Managing BC's

Protecting and Preserving Our Hidden Resource

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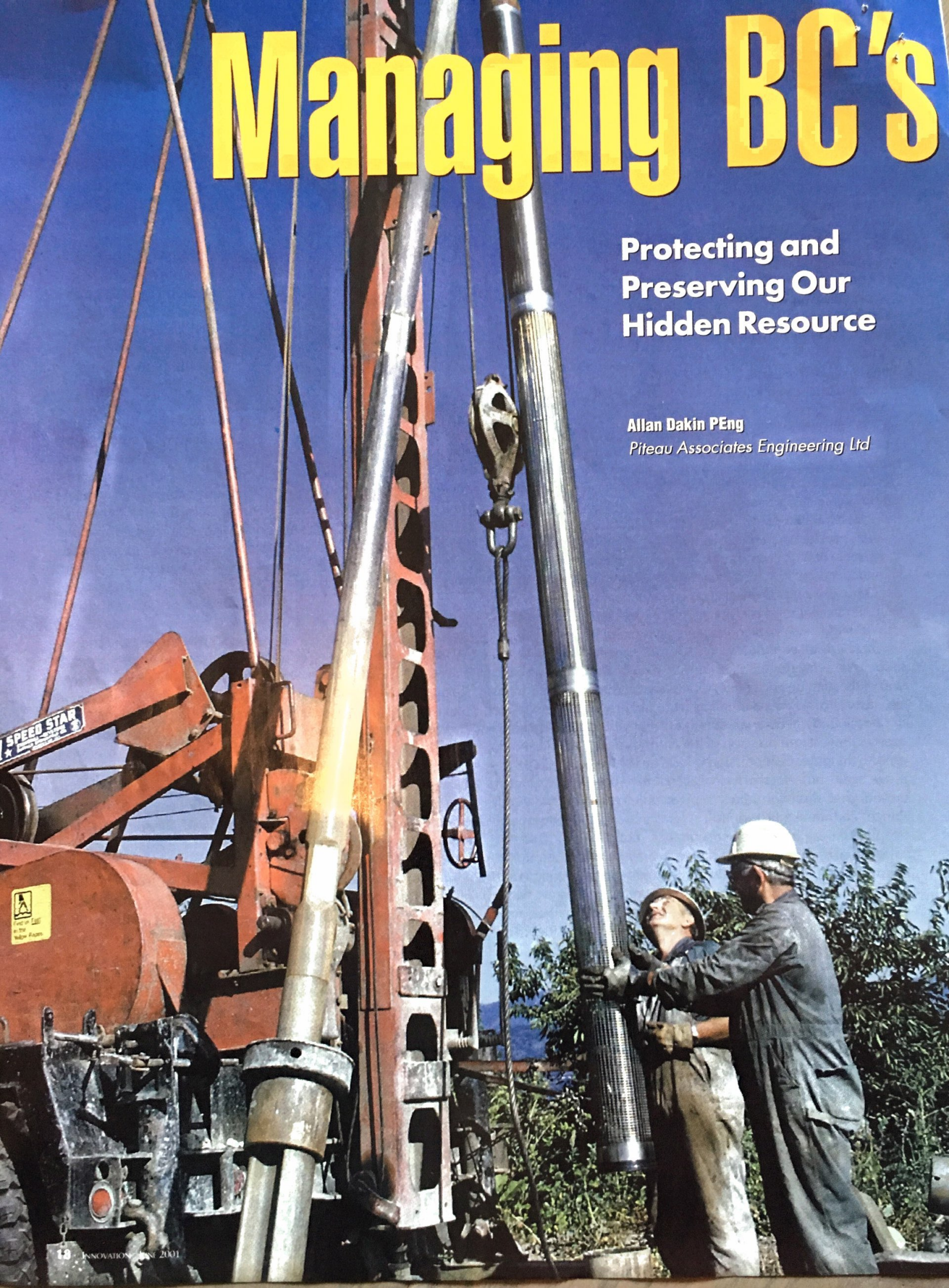


Groundwater

Groundwater — although it's largely unseen — is one of BC's most valuable natural resources, serving thousands of residents around the province. About 22% of our population depends on groundwater (mostly derived from aquifers, or permeable, saturated bodies of sediment and rock) for their water supply. Groundwater is also a vitally important and economical source of water for activities such as irrigation, pulp and paper and mineral processing, aquaculture and, more recently, water bottling. Industry is the largest user of groundwater in BC (55%) followed by agriculture (20%), municipal (18%) and rural domestic (7%).

Although in the past the assessment and protection of groundwater has not been high on the political agenda, the contamination of water supply systems in Walkerton, Ontario and Battleford, Saskatchewan has highlighted the urgency of properly protecting and managing Canada's water supplies. In BC, a recent series of public consultations has led to the development and rapid passage of the Drinking Water Protection Act (Bill 20). This comprehensive legislation is designed to help protect all drinking water sources including groundwater, which is becoming more vulnerable to contamination from increased urban development and industrial and agricultural activities.

The upgrading work entailed by Bill 20 will require the services of professional engineers and geoscientists to carry out assessments, develop and implement plans, and assist with long-term monitoring of surface and ground water supplies. Combined with existing related legislation, Bill 20 is expected to lead to increased funding for better management and protection of groundwater in BC. As it is hidden underground, groundwater is difficult to characterize, assess and monitor. Geoscientists have the right training for this type of work and clearly should play an important role in its implementation.

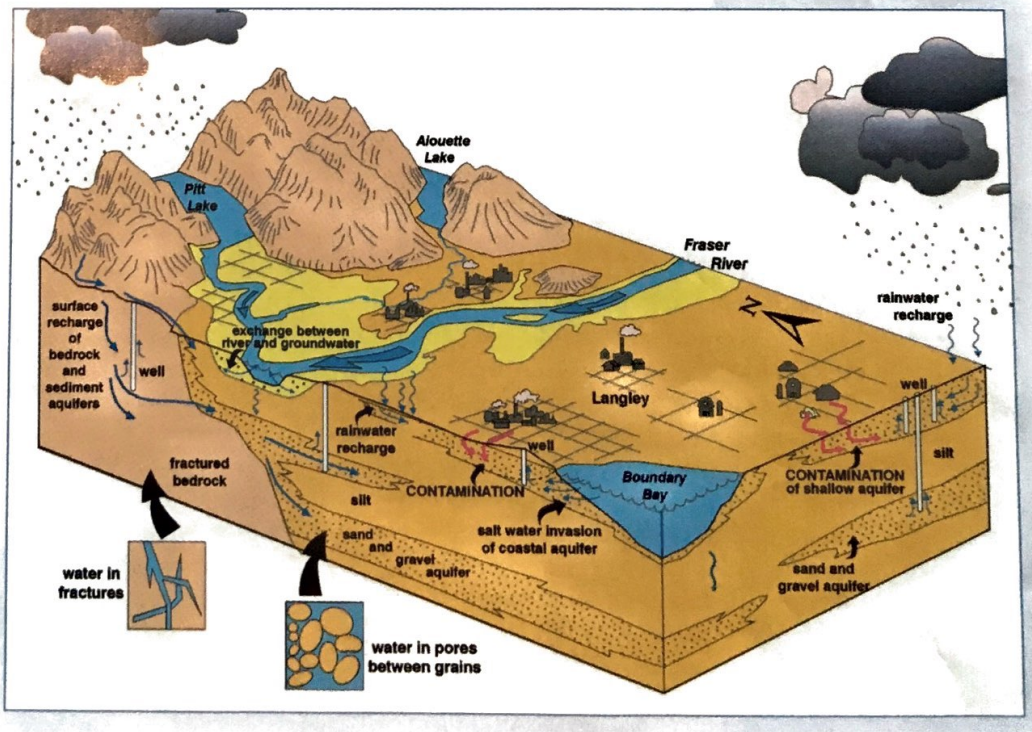
Aquifer Management to Date

In addition to its industrial and agricultural uses, groundwater developed through wells and springs provides water for communities throughout BC such as Langley, Abbotsford, Chilliwack, Prince George, Williams Lake, Smithers, Duncan, Parksville, Qualicum, Merritt and Grand Forks as well as isolated residences all over the province.

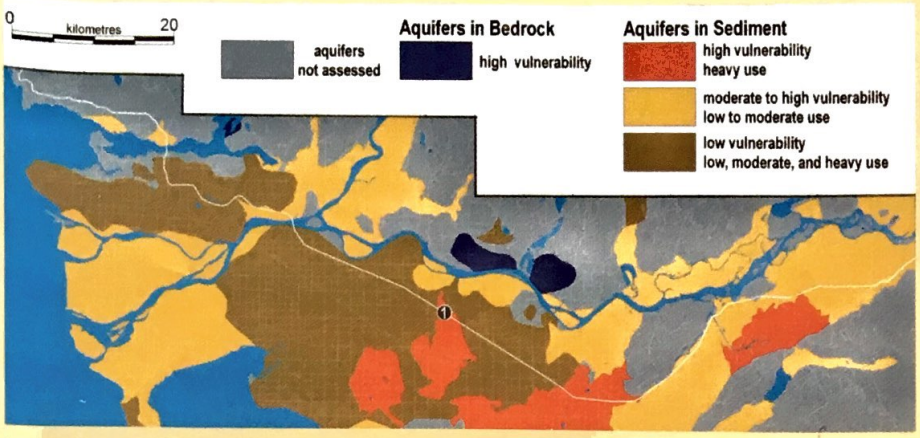
It has long been a common perception that the ground can somehow magically offer up unlimited quantities of pure, clean groundwater. However, groundwater quality has been degraded in many areas by seeping contaminants such as fertilizers, pesticides, septic field effluent and industrial chemicals. Because the principal thrust of earlier hydrogeological work was finding sources of groundwater, assessments relating to the contamination of groundwater sources, and the impact of pumping on aquifers and other supply wells, were rarely conducted.

As contaminated groundwater is not seen by the public, it engenders an "out of sight, out of mind" attitude, meaning that management and protection of groundwater resources has not been a major concern. To some extent, the lack of public awareness has also been a result of insufficient effort by groundwater professionals to make the public aware of the resource and the need to better manage and protect it. This attitude is part of the reason why BC was, until this year, the only province without comprehensive legislation on groundwater management. Until recently, very little funding was made available for aquifer management.

Yet even the small amount of available information on groundwater in this province shows evidence of local problems relating not only to aquifer contamination but the consequences of aquifer depletion. For example, overpumping of fractured bedrock aquifers in local areas of the Gulf Islands is causing salt water intrusion, and overpumping of sand and gravel aquifers in many areas is reducing stream base flows.



Facing page: **Installing a stainless steel screen in a high capacity well (photo Mike Wei PEng).**
Right: **Groundwater flow systems and use in the Fraser River Delta showing potential sources of contamination (from *Geoscape Vancouver*, Geological Survey of Canada).**



Lower Fraser Valley principal aquifers and their vulnerability to contamination from surface sources and groundwater usage (from *GeoMap Vancouver*, Geological Survey of Canada).

Publicity surrounding the contamination of the Walkerton water supply, and the perceptions conveyed in recent movies such as *A Civil Action* and *Erin Brockovich,* have also raised the public's awareness of the consequences of poor aquifer management and potential threats to drinking water quality.

Threats to BC's Groundwater Quality

Contamination from Fertilizers

In the early 1950s, it became known that some aquifers in BC, such the Abbotsford-Sumas aquifer, contained elevated concentrations of nitrate. The suspected source was agricultural fertilizers: both animal manure and chemical fertilizers have been shown to cause nitrate contamination in other areas such as Osoyoos and Grand Forks. Over the past 10 years, hydrogeological investigations and monitoring by the provincial and federal governments have shown that these aquifers were vulnerable to surface contamination and that nitrate was leaching into the groundwater.

The issue of fertilizer contamination has only recently been seriously evaluated and farmers have been made aware of the problem. Had regional scale hydrogeological assessments been carried out much earlier and appropriate remedial measures taken, as recommended by APEGBC in a brief presented to the BC Ministry of Environment in 1985 (*BC Professional Engineer,* May 1985), the extent of this type of contamination would be far less than it is today.

Contamination of the Abbotsford-Sumas aquifer has resulted in groundwater flowing across the border into Washington State with nitrate concentrations far in excess of the Canadian drinking water limit of 10 mg/L. This has led to the establishment of a joint international task force to try to develop and recommend solutions for implementation.

Pesticide Contamination

Low level concentrations of several pesticides have also been detected in the Abbotsford-Sumas aquifer. This became an important issue when it was suggested there were unusually high numbers of people with nervous disorders in the Abbotsford area. Subsequent studies have not been able to show a direct linkage. However, at the time the public was expressing concerns about the so-called "enviro disease," only sketchy data was available on the nature and extent of this type of contamination.

Detailed studies in some areas have been carried out by the federal government, but much more needs to be done to both document the extent of contamination and implement measures to minimize its spread. Studies are also needed to better link groundwater contamination to reported health problems.

Ground Disposal of Treated Sewage

Until recently, the density of septic tanks in BC was relatively low and data on groundwater quality was limited. The Ministry of Health typically approved septic tank systems on a case by case basis with little regard to cumulative impacts. Occasionally, a professional geoscientist was retained to evaluate the hydraulic aspects of ground disposal, but was rarely asked to address the regional scale contamination issue.

A hydrogeological study commissioned by the Township of Langley in 1983 concluded that parts of the Brookswood Aquifer had elevated nitrate concentrations and that further urban development with septic systems over the aquifer would seriously threaten the municipal well field. A decision was made to construct a sanitary sewer system and then allow development to proceed. Because of this decision, the Township can still rely on low cost, good quality water being pumped from their well field.

Today, with the knowledge of this and other similar case histories, regulators and members of the public are more frequently demanding that hydrogeological impact assessments be carried out prior to approving large developments using septic systems.

Toxic Leaks and Spills

Historically, the contamination of water supply wells in BC by toxic substances was considered to be accidental in nature. If it occurred, typically the well was abandoned with little consequence to the polluter. However, there were a few exceptions.

For example, when one of the City of Grand Fork's production wells was contaminated with gasoline in 1981, a hydrogeological study carried out by Piteau Associates showed that two nearby gasoline retail operations were the likely source. The City eventually received compensation for the lost well and all expenses, which amounted to several hundreds of thousands of dollars. The City also compelled the property owner to ensure that the contamination was cleaned up, and received assurances that this and future spills would not impact other City production wells in the area. The latter negotiation was difficult, as at that time no standard for "clean" water existed.

In 1986, a CN freight train was derailed near Fort Langley and a number of tank cars split open, spilling about 248,000 litres of ethylene dichloride. This dense, non-aqueous phase liquid ponded in a ditch and in a matter of hours seeped into the ground. The spill necessitated an extensive hydrogeological assessment and a very prolonged and expensive cleanup. As there were no laboratories in Vancouver equipped to analyze for ethylene dichloride at that time, a gas chromatograph was brought in from Alberta and set up in a fire hall for the initial phase of the investigation.

Today, most of BC's old underground fuel storage tanks have been removed and, with the help of geoscientists and engineers, the nearby soil and groundwater have been (or are in the process of being) cleaned up to an approved government standard. Most of the larger firms handling toxic liquids have developed safe handling methods to prevent spills as well as rapid response procedures to contain any spills that do occur. Geoscientists have often participated in developing emergency plans and, where appropriate, are called upon to help mitigate the impact of the spill.

Finally, many laboratories in BC offer analytical services for trace organics and some even offer a mobile field laboratory.

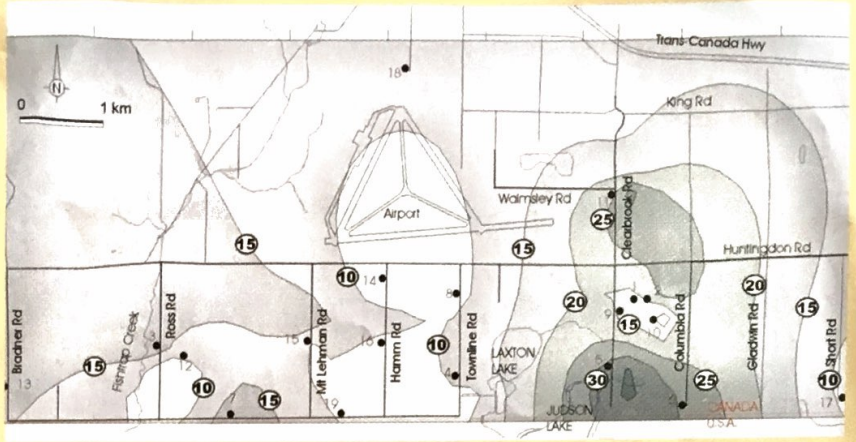
New Groundwater Legislation for BC

The Drinking Water Protection Act, introduced in the spring of 2001 by the (now former) NDP government, proposes to provide $11 million to help operators upgrade and better manage public water supply systems. The (then) Liberal opposition did not oppose the Bill and have agreed on record that drinking water sources must be protected. This new legislation has, among other things:

- Ensured the improved regulation of water supply systems and protection of water sources.
- Confirmed the public's right to know about their drinking water by requiring that assessments, water monitoring results and emergency response plans be made public.
- Established a requirement for province-wide and system-specific water quality standards.
- Confirmed that water suppliers will be required to assess their drinking water sources and systems to identify potential threats to public health.
- Required that plans be developed to address and manage those threats.
- Enabled the development of community-based drinking water protection plans as ordered by the Minister of Health, or as requested by a drinking water officer or local government.
- Strengthened inspection and order powers and established new prohibitions and penalties against contaminating drinking water or tampering with a water system.
- Provided a framework for specifying minimum well construction standards and reporting and testing procedures.

As a result of the legislation, it is proposed that funding will be provided to help improve water supply infrastructures and develop protection plans. It is anticipated that the recently released *Well Protection Toolkit* handbook will be used to assist with well water source assessment and planning. The level of detail of assessment required will likely vary according to the size and complexity of each system.

Over the past seven years, the Ministry of Environment, Lands and Parks has begun mapping and classifying aquifers in the province to develop an inventory of aquifers and to support land use planning. General information on aquifers in BC is now available at www.elp.gov.bc.ca/wat/aquifers/index.html. This information is beginning to raise awareness by making information on aquifers more freely available to planners and the interested public in an easier to understand format.



Isoconcentrations of mean nitrate groundwater concentrations in the southern Abbotsford Aquifer along the US border (image from Environment Canada).

The Future

Over the next few years, professional geoscientists in BC will have a unique opportunity to show the public how their expertise can help develop and implement groundwater source drinking water protection plans. This will require skills in a wide range of activities — such as computerized management of masses of data, regional geology interpretation, and computer simulation of groundwater flow and contaminant migration — working with others such as planners, professional engineers, biologists and ecologists. Geoscientists will also be called upon to work with local citizens, making public presentations and helping with conflict resolution. The road to protecting and managing BC's groundwater resources promises to be an exciting one. ◘

Acknowledgments

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