LGMA
LOCAL GOVERNMENT MANAGEMENT ASSOCIATION OF BRITISH COLUMBIA
LEARN, LEAD, GROW

GEOTECHNICAL HAZARDS

GEOTECHNICAL HAZARDS

APPROVING OFFICER ROLE

- APEGBC – Site safe for intended use?
- Rezoning
- Development Permit
- Subdivision

APPROVING OFFICER ROLE

- The Approving Officer may reject an application if the AO considers that:
- the land is subject, or could reasonably be expected to be subject, to erosion, land slip or avalanche. This is obviously of particular significance on hillsides. Some evidence that the Approving Officer may look for during a site inspection to determine if a hazard exists is:

• debris at the bottom of a slope;
• evidence of rock fall;
• pistol butt trees (i.e., trees that grow out from the side of a steep slope at a near horizontal angle and then curve up to take the shape of a pistol - these trees are indicative of steep and potentially unstable banks); or
• cracks or fissures in a slope.

WHEN IN DOUBT ASK THE EXPERTS

GEOTECNICAL HAZARDS

Introduction
Current Legislation
Seismic Considerations
Settlement
Slope Stability
Stability Assessments
Stabilization Methods
Global Stability Considerations
Approval Officer Role
Question and Answer

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GEOTECHNICAL HAZARDS

Hazard – Source of potential harm, in terms of human injury, damage to health or property.

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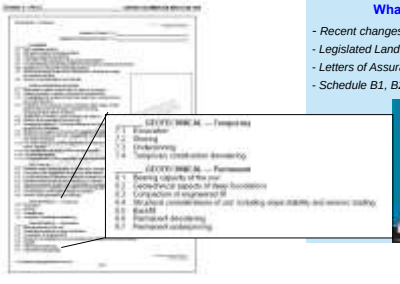
GEOTECHNICAL HAZARDS



What's New?

- *Recent changes to the Building Code*
- *Legislated Landslide Assessments*
- *Letters of Assurance*
- *Schedule B1, B2, and CB*

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GEOTECHNICAL HAZARDS

Hazard – Source of potential harm, in terms of human injury, damage to health or property.

Geotechnical Hazards:

- Seismic
- Settlement
- Slopes
- Flooding

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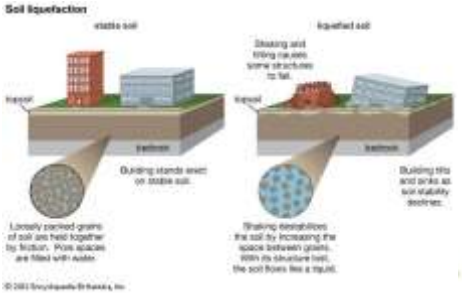
GEOTECHNICAL HAZARDS

Seismic hazards that require geotechnical consideration:

- Liquefaction
- Slope Instability

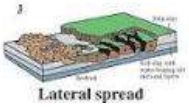
GEOTECHNICAL HAZARDS

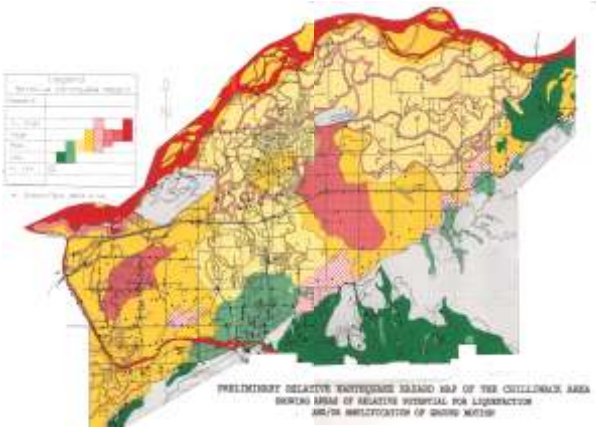
Seismic Liquefaction:



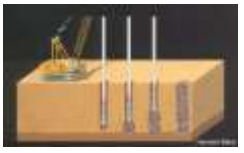
Liquefaction

Liquefaction Induced Lateral Spread and Slope Instability

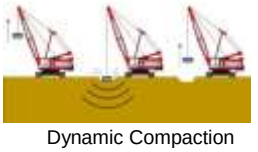




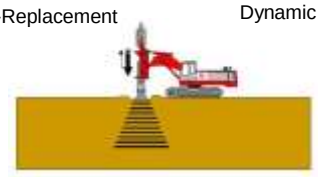
GEOTECHNICAL HAZARDS
Seismic Hazard Mitigation Technques



Vibro-Replacement

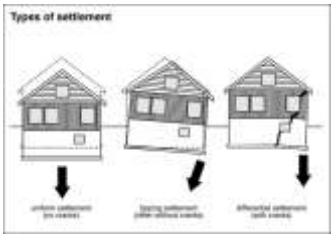


Dynamic Compaction



Rapid Impact Compaction

GEOTECHNICAL HAZARDS
Settlement



GEOTECHNICAL HAZARDS
Settlement/Subsidence

Soils/areas susceptible to settlement:

- Peat and organic rich soils
- Soft silt and clay
- Uncontrolled fill
- Sites with underlying abandoned utilities
- Abandoned mine workings

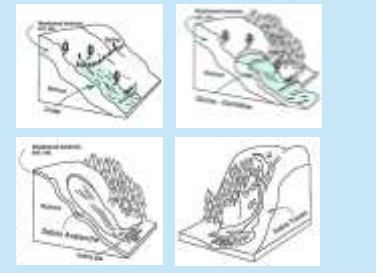
Settlement hazard mitigated by:

- Remove unsuitable soil
- Preload with a surcharge fill
- Injection of self levelling fill material to fill voids

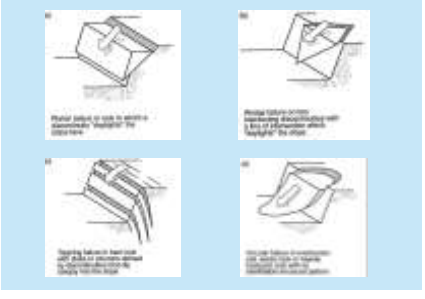
GEOTECHNICAL HAZARDS

Flatland/Valley Floor can also be impacted from debris flows, debris floods and other landslide runout.

GEOTECHNICAL HAZARDS
Soil Slope Failure Modes



GEOTECHNICAL HAZARDS
Rock Slope Failure Modes



Rock Slide - Abbotsford

Circular Slump – Promontory

Tension Cracks – Impending Failure
Fraser Valley

Debris Avalanche - Old Orchard Road

Debris Avalanche - Chilliwack

SOIL STABILITY HAZARDS

Stability Assessments
Stabilization Methods
Global Slope Stability
Levelton Consultants & the City of Chilliwack
Question and Answer

Stability Assessments:
Proactive Avoidance

Necessary Components
- Background Research
- Site Investigations by Qualified Professionals
- Terrain Assessments
- Stability Analyses
- Geotechnical Reports

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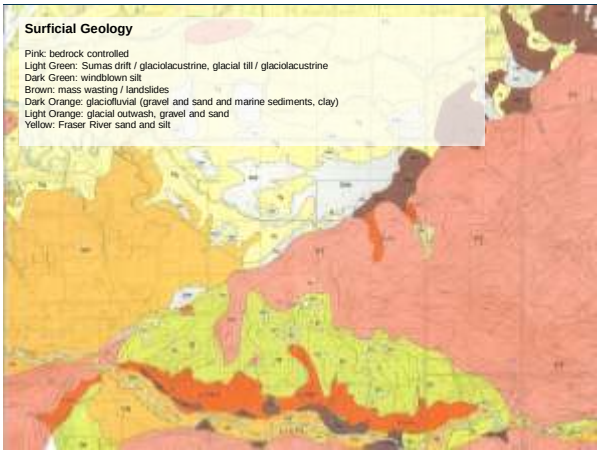

GEOTECHNICAL HAZARDS

Geotechnical Reports

Geotechnical reports need to be in accordance with:

-2012 Building Code
-2010 APEGBC Legislated Landslide Assessment Guidelines

Reports should address all relevant geotechnical hazards. The following provides an excellent framework for assessing geohazards:

"HAZARD ACCEPTIBILITY THRESHOLDS FOR DEVELOPMENT APPROVALS BY LOCAL GOVERNMENT", (Revised Nov. 1993), Dr. Peter Cave.

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SOIL STABILITY HAZARDS

Stabilization Methods:
When Slope Hazard Avoidance is NOT Feasible

*Implement **Project-Specific** Stabilization Methods*

Four Basic Stabilization Methods:

1. ***Improve Drainage***
2. ***Decrease Load at Top of Slope***
3. ***Buttress the Toe of Slope***
4. ***Reinforce Slope Materials***

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Improve Drainage
Roadside Drainage Improvements-
Promontory


Decrease Load at Top of Slope
And Buttress the Toe
Retaining Wall Buttress to Stabilize
Slope – Cherrywood Dr.


Buttress the Toe
Buttressing Small Slump with RipRap


Reinforce Slope Materials
Geogrid Reinforcement

Reinforce Slope Materials

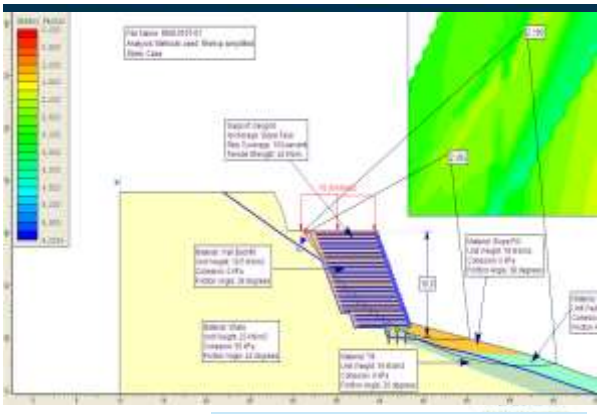
Soil Anchor Drilling / Slope Reinforcement

Reinforce Slope Materials

Grouted Rock Bolts

Reinforce Slope Materials

Piled Retaining Wall With "Deadmen" Tiebacks



Retaining Wall Stabilization - Ryder Lake Road

Example of REDUCING STABILITY

Increased load on top of slope reduces stability.

Example of REDUCING STABILITY

Excavation at the base of a slope reduces stability.

SOIL STABILITY HAZARDS

Case Study

Rock slopes that appear stable
may not be…

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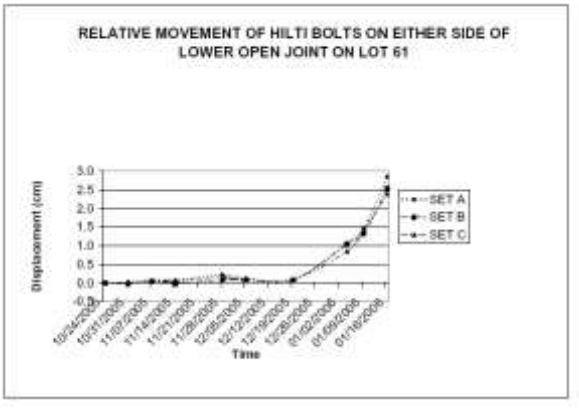

Planar and Toppling Failure (After)

Down-slope displacement from failure on future building sites

Rock face stabilization with rock bolts, horizontal drains, and shotcrete

SOIL STABILITY HAZARDS

Global Slope Stability

Individual projects affect the global stability of site and its surroundings.

Both site and surroundings should be considered

SOIL STABILITY HAZARDS

Municipalities should:

- Update Regional Overview Studies
- Require independent / 3rd party review of proposed steep slope sub-divisions, settlement sensitive areas, and seismic hazard areas
- Initiate infrastructure risk assessments and review maintenance procedures

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GEOTECHNICAL HAZARDS

- **QUESTIONS?**

Thank You

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