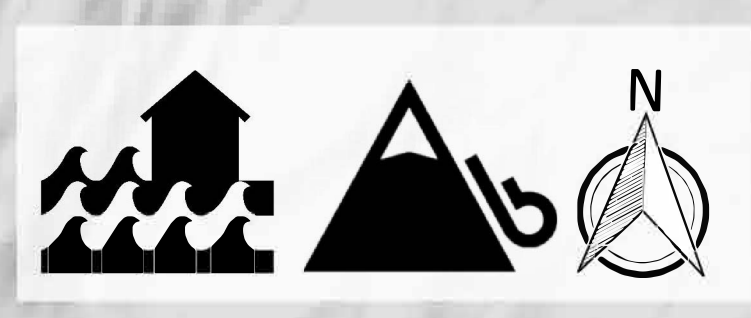
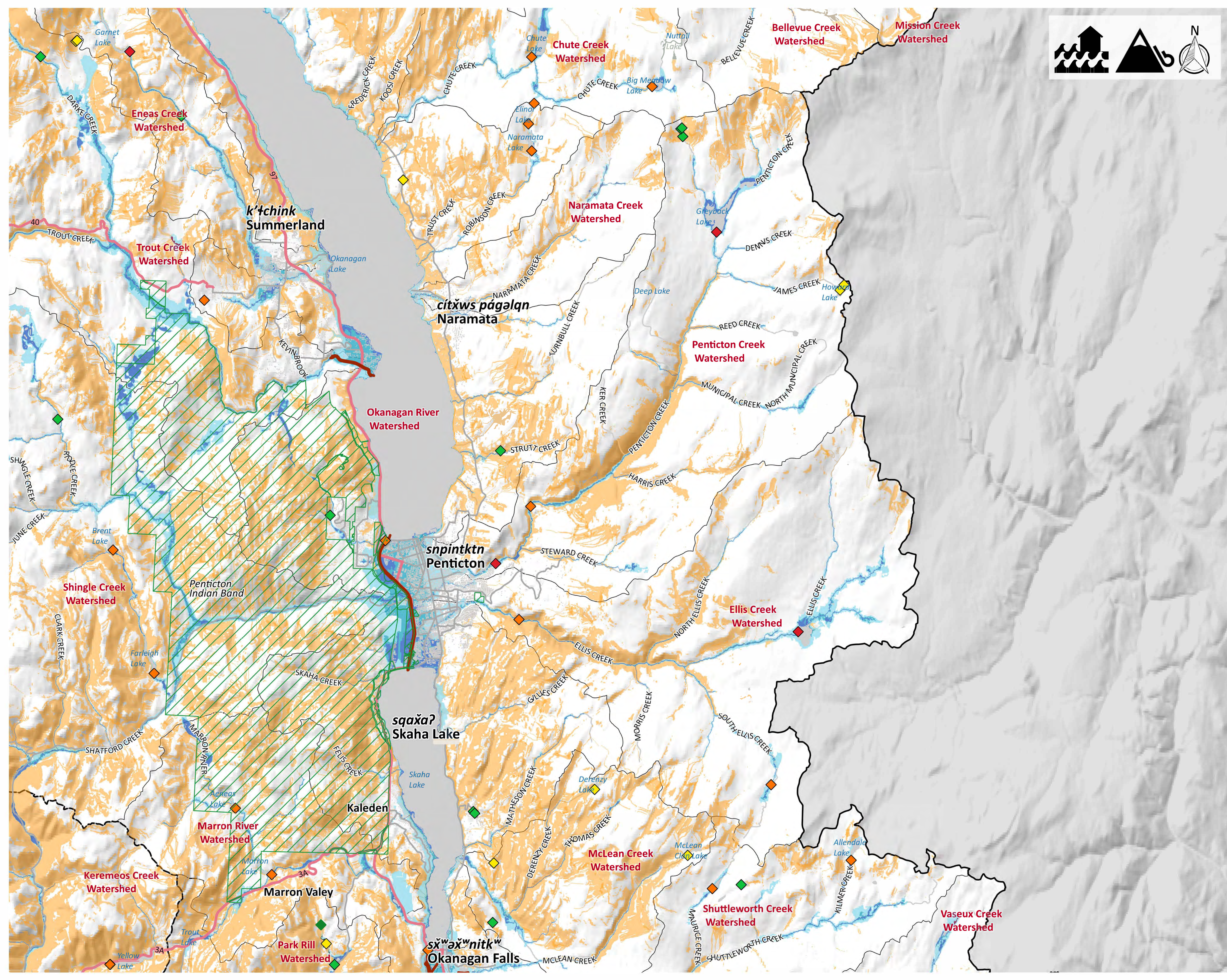
Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	
— Canada - US Border	Flood Hazard Area
▭ Reserves	Low Magnitude
▭ Lakes	Moderate Magnitude
▭ Watercourses	High Magnitude
— Dikes	
— Highway	Dam Failure Consequence
— Major Road	Extreme
▭ Building Footprints	High
— Okanagan-Similkameen Boundary	Significant
	Low
	Not Available

Date: 31 December 2019
 Produced by: Ebbwater Consulting Inc.

Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 07 of 11

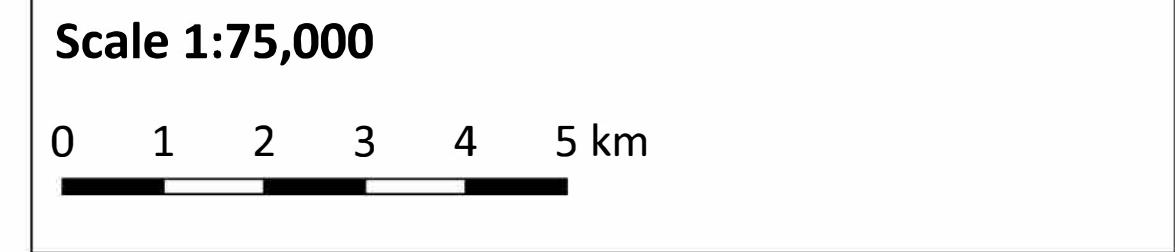
ANSI D - Map No. HA-002-007



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 4. *Sylix* Place Names: Okanagan Nation Alliance.
 5. Base Layer: OpenStreetMap data – openstreetmap.org (© OpenStreetMap contributors; cartography licence CC BY-SA) and hill shade created using CDEM and USGM GMTED2010.

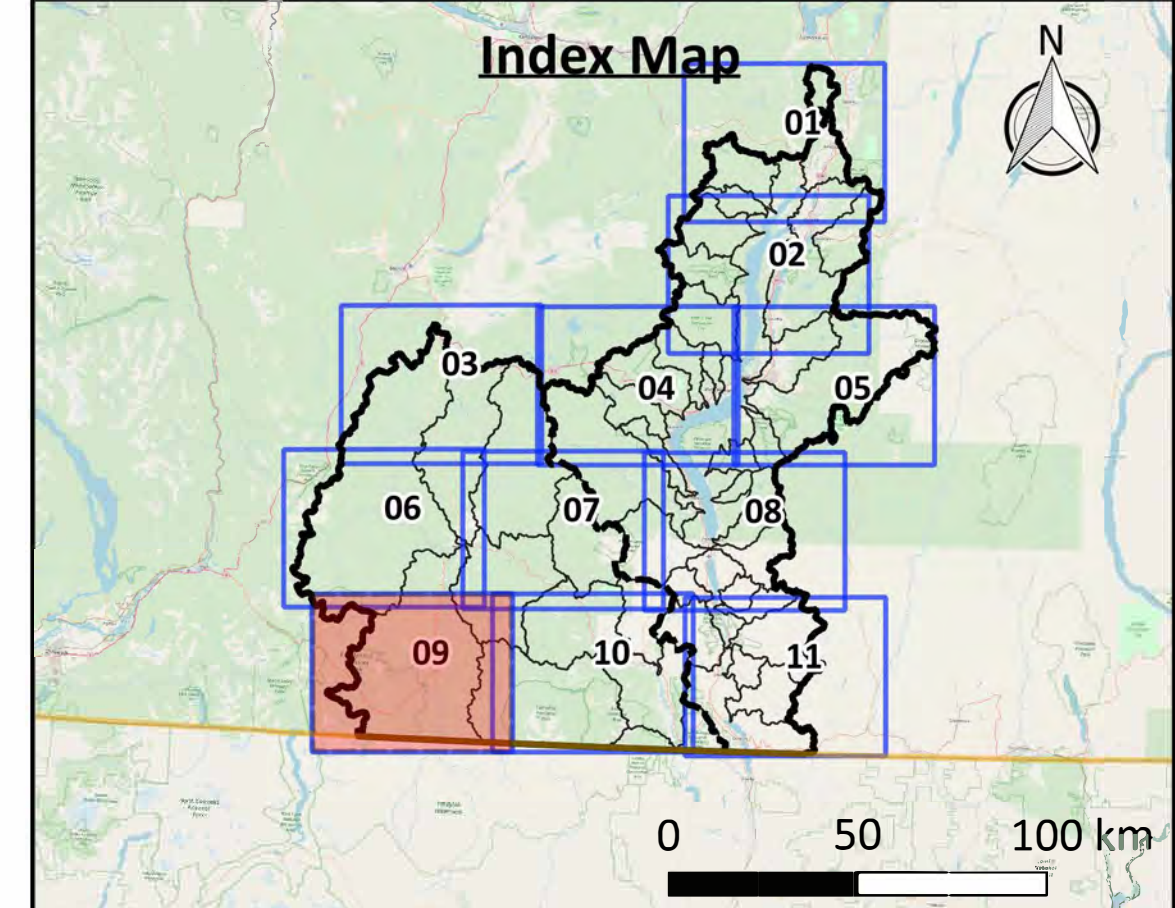
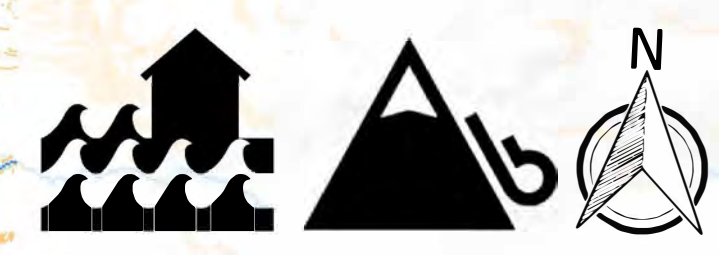
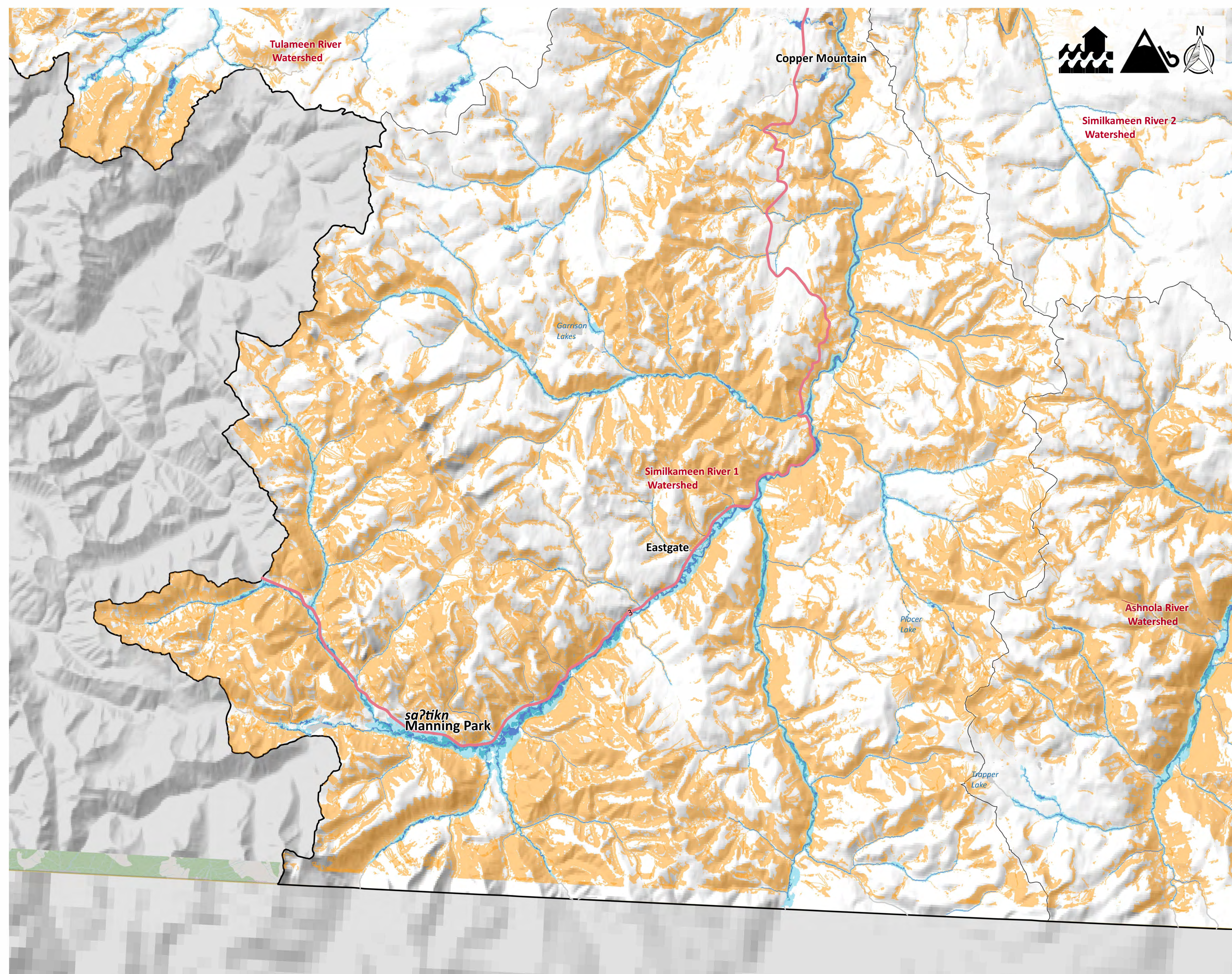


Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
□ Reserves	Moderate Magnitude
— Watercourses	High Magnitude
— Dikes	Dam Failure Consequence
— Highway	Extreme
— Major Road	High
— Building Footprints	Significant
— Okanagan-Similkameen Boundary	Low
	Not Available

Date: 31 December 2019
Produced by: Ebbwater Consulting Inc.

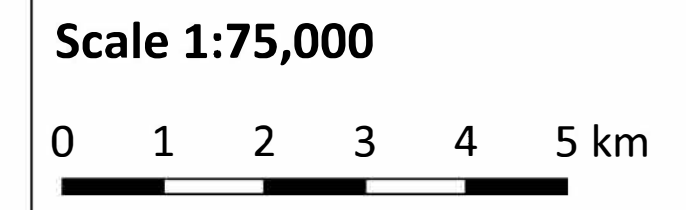
Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 08 of 11
 ANSI D - Map No. HA-002-008



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[Click here for Project Area Map](#)

Map Notes
 1. Map produced by Ebbwater Consulting Inc.
 2. The debris flow hazard layer was produced by Palmer Environmental Consulting Group Inc. and the flood hazard layers by Ebbwater Consulting Inc. The method used to produce the hazard layers is described in the Quantitative Study.

Data Sources
 1. Lakes and Watercourses, Roads, Dikes, and Reserves: BC Data Catalogue.
 2. Dam Failure Consequence: BC Ministry of forests, lands and natural resource operations
 3. Building Footprints: Regional districts, municipalities, WFN and hand digitized using Bing Satellite Imagery.
 4. Sylix Place Names: Okanagan Nation Alliance.
 5. Base Layer: OpenStreetMap data – openstreetmap.org (© OpenStreetMap contributors; cartography licence CC BY-SA) and hill shade created using CDEM and USGM GMTED2010.

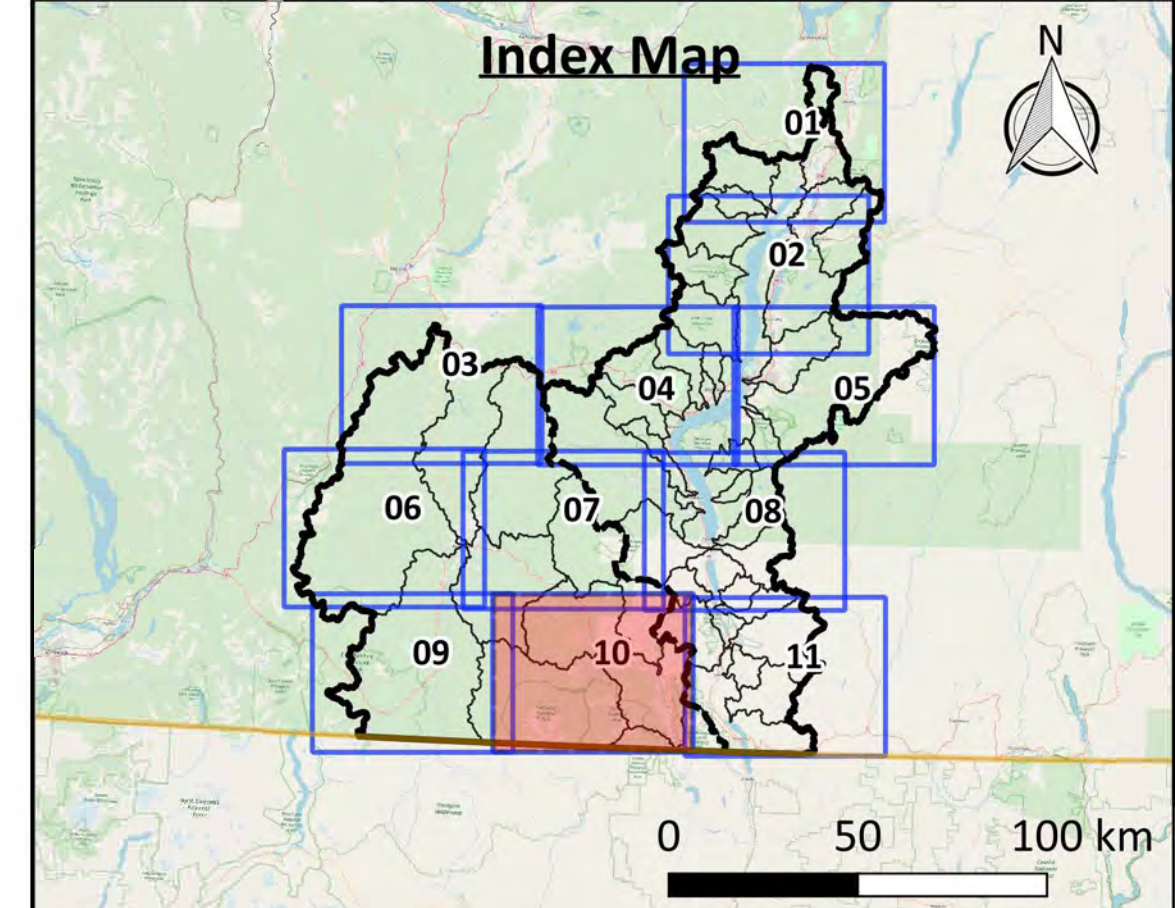
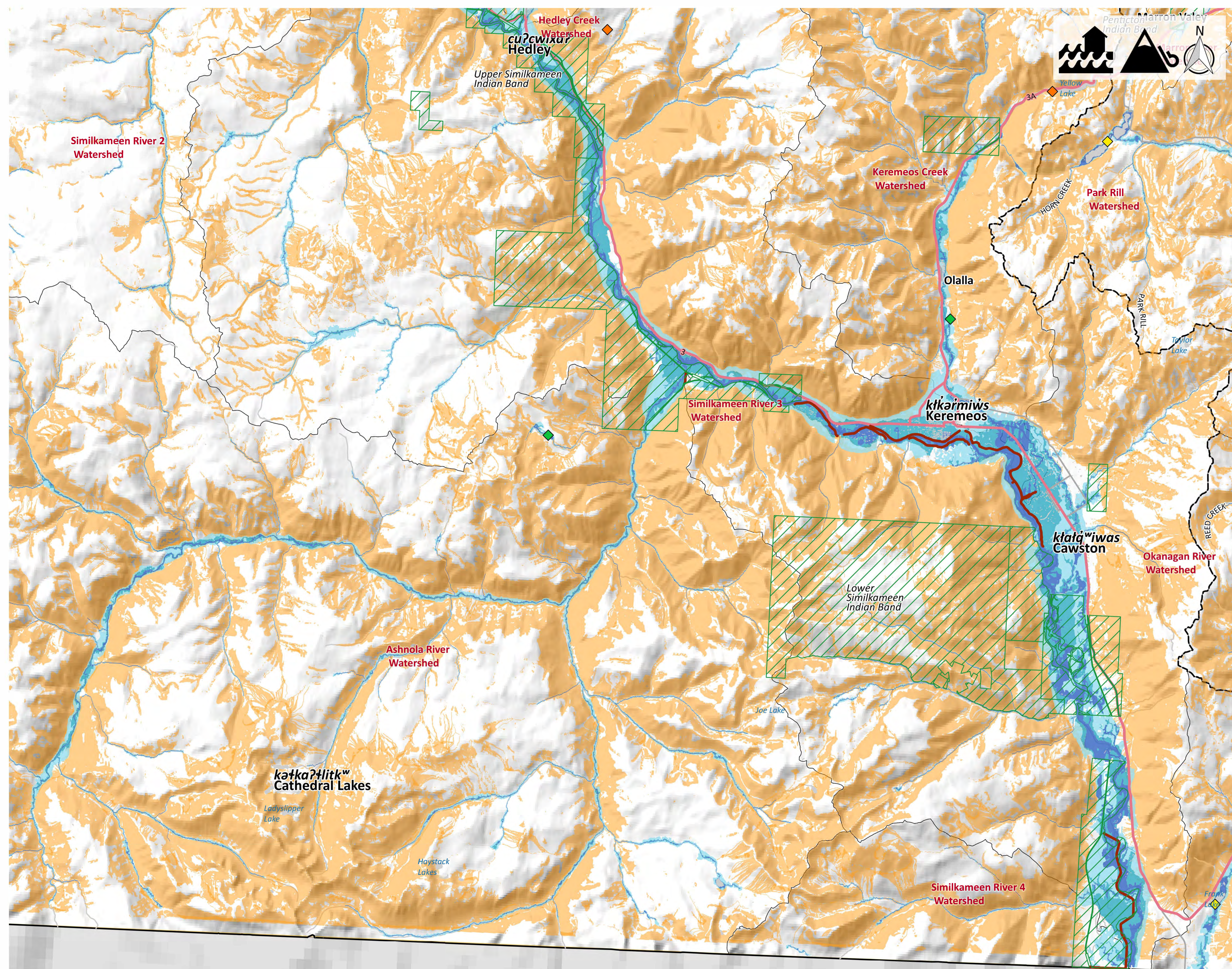


Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	Flood Hazard Area
— Canada - US Border	Low Magnitude
□ Reserves	Moderate Magnitude
□ Lakes	High Magnitude
— Watercourses	Dam Failure Consequence
— Dikes	Extreme
— Highway	High
— Major Road	Significant
□ Building Footprints	Low
— Okanagan-Similkameen Boundary	Not Available

Date: 31 December 2019
Produced by: Ebbwater Consulting Inc.

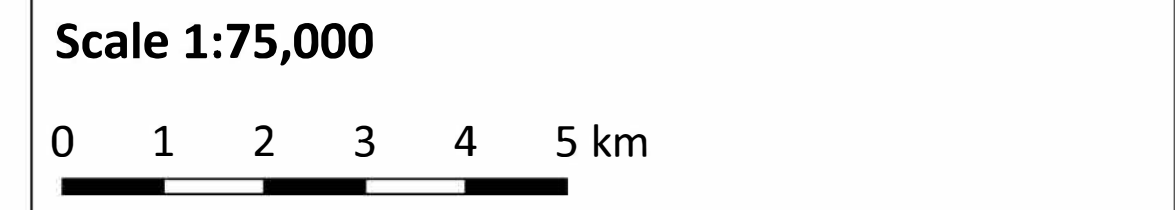
Sylix (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 09 of 11



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Map Notes
 1. Map produced by Ebbwater Consulting Inc.
 2. The debris flow hazard layer was produced by Palmer Environmental Consulting Group Inc. and the flood hazard layers by Ebbwater Consulting Inc. The method used to produce the hazard layers is described in the Quantitative Study.

Data Sources
 1. Lakes and Watercourses, Roads, Dikes, and Reserves: BC Data Catalogue.
 2. Dam Failure Consequence: BC Ministry of forests, lands and natural resource operations
 3. Building Footprints: Regional districts, municipalities, WFN and hand digitized using Bing Satellite Imagery.
 4. *Sjilx* Place Names: Okanagan Nation Alliance.
 5. Base Layer: OpenStreetMap data – openstreetmap.org (© OpenStreetMap contributors; cartography licence CC BY-SA) and hill shade created using CDEM and USGM GMTED2010.



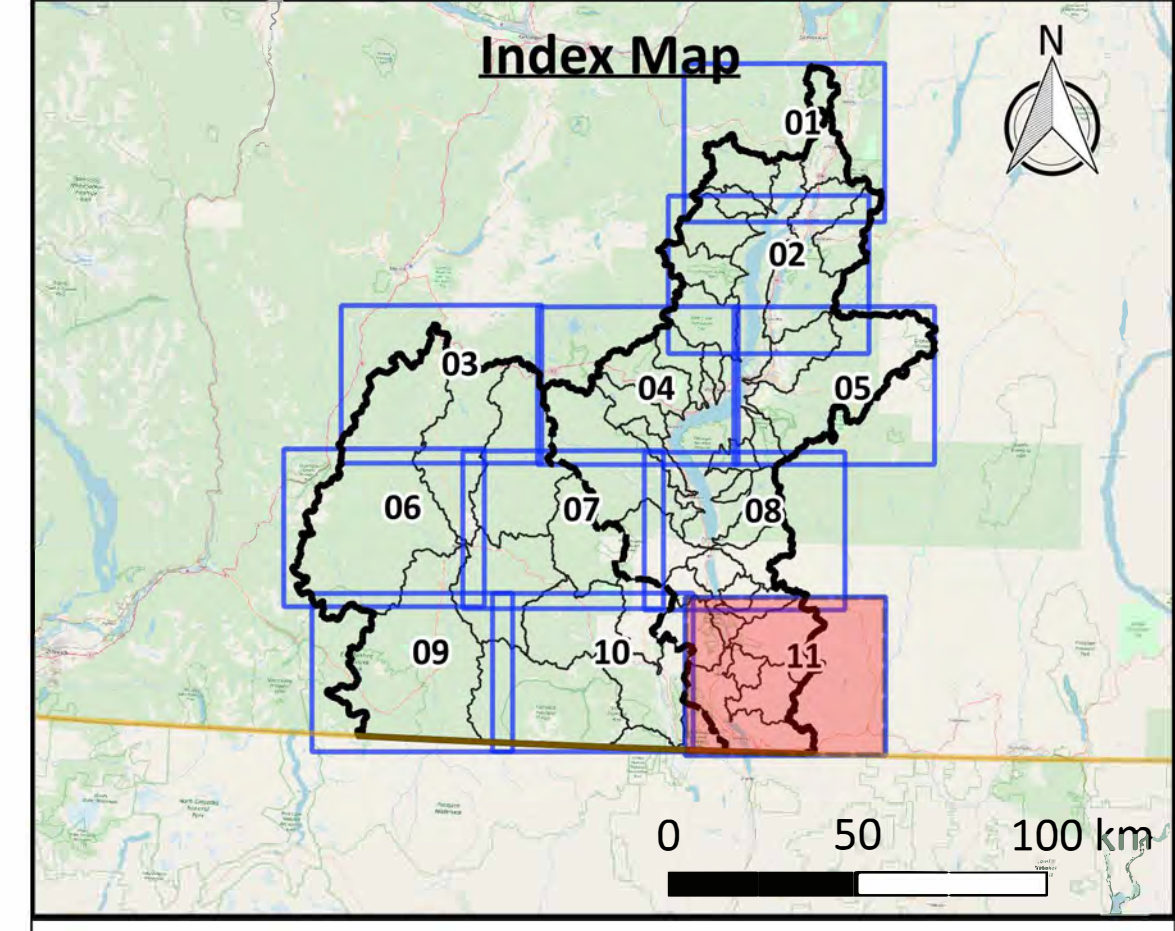
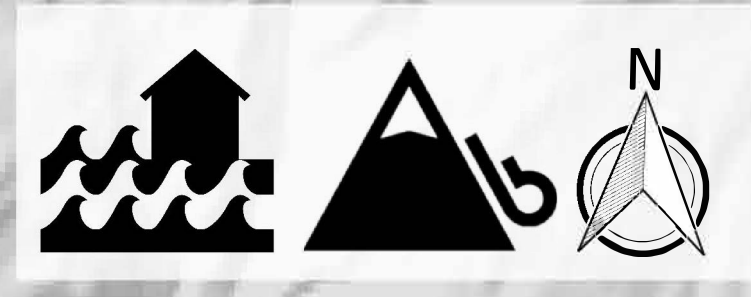
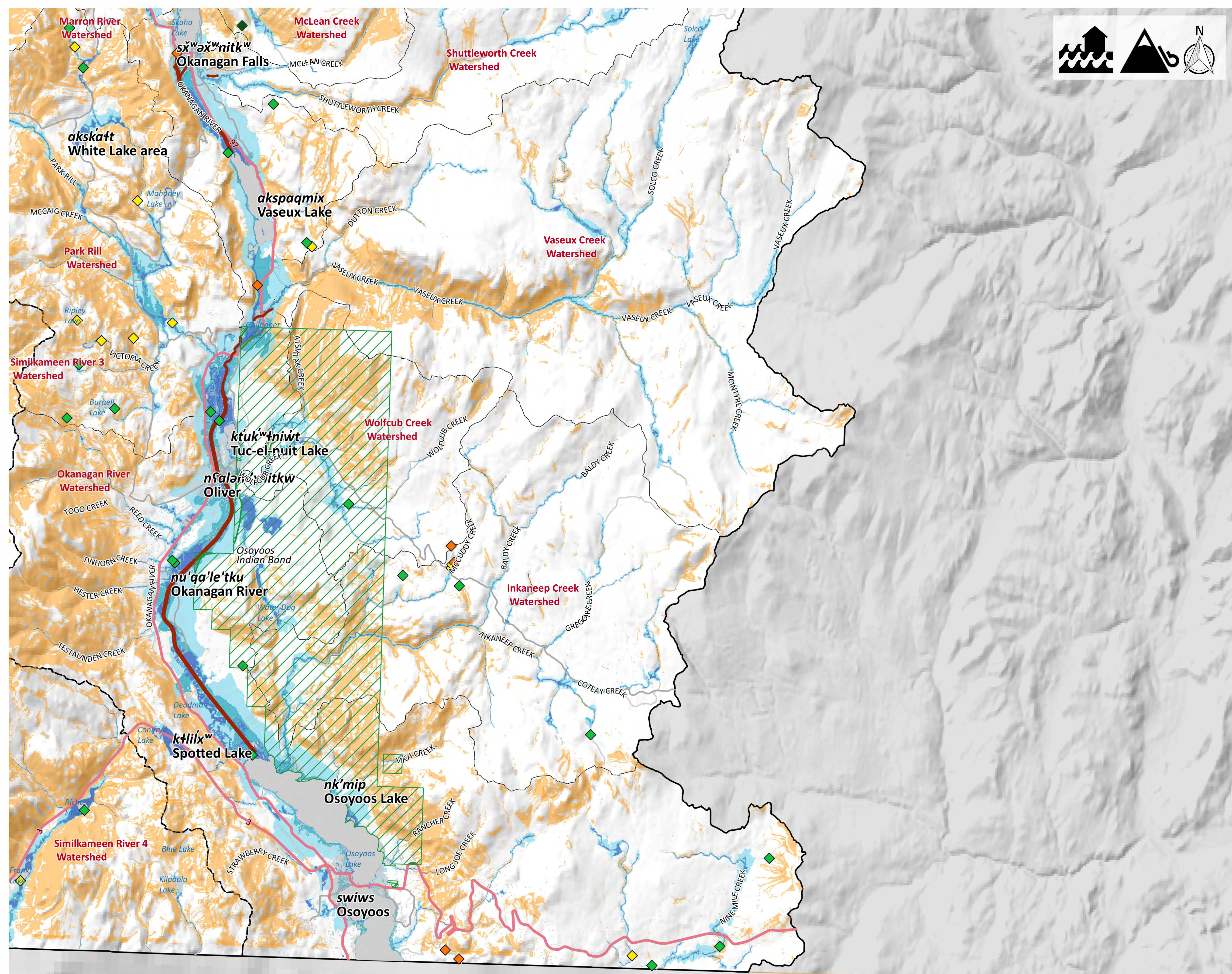
Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	
— Canada - US Border	Flood Hazard Area
□ Reserves	Low Magnitude
— Lakes	Moderate Magnitude
— Watercourses	High Magnitude
— Dikes	Dam Failure Consequence
— Highway	Extreme
— Major Road	Significant
— Building Footprints	Low
— Okanagan-Similkameen Boundary	Not Available

Date: 31 December 2019
Produced by: Ebbwater Consulting Inc.

Sjilx (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 10 of 11

ANSI D - Map No. HA-002-010



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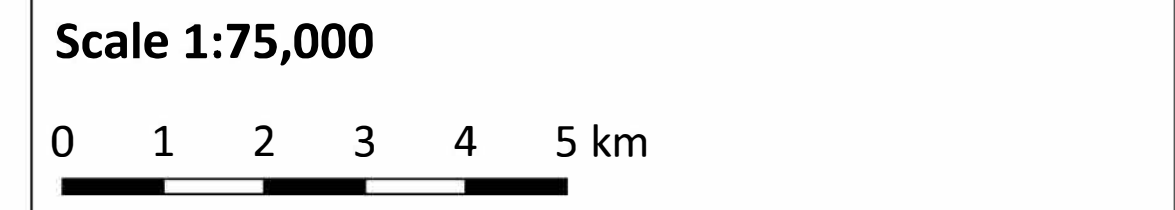
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Map Notes

1. Map produced by Ebbwater Consulting Inc.
2. The debris flow hazard layer was produced by Palmer Environmental Consulting Group Inc. and the flood hazard layers by Ebbwater Consulting Inc. The method used to produce the hazard layers is described in the Quantitative Study.

Data Sources

1. Lakes and Watercourses, Roads, Dikes, and Reserves: BC Data Catalogue.
2. Dam Failure Consequence: BC Ministry of forests, lands and natural resource operations
3. Building Footprints: Regional districts, municipalities, WFN and hand digitized using Bing Satellite Imagery.
4. Syilx Place Names: Okanagan Nation Alliance.
5. Base Layer: OpenStreetMap data – openstreetmap.org (© OpenStreetMap contributors; cartography licence CC BY-SA) and hill shade created using CDEM and USGM GMTED2010.



Legend

Background	Hazard
— Watershed Boundary	Debris Flow Hazard Area
□ Named Subwatersheds	
— Canada - US Border	Flood Hazard Area
□ Reserves	Low Magnitude
□ Lakes	Moderate Magnitude
— Watercourses	High Magnitude
— Dikes	
— Highway	Dam Failure Consequence
— Major Road	Extreme
□ Building Footprints	High
— Okanagan-Similkameen Boundary	Significant
	Low
	Not Available

Date: 31 December 2019
Produced by: Ebbwater Consulting Inc.

Syilx (Okanagan) Flood and Debris Flow Risk Assessment Project
Flood and Debris Flow Hazard Map Tile 11 of 11