KONTUR
GEOTECHNICAL CONSULTANTS

May 10, 2023 (Version 0)
Project No.: **K-231113-00**

Stuart Sambell
c/o Stark Architecture
Unit 210 – 38026 Second Ave
Squamish, BC
V8B 0C3

Attention: [redacted]

RE: Flood Construction Level
Mixed Residential Retail Development
7451 & 7453 Frontier Street, Pemberton, BC

Dear Stuart Sambell,

1.0 INTRODUCTION

In accordance with your recent authorization, Kontur Geotechnical Consultants Inc. (Kontur) has completed this review of Flood Construction Level (FCL) for the above-referenced project. The purpose of this study was to review available information and determine an appropriate FCL for the subject properties and discuss restrictions on suitable land use with respect to the recommended FCL.

This letter, which summarizes the findings of the FCL review, has been prepared in accordance with standard and widely accepted geotechnical engineering principles and practices for similar projects in this region. This letter does not address any environmental issues or considerations related to the proposed project.

Review and use of this letter should be completed in accordance with the attached *Interpretation and Use of Study and Report* document. It is included as an integral part of this letter and should be read in conjunction with all parts of this letter.

2.0 UNDERSTANDING OF PROJECT

Based on a discussion with representative for the property owner the project generally consists of the construction of a mixed-use building with the lower level being for retail/ commercial and the upper levels for residential.

3.0 SOURCES OF INFORMATION

The following sources of information were reviewed as part of this study:

- Site Reconnaissance by senior Kontur personnel to assess existing site conditions;
- Surficial geology map "*Surficial Geology and Landslide Inventory of the Upper Sea to Sky Corridor*";
- Relevant information obtained from the Squamish Lillooet Regional District (SLRD) online web-mapping applications;
- Report titled "*Lillooet River Floodplain Mapping – Final Report*" prepared by Northwest Hydraulic Consultants Ltd. (NHC), dated November 22, 2018; and,

- Plan showing Topography and Site Features prepared by Doug Bush Survey Services Ltd. (DBSS).

4.0 SITE DESCRIPTION

4.1 General

The subject properties are located on the northern side of Camus Street between Frontier Street and Menzel Lane within the Village of Pemberton. The properties were rectangular in shape with a north-south dimension of about 40m and an east-west dimension of about 40m. The properties were bonded by a single-family residential lot to the north, Frontier Street to the east, Menzel Lane to the west and Camus Street to the south.

4.2 Surface Conditions

The subject properties were generally flat lying at an elevation of about 210m.

The northern property (7453 Frontier Street) contained a two-level single family residential building with the southern lot (7451 Frontier Steet) containing a small shed.

Vegetation generally consisted of grass lawns with a couple of large coniferous trees and some deciduous trees along the property boundaries.

4.3 Soil Conditions

A review of the surficial geology map "*Surficial Geology and Landslide Inventory of the Upper Sea to Sky Corridor*" indicates the subject properties are underlain by Fan Deposits consisting of poorly sorted sand and gravel with diamictons; generally, 2 to 15m thick.

Kontur has not completed any subsurface exploration within the subject property.

4.4 Groundwater Conditions

No seepage was noted within the subject properties during site reconnaissance; however , based on Kontur's previous experience in the area groundwater can typically be encountered about 2m below ground surface. The depth to groundwater table was unknown at the time of this report.

5.0 COMMENTS AND RECOMMENDATIONS

5.1 General

It is understood that the property owner is proposing a multi-level building with retail/Commercial units on the first level and residential units on the upper levels. The lower level would have area below the FCL provided in the NHC report. The sections below address the risks associate with such an approach.

5.2 Flood Construction Level

A review of the NHC report indicates the recommended FCL for the subject property is 212.1m geodetic including a 0.6m freeboard. A review of topographic information contained in the survey plan prepared by Doug Bush Survey Services Ltd. (DBSS), dated August 12, 2021 indicates existing elevations within the

subject property range from about 210.0m along the northern property boundary to about 210.5m along the southern property boundary. Based on the above discussion the recommended FCL would be about 1.6m to 2.1m above the existing grade. A review of the Flood Hazard Area Land Use Management Guidelines provided by the BC Ministry of Water, Land and Air Protection Section 1.3 indicates that subject to review by and if acceptable to the local government, a flood plain bylaw may be modified. This discretion extends to the reduction of elevation requirements, where flood plain mapping exists, by the freeboard, provided the subject property is in the flood plain fringe area and that there are not major erosion or channel avulsions hazards in the immediate vicinity. As the subject property is on the fringe of the flood hazard as defined by the NWH report and there are no major erosion or channel avulsions in the immediate vicinity the recommended FCL could be reduced by the freeboard (0.6m) provided in the report. This would result in a FCL of 211.5m or about 1.0m to 1.5m above existing grade. It should be noted that parking is permitted below FCL by British Columbia floodproofing guidelines.

5.3 Flood Depth

The NHC report provides estimated ranges of Flood Depths during the 50-, 100- and 200-year flood events. The table below summarizes the Flood8 Depth estimates for the referenced flood events. The Flood Depth maps are attached to this report.

Flood Event Return Period (Yrs)	Estimated Flood Depth Range (m)	Description
50	0.0	N/A
100	0 to 0.5	Most houses are dry; walking in moving water or driving is potentially dangerous; basements and underground parking may be flooded; potentially causing evacuations
200	0.5 to 1.0	Water on ground floor,; basements and underground parking flooded; potentially causing evacuation; electricity failed; vehicles are commonly carried off roadways.

5.4 Flood Hazard Rating

The NHC report provides a Flood Hazard Rating for the 50-, 100- and 200- year flood events. The Flood Hazard Rating is based on the Flood Depth x (Flow Velocity + 0.5m/s).

Flood Event Return Period (Yrs)	Degree of Flood Hazard (m)	Description
50	0.0	N/A
100	Low (<0.75)	Caution: Flood zone with shallow flowing water or deep standing water.
200	Low (<0.75)	Caution: Flood zone with shallow flowing water or deep standing water.

5.5 Discussion

Based on the above discussion flooding for the subject property would only occur in the case of a 100 year or greater return period. For the design 200-year flood event the flood levels above existing grade are anticipated to be greater than 1.0m. Based on the inverse relationship for Flood Hazard versus Flood Depth, it is expected that deeper flood levels would result in slower water flow velocities. It is considered that the relatively low flow rates are associated with deeper water and shallow flood events with faster flow rates. As described in the Flood Hazard table above, the Degree of Flood Hazard is less than 0.75m shallow flowing water or standing deeper water. The NHC report indicates that a Degree of Flood Hazard between 0.75m and 1.25, would result in flowing water that would be dangerous for some (i.e. children). Hence it can be extrapolated that a Degree of Flood Hazard less than 0.75m could be resisted by a typical person, even children.

Part 16 and 16.1 of the Pemberton Building Bylaw allows for the Building Official to exercise the authority to provide an exemption to the for land that the Building Official considered that construction would be subject to flooding provided a report by a professional engineer who has assessed the condition of the land and certifies in the report the land may be safely used for its intended purposes. Section 16.2 indicates that if the report required under Section 16.1 is not provided or the engineer or geoscientist determines that the land cannot be used safely for the intended use a building permit may not be issued. Section 16.3 indicates that if the engineer or geoscientist certifies that land may be used safely for the use intended if used in accordance with the conditions specified in the report provided to the Chief Building Official, a permit may be issued subject to the following conditions:

a) the owner covenants with the Village to use the land only in the manner certified by the engineer or geoscientist as enabling the safe use of the land for the use intended;
b) the covenant contains conditions for reimbursing the Village for any expenses that may be incurred by it as a result of a breach of the covenant; and
c) the covenant is registered under section 219 of the Land Title Act (British Columbia).

Based on the above discussion Kontur cannot provide the assurance that the subject property can be used for residential/ commercial/ retail space below the FCL of 211.5m as such space would be considered habitable space by the Flood Management Land Use Guidelines and damage to the building and goods stored within without suitable precautions, would be possible. However, Section 1.3 of the Flood Management Land Use Guidelines further indicates that the review of the local government may not

support modification on technical grounds, but the applicant may nevertheless demonstrate a hardship. A valid hardship should only be recognized where the physical characteristics of the lot and size of the lot are such that building development proposals, consistent with land use zoning bylaws, cannot occur unless included requirements are reduced. In order to avoid setting difficult precedents these sites should be unique to the subject property and environs. In the case of the subject property, it is understood that similar difficulties would be present for several properties in the Pemberton downtown core.

Should the Village of Pemberton permit construction of retail/ commercial space below the FCL as indicated in the NHC report the following precautions are recommend:

- No area used for habitation below FCL be used for installation of heating, ventilating, electrical switches, major electrical switchgear or other equipment susceptible to damage by floodwaters unless the space is protected by engineered flood control doors or tanked up to the required elevation with continuous floodproofed concrete walls.
- There should be no openings or vents allowing floodwaters to enter electrical/ mechanical rooms, habitable spaces or storage areas.
- All cracks, ducts and pipes must be adequately sealed with non-shrink grout and all walls below the FCL are protected by the installation of an impermeable waterproof barrier.
- All windows below the FCL should be waterproofed.
- All drains within the building should have backwater preventers or valves installed to prevent backflow into areas below FCL as noted above.

Areas below recommended FCL may be used for parking, as it is not considered to be habitable space by provincial guidelines. If such space is to be developed there must be unobstructed pedestrian ingress and egress to areas above FCL as in directed in the "Flood Hazard Area Land Use Management Guidelines" 2004. No storage should be permitted in the below FCL areas. Electrical and mechanical equipment must be located above FCL. Any parts of the building constructed below FCL should be constructed with "flood resistant" materials not easily damaged by floodwater.

6.0 CLOSURE

The geotechnical comments and recommendations presented in this letter are based on the referenced information and Kontur's understanding of the project as described herein. If site conditions or project parameters differ from those described in this letter, Kontur should be notified promptly to review geotechnical aspects of the project and provide additional or modified comments and recommendations, as deemed appropriate. Contractors should make their own assessments of subsurface conditions at this site and select the construction means and methods that are most appropriate for encountered site conditions.

This letter has been prepared for the exclusive use of Stuart Sambell and/or their designated agents or consultants for the intended purpose described herein, that being for determination of suitable waterproofing for a proposed mixed-use building. Any use of the information contained in this letter for other than its intended purpose or by any other party must first be verified in writing by Kontur. Kontur does not accept any responsibility or damages because of any other party relying on or using the information, interpretations, opinions, comments, and/or recommendations that are contained in this letter.

Kontur trusts that the information described above meets your current requirements. If you should have any concerns or questions, please do not hesitate to contact the undersigned.

Sincerely,

Kontur Geotechnical Consultants Inc.
EGBC Permit to Practice #1000925

Per:

Evan Sykes, P.Eng.
Project Manager | Geotechnical Engineer

Reviewed by:

Matthew Yip MEng PEng
Principal | Geotechnical Engineer

Cc: Caroline Lamont, Bethel Corporation, clamont@bethelcorp.ca

Attachments: Interpretation and Use of Study and Report Document
Flood Hazard Maps

INTERPRETATION AND USE OF STUDY AND REPORT DOCUMENT

1.0 STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental engineering or consulting.

2.0 COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3.0 BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4.0 USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5.0 INTERPRETATION OF THE REPORT

Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

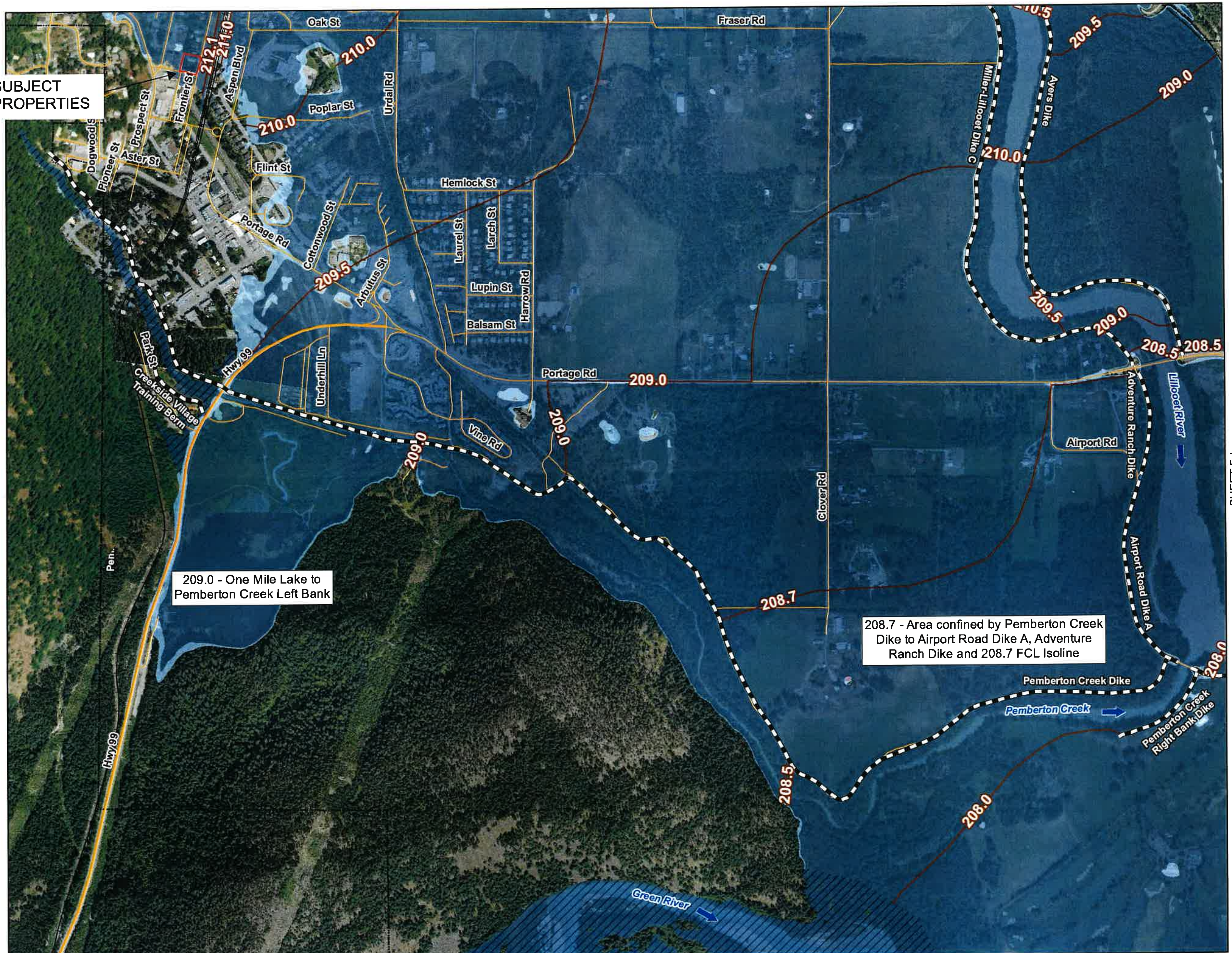
To avoid misunderstandings, KONTUR should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by KONTUR. Further, KONTUR should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with KONTUR's recommendations. Any reduction from the level of services normally recommended will result in KONTUR providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When KONTUR submits both electronic file and hard copies of reports, drawings and other documents and deliverables (KONTUR's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by KONTUR shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by KONTUR shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of KONTUR's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except KONTUR. The Client warrants that KONTUR's instruments of professional service will be used only and exactly as submitted by KONTUR.

The Client recognizes and agrees that electronic files submitted by KONTUR have been prepared and submitted using specific software and hardware systems. KONTUR makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.



PEMBERTON VALLEY DYKING DISTRICT

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Flow Direction
Dike
FCL Isoline
Railway
Major Road
Local Road
Pemberton Valley Dyking District
Flood Extents Including 0.6m Freeboard
Flood Extents
Flood Extents - Tributaries

Please refer to General Notes on Map Index Sheet

SCALE - 1:10,000

0 100 200 400 Metres

Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES Vertical Datum: CGVD(2013)

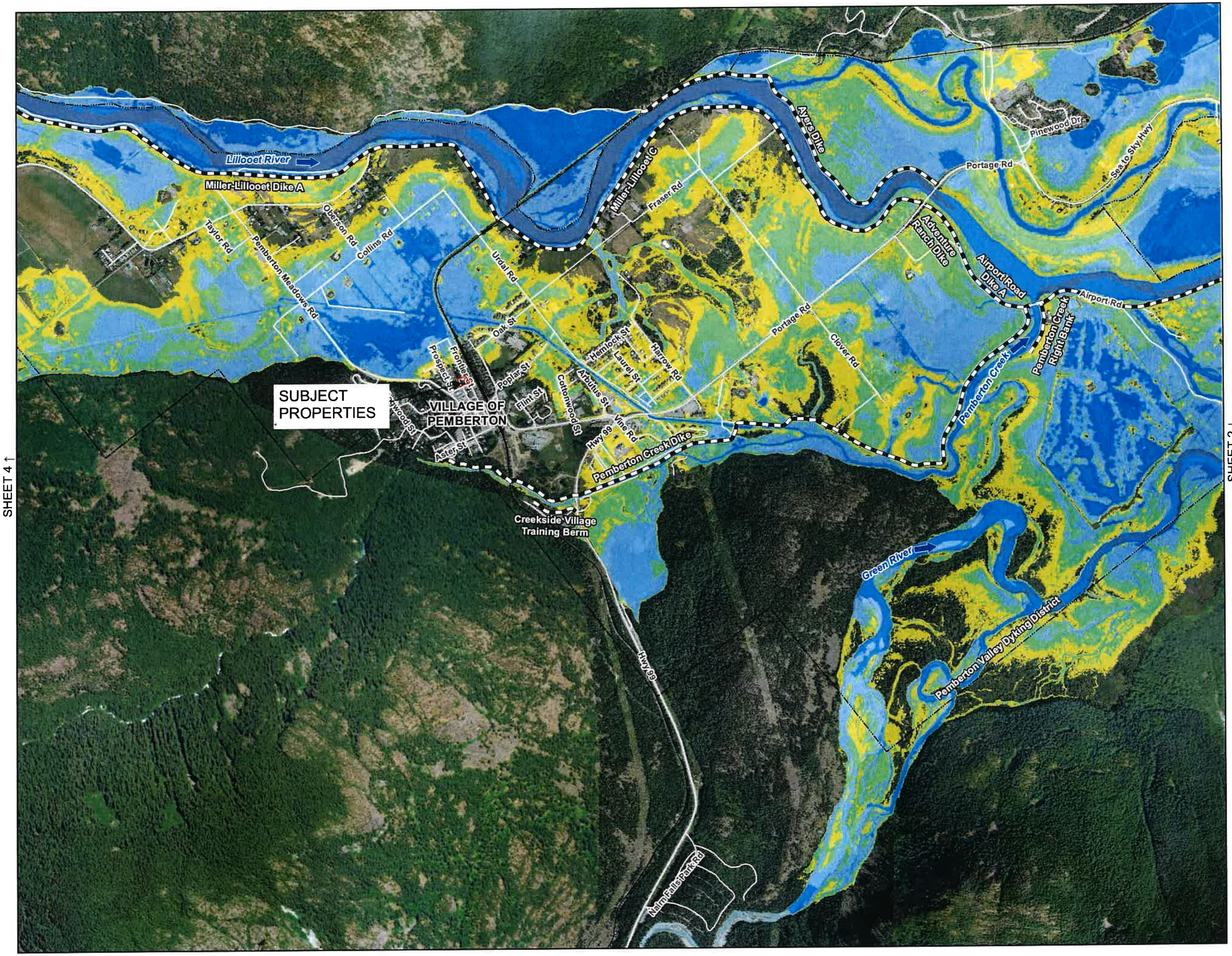
Engineer	GIS	Reviewer
CTL	MAO	MCM

Job Number	Date
3002903	31-AUG-2018

LILLOOET RIVER FLOODPLAIN STUDY

200-YEAR DESIGNATED FLOODPLAIN MAPS INCLUDING FREEBOARD

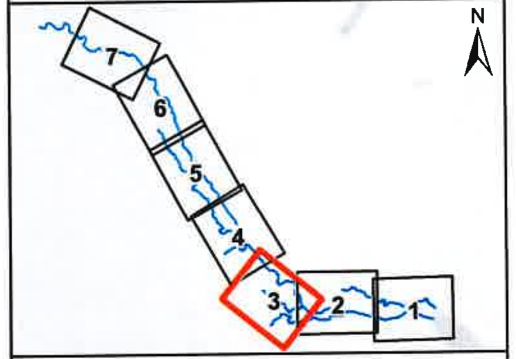
SHEET 4 ↑



SHEET 2 ↓

PEMBERTON VALLEY DYKING DISTRICT

nhc northwest hydraulic consultants



Flow Direction

Dike

Pemberton Valley Dyking District

Depth (m)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- > 5.0; River

0-0.5m: Most houses are dry; walking in moving water or driving is potentially dangerous; basements and underground parking may be flooded, potentially causing evacuation.
0.5-1.0m: Water on ground floor; basements and underground parking flooded, potentially causing evacuation; electricity failed; vehicles are commonly carried off roadways.
1.0-2.0m: Ground floor flooded; residents evacuate.
2.0-5.0m: First floor and often roof covered by water; residents evacuate.

Please refer to General Notes on Map Index Sheet

SCALE - 1:20,000

0 200 400 800 Metres

N

Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES Vertical Datum: CGVD(2013)

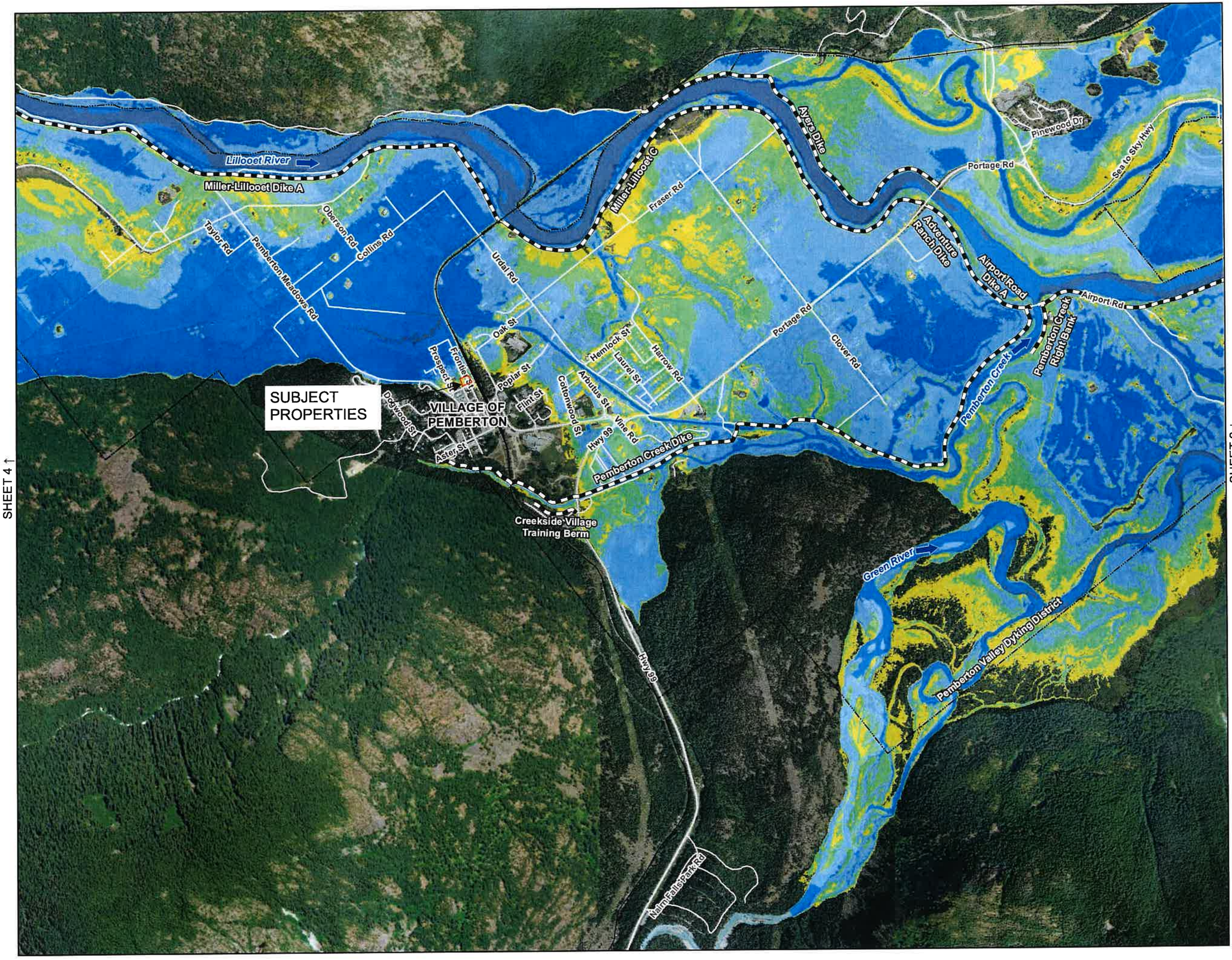
Engineer	*GIS*	*Reviewer*
CTL	*MAO*	*MCM*

Job Number	*Date*
3002903	*31-AUG-2018*

LILLOOET RIVER FLOODPLAIN STUDY

FLOOD DEPTH 50-YEAR LILLOOET EVENT

SHEET 3 OF 7



PEMBERTON VALLEY DYKING DISTRICT

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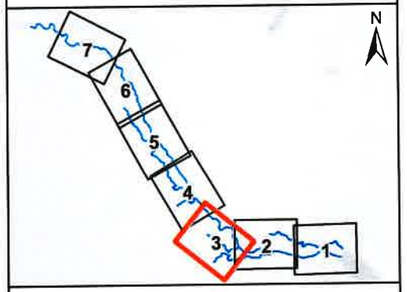
northwest hydraulic consultants



Flow Direction
Dike
Pemberton Valley Dyking District

Depth (m)
- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- > 5.0; River

0-0.5m: Most houses are dry; walking in moving water or driving is potentially dangerous; basements and underground parking may be flooded, potentially causing evacuation.
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Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES Vertical Datum: CGVD(2013)

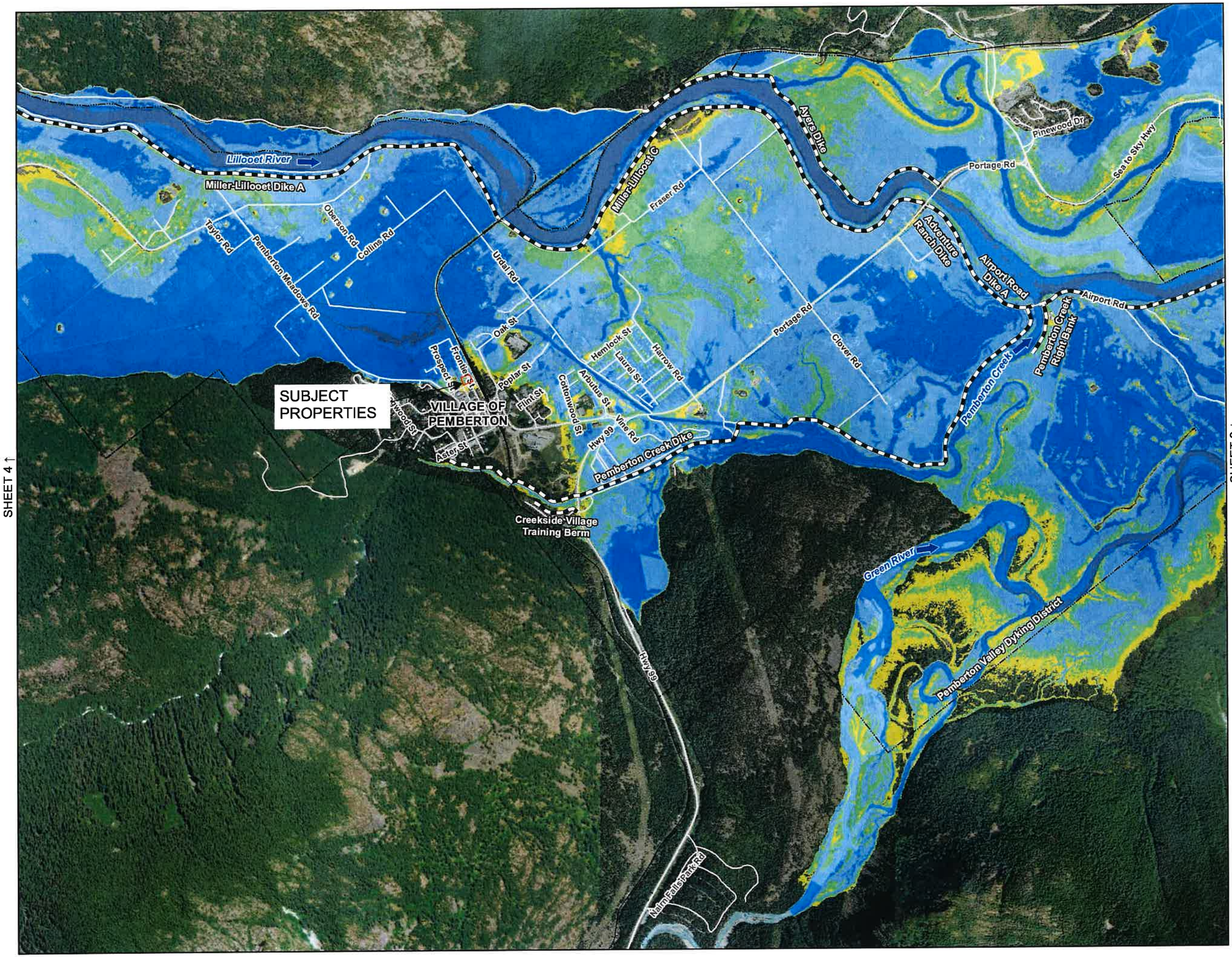
Engineer	GIS	Reviewer
CTL	MAO	MCM

Job Number	Date
3002903	31-AUG-2018

LILLOOET RIVER FLOODPLAIN STUDY

FLOOD DEPTH 100-YEAR LILLOOET EVENT

SHEET 3 OF 7



PEMBERTON VALLEY DYKING DISTRICT

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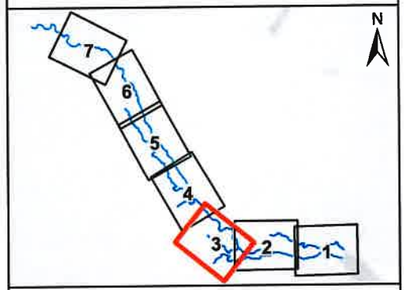

Flow Direction
Dike
Pemberton Valley Dyking District

Depth (m)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- > 5.0; River

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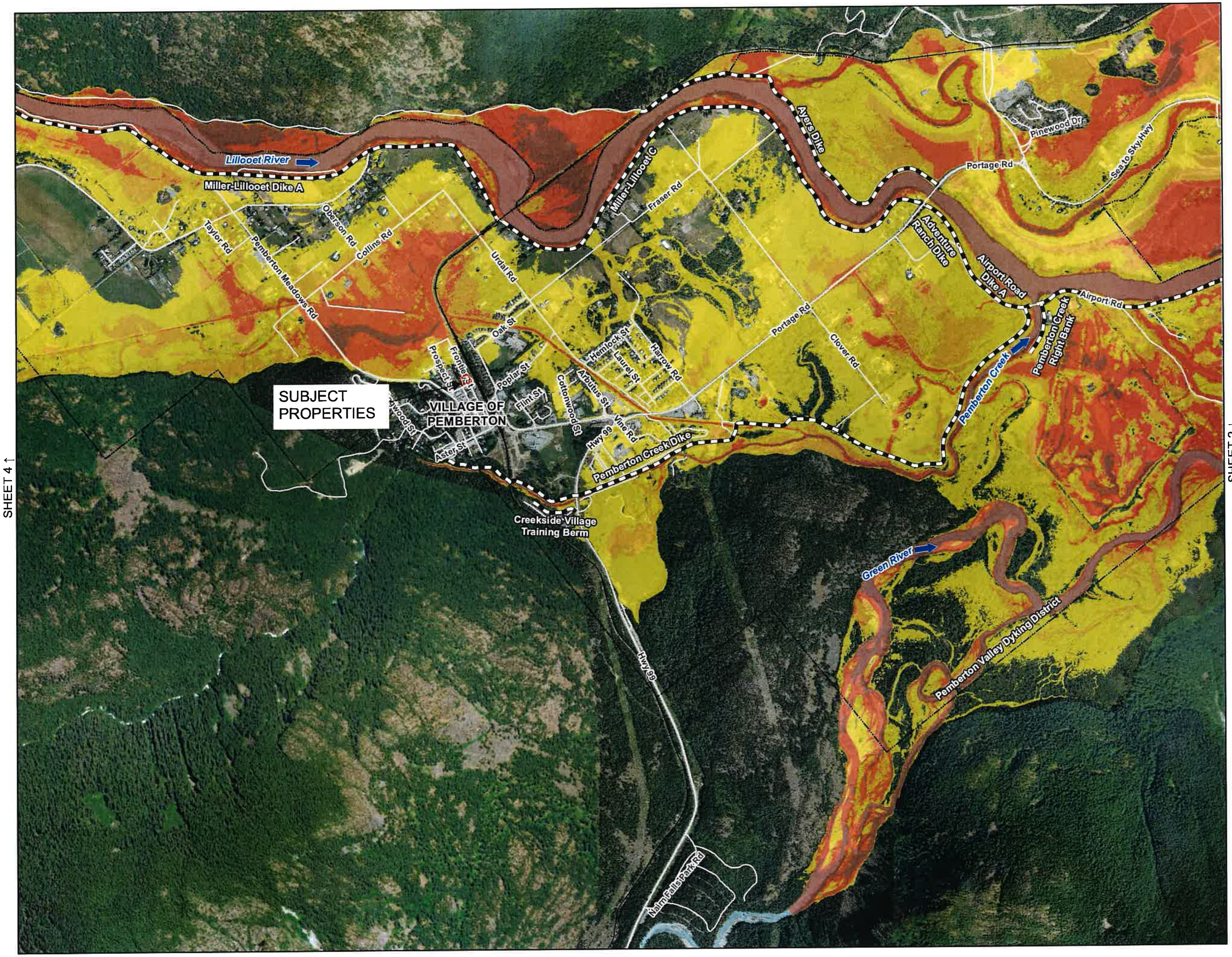
LILLOOET RIVER FLOODPLAIN STUDY

FLOOD DEPTH 200-YEAR LILLOOET EVENT

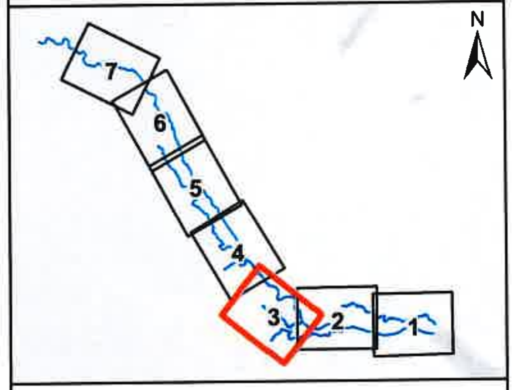
SHEET 3 OF 7

MAO, O:\3002903_Lillooet_River\GIS\05_GIS_Sea3\3002903_Lillooet_FloodOverview_Depth.mxd



PEMBERTON VALLEY DYKING DISTRICT

nhc northwest hydraulic consultants



Flow Direction

Dike

Pemberton Valley Dyking District

Hazard Rating (m*m/s)

Hazard Rating = Depth x (Velocity + 0.5)

Low: < 0.75

Moderate: 0.75 - 1.25

Significant: 1.25 - 2.5

Extreme: > 2.5

Low: Caution - Flood zone with shallow flowing water or deep standing water.

Moderate: Dangerous for some (i.e. children) - flood zone with deep or fast flowing water.

Significant: Dangerous for most people - flood zone with deep fast flowing water.

Extreme: Dangerous for all - flood zone with deep, fast flowing water.

Please refer to General Notes on Map Index Sheet

SCALE - 1:20,000

0 200 400 800 Metres

N

Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES Vertical Datum: CGVD(2013)

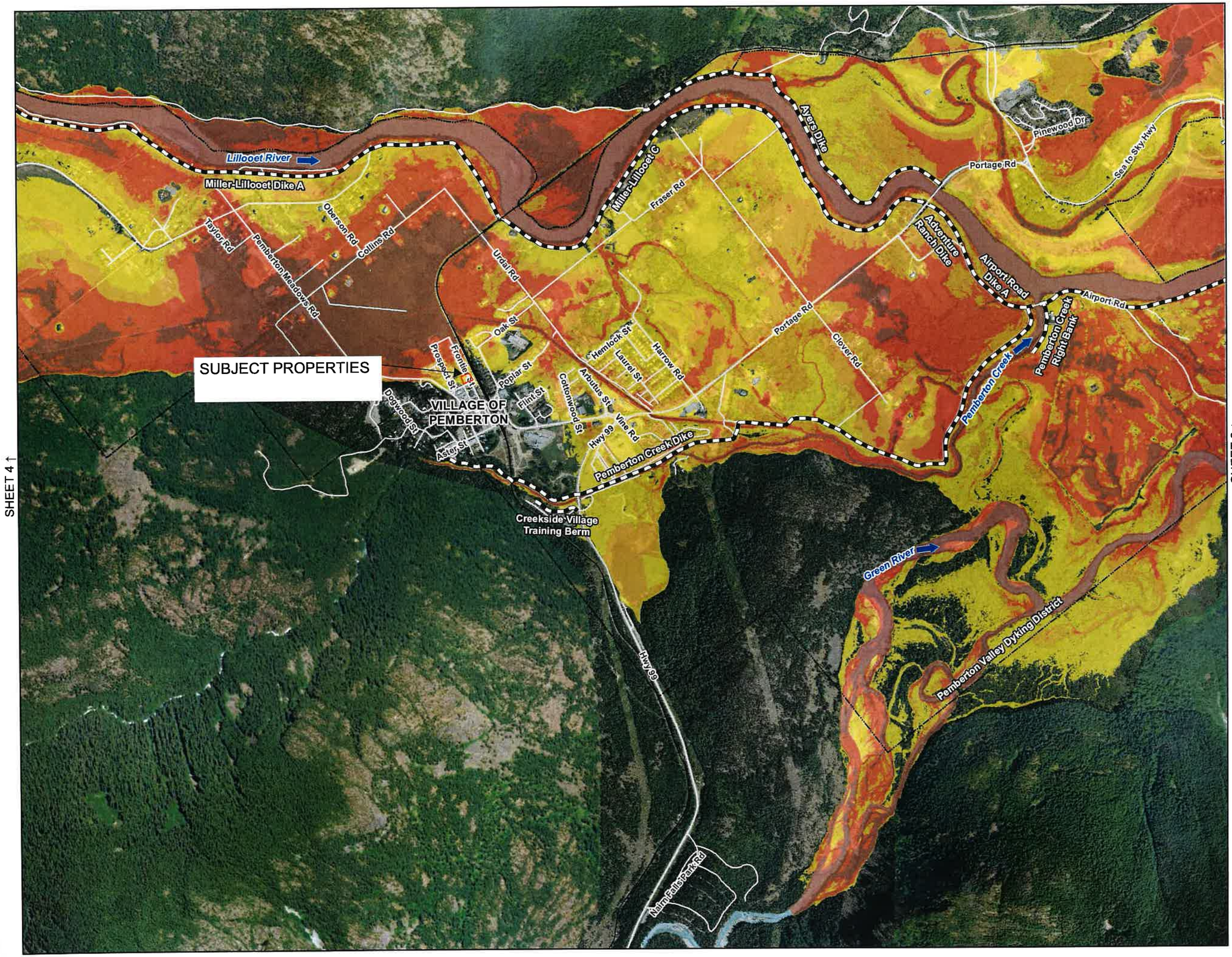
Engineer	GIS	Reviewer
CTL	MAO	MCM

Job Number	Date
3002903	31-AUG-2018

LILLOOET RIVER FLOODPLAIN STUDY

FLOOD HAZARD RATING
50-YEAR LILLOOET EVENT

SHEET 3 OF 7



PEMBERTON VALLEY DYKING DISTRICT

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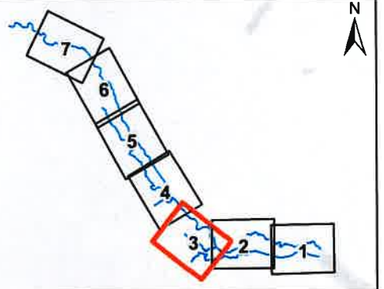


Flow Direction
Dike
Pemberton Valley Dyking District

Hazard Rating (m*m/s)
Hazard Rating = Depth x (Velocity + 0.5)
- Low: < 0.75
- Moderate: 0.75 - 1.25
- Significant: 1.25 - 2.5
- Extreme: > 2.5

Low: Caution - Flood zone with shallow flowing water or deep standing water.

Moderate: Dangerous for some (i.e. children) - flood zone with deep or fast flowing water.

Significant: Dangerous for most people - flood zone with deep fast flowing water.

Extreme: Dangerous for all - flood zone with deep, fast flowing water.

Please refer to General Notes on Map Index Sheet

SCALE - 1:20,000

0 200 400 800 Metres

N

Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES Vertical Datum: CGVD(2013)

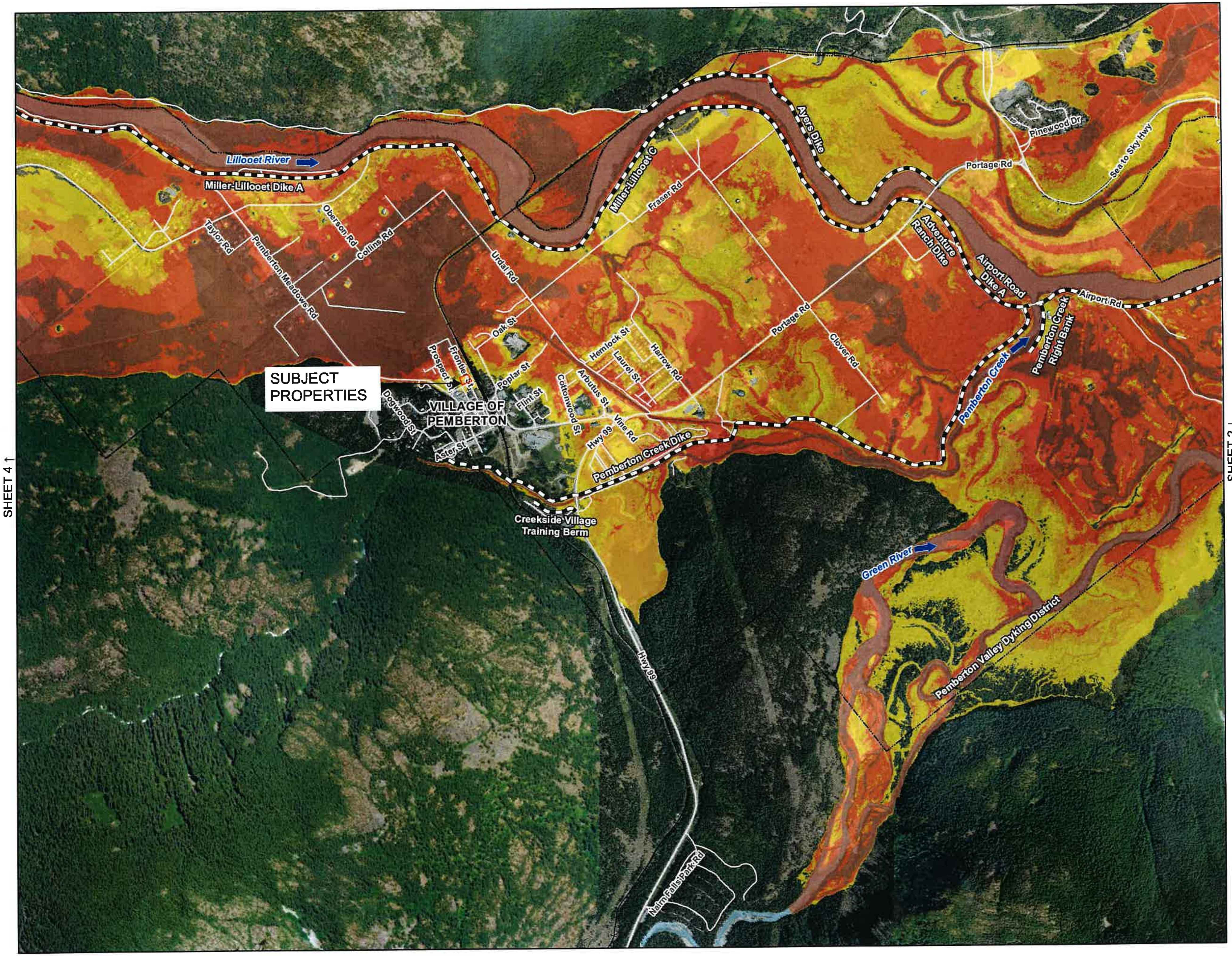
Engineer	GIS	Reviewer
CTL	MAO	MCM

Job Number	Date
3002903	31-AUG-2018

LILLOOET RIVER FLOODPLAIN STUDY

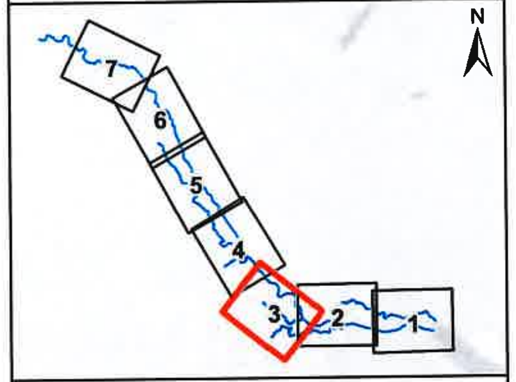
FLOOD HAZARD RATING 100-YEAR LILLOOET EVENT

SHEET 3 OF 7



PEMBERTON VALLEY DYKING DISTRICT

nhc northwest hydraulic consultants



- Flow Direction
- Dike
- Pemberton Valley Dyking District

Hazard Rating (m*m/s)

Hazard Rating = Depth x (Velocity + 0.5)

- Low: < 0.75
- Moderate: 0.75 - 1.25
- Significant: 1.25 - 2.5
- Extreme: > 2.5

Low: Caution - Flood zone with shallow flowing water or deep standing water.

Moderate: Dangerous for some (i.e. children) - flood zone with deep or fast flowing water.

Significant: Dangerous for most people - flood zone with deep fast flowing water.

Extreme: Dangerous for all - flood zone with deep, fast flowing water.

Please refer to General Notes on Map Index Sheet

SCALE - 1:20,000

0 200 400 800 Metres

Coordinate System: NAD 1983 UTM ZONE 10N
Units: METRES Vertical Datum: CGVD(2013)

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3002903	31-AUG-2018

LILLOOET RIVER FLOODPLAIN STUDY

FLOOD HAZARD RATING 200-YEAR LILLOOET EVENT

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