Projecting Alberta's Groundwater Future

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Groundwater exists as a significant resource in Canada. Roughly 23% of Alberta's population, or roughly 970,000 people rely on groundwater to fulfill their everyday needs. To date there are roughly 215,000 water wells on file with Alberta Environment and Parks estimated to extract up to roughly 80 m^3 per well each year. Most of these wells are completed in the upper 100 m of the subsurface and are concentrated in certain areas surrounding large urban centres. Other activities such as agriculture, mining, and energy extraction rely on groundwater to accomplish their development goals, and in turn generate GDP dollars for the province.

Phase 1 of a study to understand Alberta's water supplies was concluded in 2011, resulting in some high-level estimates of non-saline groundwater volumes in Alberta (i.e., the inventory). Phase 2 was initiated in 2014 to, among other things, assess the potential future state of Alberta's groundwater resources under projected growth scenarios (i.e., assumed at 2% growth per year). As part of this multidisciplinary study (coordinated through the University of Alberta and funded by Alberta Innovates - Energy and Environment Solutions) an Analytic Element groundwater model of the province was developed to forecast possible drawdown conditions out to the year 2050. Implications for baseflow in major rivers draining the province were also assessed. The model utilized existing information relating to the density of unlicensed water wells and locations of licensed extractions to provide a cumulative, and conservative, assessment of potential impacts to near-surface hydraulic head conditions taking into account the balance between estimated recharge and withdrawal.

Results of the study thus far have revealed the dominance of a topographically-driven system of groundwater flow in the province, as well as certain areas where projected impacts to available head exceed 25%. Areas most affected include the Athabasca oil sands mining region, north and east of Edmonton, north of Cold Lake, and portions of the Edmonton-Calgary corridor. Additionally, impacts to baseflow in certain rivers (in particular the lower reaches of the Athabasca and North Saskatchewan) ranging from a reduction of 0.6-0.9 m^3/s, or 19-28 million m^3/yr, were simulated. When compared to median annual flows in those rivers (7 million and 20 million m^3/yr, respectively) the reductions represent less than 0.3%.

Although this groundwater modeling exercise only provides a strategic-level assessment, it is one of the first to look at the province as a whole with respect to the potential future state of our groundwater resources. The benefits of this model are as follows: i) its cost-effectiveness, ii) ease of completion, iii) ability to identify potentially stressed areas, and iv) possible utility in current management initiatives relating to Alberta's groundwater resources. This presentation will highlight the process of model construction, simulation results, and a glimpse into Alberta's possible groundwater future.

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Dr. Fennell is Vice President of Geosciences and Water Security, and Principal Hydrogeologist at Integrated Sustainability Consultants Ltd. (a water, waste and energy management firm based in Calgary). He has over 28 years consulting experience in the natural resource sector, the majority of which is directly related to water management in the conventional and unconventional oil and gas sector. Jon received his B.Sc. degree in Geology from the University of Saskatchewan in 1985, M.Sc. in Hydrogeology from the University of Calgary in 1994, and Ph.D. in Geochemistry from the University of Calgary in 2008. His areas of specialization include physical and chemical hydrogeology, groundwater-surface water interactions, environmental forensics, water supply, waste disposal, risk assessment and risk mitigation. Jon's skills also extend to assessing the effects of climate variability, climate change, and land use on basin hydrology, as well as developing effective management strategies to ensure water security and basin sustainability.