Okanagan Water Supply and Demand Project
Water Science for the Long-term

Water is one of the most precious natural assets in BC – essential to the beauty of our landscapes, the health of our ecosystems, our healthy economy and the well-being of our citizens. Changes in BC's climate have already resulted in altered water flows, such as longer summer low flows and droughts, with impacts to fisheries and community water supplies, among others. This case study describes how governments and community organizations are working together in the Okanagan basin in southern BC to understand and adapt to climate change impacts on watershed values.

SUMMARY

The Okanagan watershed is one of the largest in south-central BC, stretching almost 200 kilometres from north to south, and has the lowest per person water supply in Canada. Relatively low precipitation and a large and growing population lead to this status. Over time, concerns have grown that the water supply is over-allocated, putting community use, agricultural irrigation and continuing flows for aquatic ecosystems at risk. Anticipated population growth, with increased demands on the already scarce water supply, coupled with climate change, which is expected to increase the frequency and intensity of droughts, heightens concerns that water demands are increasing as supplies diminish

Between 2001 and 2005 several events galvanized the commitment of basin organizations to work together to address this issue - a research project signaled that climate change was likely to reduce water supplies; a severe drought led to legal struggles over limited stream flows; a basin economic growth dialogue quickly identified water supplies as a limiting factor; and a national water resources conference highlighted the water challenges in the basin as nationally unique because of the low supply and high expected population growth.

The Okanagan Basin Water Board (OBWB) was established in 1970 as a regional water governance body. In 2004 the OBWB and partners in the basin initiated the Okanagan Water Demand and Supply project to explore concerns and provide scientifically credible information at local scales to support the water planning, allocation, licensing and engineering decisions and investments that are being made in the Okanagan system.

A primary goal of the most recent phase of this project, which began in 2010, is to create a series of state-of-the-art, science–based computer models of the dynamic water demand and supply systems in the basin, with the capability to explore the possible impacts of climate change, population growth and land use. An additional goal is to make this information easily accessible to decision makers and the general public to advance climate change adaptation.

This case study describes work in the Okanagan Basin to better understand and prepare for climate change impacts on key watershed values. It summarizes the observations and reflections of the individuals and organizations involved in the project, and the insights they gained about advancing climate change adaptation in the context of watershed management. The project received funding from Natural Resources Canada's Regional Adaptation Collaborative (RAC) program, managed in British Columbia by the Fraser Basin Council and the B.C. Ministry of Environment, and involving almost 50 regional partners (http://www.fraserbasin.bc.ca/programs/bcrac.html).

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The project has overcome significant data and modeling challenges to substantially complete the dynamic models. The new information is being used by some local governments, water providers and others in their decisions. Members of the public can learn about basin water issues and encouraged to change behavior through an innovative web-based WaterViewer and the Okanagan WaterWise program. The partners continue to work together via the OBWB to achieve the long-term vision of this project. OBWB staff describe advancing adaptation as their 'new way of doing business' – sharing credible information to encourage decisions and behaviours that address potential future water shortages.

Insights Summary

1. ***'The timing must be right.'*** – There must be compelling reasons for organizations to collaborate, and they must have the capacity to participate in both information gathering and integrating new information into decisions.

2. ***'Stay focused.'*** - A shared long-term vision that's always up front keeps the initiative moving forward.

3. ***'There are no cookie-cutter approaches in watershed planning.'*** – The unique characteristics of watersheds and land use, local organizations and data, as well as information and resource availability create one-of-a-kind situations, requiring individualized solutions.

4. ***'A durable, capable and credible lead organization is essential'*** - Leadership by a reliable organization capable of convening diverse groups, pooling resources and providing financial services over several years is essential.

5. ***'To truly collaborate you must bring all interests into the tent.'*** - Organize political champions, representatives of partner organizations, technical experts and project managers for maximum efficiency and best use of skills.

6. ***'Having the right individuals involved matters – coming together as a team matters more.'*** - Foster a solid, credible science-management team of innovative, committed individuals, with the right mix of skills, tools and networks.

7. **'Make the extra effort to create localized seasonal climate information that accurately depicts historical variability.'** – Allocate resources for technical specialists to compile local historical climate data, showing past variability and change, and projected future climate scenarios.

8. '***Wish we'd had a bit more realistic idea of how complicated water modeling for climate change adaptation at a localized scale is.'*** - Creating scientifically credible data, models and information will take more time and resources than you expect.

9. **'Pay special attention to credibility.'** – In climate change adaptation credible, science-based data and expertise are essential.

10. **'Information management is critical.'** - Creating durable, accessible mechanisms to collect, analyze, store and distribute information is essential to expedite mainstreaming new information into decisions in the short term and as adaptation continues over the long-term.

11. **'Making it real takes extra effort.'** - Distilling technical climate change adaptation information to communicate effectively with residents and local governments in plain language requires effort.

12. **'Credible Information is one step on the adaptation staircase.'** - Mainstreaming information into adaptation decisions and actions takes time, though successes can happen swiftly.

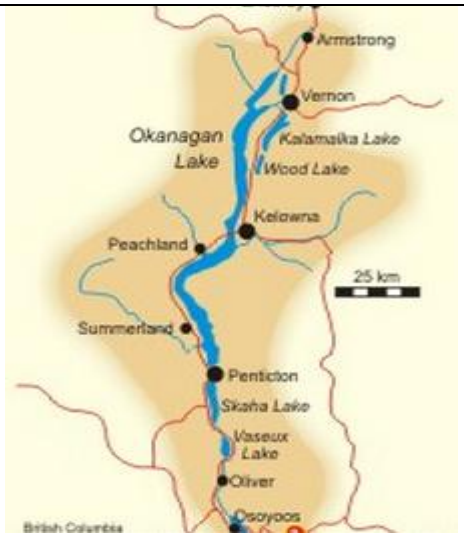
Project Timeline

This case study describes Phase 3 of a longer-term initiative to improve water sustainability in the Okanagan Basin. Phase 1 (2005-2006) identified available data and information. Phase 2 (2007-2009) produced a series of computer models depicting current and projected future water supply and demand in the Basin. Phase 2 outputs confirmed the need for more careful water management and choices about development, domestic water use, agriculture, and environmental protection. Phase 3 focused on making information from Phase 2 available to decision-makers and stakeholders, on refining models, and on related consultation and policy development.

The table below lists the main activities in this project.

2010	• Prepared and released *Phase 2 Summary Report* that recommended next steps • Hosted a workshop with Phase 2 participants and experts in scenario modeling to explore what additional scenarios should be assessed and began to gather data for analysis of two additional climate change scenarios, extended drought and different reservoir storage • Created the web-based Okanagan Water Database and Water Information Reference Library; put in place a related data-sharing protocol and co-funding arrangements and initiated training for data users with a primary focus on local governments • Created the web-based WaterViewer to make Phase 2 results easily accessible to non-technical users • Provided input, based on Phase 2 results, to the broader provincial *Water Act* Modernization initiative • Hosted the conference, From Rain to Resources: New Approaches to Stormwater Management, with more than 100 participants • Commissioned a report to identify the best ways for OBWB to support local government use of Phase 2 results in planning and decisions
2011	• Created *Local Government User Guide to the Okanagan Water Supply and Demand Project* and distributed guide with ongoing training • Created and distributed *Slow it. Spread It. Sink It. An Okanagan Homeowner's Guide to Using Rain as a Resource* • Initiated work to refine the existing Hydrologic connectivity/Water accounting model to improve water balance analysis and better show how management decisions can positively or negatively affect water balance • Initiated a study of evaporation on Okanagan Lake so this aspect of the water system can be modeled more precisely
2012	• Completed an expanded scenarios report • Completed a Hydrologic connectivity/Water accounting report

Overview

Where?	The Okanagan Basin is located in south-central British Columbia and spans almost 200 km from Armstrong to the US border. The Basin consists of a main north-south valley with five major lakes, the Okanagan River, and several major population centres (Vernon, Kelowna, Penticton, Osoyoos); and is surrounded on both sides by higher elevation plateaus. It is an arid region of 8,000 km2, with average annual precipitation of about 300 mm in the main valley bottom, and over 700 mm at the highest elevations. There is high variation in total annual precipitation and much of the precipitation evaporates. The Basin population was 294,000 in 2006, according to the Canada Census and continues to grow rapidly. 
Why?	The hydrology of the Basin is complex, with flows from the surrounding plateaus coming into the valleys through interconnected surface flows, groundwater and lakes. Much of the water used by humans in the Basin comes from the melting winter snowpack from the high elevation plateaus. Community and agriculture development has depended on capturing and storing a portion of this snowmelt in upper elevation reservoirs, and staging the release of stored water to meet demands over the year. These dams are owned and operated by many public and private water suppliers who manage the flows to meet the needs of individual customers. The Ministry of Environment licenses these operations as well as direct water removal from streams and lakes for industrial, irrigation and domestic use. The Ministry also operates dams on the main lakes to serve multiple purposes. An initial Okanagan water supply and demand assessment was completed in 1974. The impetus for the updated Okanagan Water and Demand Initiative came from a number of events during 2001-2005: • a University of BC research project that began in 2001 signaled to the engaged Basin stakeholders that water supplies were likely to be impacted by climate change, with more frequent droughts and water shortages during warm summers; • a severe drought in 2003 heightened water use conflicts such that the Department of Fisheries and Oceans and the District of Summerland were in a legal struggle over stream flow allocation, highlighting what might come with the projected future droughts; • the OBWB shifted its focus to solidly embrace water supply and demand issues and organized a Stewardship Council of partner organizations to begin to address water supply and demand concerns; • a regional dialogue on limits to economic development, initiated by the OBWB and partner organizations within the Basin, identified water availability at the top of the list of issues; and • a Canadian Water Resources Association meeting in the Basin in 2005 galvanized the commitment of organizations to work together to address the issue. Shared concerns that current water licenses for community, domestic and irrigation use over-allocate available water supplies, and that water use conflicts, particularly between domestic uses, agriculture and fish flow needs are likely in the near future drive this

	initiative. The purpose of this project, which began in 2009, is to improve water conservation and management across the Basin by enhancing water supply and demand information, providing it to governments, water providers and key stakeholders and helping them use this information to inform adaptation, including decisions such as water allocation decisions, water use plans, drought plans and eventually, an Okanagan Basin Water Management Plan.
Who?	The BC Ministry of Environment (MOE) initiated the updated Okanagan Water Supply Demand project in 2004. During Phase 1 a project management team was established, which included several committees and individuals, each with well-defined roles and responsibilities. This structure has been refined over time as the project focus has shifted. The long-term working relationships of many of the individuals involved in the project allow for simplified project organization. The most recent phase of the project (Phase 3) was coordinated by the OBWB, and led by an Invited Core Team co-chaired by OBWB and MOE senior staff. The Core Team includes 15 representatives from the main collaborators - two provincial agencies, four federal agencies, local governments, First Nations, water purveyors, universities and sector associations. Twenty-three federal, provincial and academic personnel acted as Technical Advisors. Experienced technical contractors were retained for project management, data collection and model development.
How?	Generally stated, in this project state-of-the-art customized computer models of water demand, supply and accounting were created and used to evaluate possible water futures based on scenarios of climate change, population growth and land use. These outputs provide a foundation of data and information for broad-based education initiatives and improved decisions. In Phase 3 work focused on the following primary areas: 1) **Interpret and report Phase 2 results** – Close review of the Phase 2 results revealed a bias in the projected future climate conditions, which was corrected with help from Agriculture Canada staff before the final results were prepared. The project manager led the preparation of the Phase 2 Summary Report, which was released in July, 2010. The Core Team, technical advisors and technical contractors wrote initial drafts and reviewed relevant sections. OBWB staff worked closely with the project manager and technical specialists to prepare and communicate key implications to decision-makers and the public. 2) **Analyze additional scenarios of changes in climate, population and land use** - The project hosted a workshop with Phase 2 participants and experts in scenario modeling to expand the initial 15 scenarios that were analyzed in Phase 2. Three categories of additional work were identified – two additional climate change scenarios, an extended drought scenario (based on the actual 1930's drought) and scenarios related to reservoir storage. These scenarios were reviewed by an Advisory Committee. Then analysis was completed by a technical contractor using the current versions of the models. Environment Canada and Agriculture Canada led the development of a new set of climate scenarios. Results will be reported in 2012. 3) **Improve information access** – Early in this project the OBWB lead modeller was trained in the use of the models so model refinement and training can be done locally. The OBWB website was reconfigured to host the project data and results. The OBWB then established a Data Sharing Protocol and cost sharing formula which has been implemented with several local governments so they, and approved contractors, can access the data and models for agreed-to purposes A Local Governments' Guide to the project was also created to encourage use of the project results. The project team worked with technical contract specialists to develop a web-based communication tool – the WaterViewer – so that planners, policymakers and the public can easily access to

	the data and modelling results. It proved to be a significant challenge to create this user-friendly, plain language interface. 4) **Water balance analysis** – An Advisory Committee for a customized Hydrologic Connectivity Model that links the water supply and demand models was created, and a technical specialist was contracted to complete analysis with this tool. Results will be reported in 2012. 5) **Support changes in policy and behaviour** – BC is updating the century-old *Water Act,* and the project team submitted recommendations to the provincial government regarding this initiative. A report commissioned for the project guided how local governments were encouraged to use Phase 2 results, models and data. Stormwater management is a critical element of sustainable water management in the basin so OBWB focused attention on this topic by co-hosting a Rain to Resource conference in 2010 and creating a public education booklet – Slow it. Spread it. Sink it. – based on a booklet for California.
What?	The customized data, modeling and technical expertise this project has developed make it the most advanced water resource assessment ever conducted in Canada. It was recognized with a Premier's Gold Award for Innovation and Award for Excellence in the Water and Waste Community. The Phase 2 Summary Report was pivotal for the project, stating the following implications for the future: *'Overall, the results of this work 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 through land-use planning, careful water management, and by reducing demand.'* This message, which has been widely and repeatedly emphasized in OBWB and partner activities, has concentrated public and government attention on potential adaptations to avoid water shortages. The Okanagan Water Supply and Demand website makes the project information outputs readily accessible to decision-makers and the public, with links to the water database and reference library. The Okanagan WaterViewer website displays interactive maps of water sources, water use, and other results of the project for non-technical users. These tools and the background information are being used by governments and others to Inform decisions and studies such as municipal and regional district water management approaches/plans and regional growth planning; a provincial moratorium on reservoir lot sales to protect reservoir capacity and quality; studies informing the renewal of the agreement controlling water levels in Osoyoos Lake; and agriculture sector studies. Books, maps and 3D models are being created by others based on the project information. The project identified the need to improve the base information for watershed management resulting in OBWB partnering with other organizations to drill 15 new groundwater monitoring wells, site three new weather stations, pilot the Streamlined Water User Reporting Tool (SWURT) to allow large water utilities to report essential data efficiently and fill a key data gap with a lake evaporation study.
$$	The BC RAC contributed $500,000 to Phase 3 of this project The estimated total cost of the entire project since 2004 is $3 million, including funding from the OBWB, senior governments and in-kind contributions from the collaborators.
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Insights on Advancing Adaptation

These insights were gathered from a review of project documents and interviews with eight project collaborators. The following section addresses the most significant insights – this is not an exhaustive list.

1. ***'The timing must be right.'* – There must be compelling reasons for organizations to collaborate, and they must have the capacity to participate in both information gathering and integrating new information into decisions.**

As detailed in the overview, between 2001 and 2005 several events - a collaborative climate change adaptation research project, a severe drought that caused water supply shortages in the basin and the description of the Okanagan basin as 'the most water stressed basin in Canada' at a national water resources conference hosted in the basin - emphasized the compelling reasons for this project and galvanized the commitment of organizations concerned about water supply and demand in the basin to work together to address the issues. The complexity of the issues made it impossible for any one organization to take it on alone. The shift of the OBWB focus to solidly embrace water supply and demand issues, initially by organizing a Stewardship Council of government, industry and academic stakeholders, created a home for this important work. These conditions continue to prompt collaboration during this phase of the project.

The strong commitment of local and regional governments – through their participation in the OBWB – has been essential to the project's success. Unfortunately it has not been possible to consistently involve regional and municipal planners, who are responsible for many local government plans that incorporate water-related decisions (e.g. regional growth strategies, official community plans). Staffing changes have inadvertently undermined the project attempts to involve local planners more directly. This has created a need for specific outreach to these professionals during the later stages of this project.

First Nations bands, who are important land owners and governments in the Basin, have not participated directly in the project, which is recognized as an unfortunate gap. This does not reflect a lack of interest or concern in these issues. First Nations organizations are stretched to the limit so it is difficult for them to attend meetings and provide input into water management processes. As well, some aboriginal groups are reluctant to enter into discussions that may affect title issues. The project is now shifting to outreach and trust building to engage First Nations.

2. ***'Stay focused.'* - A shared long-term vision that's always right up front keeps the initiative moving forward.**

In 2006 the OBWB created the Okanagan Water Stewardship Council (Council) to advance the Board's' goal of finding collaborative solutions to water resource concerns, and bridging the interests of all Okanagan and senior governments, water stakeholders, and citizens. The Council is composed of more than two dozen volunteer technical experts and water stakeholders that meet monthly to provide independent science-based advice to the Board. In 2008, at the request of the OBWB, the Council developed the Okanagan Sustainable Water Strategy. This Phase 3 project advances several of the actions in this strategy.

The project partners look to the vision of the Council for their inspiration and focus. More specific to this project the vision has always been to support water sustainability decisions with up-

to-date information from the latest models and computer technology depicting the patterns of water supply and demands across the valley, and evaluating the potential impacts of climate change, population growth and land use. In particular, providing information at local scales to inform water allocation decisions has always been one of the primary goals. Although existing model outputs do not fully deliver on this goal, this long-term vision continues to be the focus of the overall project.

Okanagan Water Stewardship Council Vision

The Basin will have clean and healthy water in sufficient abundance to support the Okanagan's natural ecosystems, agricultural lands and high quality of life for perpetuity. Accurate, up-to-date water information and scientific knowledge will support community and regional planning. Water will be managed in a spirit of cooperation, and a valley-wide ethic of conservation will create a lasting legacy of sustainable water resources for future generations.

3. ***'There are no cookie-cutter approaches in watershed planning.'*** **– The unique characteristics of watersheds and land use, local organizations and data, as well as information and resource availability create one-of-a-kind situations, requiring individualized solutions.**

The Okanagan encompasses a large, arid watershed with low per person water supply and a growing population. Many organizations with a range of jurisdictions, resources and expertise are responsible for water management in the basin, meeting the water needs of a variety of users and significant environmental values.

The partnering organizations, project goals, team structure, participating individuals, skill sets, data, models and communication/outreach approaches selected for this project were specifically chosen to fit the characteristics of this setting. For example, because a primary goal of the project has been to support serious and often divisive water allocation decisions, it has been essential for this project to secure detailed data and customized modeling to create state-of-the-art tools. A key aspect of designing a similar project elsewhere will be to thoroughly consider these 'place-based' characteristics, including a realistic assessment of available resources. Water management adaptation in another watershed will likely need different approaches to meet the place-based characteristics.

4. ***'A durable, capable and credible lead organization is essential.'*** **- Leadership by a reliable organization capable of convening diverse groups, pooling resources and providing financial services over several years is essential.**

The OBWB was legislated by the province in 1970 as a water governance body tasked with identifying and resolving critical water issues at the scale of the Okanagan watershed. The eleven members of its Board of Directors include representatives from the three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association of BC (which represents the interest of BC's public, domestic and irrigation water suppliers and their customers), and the Okanagan Water Stewardship Council. Programs are supported through tax assessments on lands within the Okanagan watershed and other funding sources. The four staff members contribute leadership, water stewardship, administration and communications skills.

Several characteristics of the OBWB make its role critical to the success of the project and to mainstreaming adaptation: it has been in place for over 40 years and continues to grow in reputation; its credibility as a champion for the project; its financial structure - with the ability to collect and hold funds from a number of sources; its practice of pooling intellectual and in-kind resources; its strength in communications; and its longevity and willingness to persistently move adaptation forward. Adaptation at this scale often takes many years. Relying on senior levels of government to provide leadership as was a common practice in the past, is seen to be unwise in this era of retirements, funding shifts and political changes.

5. ***'To truly collaborate you must bring all interests into the tent.' -*** **Organize political champions, representatives of partner organizations, technical experts and project managers for maximum efficiency and best use of skills.**

The OBWB Directors are local elected officials and representatives of water users. These individuals are the important champions of the project. In the initial phases, coordination was co-managed by the OBWB Executive Director and MOE staff with the support of an experienced project manager who the OBWB contracted specifically for this project. The OBWB Executive Director has been the leader of the RAC project, working closely with the same project manager. Partner organizations, including industry groups, are represented on the Stewardship Council and have representatives on the Core Team, which has 15 members. This team has been vital to the success of the project by providing strategic direction and addressing funding needs and timeline challenges. The majority of the 23 technical advisors are also from partner organizations. Hydrological modelers, communications tool designers and other specialists have been contracted as needed.

Each group and individual has had clearly defined project roles and responsibilities.

This project structure has been very effective for the team. The project management contractor was emphasized as vital to the success of the project. The complex nature of this initiative and the many diverse organizations and individuals involved made it crucial to have someone focused on 'keeping track of all the details' to manage timelines, budgets and expectations, and make sure the right people were available exactly when they were needed.

While a detailed project structure, with clear roles and responsibilities is a principle of effective project management, this is especially important in a complex adaptation project where funders, partners and specialists are often working together for the first time, on a project that can be highly controversial at times.

6. ***'Having the right individuals involved matters – coming together as a team matters more.'*** - **Foster a solid, credible science-management team of innovative, committed individuals, with the right mix of skills, tools and networks.**

Sixteen organizations and over 50 individuals with a mix of science and management backgrounds are involved in this project. Passion about the hydrological system in the Okanagan Basin, a desire to understand the risks that climate change presents to the system, and a shared vision of the value of improved information creates shared commitment to the project.

As in any large, complex project, explicit attention to relationship building is an important project management and leadership skill. This is particularly important in climate change adaptation where experts from multiple disciplines such as climate, water, agriculture and engineering who

likely have never worked closely together before must collaborate to brainstorm and collectively decide on effective scientific and technical solutions, in a setting with highly uncertain future projections, and sometimes high stakes.

Fostering a friendly 'we can do it' atmosphere by the OBWB lead and the project manager has resulted in a high level of group strength that was not anticipated. Trust is one of the foundations of this strength, built through respectful give and take amongst the experts and partner organizations over the long time period the core team and technical advisors have worked together. This has been essential to keeping these individuals engaged through the valleys of funding and modeling challenges, and even though the demands on their time, energy and intellectual capacity have been enormous. The contributions of technical experts from government agencies have been crucial. There are concerns in the region about how this will continue as senior governments downsize and reconfigure.

7. 'Make the extra effort to create localized seasonal climate information that accurately depicts historical variability.' – Allocate resources for technical specialists to compile local historical climate data, showing past variability and change, and projected future climate scenarios.

The water users and decision makers participating in the project made it clear early on that to be helpful, the project needed to provide seasonal information at the geographic scale at which their decisions are made (e.g. a single stream for a single irrigation user or a watershed for a municipal water system). Seasonal information is essential in the Okanagan system where demand is seasonal (e.g. high agricultural and domestic outdoor use in summer) and water supplies are largely provided by the melting winter snowpack. Reservoirs throughout the basin capture and store the melt water in the spring, then regulate outflows through the rest of the year. As well, year-to-year climate variability is crucial in these systems, particularly with regards to the historical frequency of drought events and the potential for more frequent and extreme droughts as the climate changes. In addition extreme rainfall events can damage and overwhelm existing water management infrastructures.

The readily available climate information did not meet these needs so federal staff worked closely with academic climate scientists to prepare localized seasonal data for the project. Accurately depicting historical climate variability and extremes, and projecting variability into the future proved to be a challenge that required specific attention. Examining future extremes has not been possible and is therefore one of the next 'bites' for the project.

8. '***Wish we'd had a bit more realistic idea of how complicated water modeling for climate change adaptation at a localized scale is.'*** - **Creating scientifically credible data, models and information will take more time and resources than you expect.**

To provide credible information for the serious water planning, licensing and engineering decisions and investments that are being made in the Okanagan system required state-of-the-art, customized science–based computer modeling of the dynamic water demand and supply systems with the capability to explore the possible impacts of climate change, population growth and land use. Throughout the overall project a primary lesson has been the difficulties and the time and resources needed to customize the available models to reflect the Okanagan system in a changing climate. There are no 'off-the-shelf' hydrological models available, and none that adequately provide information at the scales needed for this project. Existing models required

significant customizing and downscaling – often stretching the limits of the models, and the technical experts.

The team quickly learned that in this new discipline of climate change adaptation, 'the more you know, the more you need to know'. As one question was answered, another emerged which prompted the need to gather more data, embark on further improvements to the modeling and seek more resources. The most recent example of this has been the need for more exact measures of lake evaporation and further research on groundwater resources.

Fortunately, from the beginning the team has implemented the project using a logical, defensible series of 'bite-sized' steps, an important approach that they continue to follow. This allowed them to get started even though they did not have all the resources in place for the entire initiative, or an exact picture of what would need to be accomplished. There is a sense that if they had waited to have funding in place, they might never have gotten started. In fact, if the team had designed the entire, multi-year project before they began, much of its initial thinking would have been derailed by the insights gained along the way.

Early on, team members realized that to achieve their vision they would need to stretch beyond their own capacities. Individual team members and technical advisors activated their networks to find the best minds, data and models for the project.

Several factors led to unexpected and challenging delays throughout this project – extensive data needs; the sheer complexity of creating improved models that incorporate climate change; limited availability of 'irreplaceable individuals' with the expertise for complex, ground-breaking modeling; the linear fashion of the model linkages, with the work of one aspect relying on another; and perhaps unrealistic timelines sometimes driven by hard funding deadlines. The team responded to these challenges in later aspects of the project by tightening contract language. They also identified partitioning contract work into multiple stages as another possible solution. However, these challenges continued into Phase 3, where improving the final model in the series is again proving to be time-consuming and is stretching the limits of the original model without fully supporting the local level water allocation decisions that need to be made.

9. 'Pay special attention to credibility.' – In climate change adaptation credible, science-based data and expertise are essential.

There continues to be public debate about whether the climate is changing, whether it will change into the future and how human society should respond, if at all, creating challenges for adaptation initiatives. In this unstable public setting, one small, inadvertent error in data collection or reporting can call an entire adaptation project into question, stalling movement forward on adaptation for some time.

The project team worked diligently to source credible local data through sound, science-based approaches to avoid being vulnerable to all kinds of questions and to secure the confidence of the project participants and the public. In particular, the property-specific water demand data that is recorded and readily accessible in a geographic information system has brought substantial credibility to the project.

The credibility and diligence of the team was identified as one of the reasons the project continues to attract funding from a variety of sources.

10. 'Information management is critical.' - Creating durable, accessible mechanisms to collect, analyze, store and distribute information is essential to expedite mainstreaming new information into decisions in the short term and as adaptation continues over the long-term.

The rich portfolio of updated baseline data and information in reports, as well as the customized models, is an invaluable legacy from the overall project. The power of geographic information systems (GIS) to integrate information, illustrate spatially explicit results and promote systems thinking has been a particular asset to the team.

This project was in part focused on creating mechanisms to make this information readily and broadly accessible to decision makers and the general public. The OBWB has recognized that information management and data delivery have become a central activity for their organization and they are building their capacity to fulfill this role. They also realize that this will be a continuing priority as they learn more about climate change and new information for the Okanagan system is developed.

Two tools have been established to facilitate easy access to the reports, data and models: the Okanagan Water Science Library is a searchable digital document database of the water-related information compiled, studied and acquired about the Okanagan Basin; the Okanagan Water Database houses all the data collected in the project.

The project team is especially eager for local governments to begin to access and use project information in their ongoing planning and operational decisions. The OBWB created a Data Sharing Protocol and cost-sharing arrangement to expedite access and worked with local government staff to design *A Local Government User Guide* which outlines how to access current and future water supply and demand information to support effective decision making in the Okanagan Basin.

These tools appear to be working as communities are excited about having access to the data and several local governments and researchers have already begun to incorporate the information in local planning processes and projects. This includes using the computer models to explore specific issues beyond what has been examined in this project, which was not anticipated.

11. 'Making it real takes extra effort.' - Distilling technical climate change adaptation information to effectively communicate with residents and local governments in plain language requires significant effort.

The project partners expected to find that agriculture use, specifically for irrigation, was the overwhelmingly dominant user of Okanagan water supplies and would be the target for water conservation adaptations. It was an 'aha' moment for the project to learn that in fact 24% of water supplies are used for outdoor domestic lawn and garden watering, shifting the focus of communications and education to individual homeowners as well as to local governments. The agriculture sector, which is primarily made up of small businesses, remains an important sector for water conservation. To appeal to all three audiences the technical information from the project must be transformed into plain language messages and tools to make the information real in their day-to-day lives and thus encourage adaptation.

The communications role is clearly assigned to the OBWB, which other team members recognize is an essential responsibility that OBWB does well. An important task for OBWB staff is to work closely with the technical experts to define the primary outcomes of each technical report, then

review and reframe summaries if needed to craft clear messages for target audiences.

The project website uses plain language and is highly graphic to appeal to non-technical users. The WaterViewer website has been specifically designed for non-technical users, with displays of interactive maps of water sources, water use, and other results from the overall project. A YouTube video introduces users to this tool. Creating the WaterViewer website in its current form proved to be an overambitious endeavor, in hindsight. Although a Grade 8 reading level was the goal the site currently requires much higher literacy. Based on experiences creating another website, team members suggest that perhaps structuring the contract team with website design specialists in the lead, with technical experts acting as advisors and plain language specialists on hand would have been more effective.

Communicating with the residents of the basin is a big task that can take endless resources. As a small organization, the OBWB works within the confines of their staffing resources, finding ways to reach people effectively without large-scale events and major expense.

Communication about this project is integrated in the OBWB 'Okanagan WaterWise' community engagement strategy and website. OBWB staff include communication and outreach activities in their day-to-day business, with staff doing talks at least weekly. The OBWB has added journalism capacity so staff can work closely with the media to get the word out. When a new tool is needed they research other initiatives to find models to follow, to avoid costly investment in 'reinventing the wheel'. For example, the new OBWB

Okanagan WaterWise

We're one community, one valley, one water.

handbook *Slow it. Spread it. Sink it. A Homeowner's' Guide to Using Rain as a Resource* is modeled after a handbook for areas in California. The OBWB Executive Director is also exploring electronic communications with a blog. The OBWB perceives itself as still actively learning how to reach out beyond the interested public – people who are clamouring for more information – to those who should be interested 'but don't know it'. How to work effectively with community organizations is another expanding activity area.

12. 'Credible Information is one step on the adaptation staircase.' - Mainstreaming information into adaptation decisions and actions takes time, though successes can happen swiftly.

This project has established a credible baseline of information about the Okanagan water system, and scenarios about possible futures, with a growing population and shifting land use in a changing climate. This is an effective and essential foundation for adaptation.

This information has already supported at least one decision that is seen as an important adaptation; in part based on future water shortages projected by the project, the provincial government has put a moratorium on the sale of public lands within drinking water reservoir catchments. The information also provided a foundation for the OBWB's submission to the development of a new provincial *Water Sustainability Act*, which included recommendations to protect water supplies and manage demand.

The current step in this long-term project is to disseminate this information more broadly to basin residents including local governments, water suppliers, businesses and households. The OBWB is actively leading this step, as described in Insight #12.

Because water suppliers have not traditionally used detailed water supply and demand information to make water management decisions, it may take some time for them to incorporate the new information into their decisions. While local governments are keen to access and use the best available information on current hydrology and water demand for planning processes (e.g. official community plans, regional

growth strategies) it isn't clear to what extent they are using future climate change projections in these processes.

It remains unclear to the team exactly how precise information about future water shortages has to be to justify expensive investment decisions (e.g. building a new dam), for water allocation and licensing decisions, or to convince individuals to conserve water in their day-to-day activities. The team expects to learn more about information needs for specific decisions as users access and use the available information.

These initial observations suggest that this foundation of credible information, created over five years, will not be sufficient, on its own, to achieve swift, broad-scale adaptation. The OBWB and its partners plan to informally monitor the integration of the new information in basin decisions and encourage consideration of the future scenarios when appropriate. It seems possible that the value and usefulness of this information will be fully realized when the basin is faced with the next inevitable drought event.

Continuing to Advance Adaptation

The OBWB and its partners continue to be committed to advancing adaptation to achieve their vision of sustainable water management in the Okanagan Basin. In this 'living initiative' the partnerships, project structure and participants remain in place, continuing to work together on the next 'bites' (see box below). OBWB staff describe adaptation as their 'new way of doing business' – sharing credible information to encourage decisions and behaviours that consider the potential for more frequent and severe water shortages.

Okanagan Water Supply and Demand Project Next Steps

Maintain the legacy

- Keep the models 'live' via academics, government users, or others
- Update the websites, databases, library and WaterViewer

Reach out

- Outreach and trust building with First Nations
- Share information with technical practitioners, communities and households in new, more effective ways
- Use information to inform development of a regional Invitational Drought Tournament that explores management options in a time of severe water shortage

Move to action

- Mainstream information into decisions, especially by local governments and water supplieres
- Get shovel ready projects on the shelf

Continue the learning

- Refine the hydrology connectivity model to better support localized water allocation decisions
- Incorporate refined future scenarios in the project results
- Research projects to fill key information gaps – lake evaporation, groundwater, extremes, - especially drought
- Link results to engineering rules for infrastructure decisions
- Explore how best to respond to potential impacts – with continuous/gradual adjustments, or significant changes