DRINKING WATER SOURCE PROTECTION IN THE OKANAGAN VALLEY

J. Ivor Norlin, Interior Health – Health Protection*
Mike Adams, Interior Health - Health Protection

ABSTRACT

Safe, clean, and reliable tap water is essential for the prosperity and health of all communities in the Okanagan Valley. A multiple-barrier approach is the best means of addressing the numerous challenges to supplying safe drinking water in this fast growing, water limited region of British Columbia. A multiple-barrier approach recognizes and applies efforts at all points where risks to drinking water and public health can be reduced. Source protection is a core element of the multiple-barrier approach.

As is the case for most regions in British Columbia, the needs of Okanagan communities make exclusion of human activity and dedication of entire watersheds for the sole purpose of providing drinking water typically unfeasible. Thus, successful source protection for most hinges on integrated watershed management to control potential threats to drinking water and public health. The ultimate vision is that everyone (including water suppliers, industry, land-use agencies, and the public) has the information and opportunity they need to be empowered stakeholders in management of drinking water sources. Collaborative efforts of water suppliers, government, and other watershed stakeholders have resulted in improvements. However, without source-to-tap water system assessments to characterize health risks and support a comprehensive approach to drinking water management efforts to protect drinking water sources in the Okanagan will undoubtedly fall short.

INTRODUCTION

Located in the southern interior of British Columbia (Figure 1), the Okanagan Valley is home to over 325,000 people (BC Stats, 2008) and with its lakes, ski hills, and warm climate is a world-class, year-round tourist destination. It is also one of the driest watersheds in Canada (Stats Can, 2003). As such, water has traditionally been a critical factor for the valley’s communities and ecosystems. But even in the Okanagan drinking water is often taken for granted; when turning on the tap we expect safe, pleasant tasting water. Tap water delivers public health, fire protection, and economic development and is an essential element to overall quality of life. Safe, clean, and reliable tap water is valuable; considering the critical tap water addresses some might consider it a bargain!

To have an adequate supply of safe water for everyday drinking, cooking, and all other domestic uses, it is essential to ensure it is properly protected. The link between water supply and disease, particularly from microbial pathogens, is well recognized (CCME, 2004;

* (corresponding author), jivor.norlin@interiorhealth.ca

An earlier version of this paper was published in the proceedings for the Canadian Water Resource Association’s “One Watershed, One Water” conference held in Kelowna, BC, October 2008.

The views expressed in this document are those of the authors and not necessarily of Interior Health. Any errors are the sole responsibility of the authors.
At greatest risk are the immunocompromised, young children and the elderly (BC-PHO, 2001). The first responsibility of all water suppliers must be the provision of continual access to clean, safe and reliable tap water.

Within the Okanagan Valley there are 220 identified water suppliers of various sizes, from those that serve a few homes to large municipal scale systems. Approximately 70% of the core population in the Okanagan is provided water from 10 community water systems (Table 1), most of those relying heavily on surface water sources from upland community watersheds (Figure 2). Using observations from other regions of British Columbia and North America this paper seeks to identify the key elements for defining and over-coming obstacles to protecting these sources.

**MULTIPLE-BARRIER APPROACH TO PROTECTING DRINKING WATER**

No single barrier can be 100% successful 100% of the time against all potential hazards. A recognized universal standard for drinking water protection, the multiple-barrier approach is an effective way to reduce the risk of illness from drinking water contamination to acceptable levels (NHMRC/NRMMC, 2004; CCME, 2004). Multiple barriers compensate for short term reductions in performance of any individual barrier, thus providing a greater assurance that the water will be safe to drink over the long term (CCME, 2004; Hrudey & Hrudey, 2004).

The components of a multiple-barrier approach differ slightly between jurisdictions, but always include the following key elements:

- Source selection and protection (high-quality and protected water source)
- Appropriate water treatment (as determined by source characteristics and risks)
- Water distribution system protection (secure with appropriate monitoring)
- Water quality monitoring (including timely, appropriate response to adverse results)
- Financing and governance (engaged, supportive management and regulatory oversight)

These elements need to be managed in an integrated manner and supported by vigilant, qualified operators (Hrudey, 2003).

Several factors hinder water supplier’s pursuit of providing the elements of a multiple-barrier system in the Okanagan, including:

- Multi-use watersheds and a multi-agency regulatory environment
- Large scale residential development based on systems originally built for irrigation
- Emerging threats (e.g. protozoan parasites Cryptosporidium and...
Giardia

- Climate change (e.g. changing seasonal and extreme weather patterns)
- Competition with home treatment and bottled water industries
- Numerous water supply systems with differing governance structures

When considering how to move forward with improving drinking water safety, it is important to recognize that in terms of the ultimate goal (i.e. protecting public health) not all barriers are equal. In their 2002 report on safe drinking water, the Network of Environmental Risk Assessment and Management (NERAM) made the following observations and recommendations for enhancing robustness of drinking water systems in Canada:

- Health risk is a direct function of raw water quality; as such source characterization and protection should be the basis of providing safe drinking water
- Source protection can not be relied upon to provide significant improvements over the short-term nor absolute protection; as such, initial focus should be on upgrading treatment, monitoring, and emergency response
- Robustness of water sources, treatment operations, institutional, and human elements of water systems all need to be evaluated when assessing water supply systems
- Distribution protection is important, but is typically of a lower importance and cannot counter the effects of inadequate treatment (Hrudey, 2003)

Since proclamation of the BC Drinking Water Protection Act and Regulation in 2003, regulators in the Okanagan have focused on critical improvements to treatment, operations, and monitoring (Interior Health, 2007). In consideration of the long-standing (circa 1986) Canadian water quality guideline that filtration be provided for all surface waters (Health Canada, 2004), upgrading treatment on systems providing only chlorine disinfection has been a top priority. However, many suppliers have made other significant improvements including:

- Recruitment, training, and retention of certified operators
- Improved online monitoring and biological/chemical sampling programs
- Updated emergency response plans that are reviewed annually

Having taken these initial crucial steps to protect public health, attention is...
shifting towards the complex, difficult tasks of assessing water systems and taking action to protect drinking water sources.

**SOURCE PROTECTION**

Selection and protection of a high quality water source is the first step in a multiple-barrier approach and a cornerstone of safe, clean, reliable tap water (CCME, 2004). However, there are limitations to what protection can be achieved through watershed management alone; even the most pristine watersheds devoid of any human activity still harbour contaminants harmful to human health. But by avoiding or controlling potential hazards before they enter the drinking water system threats to public health are reduced and operation costs are minimized (CCME, 2004). In some cases intake location and source protection can make a difference to the level of treatment required (e.g. Metro Vancouver’s Coquitlam Source). More commonly the economic benefits of source protection and improved water quality are decreased operation and maintenance costs over the life of the treatment plant.

With human activity in a drinking water source comes an increased risk of introducing hazards to drinking water supplies. Although mitigation (e.g. engineering; operations) and natural properties of the watershed (e.g. dilution; filtration) may reduce risk, if a hazard exists the risk it poses cannot be eliminated with 100% certainty. As such, the only means to completely avoid risks from human activity is to exclude it. However, even in the absence of human activity, threats to quantity (e.g. drought) and quality (e.g. wildlife; mineral deposits; erosion) of drinking water may still exist. As such, focused management of the watershed is required to achieve the highest quality source water possible.

Examples of this gold standard include the Metro Vancouver and Greater Victoria water supplies. The three watersheds supplying Metro Vancouver comprise a total area of over 580km² to which public access is restricted and all activities are managed in the interest of protecting the one billion litres of water delivered daily (Metro Vancouver, 2008). Greater Victoria’s Sooke Reservoir watershed is strictly controlled, including specific wildfire, wildlife, and security programs for the purpose of providing safe water to over 300,000 residents (CRD, 2008). In both examples intakes are located at higher elevation thus decreasing reliance on treatment while increasing distribution costs.

Exclusion of human activity from water supplies as a means of reducing risk to drinking water and public health seems intuitive; however, exclusion of human activity from water sources is not practiced for the majority of water supplies in North America. Communities and governments often allow forestry, agriculture, recreation, settlement, liquid waste disposal … etc to occur in their drinking water supply areas. Whether a conscious decision or a product of ignorance, activities increasing risk of exposing the public to drinking water health hazards are permitted in the majority of watersheds in North America.

At first glance, it is easy to conclude that since drinking water is such a high priority all activities potentially impacting drinking water should be banned. However, the exclusion of all activities from a watershed is often not in the best interests of the community or public health (BC-PHO, 2001). When considering the factors that determine the overall health of a community, physical environment is a key, but typically not the only (or even most critical) factor. The Public Health Agency of Canada currently recognizes a number of key determinants for public health (Figure 4), with physical environment (including access to safe, clean drinking water) listed as number six (PHAC, 2008). As such, when deciding on what activities should be tolerated in a watershed, the best interests of the community necessitates considering not only threats to drinking water but also the impact the proposed activity will have on economic and social well being.

So what is a reasonable level of protection to expect for drinking water sources? Each watershed and community is unique and, as such, it is difficult to establish a standard benchmark. However, from observation of communities with and without dedicated watersheds the following three factors appear significant:

1. Population Served – shear number of people served is a factor in the comparative value of drinking water production. As community size increases, the relative importance of activities in any specific watershed to the overall economic and social wellbeing of the community will
tend to decrease.

2. Available Water Sources – of seemingly equal importance is availability of a suitable water source. Despite having large populations served by large water systems, many urban centers in North America (e.g. New York City; Edmonton; Calgary; Toronto) do not have dedicated water supplies. Economic and political costs of obtaining and managing a dedicated watershed that may be located 100s or even 1,000s of kilometers away outweigh potential benefits. Conversely, there are a number of small communities in British Columbia (e.g. Revelstoke; Nelson) that enjoy highly protected sources due in part to the proximity of high yield, relatively un-developed watersheds.

3. Governance – the way water supply systems and land-use are managed and regulated also impacts the level of protection achieved. For example, both Metro Vancouver and Victoria are served by a single, publicly-owned water supplier that has the financial and political capacity to acquire and manage a large watershed. New York City’s aggressive source protection campaign is in large part a response to pressure from their regulator (the US Environmental Protection Agency) (NYC-DEP, 2008). In New Hampshire, legislation is available to bar activities that may cause adverse impacts to water quality in drinking water supply areas (NH-DES, 2008).

Given the common reality of multiple-use watersheds, best practice for protecting drinking water sources is typically the provision of transparent, evidence-based management of watersheds to ensure the appropriate allocation of resources (O’Connor, 2002; Hrudey, 2003; CCME, 2004). Integrated watershed management (and the related ecosystem-based or place-based management approaches) strive to comprehensively address physical and biological issues to achieve locally-established goals and objectives. These local goals and objectives are determined based on watershed characteristics, public needs, and regulatory/resource management considerations (Hartig, 1995). This approach requires a thorough understanding of the water systems and watersheds involved. Without, the ability to characterize risks, identify options (e.g. limiting land-use vs. relocating intakes vs. increasing reliance on treatment) and assess costs and benefits is severely limited.

From the perspective of protecting drinking water sources, the primary objective of integrated watershed management is to limit hazards and maximize treatment (e.g. filtration, disinfection) provided by the natural environment. This approach of utilizing natural processes to purify source water as much and whenever possible is consistent with BC provincial government’s Water Plan (BC Gov., 2008) and carbon reduction initiatives and is typically achieved through:

1. Compliance with (and when necessary enforcement of) environmental best management practices for land-use and resource extraction activities, particularly in sensitive areas,
2. Maintaining natural functions of watersheds (e.g. riparian area preservation; stream corridor protection; rainfall runoff management),
3. Appropriate location and design of intakes (e.g. maximizing natural barriers to contaminants)

SOURCE PROTECTION IN THE OKANAGAN

Although a few communities in the Okanagan benefit from relatively under-developed watersheds (e.g. City of Armstrong’s Fortune Creek source), at this time none of the communities in the Okanagan enjoy the gold standard of a watershed dedicated exclusively for the production of drinking water. It is beyond the scope of this paper to assess why each individual system and/or community has not achieved this standard. However, a cursory assessment suggests that the three factors identified above play a role in the current state of source protection in the Okanagan. For example:

- Population Served – Kelowna, the largest population centre with over 100,000 permanent residents, is served by five different water systems with distinct sources. As a result, the relative importance of each of the water sources is diluted over the entire population. Greater Vernon Services water system (with plans for Duteau Creek to be the primary water supply to over 50,000 (GVS, 2006)), and the City of Penticton (which uses Penticton Creek as a source for over 38,000 (City of Penticton, 2007)) have the next greatest potential political/economic influence (Figure 5).

- Available Water – with its relatively under-developed upland watersheds (Turner et al., 2006), available water sources would not seem a significant barrier to achieving optimal source protection. However, historic development patterns have contributed a reliance on valley bottom sources and multiple-use watersheds for drinking water. Coordinated water system planning, focused management of upland sources (e.g. reservoir construction), and demand side management could make dedicated upland watersheds a realistic alternative for some. To date comprehensive assessments exploring this potential have not been completed.
Governance – Patrick et al. (2008) provided a detailed review of the regulatory structure supporting source protection in the Okanagan. Key findings included:

1. Direct water supplier engagement in watershed management has brought about measurable, sustained improvements in drinking water source protection.
2. A lack of co-ordination and engagement at the provincial agency level poses a significant obstacle to source protection.

The conditions observed by Patrick et al. are likely in part a result of poor coordination between water system management and land-use governance in the Okanagan. Even in cases where local governments are the water suppliers, consideration of drinking water in land-use approvals has often been inconsistent or ineffective. For example, Greater Vernon Services has been active in the Duteau Creek watershed for many years working collaboratively with other stakeholders (e.g. forestry companies, range users) to better protect their source. However, they have experienced difficulty in achieving a high level of protection due in part to a perceived lack of support from provincial agencies responsible for regulating land-use and drinking water (GVS, 2008).

Forestry (as demonstrated by the numerous mills throughout the valley) and agriculture (producing 25% of total crop by value in BC (Turner et al. 2006)) have historically provided the economic foundations for Okanagan communities. More recently settlement (population projected to exceed 425,000 within 30 years (BC Stats, 2008)) and tourism (~25,000 jobs linked to tourism in region (Okanagan Partnership, 2004)) have increased in importance. As is the case with most other areas of
BC (BC Gov., 2008), the significance of these sectors makes integrated use of watersheds a preferred scenario despite the potential threats to drinking water and public health.

DISCUSSION AND CONCLUSIONS

Integrated watershed management to control risks to drinking water needs efficient, effective collaboration at all levels to be successful. Cooperation and planning between provincial (e.g. Southern Interior Regional Drinking Water Team) and regional (e.g. Okanagan Basin Water Board – Water Stewardship Council) stakeholders along with focused planning for priority areas (e.g. Shuswap Lake Integrated Planning Process (FBC, 2008); East Kootenay Integrated Lake Management Partnership) serve to break down the historical barriers to source protection identified by Patrick et al.. However, real protection of drinking water resources on the ground requires engagement and commitment of those who live and work in the watersheds.

Comprehensive, transparent, evidence-based assessments (Figure 6) characterize the hazards and events that can compromise drinking water quality while identifying and evaluating options for addressing risk to health. This information also serves to empower water suppliers in the management of their watersheds. Defensible information on health risks provides a basis for fair, evidence-based application of legislation to protect drinking water and public health. It is also a necessary precursor for area specific governance models (e.g. Water Management Plans under the BC Water Act; Drinking Water Protection Plans under the BC Drinking Water Protection Act) to deal with issues that existing legislation is unable to address.

The shift of regulatory focus towards drinking water source protection in the Okanagan is still in the relatively early stages. To date the attention to, and validation of, concerns regarding risks to community water sources is resulting in improved range-use (e.g. installation of off-stream watering; upgrading of fencing in sensitive areas), industrial practices (e.g. direct collaboration with water suppliers), and recreational practices (e.g. off-road vehicle trail management planning). However, a

Figure 5: Ratio of Community Size Served to Area of Principal Watershed Source

Figure 6: Drinking Water Risk Assessment Process
lack information regarding threats to drinking water and options for water supply system design/management remains a common obstacle. Only with a firm understanding of all components of the water system (including water source, treatment, financial capacity, and governance) can all options for improving and protecting source water quality and public health be given adequate consideration.

Taking the time to conduct comprehensive assessments and planning can frustrate those who yearn for immediate improvements to drinking water source protection, but responsible drinking water management requires consideration of all water system elements. The future of clean, safe, reliable tap water in the Okanagan depends on it.

REFERENCES


