

Terms of Reference

The term of reference for the hydrogeological study (Section 5.3 – Groundwater) should include and cover (minimum) the following:

Description of the proposed project and its effects

- A water balance describing the present elements of the water budget as well as their modifications over the next 100 years, taking into consideration the anticipated effects of climate change;
- A detailed conceptual model describing the flux of water, from ridge to shore, through representative cross sections. The soil and bedrock layers should represent the layers encountered in the region. The thickness of the bedrock horizon should represent the main geological units and their state of fracturation and be at least 1000 m thick.
- Models (conceptual, analytical, numerical) have to be produced to describe the flux of water pre, during, and post mining (at least 100 years post mining).
- The models have to describe the flux of water both in the upland of the land tenure (where mining will occur at and close to surface), and in the low land area of the land tenure (where mining will take place at depth).
- The detailed conceptual (and analytical/numerical) model has to describe the interaction between groundwater and surface water for all the surface water features that may be impacted by the direct and indirect effects of the proposed mining operations within and outside of the land tenure.
- The potential effects of mining should be estimated over a sufficient length of time to take into account delays when effects would start to be observed, due to the specifics of the groundwater regimes.
- The detailed conceptual (and analytical/numerical) model has to describe where and how the fresh water and salt water interface will be encountered and how the mining operations will potentially modify the location and movement of this interface.
- The detailed conceptual (and analytical/numerical) model has to describe how the groundwater discharge along the foreshore will be modified by the proposed project.
- The proponent has to describe the estimated permanent and irreversible changes to the groundwater regimes that may result from the proposed work.
- Where impacts are expected, the proponent has to clearly describe/define what would be an “acceptable” and an “unacceptable” impact. It should also provide the rationale for these definitions.
- Should there be a potential for an extension of the mined area (i.e. by later applying for an amendment of the permit of operation to include the Bear and Anderson Lake projects), the hydrogeological study completed for the Raven project should be adjusted both for its scope and for the boundaries of the study area to reflect this possibility.

Tools

- The data collection must be conducted at a scale that adequately represents the heterogeneity of the system (watershed and subsurface) and its anomalies.
- The information must be gathered with tools (e.g. monitoring wells) designed for the information to be gathered.
- The data collection (monitoring) must describe and be representative of the fluctuation (seasonal, yearly, over decades) of the representative parameters.
- The monitoring programs must be long enough to adequately cover periods pre and post the proposed mining operations.

The above described requested tools infer that an adequate description of the aquifers (both in the overburden and in the bedrock) and of the groundwater regimes is a pre-requisite for the proposed project.

Organisation and funding

- The proponent has to describe the proposed plan to collect, interpret and review monitoring data that will be collected a long time after the proposed mining operations will have stopped. What will be its long-term cost? What organisation(s) will be responsible for conducting this long-term work, and what will be its source of funding?
- Should there be some un-expected effects on the groundwater regimes requiring remediation works, what is the contingency plan. What organisation(s) will be responsible for conducting this potential long-term work, and what will be its source of funding?

Dr. Gilles Wendling, P.Eng. - Credentials

Education: Ph.D. (1991), M.Sc. (1985) and MST (B.Sc. equivalent) (1983).

Employment: Dr. Wendling has started the firm GW Solutions Inc. in 2005. Dr. Wendling has been involved in over a thousand projects in his consulting carrier.

Professional involvements:

- Gilles Wendling has been the Director -Technical and Professional Division of the Canadian Groundwater Association in 2003 and 2004.
- Dr. Wendling has been the Director -Technical and Professional Division of the BC Groundwater Association from 2001 to 2006, and its managing Director in 2006, 2007 and 2008.

Involvements in the design and implementation of rules and regulations:

- Drafting of water well construction specification for water wells in the Yukon Territories, Government of Canada, 2004
- Design of material and delivery of workshops to educate the water industry and water purveyors on the Groundwater Protection Regulations, part of the Drinking Water Protection Act, BC, 2005
- Design of a Handbook to illustrate the BC Groundwater Protection Regulations – Phase 1 - 2005 - 2006

EAO process

- Dr. Wendling has completed a review and critique of a large hydrogeological study on behalf of the Halalt First Nation for a proposed series of production wells (water supply for the District of North Cowichan) as part of a provincial and federal environmental assessment process, Chemainus River Aquifer, Halalt First Nation, BC

International

- Gilles Wendling has worked in Europe, Asia, Africa, and North America.
- Gilles Wendling is the president and founder of Global Aquifer Development Foundation (GADF), a Canadian charity creating partnerships with developing countries and assisting in the establishment of groundwater management systems. GADF has merged with Hydrogeologists Without Borders (HWB) in 2010.