

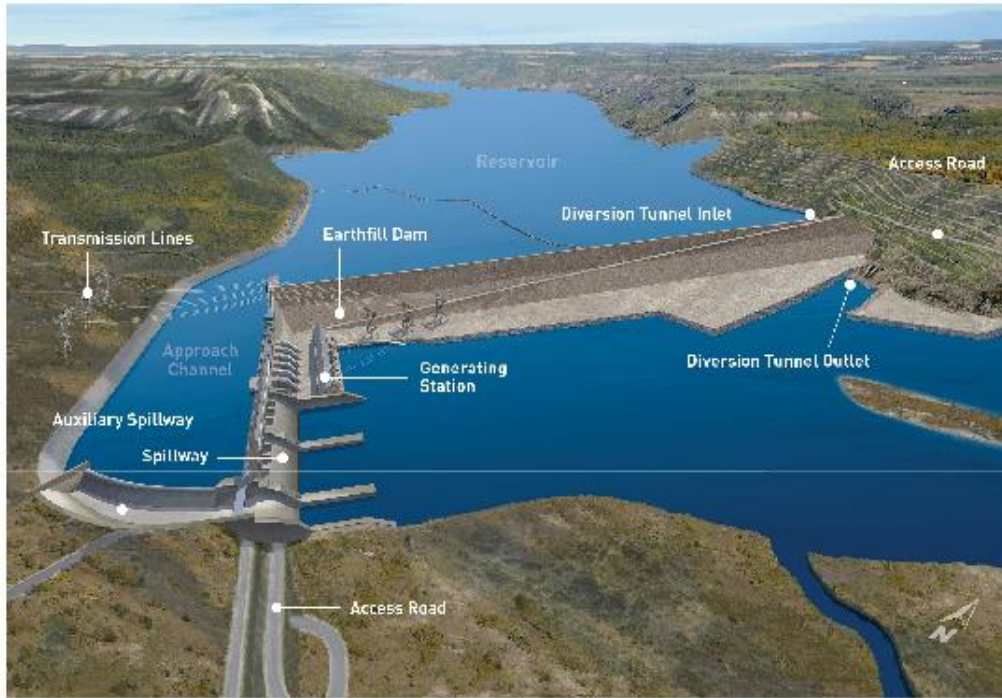
Site C Dam - Inadequate Hydrogeological Assessment and Lack of Assessment of Cumulative Effects



By Dr. Gilles Wendling, GW Solutions, BC, Canada

Montpellier, September 2016





BChydro

SITE C CLEAN ENERGY PROJECT

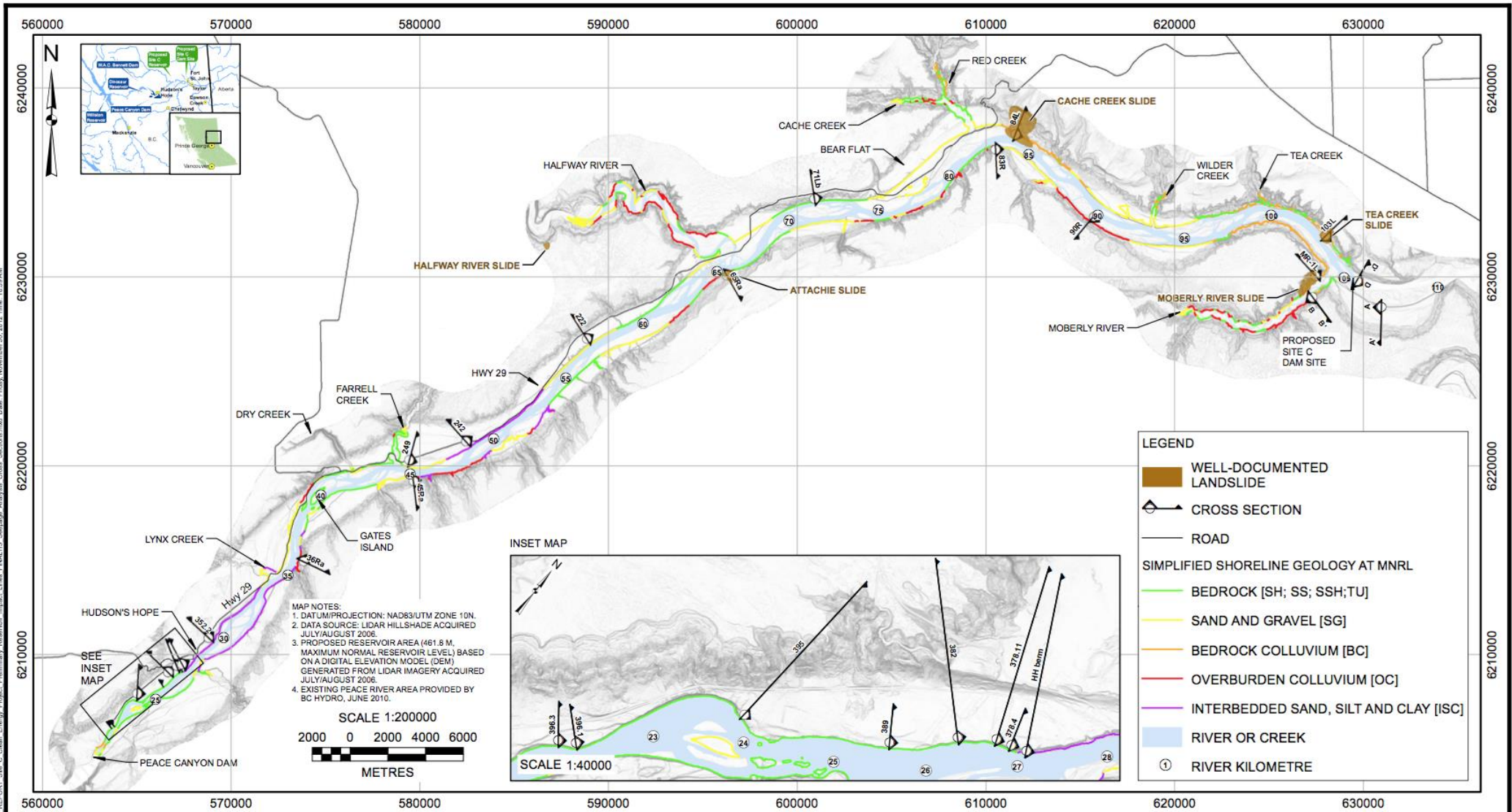
Figure 4.13 Artist's rendition of dam, generating station, and spillways



Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification

Lack of Information

Seepage Analysis Cross-Sections with SEEP/W



REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	1:200,000	PROFESSIONAL SEAL:	
DATE:	NOV 2012		
DRAWN:	LL		
DESIGNED:	KV		
CHECKED:	SM		
APPROVED:	MP		

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

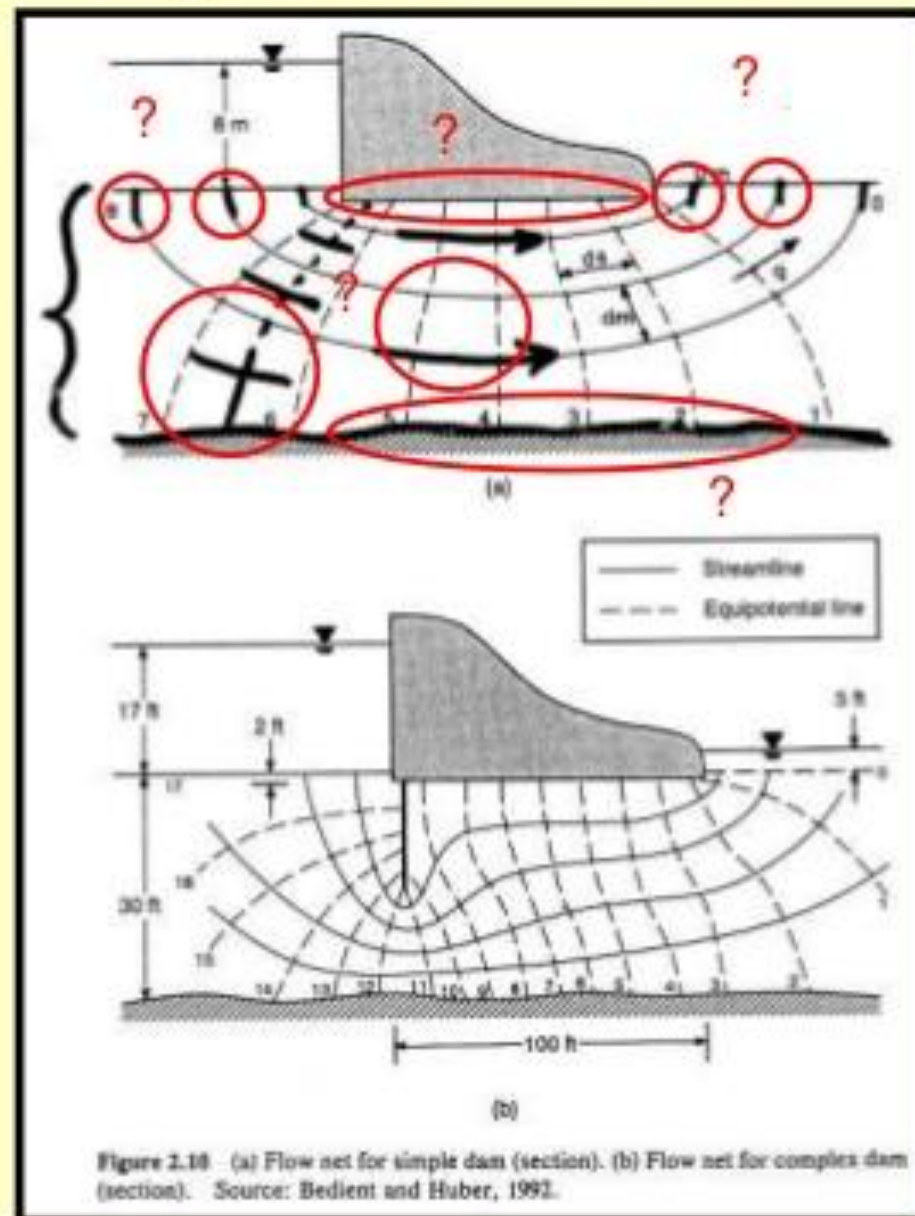
CLIENT: **BC Hydro**

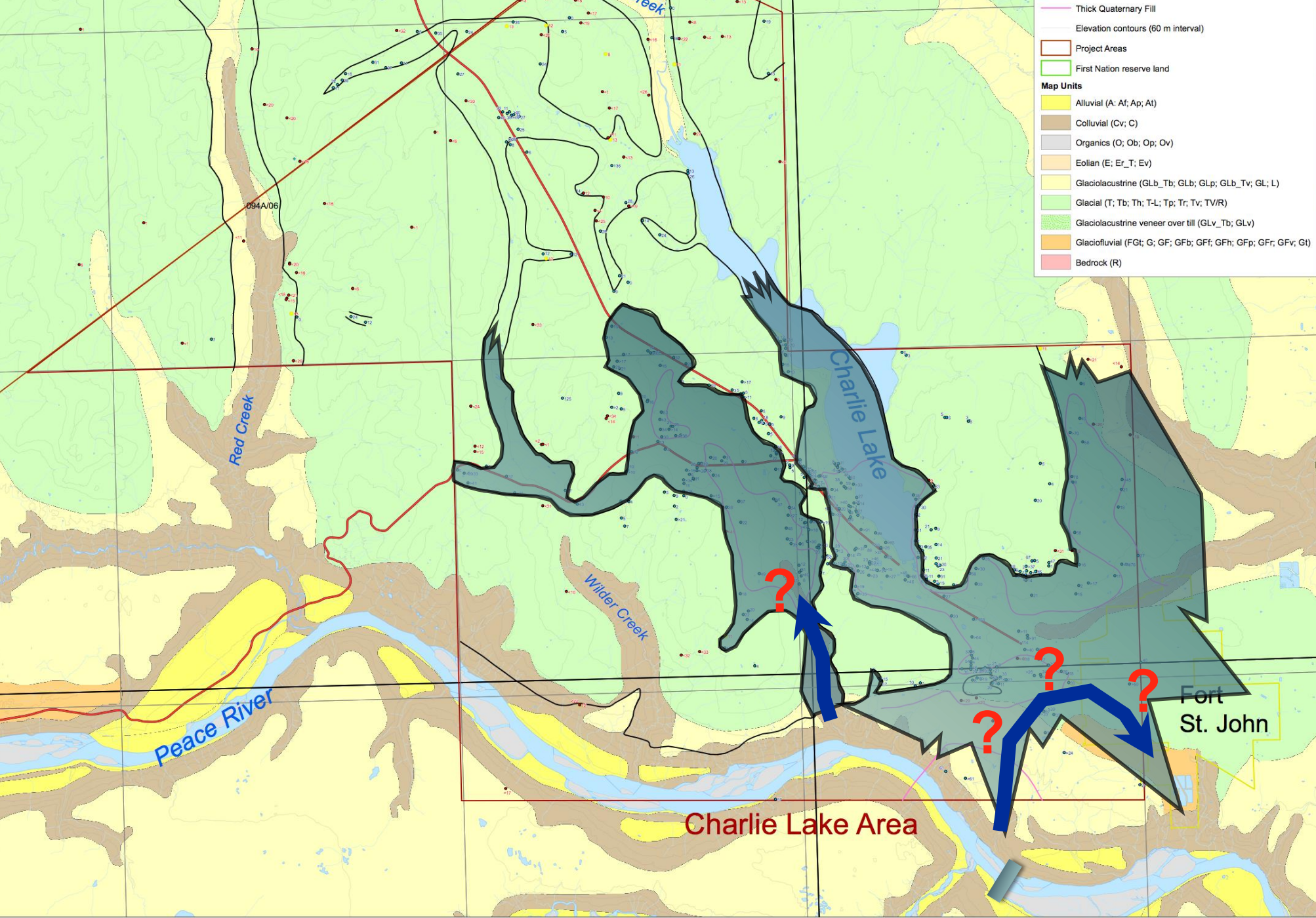
PROJECT: SITE C CLEAN ENERGY PROJECT PRELIMINARY RESERVOIR IMPACT LINES – FINAL		
TITLE: SEEPAGE ANALYSIS CROSS SECTIONS		
PROJECT No.: 0521011	DWG No.: 13	REV.:

X:\Projects\0521011 - Site C\0521011-01 - Site C\0521011-01 - Seepage Analysis - Cross Sections.mxd Date: Friday, November 26, 2012 Time: 15:59:44
 REPORT: Site C Clean Energy Project - Preliminary Reservoir Impact Lines - FINAL - Seepage Analysis - Cross Sections.mxd Date: Friday, November 26, 2012 Time: 15:59:44

GW Movement
Near Dam
&
Paleovalleys

Effects of Boundary Condition on Shape of Flow Nets

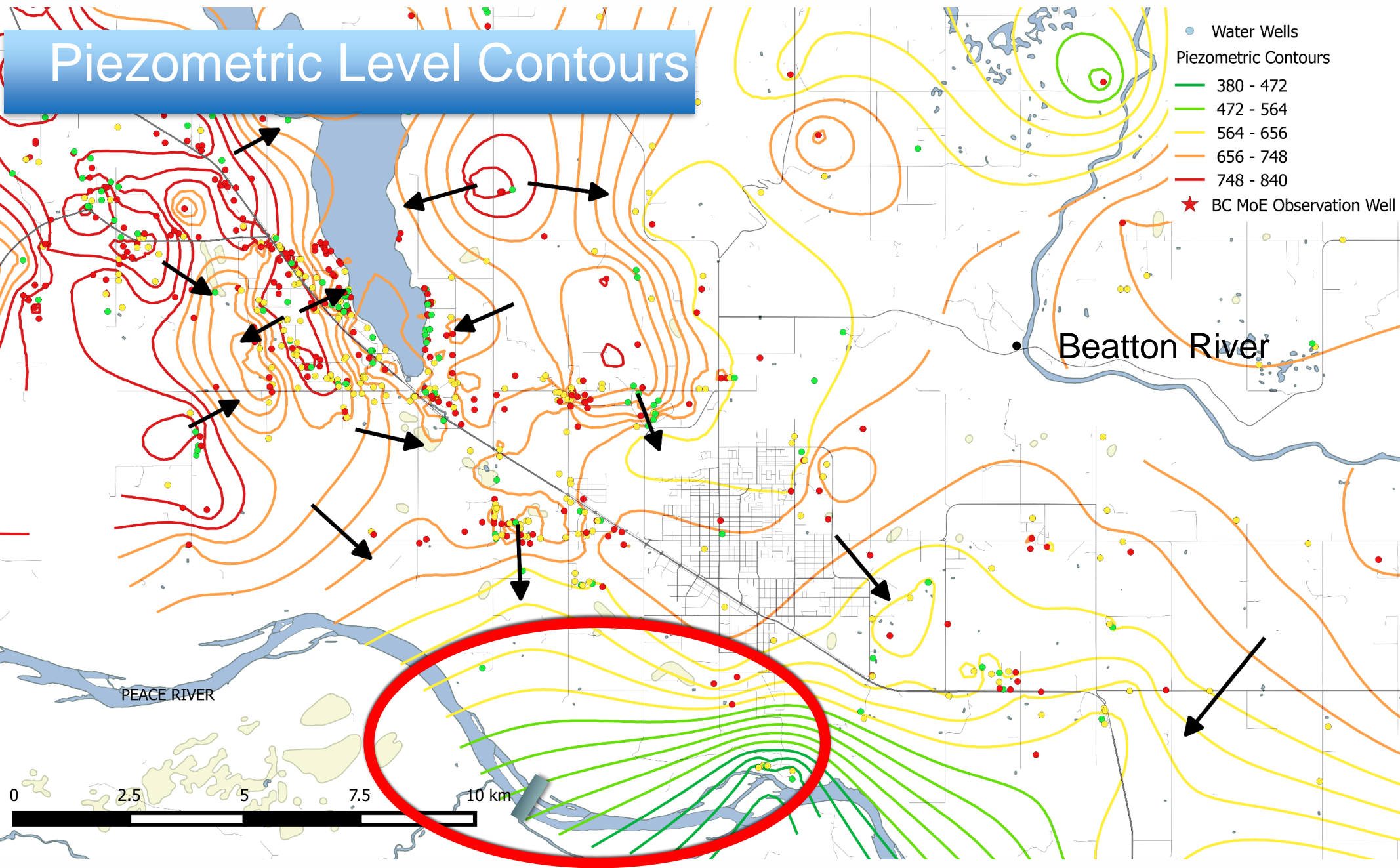




Advance access to map provided by
Geoscience BC

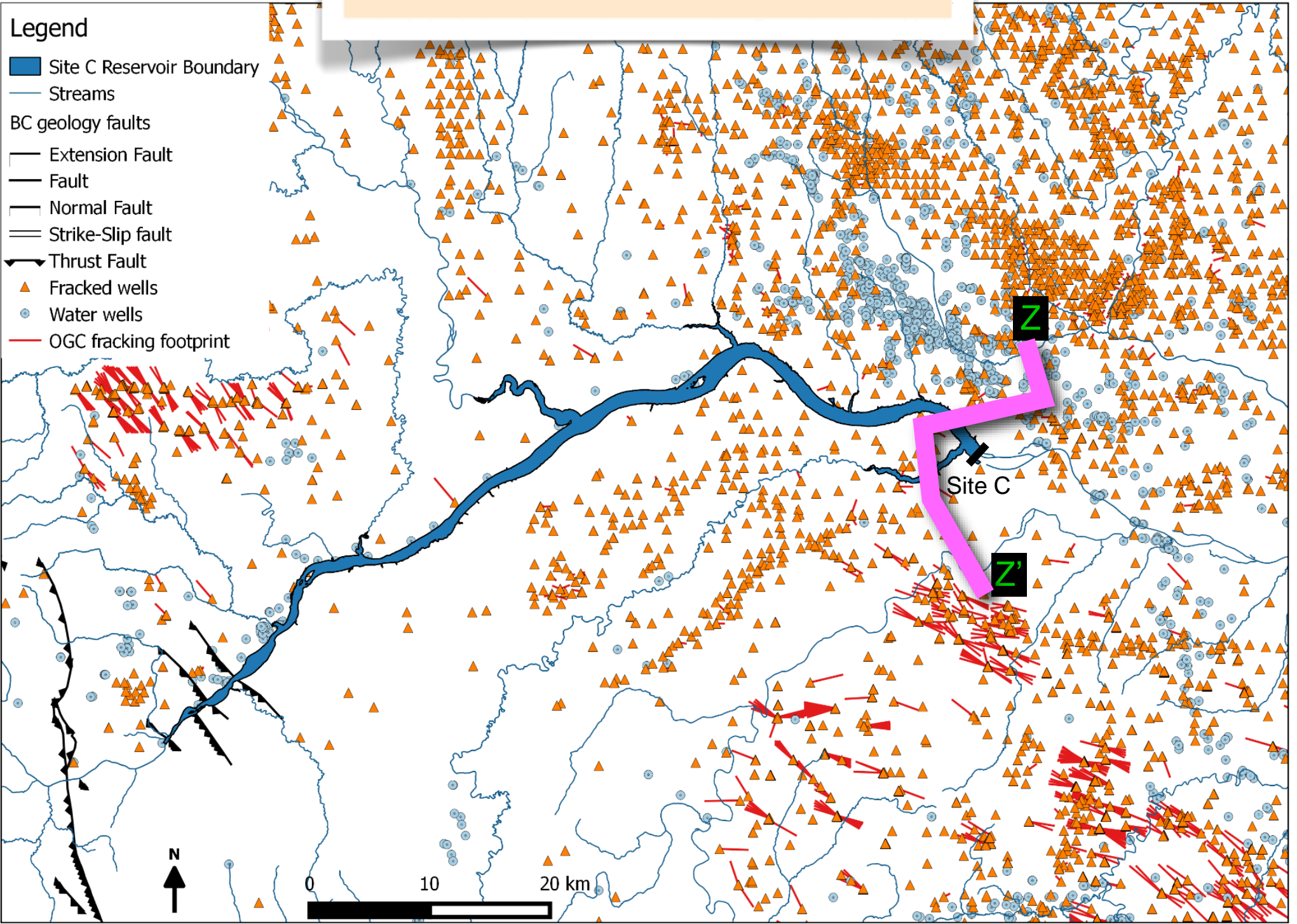
(Modified from Petrel Robertson)

Piezometric Level Contours

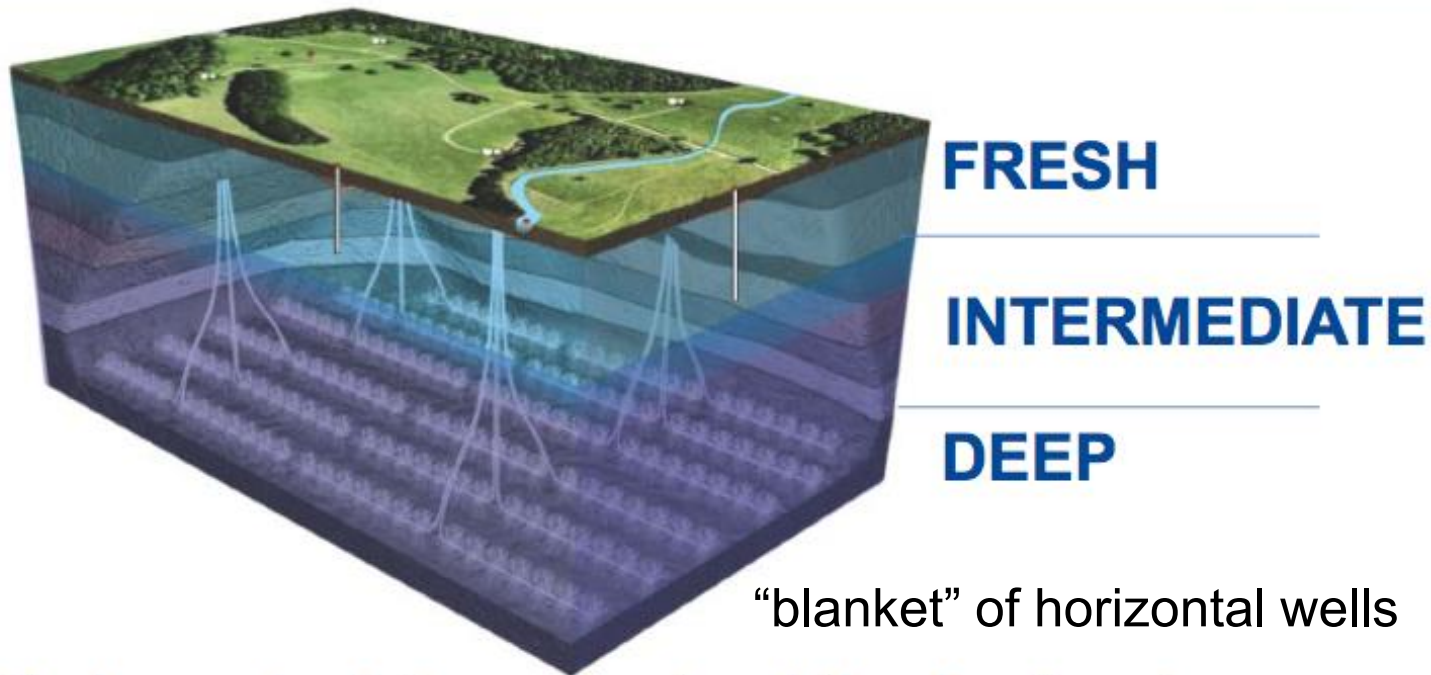


Groundwater and Oil&Gas Wells

Cumulative Effects



Three Zones Terminology



Hydrogeologists understand the freshwater zone and petroleum industry scientists/engineers understand the deep zone.

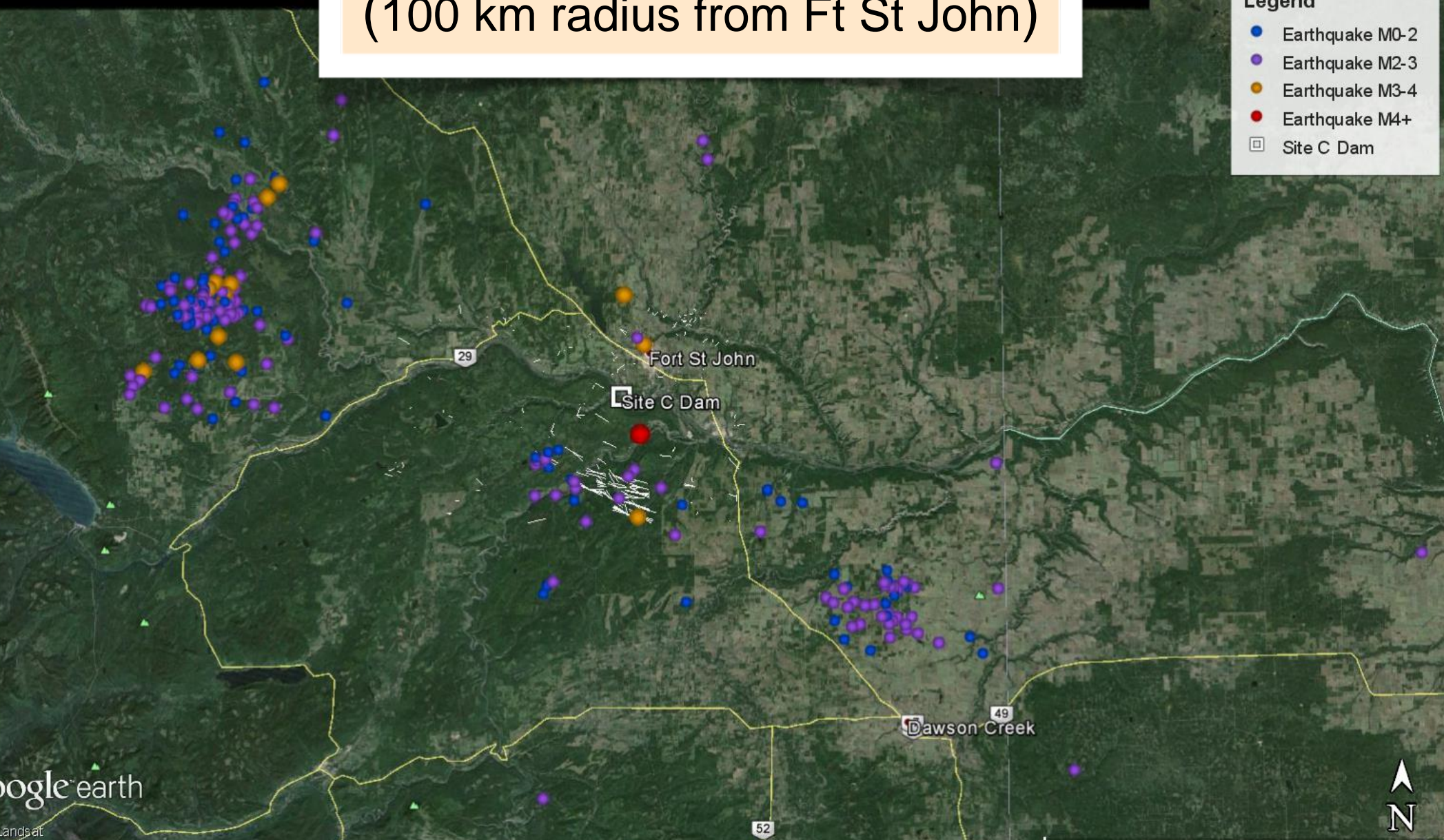
Nobody understands the Intermediate zone.



Earthquakes since 2011 (100 km radius from Ft St John)

EarthQuakes Canada

- Legend
- Earthquake M0-2
 - Earthquake M2-3
 - Earthquake M3-4
 - Earthquake M4+
 - Site C Dam



Effects on fractures in the bedrock & Deep wells seals ?

Legend

- Earthquake location
- Site C Dam

2013/05/28 04:36:08 Magnitude: 4.2

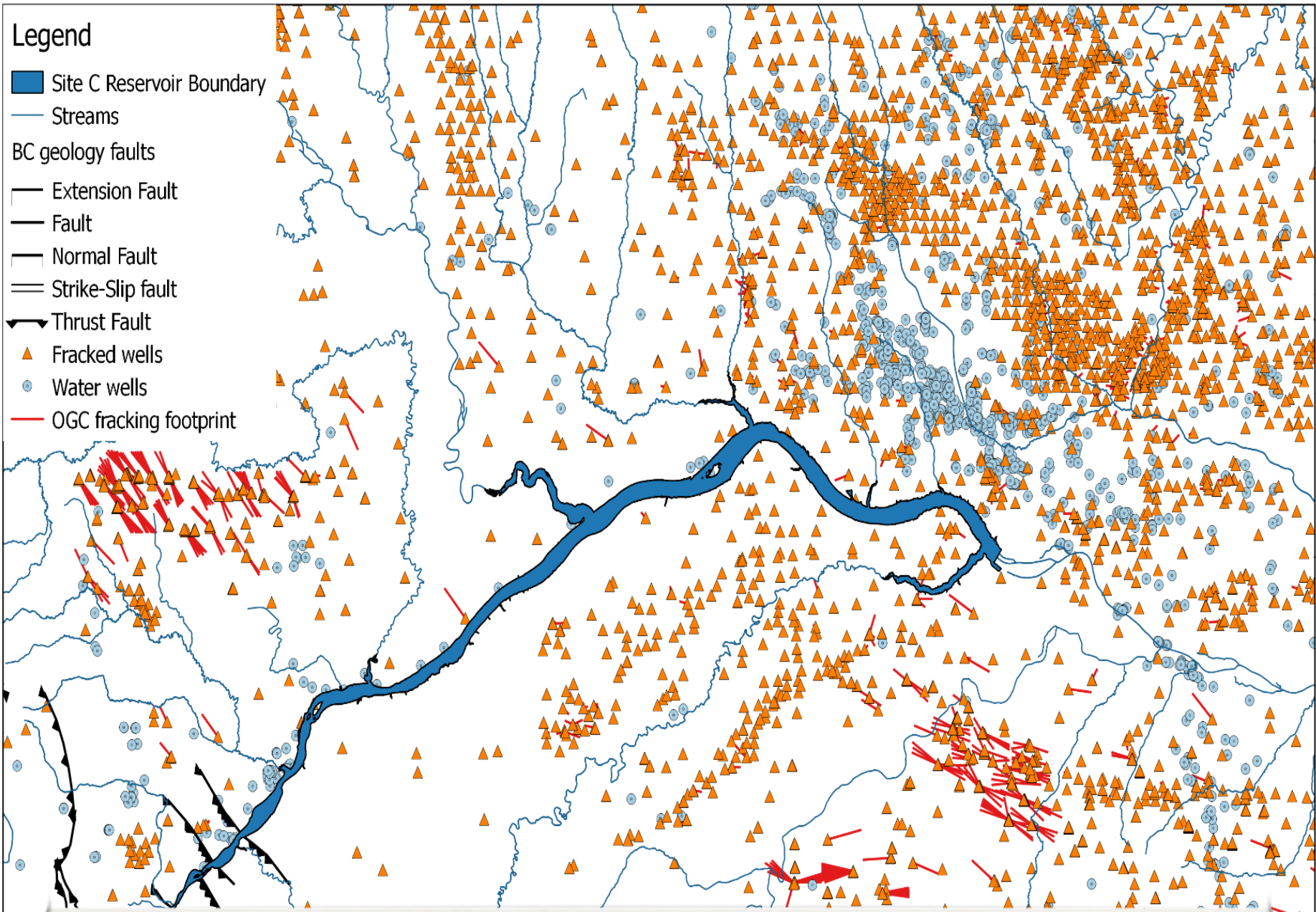
Date	2013/05/28
Heure(TU)	04:36:08
Magnitude	4.2
Latitude	56.145
Longitude	-120.868
Profondeur	5.0 km (fixe par sismologue)
Lieu	11 km S de Fort St. John

Directions: [To here](#) - [From here](#)

6.5 km

Legend

- Site C Reservoir Boundary
- Streams
- BC geology faults
 - Extension Fault
 - Fault
 - Normal Fault
 - Strike-Slip fault
 - Thrust Fault
- Fracked wells
- Water wells
- OGC fracking footprint



Cumulative Effects in 50, 100, 200 years??



Key Question

- In 120 years (7 generations) how is the groundwater discharging to the Peace River going to be modified due to the cumulative effects of:
 - The Site C reservoir;
 - Aged/degraded O&G wells;
 - Disposed liquid waste in disposal wells;
 - Induced earthquakes (more fractured bedrock + cracked O&G wells)?

Thank you



Photo: Gilles Wendling

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Montpellier, France, September 2016