



QUALIFICATIONS AND LIMITATIONS OF THE SITE CLASS AND SUSCEPTIBILITY TO AMPLIFICATION OF SEISMIC GROUND MOTION HAZARD MAP

- The map is intended for regional planning and assessment purposes only and should not be used for site-specific evaluations.
- The map reflects the relative variation in the susceptibility to the amplification of seismic ground motions due to the variation in shallow geological conditions. It does not address the seismic hazard directly because the regional variation in natural and induced seismicity is not considered.
- The map is based on a compilation of published surficial geological maps prepared at scales of 1:20,000 to 1:250,000, and is presented at a scale of 1:250,000. Consequently, the map lacks fine scale detail. Furthermore, the susceptibility to amplification of ground motions is dependent on subsurface conditions, which are indirectly indicated by the surface maps. Because of these factors, the map unit boundaries are approximate, may enclose smaller occurrences of other map units, and are subject to revision as more data become available. Furthermore, geological materials are variable, and deposits of a map unit may locally have unusual properties. Thus, the susceptibility at a specific site could be either higher or lower than that shown on this map.
- The susceptibility to amplification of ground motion hazard has been estimated on the basis of the National Earthquake Hazard Reduction Program (NEHRP) Site Classes (Building Seismic Safety Council, 2003), which are based on the average response of various types of soils. Variation in amplification factors within a site class is to be expected.
- This map does not fully address man-made alterations to ground conditions, nor considers the seismic stability of dams.
- This map does not directly address other earthquake hazards such as amplification of ground motion due to topography and three-dimensional effects, or earthquake-induced liquefaction and slope instability.
- This map cannot be used on its own to predict the amount of damage that could occur at any one site because other factors, such as building type and construction details, must be considered.



Map 2. NEHRP Site Class and susceptibility to amplification of seismic ground motion, Peace Project Area

Date: November 2018 Projection: UTM Zone 10N Datum: NAD 83
Scale: 1: 250 000 Map 2
PETREL ROBERTSON CONSULTING LTD.

To accompany Geoscience BC Report 2016-16 "Mapping the Susceptibility to Amplification of Seismic Ground Motions in the Monney Play Area of Northeast British Columbia" by P.A. Monahan, V.M. Levson, B.J. Hayes, K. Dorey, Y. Mykula, R. Brenner, J. Clarke, B. Galambos, C. Candy, C. Krummiegel, and E. Calderwood

Site Class Assignments by Patrick A. Monahan and Victor M. Levson
Compilation of surficial geology by:
Victor M. Levson, Quaternary Geosciences Inc.
GIS and Cartography by: Mike A. Fournier, MAF Geographix,
Martin C. Perla, Petrel Robertson Consulting Ltd.



0 2.5 5 10 15 20 25
Kilometers

Legend

Vs Sites

Field Sites

Petroleum Wells

BR Depth

0 - 5

5 - 10

10 - 20

20 - 30

30 - 100

100 - 1000

Geotechnical Data

BR Depth

0 - 5

5 - 10

10 - 20

20 - 30

30 - 100

100 - 1000

No BR Depth

Well Total Depth - No BR Reported

<30m

30 - 50m

>50m

Water Wells

BR Depth

0 - 5

5 - 10

10 - 20

20 - 30

30 - 100

100 - 1000

Well Total Depth - No BR Reported

<30m

30 - 50m

>50m

Project Area

Site Classes

Site Class	Susceptibility to amplification of seismic ground motions	Map unit	Principal surficial lithologies
N/A	No Site Class assigned. moderate to high hazard due to moderate to steep slopes	colluvial	slopes on steep valley walls incised into bedrock and unconsolidated sediments, steep slopes in foothills
D ₁ *	Moderate	Alluvial	modern alluvium, sand, gravel and silt of floodplains, islands and bars of modern streams
D ₂ *	Moderate	organic	peat overlying glaciolacustrine silt or till
D ₃ *	Moderate	colluvial	sand dunes and loess overlying glaciolacustrine silt
D ₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₂₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₃₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₄₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₅₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₆₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₇₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₈₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₁ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₂ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₃ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₄ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₅ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₆ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₇ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₈ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₉₉ *	Moderate	glaciolacustrine	silt, clays and very fine sands
D ₁₀₀ *	Moderate	glaciolacustrine	silt, clays and very fine sands

*Units D₁, D₂, and D₃ consist of different surficial deposits. They are all in Site Class D, where they are sufficiently thick, but elsewhere are in Site Class C. The differences between the units is the approximate minimum thickness of the surficial deposits required for any one location to be in Site Class D. In unit D₁, it is 20 m; in D₂, it is 15 m; and in D₃, it is 8 m.

Amplification of short-period ground motions due to resonance may occur where Holocene and recessional phase deposits of the last glaciation are a few metres thick. These areas could occur on either side of the boundaries between the glaciolacustrine, glaciolacustrine, glaciolacustrine, organic and silt map units on one hand and the glacial and glaciolacustrine map units on the other. Resonance occurs where the site period matches the period of the dominant ground motions. Structures with the same natural period as the site would be particularly vulnerable to damaging ground motions there.

Geotechnical borehole data obtained outside the project boundary contributed to the interpretations.

Petroleum well data plotted includes all wells with shallow gamma ray log normalized and interpreted for this project and the Petrel Robertson Consulting Ltd. depth to bedrock study (2016). These data sets include well data outside the project boundary.

Site Class Definitions*			
Site class	General description	Definition by V _{sh} (m/s)	Susceptibility Rating
A	Hard rock	V _{sh} > 1500	Nil
B	Rock	750 < V _{sh} < 1500	very low
C	Very dense soils and soft rock	350 < V _{sh} < 750	low
D	Stiff soils	180 < V _{sh} < 350	moderate
E	Soft soils, or soil profile with >3 m soft silt or clay	V _{sh} < 180, or >3m silt and clay with plasticity index >20, moisture content >40%, and undrained shear strength <25 kPa	high

V_{sh} is the time-averaged V_s in the upper 30 m (i.e. harmonic mean), and is calculated using the following formula:
V_{sh} = 2V_s / (1 + V_s / V_h)
where:
V_s = each measured interval thickness, where V_s = 30 m, and
V_h = the measured interval travel time; 1 = 1/V_s for each interval
(Building Seismic Safety Council, 2003). Susceptibility ratings from Hollingshead and Watts, 1994.