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PILOT DEWATERING WELL TEST
WEST QUESNEL LAND STABILITY STUDY
QUESNEL, BRITISH COLUMBIA

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EXECUTIVE SUMMARY

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), has completed a dewatering well test in the West Quesnel District of Quesnel, B.C. Previous studies by AMEC have identified a large, slow-moving, ancient landslide underlying a large portion of the West Quesnel area. AMEC has also identified that dewatering (groundwater pressure reduction) in the slide mass was considered the most cost-effective means for reducing slide movements to manageable levels. The objectives of the dewatering well test were as follows:

- to further understand soil and groundwater conditions underlying a selected area known to be affected by the landslide; and
- to assess the feasibility of conventional pumped wells as a means for stabilizing the landslide.

Two pumping wells (PW03-1 and PW03-2) and nine observation wells (piezometers) were installed in a test area bounded by Flamingo St., Abbott Drive, Blair Street, and Lark Avenue. The pumping wells were completed to depths of 55 and 61 m below ground at two different locations. PVC slotted pipe was installed at each pumping well location at depths ranging between 30 and 55 m below ground. Observation wells were installed at three different locations. At each location, three different wells were completed (each at its own distinct depth) to depths ranging between 23 and 88 m below ground level.

Generally, the stratigraphy encountered within the dewatering well test area consisted of fill overlying silt followed by a sand or gravel layer.). There was only limited horizontal continuity in stratigraphy between drill holes. The upper silt and granular layer was underlain by clay, locally interbedded with thin (less than 0.6 m) lignite (coal) layers, followed by dense weathered volcanic bedrock. The weathered volcanic bedrock has the consistency of silt or clay. Within the dewatering well test area, the slide surface was inferred to exist within the clay and lignite layers at depths ranging between 38 and 50 m below ground surface.

Significant flows of water were not encountered during the actual drilling installation of the wells. However, water levels at most locations slowly rose over time to within a few metres of the ground surface, confirming the high groundwater pressures encountered during earlier investigation.

Short-term pumping tests were performed in PW03-1 (October 9 to November 5, 2003) and PW03-2 (November 6 to December 15, 2003). A longer term pumping test was then conducted in PW03-01 (December 15, 2003 to March 8, 2004). While the wells were pumped, the volume of water removed and the water levels in neighbouring observation wells, were recorded. The results and conclusions of the pumping tests are summarized below:

1. Both pumping wells were pumped dry in less than 30 minutes and it took approximately three days for water levels to recover to the point where pumping could resume. Less than 9,000 litres of groundwater was removed during each pumping test and pumps operated only intermittently.

2. The observation wells generally indicated only small or negligible water level drops during pumping of the test wells.

3. The small volume of water removed and poor response of observation wells indicated that the stratigraphic zone containing the slide surface at the pumping well transmits groundwater poorly. This is likely due to the fine-grained nature of the soils, lensing in the soils such that there is little lateral continuity, and few continuous fractures in the soils.

4. The capacity of the stratigraphic units to transmit groundwater at or near the slide surface is variable. Dewatering directly from the slide plane is judged unlikely to be cost-effective in lowering the groundwater pressures acting on the slide surface. Based on conditions observed to date, pumping wells drawing from the slide plane would need to be spaced no more than 10 m apart to have any significant impact on slide movement.

5. Of the stratigraphic units encountered, the sand and gravel units (although likely discontinuous) overlying the slide plane offer the best potential to transmit groundwater. The overlying, saturated, sand and gravel units likely transmit the failure zone.

Subsurface conditions within the dewatering test area may not be representative of subsurface conditions elsewhere in the slide area. To further explore the potential for reducing groundwater levels in the slide area, AMEC recommends the following scope of work:

- In four different areas within the West Quesnel study area, assessment of the saturated sand and gravel units overlying the stratigraphy containing the slide surface for their continuity and capacity to transmit groundwater.

- Pump testing and hydrogeologic assessment in at least four different areas within the West Quesnel study area.

- Testing of innovative methods for dewatering such as vacuum enhancement of pumping wells, as a means to enhance flow rates in any future dewatering in the area.

- Use of fast response vibrating wire piezometers should be used rather than conventional standpipe observation wells for water level monitoring.

To further understand the geological and groundwater conditions in the study area, with a view to implementing a long-term management plan for the study area, AMEC makes the following recommendations (some of which are re-iterated) from our 2002 report:

- Implementation of a comprehensive surface water management plan that will reduce groundwater infiltration within the study area.

- Direct measurement of precipitation in the study area via a dedicated weather station.

- Continued monitoring and characterization of subsurface conditions throughout West Quesnel via additional drilling, groundwater instrumentation, and possible use of indirect geophysical methods (e.g. electrical resistivity tomography).

- Continued monitoring of ground movements via continued GPS surveys, installation of additional slope indicator casings, and the possible use of innovative satellite based remote sensing techniques (e.g. InSAR).