KEY FINDINGS

OKANAGAN WATER SUPPLY & DEMAND PROJECT
PHASE 2

It is up to all of us to protect our shared water for future generations.

“We are one community, one valley, one water.”

March 26, 2010

OKANAGAN WATER SUPPLY & DEMAND PROJECT PHASE 2

Background

There has been ongoing concern that water sources in the valley are close to fully allocated. However, a mechanism has been needed to look at patterns of water licensing and availability across the valley, and to evaluate the potential impacts of climate change.

Okanagan Water Supply & Demand Project Overview

The Okanagan Water Supply & Demand (WSD) Project is a best estimate of current and future supply and demand in the Okanagan. The project assesses natural and managed water flows, and calculates the water balance at 81 points in the valley. It shows patterns of water use, and evaluates impacts of population growth, climate change, land use and the environment. The model will be updated over time, and is essential for sustainability planning.

The WSD Project is a partnership of the Okanagan Basin Water Board and the BC Ministry of Environment. Other partners include: the BC Ministries of Community and Rural Development, and Agriculture and Lands; the federal Ministries of Environment, Agriculture and Agri-Food, and Fisheries and Oceans Canada; Okanagan Nation Alliance; UBC-O; SFU; the BC Agriculture Council; and, the Water Supply Association of BC.

Phase I (2005), identified available data and information. Phase 2 (initiated 2007), the modeling component of the project, developed an Okanagan water budget – for use by local governments for planning, and by the Province of BC for water management. The results of Phase 2 show a need for more careful management and choices on development, the future of agriculture, and environmental protection.

As these choices require informed input from many decision-makers and stakeholders, Phase 3 (2010) focuses on making data and information available, on refining modeling tools, and on consultation and policy development. It paves the way for updates by collecting data on critical elements like lake evaporation and groundwater. Phase 3 ensures that the work of Phase 2 is put to best use for planning, adaptation, education, and improved management.

This project is state of the art in Canada, and is a pilot for other water-stressed areas of British Columbia. The Water Demand Model that was developed for this project is now being reproduced in the Similkameen, Nicola, and Lower Fraser valleys and has been nominated for a Premier's Award for Innovation. Okanagan local governments have already begun using the models and data products for regional growth strategies, and planning.

SUMMARY OF KEY FINDINGS

The key outcome of Phase 2 is the successful development of Okanagan-specific state-of-the-art computer modeling tools that can simulate future water conditions in the Okanagan, and estimate the influence of both climate change and human decisions on water use and stream-flows. For the first time, the models provide a way to determine how a decision made in one area of the Okanagan Basin can affect another area of the basin.

The project includes 15 scenarios of climate change, land use alternatives and population growth - these are a small sampling of the range of possible water futures, but illustrate the power of the tool. The work has highlighted the important role (and the limitations) of demand management in adapting to climate change, the challenges facing water suppliers to provide reliable supplies into the future, and the importance of proactive decision-making to secure a sustainable water future for the Okanagan. It also points out knowledge gaps where further research and monitoring are needed.

Phase 2 of Okanagan Water Supply and Demand Project achievements:

- Comprehensive scientific studies on Okanagan water availability and use, for the first time since 1974;
- Two sophisticated computer models for Okanagan water: (1) the Okanagan Water Demand Model to estimate water needs for different human uses, and (2) the Okanagan Water Accounting Model that is used to estimate natural stream-flows and the effects of water storage and extractions on stream-flows and lake levels; and
- Together these two models provide the opportunity to examine water alternatives - under a changing climate, a growing population, a changing agricultural land base, and increased water use efficiency.

KEY FINDINGS FROM SCIENTIFIC STUDIES

Water Use

- Across the Okanagan Basin, indoor domestic use averages 150 litres per person per day – about the same as the North American average. Outdoor domestic landscaping accounts for a year-round average of 525 litres per person per day – for a total consumption of 675 litres per person per day. This means that during the mid-spring to mid-fall irrigation season, total domestic water use by Okanagan residents averages more than 1,000 litres per person per day. These rates of water use significantly exceed the B.C. (490 litres/day) and the Canadian (329 litres/day) averages.
- 86% of the water use by humans is for outdoor purposes (agriculture is 55%; domestic outdoor = 24%; golf courses = 5%; and parks and open spaces = 2%). Only 14% is used indoors (7% in homes; and 7% for commercial and institutional buildings).

- In total, an average of 219,000 million litres (ML) is used for human needs each year. The actual amount each year varies depending on climate conditions.
- The agricultural industry is a relatively efficient user of water compared with the other outdoor users. Agriculture uses 120,000 million litres (ML) of water per year to irrigate 18,300 hectares (ha), an average of 660 mm per ha; the other three main outdoor uses (golf courses, parks, and domestic landscaping) use a total of 68,000 ML to irrigate 7585 ha, an average of 900 mm per ha.
- Measurement and record keeping of bulk water withdrawals by major water suppliers and large individual licensees has not been standardized and is patchy and inconsistent, which creates problems for coordinated water management.

Water Licensing

- Because water suppliers have planned for expanded capacity, the amount of water licensed for human use valley-wide is about double the amount actually used each year.
- There are over 4,000 active water licences to store or use surface water in the basin. In total, 443,000 ML of surface water is allocated annually for offstream use (supported by 163,000 ML of licensed storage), and 350,642 ML is allocated for in-stream (conservation) uses.
- About 95% of the 443,000 ML licensed for offstream use is held by 57 large water suppliers in the basin.
- There are two independent power producer licences in the Okanagan: one held by the District of Lake Country on their reservoir outfall, and the other a small licence for domestic power supply.

Groundwater

- 67% of the water used in the Okanagan Basin is derived from surface sources (lakes and streams), and 22% is derived from groundwater (which is currently unlicensed). The remaining 11% comes from recycling wastewater and by importing water across the basin boundary from adjacent areas.
- A “significant” portion of the surface water in lakes and tributary streams is derived from groundwater.
- Our knowledge of groundwater supply potential, aquifer health, and of the actual amount of groundwater being used is poor. Significant further effort is needed to properly understand the groundwater resource and the volumes of water being drawn from wells.

Surface Storage and Flow

- 80% of incoming precipitation is lost to evapotranspiration from plants and evaporation from lake surfaces. Another 13% goes to surface flows and groundwater recharge is 7%.

- There are 36 large storage reservoirs in the basin on the plateaus east and west of the main Okanagan valley. Together, these reservoirs can store 133,000 ML of water, about 20% of the annual total volume of water that flows into the main valley lakes.
- Mission Creek is the largest creek in the Okanagan, producing 28% of the total flow in the basin. Trout and Vernon Creeks are the second and third largest contributors, each producing about 7% of the total.
- An average of 17,000 million litres is imported each year from adjacent watersheds, the largest volume from the Duteau Plateau in the North Okanagan that otherwise drains to the Shuswap Basin.
- Stream-flow during the seven months of August to February accounts for only 14% of total basin recharge, while the 5-month period March to July accounts for 86%. The August to February total stream-flow averages about 18,200 ML per month, which is primarily contributed by groundwater.
- Within the last decade, the network of stations that measure streamflow and lake levels has been reduced to about half of historical levels, presenting a challenge for hydrologic modeling and water management activities.
- Evaporation from Okanagan Lake and other main valley lakes is significant and has important consequences for dam operations and for improved modeling and forecasting of water supply in the basin, but cannot be precisely estimated without proper measurements of lake evaporation.

Fish Flows

- Most Okanagan streams do not naturally provide optimal habitat for cold water fish such at kokanee and trout. Field-based in-stream flow studies are needed to determine environmental flow regimes that sustain aquatic life and ecosystem function in any particular location.

KEY FINDINGS FROM SCENARIOS

Some 15 climate, land-use and population growth scenarios were examined in Phase 2. The scenarios considered one of six possible global climate models and the carbon emissions scenario – the emissions scenario considered most likely by the International Panel on Climate Change. Selecting a different global climate model would produce different results which will be examined in the next phase of the project. The scenarios evaluated the influence of two possible rates of population growth (the expected rate vs. a high rate); two possible agricultural conditions (the current amount of land under cultivation vs. a larger area that included all reasonably irrigable land); and two possible trends in water use efficiency (current trends vs. the Provincial guideline of achieving 33% efficiency improvements by 2020). Finally, one of the scenarios simulated the effects of a three-year drought, similar to the historically significant Okanagan drought of 1929-1931.

None of the scenarios are a specific prediction of the future, as it is impossible to predict weather conditions year-to-year. Funding is now in place to conduct additional scenario modeling and study other possible water futures. Running a range of scenarios will give a wider range of water futures and allow a more accurate estimate of risks.

Demand Scenarios

- If it is assumed that in the future only the climate changes, and everything else (including population) were to remain the same, Okanagan residents would use on average 9% more water over the 2011 – 2040 period than at present, and 18% more during the 2041 – 2070 period. Also, the growing season will be longer.
- If climate and population both change as expected, and all reasonably irrigable land is developed over the 2011-2040 period, annual water use would average 19% higher over that period than it is today, even if we continue to introduce water use efficiencies at the same rate we are doing today. If we follow the Provincial guideline of achieving 33% improvements in water use efficiency by 2020, that 19% figure drops to 12%.
- In dry summers when less rain is available, the portion of a crop's water demand that must be met from irrigation increases. If three dry years occur in a row, the water use during these three years could be 40% - 50% higher than an average year today, depending on the agricultural land base and population at the time they occur.

Supply Scenarios

- Although the climate model used for Phase 2 suggest that the average total annual precipitation won't change significantly in future, air temperatures are expected to increase – more winter precipitation will fall as rain rather than as snow. Furthermore, the future high elevation snowpack would melt sooner – by roughly one week over the 2011-2040 period and 2-3 weeks over the 2041-2070 period. This will increase the importance of reservoir storage.
- According to the computer models, climate change alone or in combination with increased irrigation and population growth is not expected to significantly affect average annual stream-flows. Stream-flows will be increased in the fall and winter. However, between June and September, stream-flows could decrease by roughly 1/3 over the 2011-2040 period, and 2/3 by the 2041-2070 period (relative to current conditions) unless winter stream-flows are captured to augment summer flows.
- Under the future three-year drought scenario, average annual net inflows to Okanagan Lake are expected to be roughly half of what they are presently. Assuming such a scenario with current operating procedures, Okanagan Lake levels would drop below normal operating ranges, and could affect the ability to keep water flowing in Okanagan River.

IMPLICATIONS

Overall, the results of the scenarios do not point to a sudden, dramatic decline in water availability. Risks of water shortages for human use and environmental needs are increasing, but it is possible to compensate for many of the consequences through land-use planning, careful water management, and by reducing demand. These models will be an extremely valuable tool for adaptation, by providing answers to specific questions about current and future water needs in different parts of the basin – and the interdependence of water sources.

Some of the specific implications of the Phase 2 work are:

Demand

- Climate change, population growth, and expansion of the agricultural land base are expected to result in significantly increased water withdrawals from surface and groundwater sources in the Okanagan Basin, especially during summer months.
- Existing competition for water in the basin, particularly during summer (e.g. when there are flow reductions in fish-bearing streams) will likely intensify in future.
- There is significant potential for conservation and demand-side management to mitigate these effects – but demand management alone may not be a sufficient response to future changes.
- Augmenting water supply by increasing water storage capacity would help meet future water management challenges – although increasing storage is more costly than reducing demand. Key water sources are upland storage reservoirs, groundwater, and main valley lakes. Ensuring adequate protection of current (and potential new) storage reservoirs will be essential for long-term water security. Improved knowledge of the sustainable limits of groundwater and understanding evaporation loss from the main valley lakes is also important.
- It will likely become more challenging to provide and maintain environmental flows, especially in late summer and early fall, and additional storage may be needed for this purpose.

Supply

- Management of upland storage reservoirs will become more challenging as snowpacks decline, more winter precipitation occurs as rain, and snowmelt occurs earlier in the spring. These trends reduce the amount of water stored in the form of snow for ongoing refill of reservoirs and aquifers in early summer.
- With three consecutive years of drought, it will become more difficult to maintain current Okanagan Lake levels and adequate stream-flows in the Okanagan River downstream of Penticton.
- Groundwater is increasingly being used as a water source as surface water becomes fully allocated on some sources. Without regulation this is likely to expand, which will

lead to management challenges because surface and groundwater systems are interconnected.
- Current water licence volumes may not be sufficient to satisfy demands on some streams in future, particularly on those with limited or no storage.
- The models are based on available scientific and water management information; however, the quality of that information is variable, and in some areas - particularly with respect to streamflow, groundwater, actual water use, lake evaporation and evapotranspiration, better information will improve the models.
- Most at risk for water shortages are water suppliers relying on upland storage reservoirs. The full volume of water licences will not necessarily always be available – even for those drawing from main stem lakes – depending on weather conditions. Risk for all water suppliers would be reduced if reservoir storage is protected and expanded.

Other implications of the Phase 2 study are still being considered as the analysis of final scenario runs is completed and the large amount of information gathered and modeled is assessed and interpreted. Further results will be rolled out through the spring of 2010.

The transition between Phase 2 and Phase 3 is the web-reporting tool, which uses graphics to show the current and future status of water availability in the valley – taking into account population, climate, and land use. The initial version of the reporting tool (to be released May, 2010) will provide the main results on water supply & demand. The web-reporting tool will be accessible to the public.

NEXT STEPS

Phase 3 of the Okanagan Water Supply and Demand Project will focus on:
- Additional future scenario modeling based on input from key stakeholders
- Policy recommendations based on the outcomes of Phase 2 and consultation with local and senior governments and water stakeholders;
- Making databases and models accessible to local government planners and decision makers; and
- Updating and improving the data and models.