EXECUTIVE SUMMARY

OVERVIEW

The Canadian Okanagan Basin (the Basin), in the southern interior of British Columbia, is the subject of the Okanagan Water Supply and Demand Project. Because of relatively high rates of water use, variable water supply, and the understanding that population growth and climate change could impact water supply and demand and the sustainability of aquatic ecosystems, in 2004 the Province initiated a project to investigate the supply of and demand for water in the Basin. The first Phase of the Project identified the information that could be used, and prepared a plan to complete the investigation. Phase 2 of the Project was initiated in 2007 by the Okanagan Basin Water Board in partnership with the Province; and was completed in collaboration with a large number of federal and provincial agencies and the Okanagan Nation Alliance. This report is a summary of Phase 2 of the Project.

OBJECTIVES

The objectives of Phase 2 were achieved:

- Completion of comprehensive basin-wide scientific studies on water supply and demand, updating work last completed in the early 1970s;
- Development of three sophisticated computer models for simulating water movement in the Okanagan: the Okanagan Water Demand Model (OWDM) that is used to determine water needs for various human uses, the Okanagan Basin Hydrology Model (OBHM), and the Okanagan Basin Water Accounting Model (OBWAM) - used to estimate natural streamflows and the effects of water storage and extractions on streamflows, groundwater, and lake levels; and
- Examining a few scenarios using the models to illustrate how they can be used to examine water alternatives under a changing climate, a growing population, a changing agricultural land base, continuation of the Mountain Pine Beetle epidemic, and changing water use efficiency.

The most important result of Phase 2 is the successful development of these sophisticated Okanagan-custom computer models. They are powerful state-of-the-art tools that can be used to simulate future water conditions in the Okanagan, and estimate the influence of both climate change and human decisions on water use and streamflows. These models also provide a way to determine how a water use or management decision made in one area of the Basin can affect another area of the Basin. These models will be useful to researchers, water suppliers, local, provincial, and federal government agencies, First Nations, and others with an interest in investigating the potential influences of natural events and human decisions on water resources.

In examining scenarios, the Phase 2 Project has not thoroughly investigated the full range of possible water futures, but instead has concentrated on illustrating some likely potential futures based on a limited examination. The technical work and the scenario outcomes have highlighted data and knowledge gaps, the important role (and the limitations of) demand management in adapting to climate change, the challenges facing water suppliers as they work to continue to provide reliable water supplies into the future, and the importance of proactive decision-making in securing a sustainable water future for the Okanagan.

Phase 2 has made optimal use of the existing information base. However, the information used has strengths and weaknesses. Each component of the Phase 2 work encountered data limitations that restrict the conclusions that can be drawn from that information. The findings, conclusions, and recommendations expressed in this report are appropriate for the level of information available. However, as more and better data become available to further develop the models, the precision and accuracy of the findings will be improved. The report makes specific recommendations for obtaining such additional data.

DELIVERABLES

Deliverables of the Phase 2 Okanagan Water Supply and Demand Project are:

- A User Needs Assessment Report;
- Reports on specific aspects of water supply and demand in the Okanagan: surface water, groundwater, water use, lake evaporation, and instream flow needs - these studies are reproduced in the Appendices to this Summary Report;
- The Okanagan Water Demand Model (OWDM), the Okanagan Basin Hydrology Model (OBHM), and the Okanagan Basin Water Accounting Model (OBWAM);
- The OkWater database, the Water Demand GIS database, and a series of climate datasets;
- The Okanagan Water Information Reference Library database;
- A web-based reporting tool; and
- A communication program.

ORGANIZATION OF THIS REPORT

This report is organized into five parts. Part One (Background) provides the context for the Phase 2 work. Part Two (Data and Databases) describes the datasets and databases developed during Phase 2, and summarizes the major technical studies completed during Phase 2. The technical studies provided the foundation for the models developed in Part Three, and are reproduced in their entirety in electronic form in the Appendices. Part Three (Models) summarizes the three models developed during Phase 2: the Okanagan Water

Demand Model (OWDM), the Okanagan Basin Hydrology Model (OBHM), and the Okanagan Basin Water Accounting Model (OBWAM). Part Four (Scenarios) describes the outcomes of the 15 Phase 2 scenarios. Part Five (Key Findings and Recommendations) lists the major findings and recommendations of Phase 2, and recommends next steps for subsequent phases of the Water Supply and Demand Project.

A glossary of key terms used in the text is provided in Section 21.0 and acronyms used are defined in Section 22.0.

KEY FINDINGS AND RECOMMENDATIONS

Key findings and recommendations of Phase 2 are described in Parts Two, Three, and Four of this report, and summarized in Sections 19.0 and 20.0. They are listed here.

- Climate change, population growth and other changes are likely to put increasing pressure on water supplies in the decades ahead. Future shortages are likely to occur in late summer when water supplies from surface sources are low and demands for water withdrawals and ecosystem needs are high.
- There is high seasonal and between-year variability in both water supply and water demand, and differences from place to place within the Basin; and robust decision-making must take into account this high variability.
- Groundwater is an increasingly important source of water for human needs, yet is under-regulated. Groundwater use should be regulated using the same system used to regulate surface water.
- Per capita water use in the Okanagan is relatively high, but there are opportunities to reduce water use through proven conservation measures.
- The Phase 2 results do not suggest an imminent widespread water crisis, rather that there is an opportunity to thoughtfully design and implement improved water management policies and practices within the Okanagan Basin. These policies and practices should include both supply-side and demand-side management strategies. Storing water in upland reservoirs will remain a key strategy for optimizing the use of tributary water sources.
- There is insufficient information available to optimize water management in the Basin. Additional data and information should be obtained on surface water, groundwater, climate, water withdrawals and distribution, aquatic ecosystem needs, lake evaporation, and evapotranspiration. Improved data on water supply and demand will enable improvements to the Project models.
- Additional scenarios should be examined to further explore the range of potential futures, and assist with the design of appropriate mitigation and adaptation measures.

- The key findings and recommendations contained within this report should be pursued in Phase 3 and potentially other future phases of the Okanagan Water Supply and Demand Project.

SUMMARY OF TECHNICAL COMPONENTS

Annual water balances

The overall annual water balance for the Basin, derived from information presented in several sections of the report, is shown in Figure 1. The values on the figure are annual totals, but they are averaged over time for the period 1996-2006, and across the entire area of the Basin. The figure does not indicate the variability which characterizes both water supply and demand. Decision-making must consider the seasonal variability in both supply and demand, the differences that exist from place to place within the Basin, and the annual variability of both supply and demand.

The annual average water balance for Okanagan Lake is shown in Figure 2.

Water Management and Use:

A summary of the water management and use studies completed in Phase 2 is provided in Section 6.0, and the key findings are summarized in Section 19.0. A total of 443,000 ML of water is licensed for withdrawal from surface sources for human use in the Basin. Of this total, 163,000 ML is supported by storage. Groundwater use does not require a licence. Although there are over 4,000 licences to store or use surface water in the Basin, about 95% of the withdrawal licences – by volume – are held by 57 of the largest water suppliers. Actual average annual water use in the Basin is 219,000 ML, derived from several sources (Figure 3).

The distribution of water used in the Basin is shown in Figure 4. Indoor domestic water use averages 150 L/person per day. Outdoor domestic water use averages 525 L/person per day year-round, i.e. more than 1,000 L/person per day during summer.

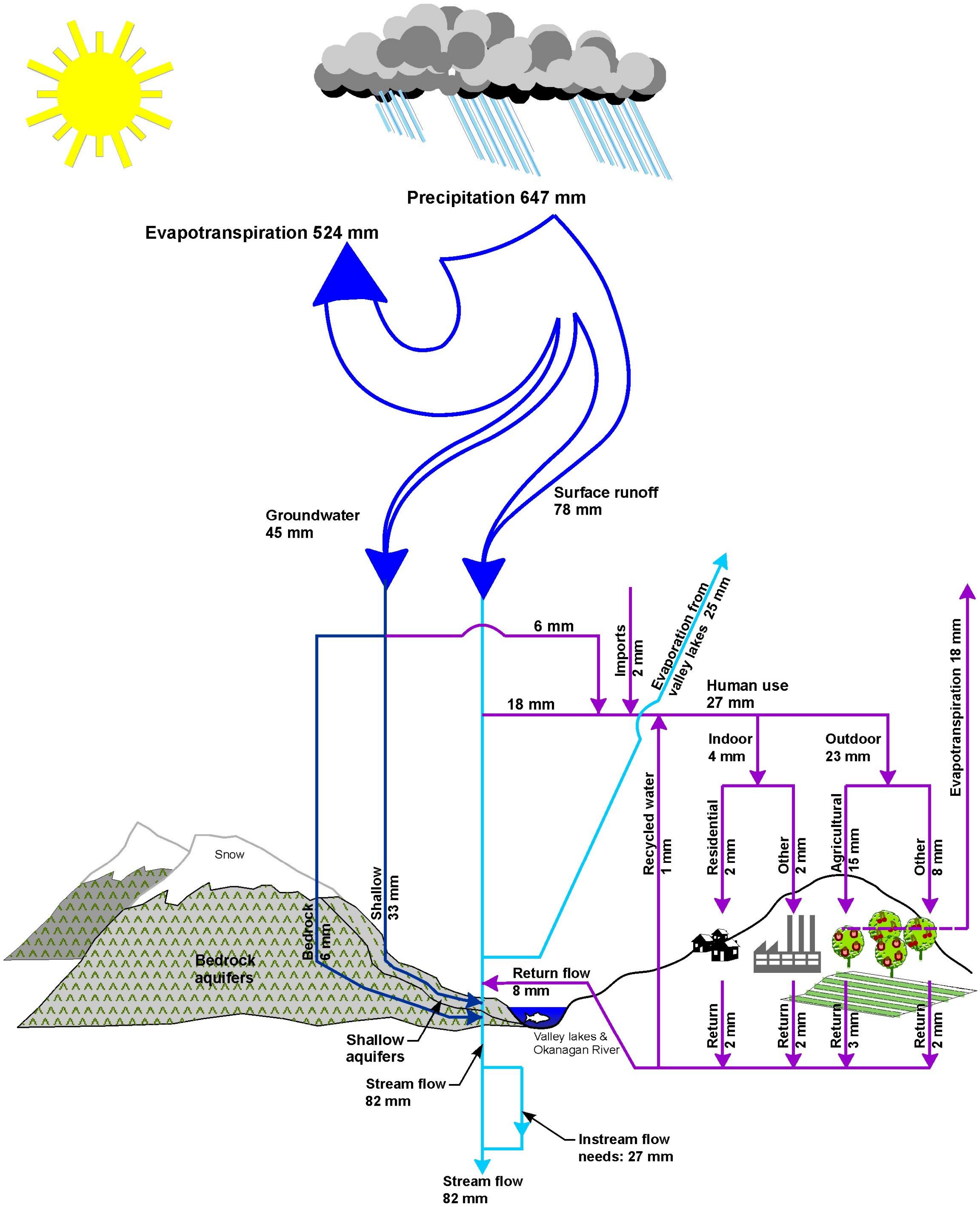

Figure 1 Average annual water balance for the Okanagan Basin.

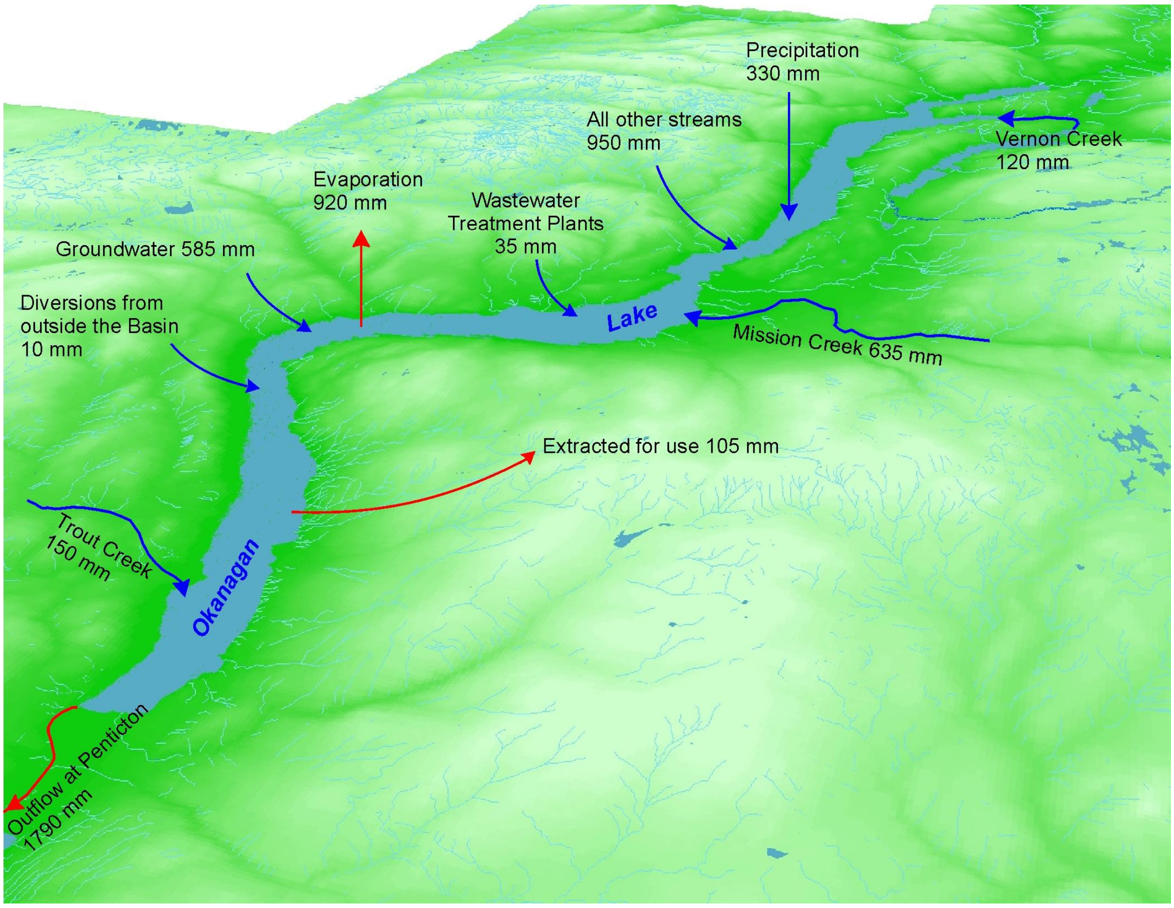

Figure 2 Average annual water balance for Okanagan Lake.

It is recommended that water suppliers measure and report their water extractions, and measure the water delivered to end-users. It is recommended that water conservation measures in all water use sectors continue to be expanded and adopted throughout the Basin, and that water suppliers should preserve their opportunities to expand storage in upland reservoirs.

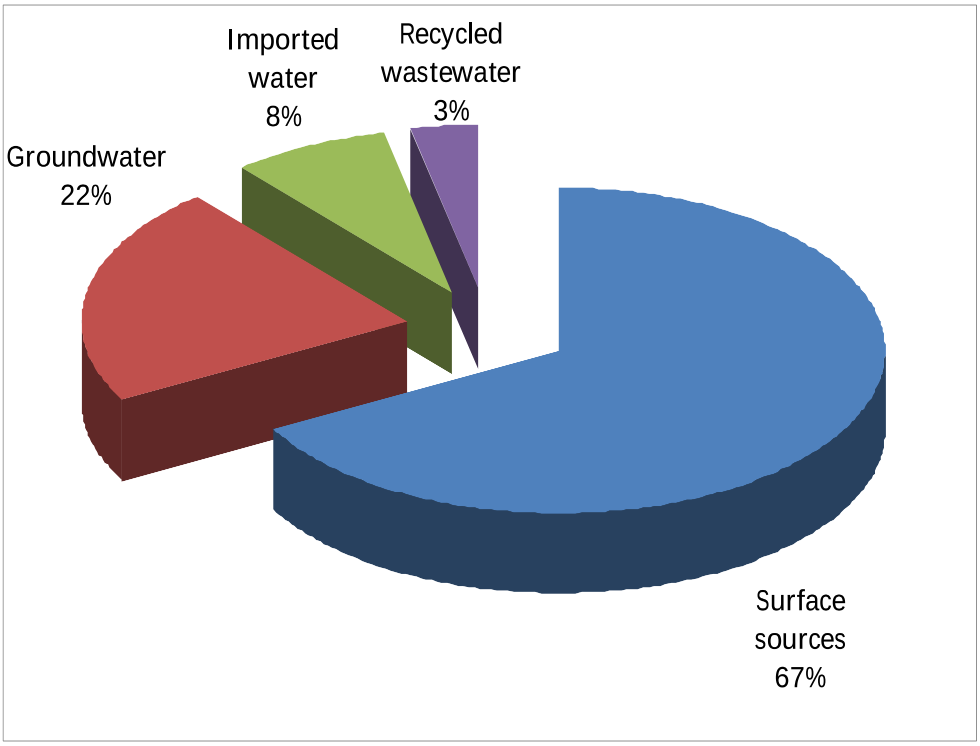

Figure 3 Distribution of total water use in the Okanagan Basin by source (based on data for 1996 to 2006).

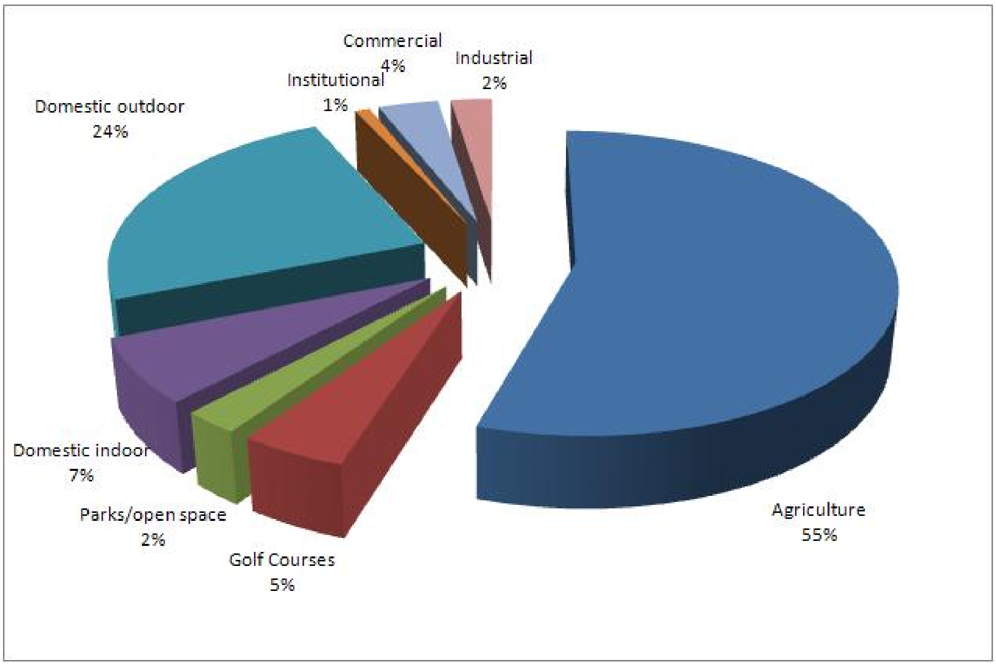

Figure 4 Distribution of water use amongst water users.

Groundwater

The groundwater studies undertaken during Phase 2 are summarized in Section 7.0. Because of minimal regulation of groundwater use, there is relatively little information on the hydrogeology and groundwater resources of the Okanagan Basin. A conceptual model of groundwater storage and flow was developed, in which most of the groundwater activity takes place in 79 distinct shallow unconsolidated aquifers, located primarily along the lower elevation valley bottoms. Estimates of groundwater discharge to Okanagan Lake vary over a wide range, which reflects the uncertainty and relative absence of information needed to make these estimates.

Additional hydrogeological characterization should be completed, and more data on groundwater extraction and on surface/groundwater interactions should be obtained. This information is needed to more adequately understand Okanagan groundwater resources. Groundwater use should be regulated using the same system used to regulate surface water.

Lake Evaporation

Section 8.0 of the report describes the investigation of lake evaporation conducted for Phase 2. The Penman-Monteith model was chosen for estimating evaporation from Okanagan Lakes, but due to a lack of direct measurements, the accuracy of the evaporation estimates is given within a fairly broad range. It is recommended that direct measurements of lake evaporation be obtained so that evaporation can be modelled with greater precision.

Surface Water Hydrology

Section 9.0 documents the studies of surface streamflow conducted during Phase 2. Several methods were used to estimate natural streamflows in tributary streams. The results were used to calibrate the Okanagan Basin Hydrology Model (OBHM). Runoff (the streamflow generated per unit of land surface area) increases from south to north, from west to east, and with elevation. About 83% of the total streamflow in the Basin enters Okanagan Lake, and areas downstream of the Lake (south of Penticton) generate only 17% of the total runoff in the Basin. Mission Creek is the largest tributary, producing 28% of the flow in the Basin, and Trout and Vernon Creeks each produce about 7% of the Basin flow. Streamflow is highly seasonal, with 86% of the streamflow generated from melting of the winter snowpack between March and July, and only 14% occurring in the other 7 months of the year.

It is recommended that additional streamflow monitoring stations be installed throughout the Basin, particularly downstream of the major storage reservoirs. Surface-groundwater interactions on the major alluvial fans in the valley bottom should be investigated to advance our understanding and improve our ability to model streamflow and groundwater discharges to the main valley lakes and Okanagan River, and our understanding of ecosystem needs during low flow periods of the year.

Instream Flow Assessment

Desk-top methods were used in this study to identify minimum instream flow regimes in Okanagan tributaries that provide (a) minimal and (b) optimal protection for aquatic populations (Section 10.0). However, these estimates are not accurate enough to describe actual instream flow needs in individual tributaries. The work demonstrated that such desk-top methods must be supported by field-based assessments to more reliably determine instream flows needed to protect aquatic ecosystems. It is recommended that an acceptable level of risk to aquatic populations be determined in advance, then site-specific studies be completed to identify the appropriate minimum instream flows.

Scenario Results

Three custom computer models for simulating water supply and demand in the Okanagan: the Okanagan Water Demand Model (OWDM), the Okanagan Basin Hydrology Model (OBHM), and the Okanagan Basin Water Accounting Model (OBWAM) were developed and used to examine 15 potential future water supply and demand conditions. The Phase 2 work did not attempt to examine all possible futures, but rather focussed on some reasonably possible outcomes to illustrate the usefulness of the models and the scenario-running process. The models are described in Part Three of the report (Sections 13.0 through 16.0). Part Four (Sections 17.0 and 18.0) summarizes the 15 scenarios examined during Phase 2.

The Phase 2 scenarios suggest that air temperatures across the Basin will increase in future. Snowpacks will decline and melt earlier, and spring snowmelt will generate smaller amounts of runoff. The summer low flow period will likely become extended, threatening both aquatic ecosystems and human demands for water. As noted earlier, water suppliers dependent on stored water in upland reservoirs for human and environmental use later in summer should protect their opportunities to expand storage. In successive drought years, Okanagan Lake could drop below its normal operating range, and threaten the ability to release water to Okanagan River. The scenarios suggest that a significant reduction in the impacts of climate change and population growth can be achieved through proven water conservation measures.

Additional scenarios should be examined to more fully explore the range of possible changes that could occur in response to the key drivers of change: climate, population, expansion of the agricultural land base, changes to the upland forest, and use of water conservation measures.

Despite the achievement of developing three custom computer models for simulating water supply and demand in the Okanagan Basin, there is substantial room for improvement in all three models using more and better scientific data (for all the water balance components, including climate), and more and better information on existing water management practices.

NEXT STEPS

It is important to communicate Phase 2 results to stakeholders and the public within the Basin, and to extend the scientific and modelling work completed in Phase 2. Accordingly, a proposed Phase 3 work program has been developed, which can be subdivided into four components:

- Communication with stakeholders;
- Maintaining the databases and models, and using them to examine other scenarios;
- Turning results into specific policy recommendations; and
- Updating and improving the data and models.

These four programs are described in Section 20.0 of this Summary Report.