February 28, 2007

Boss Creek Developments Ltd
1301 Galiano Rd.
Vernon, BC V1B 3B3
Attention: Mr. Darren Mead-Miller

RE: ASSESSMENT OF POTENTIAL IMPACTS DUE TO GROUNDWATER DEVELOPMENT AT VERNON RANCH ON GROUNDWATER USERS IN KEDDLESTON / BX CREEK NORTH OF VERNON, BC

Dear Sir:

Further to your request, Golder Associates Ltd. (Golder) is pleased to provide this letter providing additional information on the possible well interference between the Vernon Hill Ranch Site and the nearby area of Keddleston/BX Creek. More specifically, Golder has been asked to examine this issue in a proactive manner, as we understand that residents in the Keddleston/BX Creek area have been experiencing problems with the quantity of water available in their existing wells. This letter is therefore provided as a level of assurance that there will be no impacts to groundwater in the Keddleston/BX Creek Area expected as a result of the Vernon Hill Ranch residential development.

Our response includes a basic review of the hydrogeology and physical setting of both Vernon Hill Ranch and the Keddleston/BX Creek areas, along with a plan of the region to the northeast of Vernon, which shows the relative location and size of both areas and the watersheds which they occupy.

The scope of work for this assignment was discussed and authorization to proceed was received from Boss Creek Developments (the property owner) via telephone conversation on 30 January 2007. Formal authorization to proceed was received via email on 2 February 2007.
Golder is qualified to comment on the hydrogeology of both areas, as we have completed hydrogeological and geotechnical studies for the owner on the Vernon Ranch Site and we are currently working on a detailed hydrogeological assessment of the Keddleston/BX Creek area for the Regional District of North Okanagan (RDNO). Golder contacted the Director of Engineering Services at RDNO, Mr. Mike Stamhuis, P. Eng., on 5 February 2007 and received authorization to include information from the Keddleston / BX Creek Study in this letter.

A list of information sources which have been considered in the preparation of this letter is provided as an attachment to this letter. We have not included copies of testpit logs, borehole logs or maps from the references.

1.0 BACKGROUND

As shown by the highlighted areas depicted in the attached Figure 1, both the Vernon Hill Ranch Site and the Keddleston / BX Creek Area are located along the eastern slopes of Okanagan Valley, to the east and north respectively of Vernon. Both areas extend from roughly 600 meters above sea level (masl) elevation in the west along the edge of the Valley, to upwards of 1100 masl in the Shuswap Highlands to the east. The two areas are separated by roughly 3 km in distance.

Surface flow and groundwater flow in each area are driven primarily by topographic gradients, which indicate that flow is from the higher elevation areas in the east, towards the Okanagan Valley in the west. The elevation in the main Valley is approximately 530 masl.

The following provides a brief overview of the setting and hydrogeology of each area.

**Vernon Hill Ranch Site**

- The Vernon Hill Ranch Site encompasses 272 hectares of undeveloped, contiguous property, located approximately 2 kilometres (km) east of Vernon;

- The Site is underlain by relatively shallow bedrock, primarily composed of metamorphic rock, characterized by the Geological Survey of Canada as foliated and faulted (Okulitch and Campbell, 1972). Recent geological mapping indicates that contraction faulting, with no apparent relation to the major north-south oriented Okanagan Valley Fault, is present in the immediate area of the Site (Unterscutz et al (1999), Glombick et al (2000) and the BC Geological Survey (2005)).
No major creeks traverse the Vernon Hill Ranch site. Bate Creek is located in the very northern part of the Site. However, it is characterized as a dry gulch or ephemeral stream at best. Other minor drainage channels exist on Site, predominantly oriented in an east-west direction, providing for runoff from the higher elevation eastern portion of the site towards the west.

Exploratory drilling and testing identified a fractured bedrock aquifer, generally at depths greater than 120 meters below ground surface (mbgs), with higher capacity wells located in the north end of the Site.

Water levels in the fractured bedrock aquifer are higher to the east and north, indicating that recharge to the aquifer is generally from the higher elevation areas to the east. While the continuity of fractures and direction of flow in bedrock aquifers can be edious to characterize, it can be generalized that the direction of groundwater flow on the Site is west, towards the Okanagan Valley.

**Keddleston / BX Creek Area**

The Keddleston area is a semi-rural subdivision located to the northeast of Vernon, BC, on the eastern flank of the Okanagan Valley.

Water supply and sewage disposal in the subdivision is handled via individual on-site water wells and septic fields. Anecdotal reports collected from residents in the area during a recent Study by Golder and Associated Engineering for the RDNO suggest that many of the existing water wells have been chronically or periodically under performing with respect to sustainable yield.

The Study Area is located in a relatively narrow, steep-sided valley through which BX Creek flows. BX Creek enters the Study Area from the east and exits to the southwest. Several smaller creeks join BX Creek as it passes through the Study Area, including Keddleston and Abbott Creeks, which flow from the north, and Dixon Creek, which empties Dixon Lake from the south.
There are three main aquifers in the Study Area, consisting of a sand and gravel aquifer (BC Ministry of Environment Aquifer No. 349), and two bedrock aquifers (Aquifer No. 350 and 351). Water levels in the sand and gravel aquifer are at, or close to, water levels in BX Creek. Water levels in the bedrock aquifer are generally within 100 m of surface. The direction of flow based on the water levels in all these aquifers is locally towards BX Creek and on a more regional scale, towards Okanagan Valley.

2.0 SUMMARY

Based on our review of available information, the depth to groundwater in both areas is generally less than 100 m. The depth to groundwater mimics surface elevation, which in turn indicates that recharge to aquifers occurs from the eastern highlands and that flow is towards the Okanagan Valley. Given the separation of the Kedleston and Vernon Hill Ranch areas, coupled with the positioning of each in separate watersheds and the indicated recharge from upland areas to the east, there is no physical or geological evidence to suggest that groundwater withdrawal from either area is capable of impacting the other.

3.0 LIMITATIONS AND USE OF THIS REPORT

This report was prepared for Boss Creek Developments Ltd. and is intended to provide a cursory review of hydrogeology studies completed in the areas of interest. Golder Associates Ltd. understands that the report will be forwarded to the Regional District of North Okanagan and likely distributed to stakeholders as part of the public review process for the proposed Vernon Hill Ranch development. Any use which a third party makes of this letter, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this letter report.

The assessment is based on currently available information and does not account for mutual well interference created by additional wells which may be constructed in the future. It also does not consider the potential for other external factors which could affect the water balance for the Study Area, such as climate change.
The assessment of groundwater conditions presented has been made using historical and technical data collected and information from sources noted in the report. The methodologies used to conduct field investigation, to analyze information and for the preparation of a technical report were performed according to current professional standards and practices in the groundwater field.

Golder has relied in good faith on information provided by third parties noted in this report. We accept no responsibility for any deficiency, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of others. Furthermore, if new information is discovered during future work, including excavations, borings or other studies, Golder should be requested to provide amendments as required.

4.0 CLOSURE

We trust the foregoing has provided the information that you require at this time. Should you have any questions, please contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES LTD.

Jacqueline Foley, M.Sc.
Hydrogeologist

Remi Allard, P. Eng.
Associate, Senior Hydrogeologist

Encl

JF/RA/jc
REFERENCES


15. Golder Associates Ltd. (2206) in draft Groundwater potential evaluation for the Kedleston area, Electoral Area C, Regional District of North Okanagan, B.C.

