Phase 3 Okanagan Basin Water Supply and Demand Project:

Projected Water Supply and Use in the Okanagan Basin (2011-2040) - Okanagan Basin Water Accounting Model Results

Prepared for:

Okanagan Basin
WATER BOARD

Prepared by:

POLAR
GEOSCIENCE LTD.

With federal funding support through Natural Resources Canada's Regional Adaptation Collaborative Program

Natural Resources Canada | Ressources naturelles Canada

Canada

March 2012

POLAR GEOSCIENCE LTD.

Box 5721
1005 Balsam Place
Squamish, British Columbia, V8B 0C2

p. (604) 815-4548
f. (604) 815-4513
www.pgeo.ca

March 31, 2012

Reference: 240101

Anna Warwick Sears, Ph.D.
Project Manager
Okanagan Basin Water Board
1450 KLO Road
Kelowna, BC
V1W 3Z4

Dear Dr. Warwick Sears:

Re: Projected Water Supply and Use in the Okanagan Basin (2011-2040) - Okanagan Basin Water Accounting Model Results

Polar Geoscience Ltd. (Polar) is pleased to provide this report summarizing selected Okanagan Basin water supply and use projections for 2011 to 2040. The projections are based on the Okanagan Basin Water Accounting Model (OBWAM) (and its supporting models) developed in Phase 2 and updated in Phase 3 by RHF Systems under contract to OBWB. The projections are based on six (6) groups of scenarios identified by the Technical Working Group [i.e., six (6) future land use/population combinations each under the influence of two (2) future climates]. In addition, three (3) 5-year synthetic drought scenarios were assessed. Given some uncertainty in the future climate, population change, land use change, and several input parameters used by the models, the results are not considered predictions of the future, but rather indications of possible future trends and patterns of water supply and use in the Basin.

If you require any further assistance or have any questions, please do not hesitate to contact me.

Yours truly,
Polar Geoscience Ltd.

PROFESSIONAL GEOSCIENTIST
PROVINCE OF BRITISH COLUMBIA
L. S. UUNILA
#27700
March 31, 2012

Lars Uunila, M.Sc., P.Geo. (BC), P.Geol. (AB), P.H., CPESC
Senior Hydrologist & Geoscientist

EXECUTIVE SUMMARY

This report summarizes a selection of Okanagan Basin water supply and use projections for 2011 to 2040. The projections are based on the Phase 3 modeling using the Okanagan Basin Water Accounting Model (OBWAM) and its supporting models: the Okanagan Basin Hydrology Model (OBHM) and the Okanagan Water Demand Model (OWDM). Phase 3 modeling has been conducted by RHF Systems Ltd. with support from the OBWB, Agriculture and Agri-Food Canada, and Environment Canada. Polar Geoscience Ltd. was retained by the OBWB to provide technical and analytical support during Phase 3. Based on the Phase 3 projections for the 2011-2040, the following key points are made:

Future climate:

- Temperatures in the Okanagan are projected to generally increase throughout the year, however, year to year variability is high.
- Precipitation projections are mixed and highly variable but tend to suggest increases during winter.
- The proportion of rain to snow is expected to generally increase, resulting in reduced snowpacks, particularly at lower elevations. These snowpacks may also be subject to increased mid-winter melt periods.
- Snowmelt is projected to occur earlier and because of reduced snowpacks, runoff from meltwater is expected to decrease. However, this is offset by rain-generated runoff that is expected to increase considerably over the winter.

Surface water supply:

- Annual runoff is expected to increase overall, with much of this resulting from the increased runoff between October and March due to increased rain and mid-winter meltwater. Decreased runoff is expected between May and July as a result of the advancement of the freshet period. Runoff is expected to be about the same in August and September.
- Year to year variability in runoff is expected to increase, particularly in winter.
- Prolonged drought has a dramatic impact on surface water availability. After five consecutive years, up to 50% less surface water runoff in total is produced relative to normal conditions.

Surface water extraction:

- Surface water extractions represent about 68% of the total water used in the Okanagan.
- During late summer, surface water extractions from the tributary streams generally exceed the natural supply, and in Mission Creek for example, extractions in late summer are double the available natural supply; in future they may be nearly triple. In order to meet water demands, regulation of the available water supply through upland and main-stem reservoirs is and will continue to be paramount. Given the projections for reduced snowpacks, earlier freshet and increased rain-generated runoff in future, water managers may have to consider modifying their storage capabilities and current reservoir operation strategies in order to successfully meet future demands.
- Assuming climate change alone (Scenario Group A), water extractions in most months will increase modestly (5-10%), except in April when it will increase by 40%, and in late fall when it will increase by up to 20%.
- If the population increases at the expected 1% per year and if agricultural water use efficiency improved at its expected rate (Scenario Group B), surface water extraction should not dramatically change in future.
- A population boom with urban sprawl (Scenario Group C) is projected to increase overall surface water requirements by 20-30% throughout the year.
- An increase in the agricultural land base under irrigation (Scenario Group D) is expected to increase overall water extractions by 5-10% throughout the irrigation months.
- A worst case scenario of population boom and agricultural expansion (Scenario Group E) is projected to increase overall water extractions by 30-40% during spring and summer and by 50-70% during the winter.
- Improvements in water use efficiency (Scenario Group F) will mitigate the worst-case scenario (Scenario Group E) by roughly 5% during spring and summer, and up to 20% in the winter.

Net inflows to main-stem lakes:

- Net inflows to the main-stem lakes are projected to increase considerably between November and April. During these months the effect of climate change is dominant over the land use and population factors. By May, climate change is responsible for slight reductions in net inflow to Kalamalka-Wood and Okanagan Lakes, however these are not universally projected downstream, given the regulation of Okanagan Lake and River. By June, climate change is projected to decrease net inflows to Okanagan Lake by 38%, and under the worst-case scenario (Scenario Group E), a further 18% reduction is projected. Projected reductions in runoff and increased extractions in July, August and September further exacerbate conditions and maintain negative net inflows to Okanagan Lake under all future scenarios. Fortunately, with Okanagan Lake and Okanagan River regulation, downstream lakes are projected to maintain positive, albeit modestly lower, net inflows over the summer months.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

The Okanagan Basin Water Supply and Demand Project (OBWSDP) is a multi-year, multi-disciplinary basin-wide water resource study initiated in 2004 by the Okanagan Basin Water Board (OBWB) and the Province of BC, in partnership with Environment Canada, Agriculture Canada, First Nations, and other stakeholders. During Phase 2 of the OBWSDP in 2010, the Okanagan Basin Water Accounting Model (OBWAM) was developed (DHI, 2010). The OBWAM is a state-of-the-science computer-based tool (based on the MikeSHE and Mike11 hydrologic modeling platforms) used for evaluating the future availability and use of water throughout the Okanagan. The OBWAM accounts for the natural water supply and water use at multiple points-of-interest throughout the Okanagan. The water supply and use projections used in the OBWAM are determined by two (2) supporting models: the Okanagan Basin Hydrology Model (OBHM) and the Okanagan Water Demand Model (OWDM) (refer to Summit 2010 for a full description).

With the release of the OBWAM in 2010, a limited number of future climate change, population, and land use scenarios were examined (i.e. Phase 2 scenarios). The scenarios were chosen principally to demonstrate the utility of the model and provide insight on some possible future trends in the water supply in the Okanagan. With a desire to further utilize the OBWAM and examine additional future scenarios, the OBWB and its partners initiated Phase 3 modeling in late 2010. Phase 3 modeling was led by RHF Systems under contract to OBWB, with support by Agriculture and Agri-Food Canada.

In Phase 2, the climate datasets used in the OBWAM were based on the second version of the Canadian Centre for Climate Modelling and Analysis Coupled Global Climate Model (CGCM2) using the A2 emissions scenario (CGCM2 A2) (refer to Appendix N of Summit, 2010 for details on the development of this dataset). This data was a good starting point in Phase 2 since it represented a reasonable “middle-ground” scenario amongst the available climate datasets. In Phase 3, two (2) additional climate datasets were generated for the Okanagan by Environment Canada based on two global climate models (GCMs) (Table 1.1). The two models include the third generation of the Coupled Global Climate Model with the B1 emissions scenario (CGCM3 B1) and the Hadley Centre

Coupled Model, Version 3 with the A2 emissions scenario (HadCM3 A2). These two models were chosen to better characterize the variability in Okanagan climate than was originally represented in Phase 2 by the CGCM2 A2 climate model. The dataset based on the HadCM3 A2 is considered to represent somewhat warmer and drier conditions, while the CGCM3 B1 is characterized by cooler and wetter conditions. It is important to note that neither is considered better or worse than the other – they simply reflect a selection (albeit one carefully selected by Environment Canada to reasonably reflect the Okanagan) of the many plausible climate projections available.

Table 1.1 Climate models used in Phase 2 and 3.

Phase	Climate Model	Projected seasonal changes	General description
2	CGCM2 A2	Winter: warm and moderately wet Spring: hot and unchanged Summer: warm and dry Fall: warm and moderately wet	Moderate scenario
3	HadCM3 A2	Winter: warm and wet Spring: warm and wet Summer: hot and dry Fall: hot and unchanged	Warmer and drier
	CGCM3 B1	Winter: warm and unchanged Spring: cool and very wet Summer: cool and unchanged Fall: moderately warm and moderately wet	Cooler and wetter

1.2 Project Objectives

The OBWB's desire to assess more scenarios using the OBWAM was driven not only by the availability of additional GCM data but also a wish to evaluate different assumptions for land use change, population change, and water use efficiency. The principal objectives of Phase 3 modeling were to:

1. Identify a suite of possible future scenarios that can be used to evaluate the effects of each major factor driving water supply and use, principally climate change, population growth, water use efficiency, and land use,
2. Run the OBWAM and its supporting models OBHM and OWDM,
3. Compile the model output in a usable format for further investigation, and
4. Interpret and report the key results.

While this report highlights the first two (2) points above, it is focused on the third and fourth points. Those interested in the specific technical details of the models and their input datasets are referred to DHI (2010), Summit (2010) as well as technical reports and memos by contributors to the study. A copy of such a memo by RHF Systems is provided in Appendix G. Background information on climate modeling may also be found online at Environment Canada (http://www.ec.gc.ca/ccmac-cccma/) and the Pacific Climate Impacts Consortium (PCIC) (http://pacificclimate.org/).

1.3 STUDY TEAM AND ACKNOWLEDGEMENTS

The Project Manager and Contract Monitor of this study was Anna Warwick-Sears of the OBWB. Lars Uunila of Polar Geoscience Ltd. was the technical lead for this study. He was supported by Drew Lejbak, Rebekka Lindskoog and Travis Nagy of Summit Environmental Consultants Inc. Ron Fretwell of RHF Systems, Denise Neilsen of Agriculture and Agri-Food Canada and Alex Canon of Environment Canada are the key persons responsible for the development of supporting models and the data used in this study.

2.0 IDENTIFICATION OF FUTURE SCENARIOS (PHASE 3)

In Phase 2, the CGCM2 A2 climate model was the basis for 15 future scenarios [refer to Table A.1 in Appendix A and Summit (2010) for a full description]. In Phase 3, the HadCM3 A2 and CGCM3 B1 climate model data were used in assessing each of six (6) main groups of scenarios (12 total) (Table 2.1). In addition, three (3) synthetically derived 5-year drought scenarios[1] were assessed.

The current or baseline conditions in the Okanagan are represented by Scenarios 65 and 66 (1971-2006); these scenarios are developed with the HadCM3 A2 and CGCM3 B1 climate models respectively. It is important to note that while Scenarios 65 and 66 mimic the historical climate, they do not reflect specific weather patterns that were actually observed in any specific year. In order to minimize bias, the climate data under Scenarios 65 (HadCM3 A2) and 66 (CGCM3 B1) are used as references to their respective model's future projections.

In late 2010 the Technical Working Group initiated a discussion on the future scenarios to be modeled in Phase 3. Given the multitude of factors driving water supply and use and multiple objectives, the scenario list was reviewed and refined until it was confirmed in spring 2011. A total of six (6) groups of future scenarios for 2011-2040 were identified for Phase 3 modeling. Each group was run with each of the two climate models. In addition, a group of three (3) scenarios based on a synthesized 5-year drought period were modeled. The processing of these 15 scenarios by RHF Systems involved approximately 12 months, although a considerable portion of that time involved training and the transfer of knowledge between the model developers (DHI Inc.) and RHF Systems.

The main groups of scenarios assessed in Phase 3 are described generally as follows:

- *Group A* - Scenarios 28 & 29: <u>Climate change only</u>; all factors (except climate) remain constant at 2006 levels;
- *Group B* - Scenarios 30 & 31: Climate change and land-use and population <u>continue "as-is" based on current trends</u>;

[1] The 5-year drought scenarios are based on a single synthetic drought with three (3) different assumptions on land use and population change.

- *Group C* - Scenarios 34 & 35: Climate change with "population boom" (assuming "urban sprawl");
- *Group D* - Scenarios 36 & 37: Climate change and increased agricultural land base under irrigation;
- *Group E* - Scenarios 38 & 39: Climate change with a possible "worst-case" scenario for land use and population growth;
- *Group F* - Scenarios 40 & 41: Climate change with a possible "worst-case" scenario for land use and population growth, but mitigated by efficiency improvements.
- *Group G* – Scenarios 55, 56, 57: The effects of a 5-year drought assuming current conditions, future conditions, and future conditions with efficiency improvements, respectively.

In Phase 2, population growth was modeled assuming it would occur principally by infilling of developed residential areas (i.e. densification). For Group C, population growth was modeled assuming expanded residential development consistent with available planning documents and files for the Okanagan (refer to Appendix G for details). Based on discussions amongst members of the Technical Working Group and the study team, it was felt that the assumption of urban sprawl may be more realistic than densification given the observed trend in residential development in the Okanagan. Dr. Denise Neilsen of Agriculture and Agri-Food Canada and Ron Fretwell of RHF Systems Ltd. developed the methods used to describe the population boom, urban sprawl scenario.

Table 2.1 List of future scenarios assessed in Phase 3.

Scenario Group	Scenario	Period	Model	Mountain Pine Beetle	Domestic (indoor & outdoor) Efficiency	Agricultural Efficiency	Agricultural Land Base	Population growth	Description
Baseline	65	1971-2006	HadCM3 A2	Expected	Maintained constant at 2006 level	Maintained constant at 2006 level	Maintained constant at 2006 level	Actual	Baseline period – modeling based on HadCM3.A2 climate model
	66	1971-2006	CGCM3 B1						Baseline period – modeling based on CGCM3 B1 climate model
A	28	2011-2040	HadCM3 A2	Expected	Maintained constant at 2006 level	Maintained constant at 2006 level	Maintained constant at 2006 level	Maintained constant at 2006 level	Isolates the GCM effect (roughly comparable to #25 from Phase 2)
	29		CGCM3 B1						
B	30	2011-2040	HadCM3 A2	Expected	Maintained constant at 2006 level	Improves at expected rate	Maintained constant at 2006 level	Expected rate of population growth (increase at 1% +/- per year)	Continue as-is moderate scenario (roughly comparable to #1 from Phase 2)
	31		CGCM3 B1						
C	34	2011-2040	HadCM3 A2	Expected	Maintained constant at 2006 level	Improves at expected rate	Maintained constant at 2006 level	High rate of population growth (increase at 2.5%+/- per year) accommodated by "urban sprawl"	Isolates the effect of population boom with urban sprawl (NEW comparison)
	35		CGCM3 B1						
D	36	2011-2040	HadCM3 A2	Expected	Maintained constant at 2006 level	Improves at expected rate	Irrigate all available agricultural land	Expected rate of population growth (increase at 1% +/- per year)	Isolates the effect of increasing the agricultural land base (roughly comparable to #3 from Phase 2)
	37		CGCM3 B1						
E	38	2011-2040	HadCM3 A2	Expected	Maintained constant at 2006 level	Maintained constant at 2006 level	Irrigate all available agricultural land	High rate of population growth (increase at 2.5%+/- per year) accommodated by "urban sprawl"	A possible "worst-case" (roughly comparable to #4 from Phase 2)
	39		CGCM3 B1						

Table 2.1 cont'd.

Scenario Group	Scenario	Period	Model	Mountain Pine Beetle	Domestic (indoor & outdoor) Efficiency	Agricultural Efficiency	Agricultural Land Base	Population growth	Description
F	40	2011-2040	HadCM3 A2	Expected	Linear improvement of 33% (total) between 2011-2040	Improves at expected rate	Irrigate all available agricultural land	High rate of population growth (increase at 2.5%+/- per year) accommodated by "urban sprawl"	Illustrates how efficiency in both domestic and agriculture may mitigate a "worst-case" scenario under a "dry" climate (roughly comparable to #4 from Phase 2)
	41		CGCM3 B1						
G	55	5-year drought (2011-2016)	Synthetic drought sequence	Expected	Maintained constant at 2006 level	Maintained constant at 2006 level	Maintained constant at 2006 level	Maintained constant at 2006 level	Illustrates what may happen if we have a 5-year drought tomorrow.
	56	5-year drought (2039-2044)	Synthetic drought sequence	Expected	Maintained constant at 2006 level	Maintained constant at 2006 level	Irrigate all available agricultural land	High rate of population growth (increase at 2.5%+/- per year) accommodated by "urban sprawl"	A possible "worst-case" drought scenario 30 years into the future
	57	5-year drought (2039-2044)	Synthetic drought sequence	Expected	Linear improvement of 33% (total) between 2011-2040	Improves at expected rate	Irrigate all available agricultural land	High rate of population growth (increase at 2.5%+/- per year) accommodated by "urban sprawl"	Illustrates how efficiency improvements may mitigate a possible "worst-case" drought scenario 30 years into the future

3.0 FACTORS AFFECTING WATER SUPPLY AND USE

This section highlights the principal factors that drive the water supply and use in the Okanagan and identifies how these factors are projected to change in the future based on the assumptions used in this study. For the purposes of this report, technical details on the development of the input datasets have been largely omitted. Nevertheless, some of the Phase 3 modeling assumptions and methodologies are documented in a memo by RHF Systems (Appendix G). Further modeling details are available in DHI (2010), Summit (2010) and other reports being prepared by the main contributors to this study (e.g. Agriculture and Agri-Food Canada).

3.1 CLIMATE

Similar to Phase 2, Environment Canada produced gridded climate datasets for the Okanagan Basin at 500 m resolution. For each of the climate models as well as a five year synthetic drought (which attempts to mimic the 1929-1931 drought of record), hourly temperature, precipitation, and reference evapotranspiration were supplied to RHF Systems Ltd. for use in the OBHM, OWDM, and OBWAM. For presentation purposes, we have reduced this large volume of data to Basin-wide mean monthly and annual values for the period 1971 to 2006 (Scenarios 65 and 66) and the future (2011-2040) period (Scenarios 28 and 29).

In order to understand the projected Okanagan's water supply and use in future, it is useful to understand what the climate models (used in Phase 3) are projecting. The following sections illustrate the possible future patterns in temperature and precipitation.

3.1.1 Air Temperature

Figure 3.1 illustrates how the mean annual temperatures are projected to change over the next three (3) decades under Scenario 28 (HadCM3 A2) and Scenario 29 (CGCM3 B1). Figure 3.2 illustrates how temperatures are projected to vary monthly. Figures 3.1 and 3.2 indicate that both models suggest a warming throughout the year, with the HadCM3 A2 model projecting considerably warmer summer and fall temperatures. With warming temperatures in winter, it is speculated that the proportion of rain to snow may increase and the duration of freezing temperatures would decrease. Furthermore, the risk of mid-winter snowmelt may increase. All these factors could serve to reduce the volume of water available from the snowpack and affect the timing at which it is available.

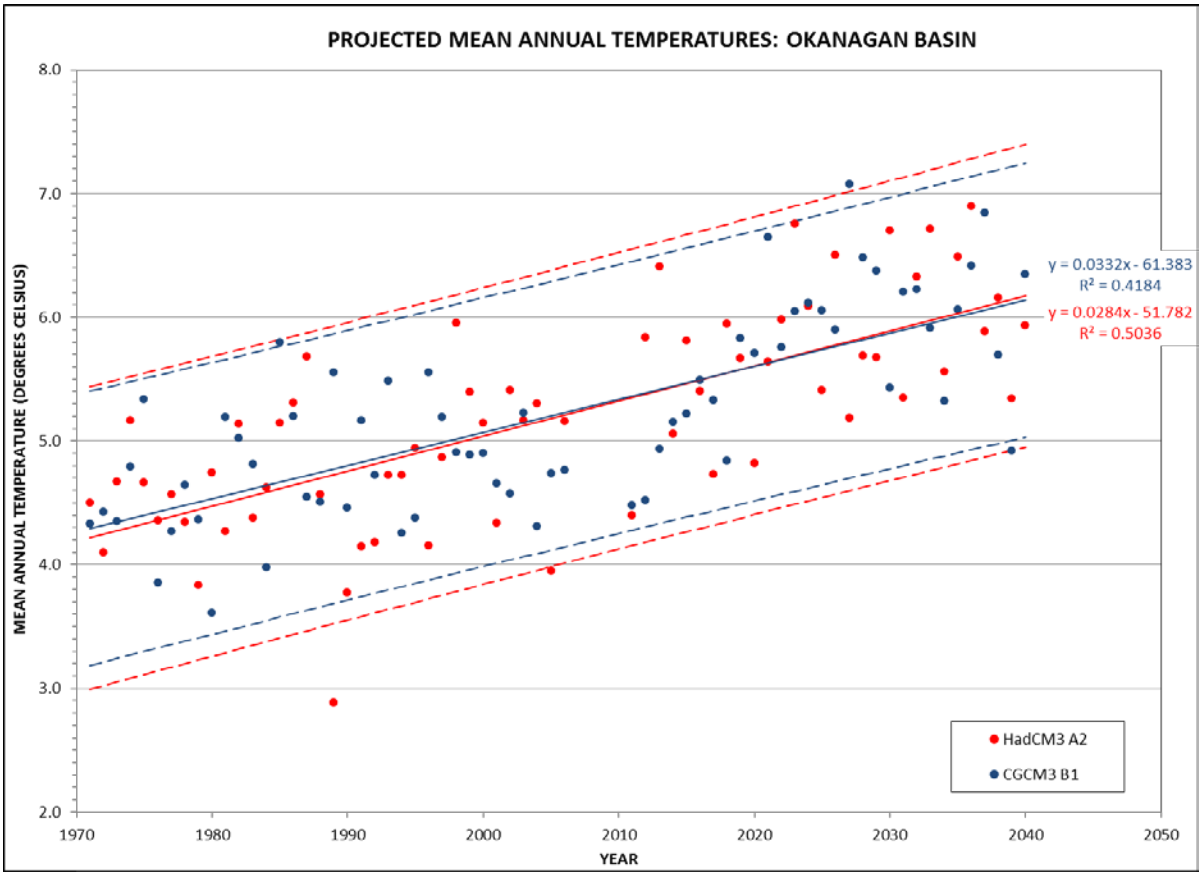


Figure 3.1 Projected mean annual temperatures for the Okanagan Basin. Red and blue data represents the projections from the HadCM3 A2 and the CGCM3 B1 models respectively. Solid lines are the best-fit regression lines, while the dashed lines indicate the 95% prediction limits. On an annual basis, the projected temperature trends based on the two models are comparable, and both have high inter-annual variability.

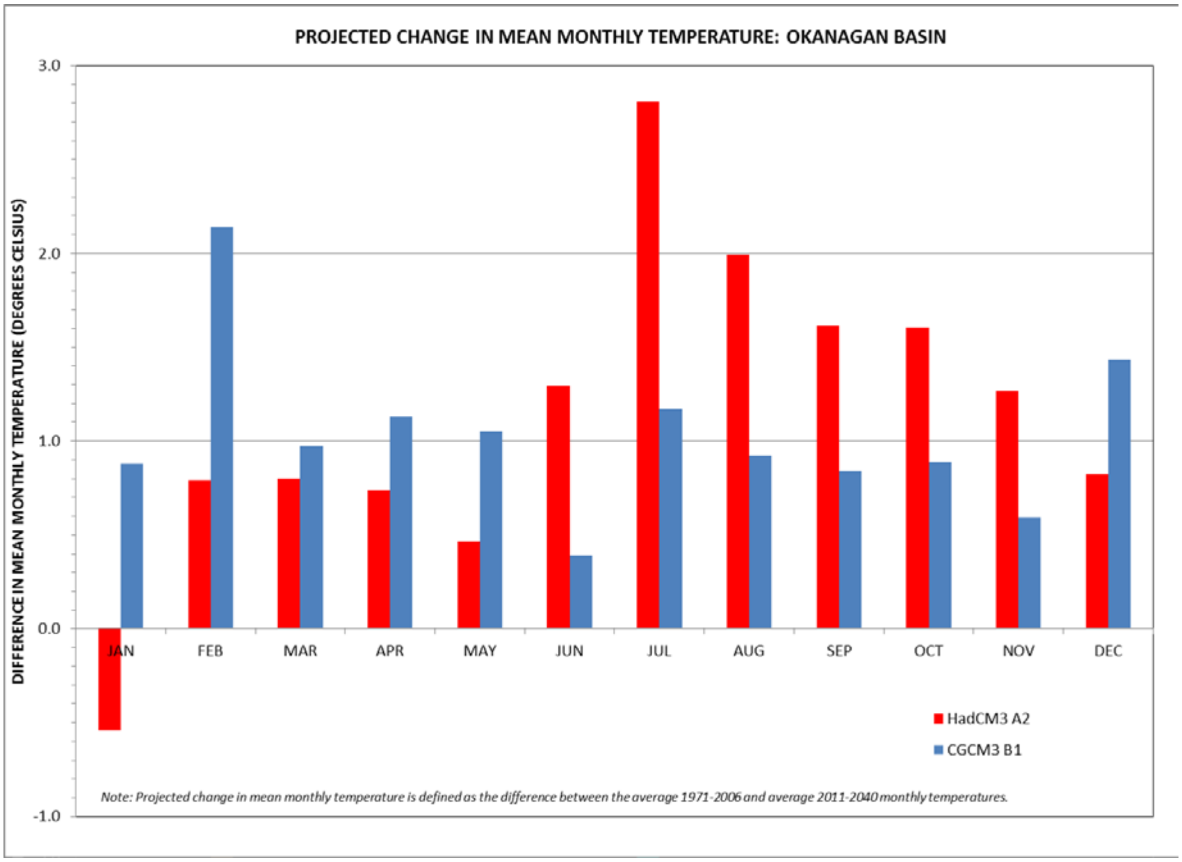


Figure 3.2 Projected change in mean monthly Okanagan Basin temperature based on the HadCM3 A2 model (red) and the CGCM3 B1 model (blue). With the exception of January, all months are projected to be warmer, however, the pattern of increases varies by climate model.

3.1.2 Precipitation

Annual precipitation projections, as shown in Figure 3.3, have a relatively high inter-annual variability and display weak and inconsistent trends in the future. Seasonally, projected precipitation change varies by climate model with the HadCM3 A2 suggesting slightly greater amounts in late fall and winter, but reduced amounts in spring and summer. The CGCM3 B1 model differs in that it projects increased precipitation in most months, including much of the summer period (Figure 3.4). This direct affects runoff production under that assumed climate model.

The Basin-wide cumulative precipitation under an assumed synthetic 5-year drought is presented in Figure 3.5. For reference, the grey lines indicate historical precipitation patterns for a suite of consecutive five-year periods between 1996 and 2006. The red line indicates the cumulative precipitation under the synthetic 5-year drought. Given the divergence of the drought and historical plots, it is clear that the longer the period of drought, the more severe the impact on the water supply will become. By the end of the fifth year, for example, the total precipitation received during the drought is about 30% less than under normal conditions. The effect of this decrease precipitation on the water supply is discussed below.

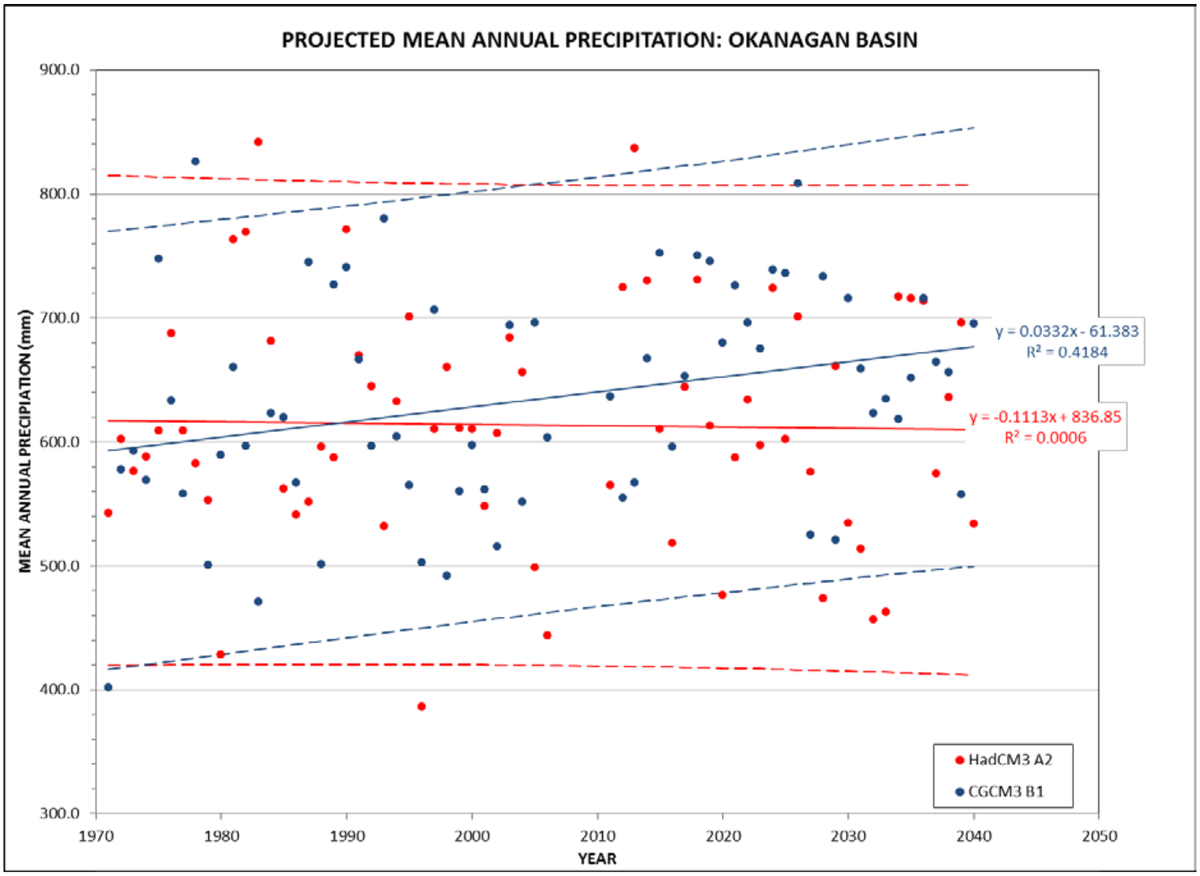


Figure 3.3 Projected mean annual precipitation for the Okanagan Basin. Red data represents the HadCM3 A2 model, blue data represent the CGCM3 B1 model. Solid lines are the best-fit regression lines, while dashed lines indicate the 95% prediction limits. Overall, the long-term trends are weak and inter-annual variability is high.

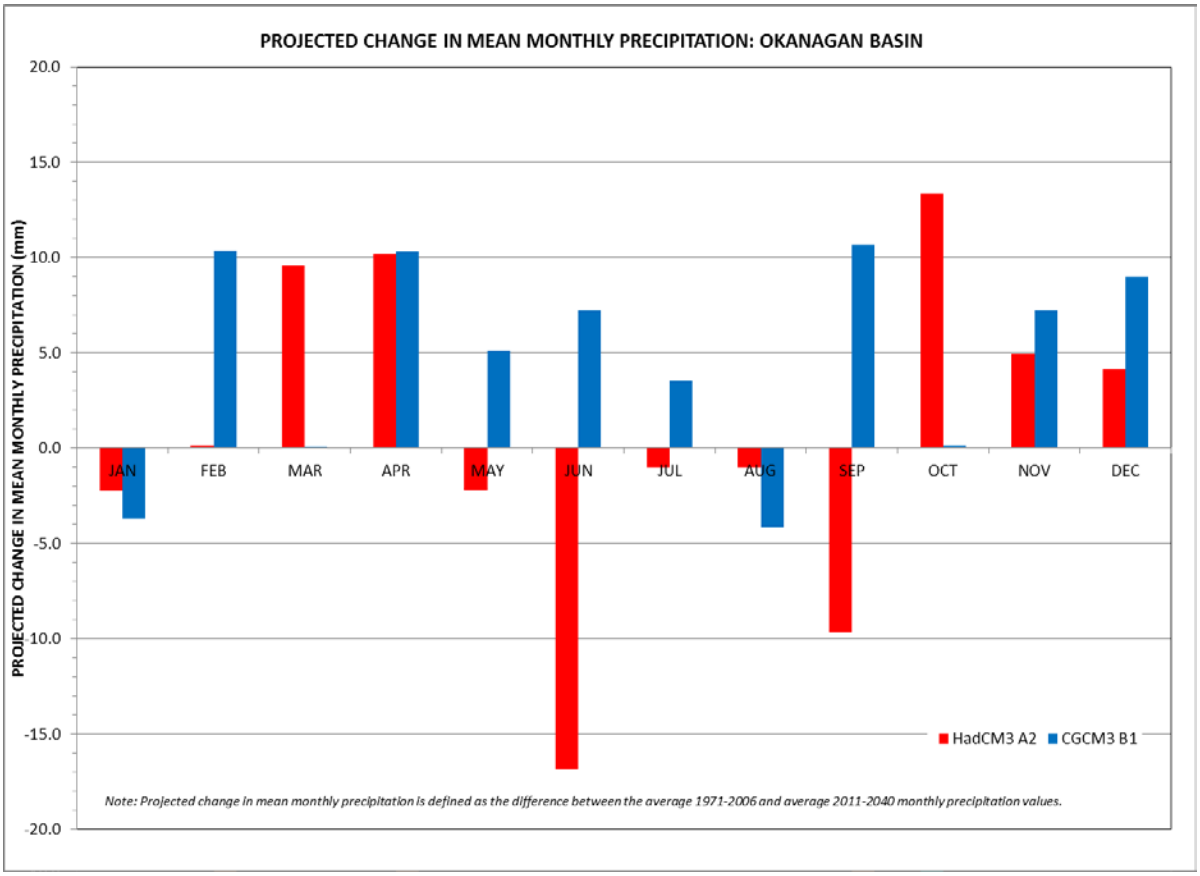


Figure 3.4 Projected change in mean monthly Okanagan Basin precipitation based on the HadCM3 A2 model (red) and the CGCM3 B1 model (blue). The pattern of changes varies by climate model. Both models suggest some increase in precipitation over the fall and winter, however over summer, the CGCM3 B1 projects wetter conditions while the HadCM3 A2 projects drier conditions.

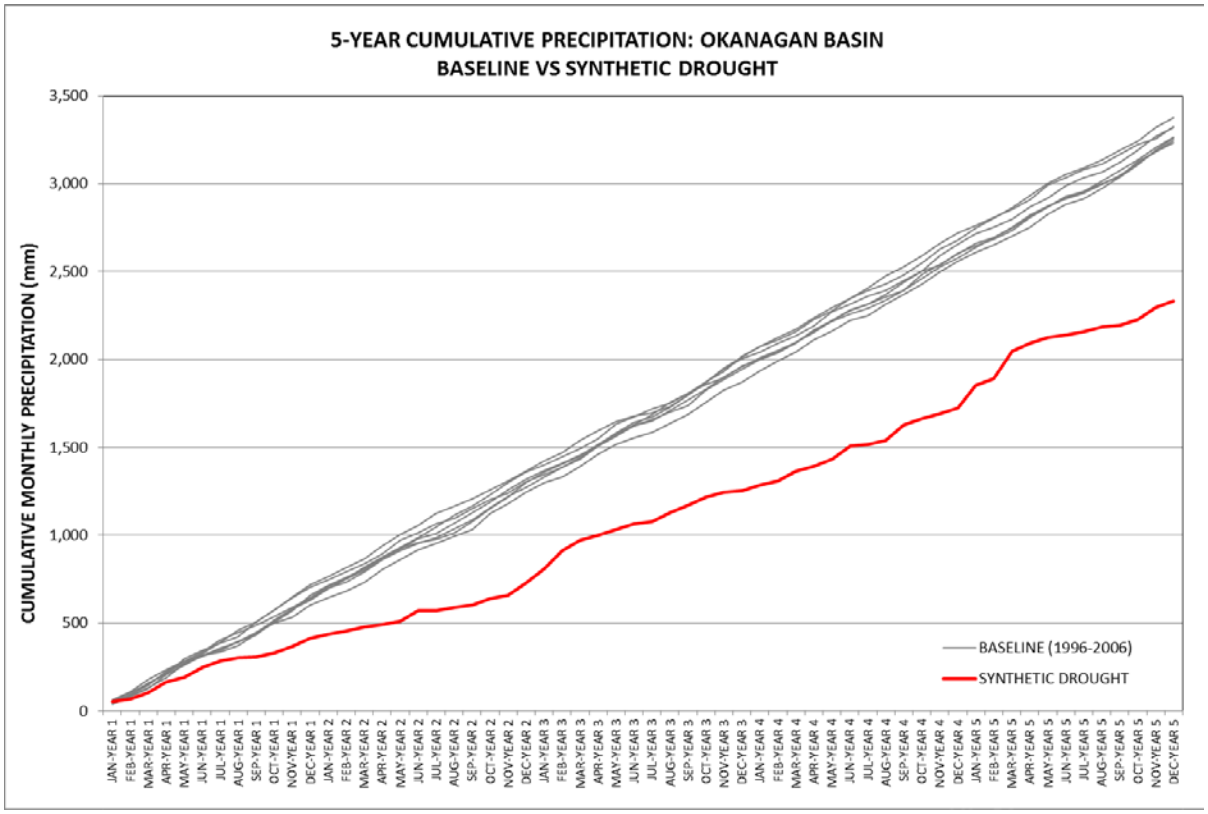


Figure 3.5 Overall cumulative precipitation in the Okanagan under normal conditions between 1996 and 2006 (grey) and under an extended drought (red). The drought was synthesized by Environment Canada to mimic climatic conditions similar to the 1929-1931 drought of record in the Okanagan.

3.2 WATERSHED CONDITIONS

Phase 3 modeling of the past and future watershed conditions adopted the assumptions and parameters used in the Phase 2 modeling (DHI, 2010). This included assumptions on the evolution of the forest cover over time (i.e. by logging, fire and mountain pine beetle). For all Phase 3 scenarios, the same assumed evolution of the forest cover was used.

3.3 WATER USE EFFICIENCY

The efficiency by which water is used is an important factor that can affect water use. In Phase 3 modeling, the effects of both domestic and agricultural (irrigation) water use efficiency was evaluated. The specific assumptions used during Phase 3 modeling by RHF Systems are outlined in a memo in Appendix G.

3.3.1 Domestic (Indoor and Outdoor) Efficiency

As shown in Table 2.1, domestic (indoor and outdoor) efficiency was either assumed constant (at 2006 levels) or assumed to improve linearly by approximately 1% per year over the period 2011-2040.

3.3.2 Agricultural Efficiency

Agricultural water use efficiency was either assumed constant (at 2006 levels) or assumed to improve at the expected rate based on historical trends.

3.4 AGRICULTURAL LAND BASE

The agricultural land base was modeled either using the assumption that it is maintained constant at 2006 levels or that all available agricultural land becomes irrigated (refer to Appendix G).

3.5 POPULATION GROWTH

During Phase 3 modeling, three (3) assumptions for the rate of population growth and type of residential development were used (refer to Appendix G):

1. Population maintained constant at 2006 levels,
2. Population growth occurs at a rate of 1% per year and growth occurs principally by infilling of existing residential areas (i.e. densification).
3. Population growth occurs at a rate of 2.5% per year, and growth occurs principally by expansion into formerly undeveloped lands (i.e. “urban sprawl”).

4.0 PROJECTED WATER SUPPLY

4.1 SNOWPACK

Given the interior climate in the Okanagan, the availability of water currently depends largely on the accumulation and melt of snow in the higher elevation uplands. The many upland reservoirs in the Okanagan are a testament to the importance of capturing snowmelt in spring for controlled release as demands require during drier times of the year.

The term snow water equivalent (SWE) is used to indicate the water content of the snowpack (in mm). For the purposes of this study, SWE estimates were extracted from the Okanagan Basin Hydrology Model (OBHM). To provide an indicator of the possible future changes in snowpack, SWE estimates for the Okanagan Lake watershed (i.e. the drainage area above the outlet of Okanagan Lake at Penticton, not the entire Okanagan River Basin) were averaged across all areas above 1,000 m elevation (Figure 4.1). This area was used since it is similar to the area considered by the BC Ministry of Environment when developing Okanagan Lake inflow forecasts each spring.

Projected SWE data was provided for both climate models: HadCM3 A2 and CGCM3 B1. Figure 4.2 presents this data as annual maximum SWE. The two models indicate that inter-annual variability in the maximum SWE is high; a fact that is clearly reflected in the historical annual inflow volumes to Okanagan Lake. For example, since 1971, Okanagan Lake inflows have ranged from a low of about 129,000 million litres (ML) to a high of 1,330,000 ML (i.e. a difference of about 10 times). In spite of the wide year to year fluctuation in SWE, there is a subtle shift towards lower values in the future. Such a shift is likely driven not so much by changes in precipitation (Figure 3.3), but by the increasing temperatures during winter, which can affect the distribution of snowfall (versus rain) and the duration and amount of snow on the ground. In addition, there is evidence that the timing of the annual maximum SWE may be earlier in the future (Figure 4.3).

Figure 4.1 The yellow area shows the elevations greater than 1,000 m within Okanagan Lake watershed (i.e. the drainage area above the outlet of Okanagan Lake at Penticton). This is the area from which snow water equivalent (SWE) data was extracted.

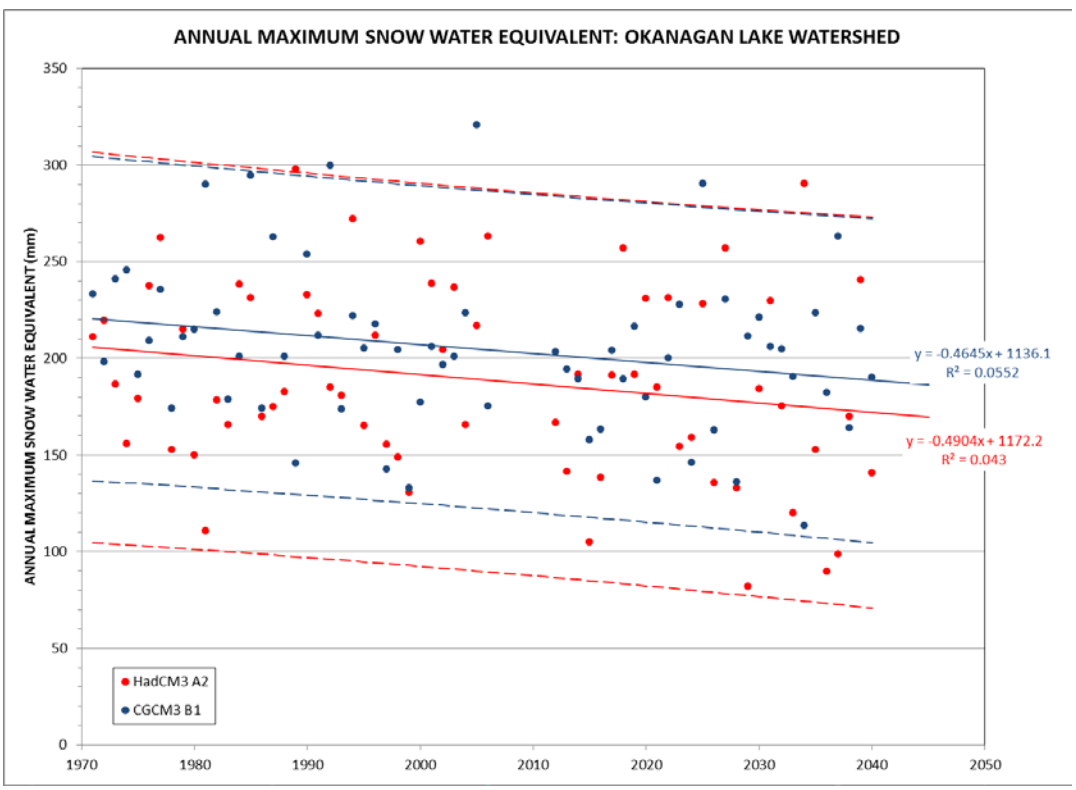
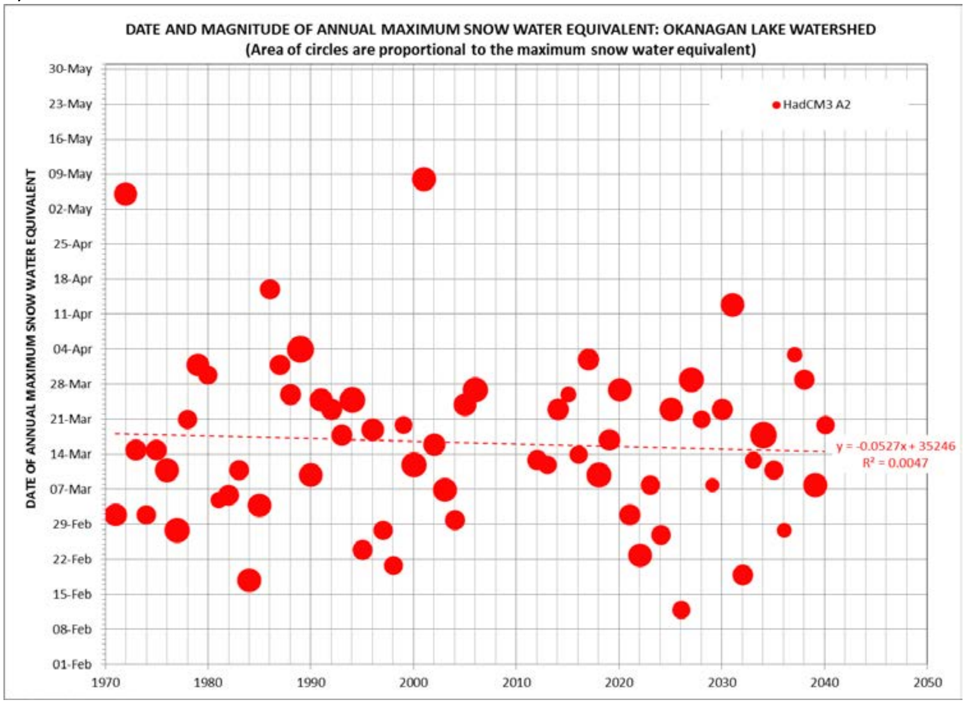


Figure 4.2 Projected annual maximum snow water equivalent (SWE) averaged across all elevations greater than 1,000 m within the Okanagan Lake watershed. Red data represent SWE estimates based on the HadCM3 A2 model, while blue data represent estimates based on the CGCM3 B1 model. Notice the wide variability in the SWE predicted by both models.

a)



b)

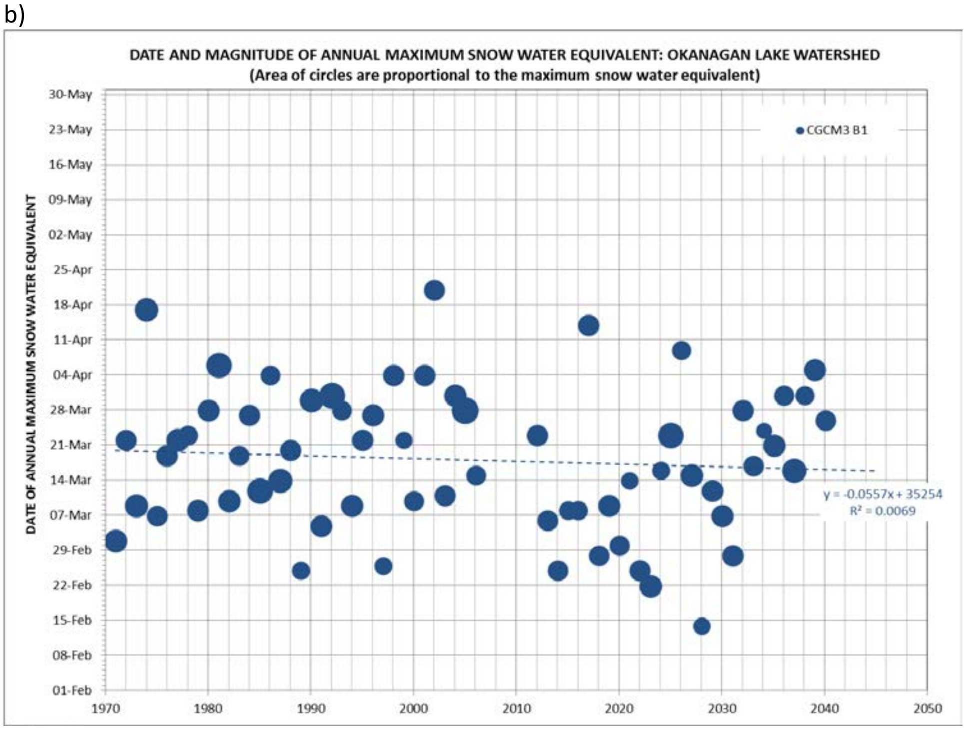


Figure 4.3 Projected date of annual maximum snow water equivalent (SWE) for the Okanagan Lake watershed: a) based on the HadCM3 A2 model, and b) based on the CGCM3 B1 model. The size of the dots is proportional to the maximum snow water equivalent on that date.

Although the trends in the timing and magnitude of the annual maximum SWE are subtle, on a monthly basis there is stronger evidence that the snowpack is diminishing in late winter (Figure 4.4). The changes however are dependent upon the assumed climate model. Under the HadCM3 A2 model, reductions throughout the winter/spring season are projected, while under the CGCM3 B1 model, these reductions tend to be skewed primarily towards the late spring.

In summary, based on the SWE projections under two climate models, there is some evidence that the volume of water represented by the snowpack will decrease in future, and that the period with snow cover in the uplands may also be reduced. The implications of this are an earlier onset of spring freshet and a reduction in the volume of snowmelt runoff produced. However (as discussed below) this may be mitigated by increased precipitation as rain.

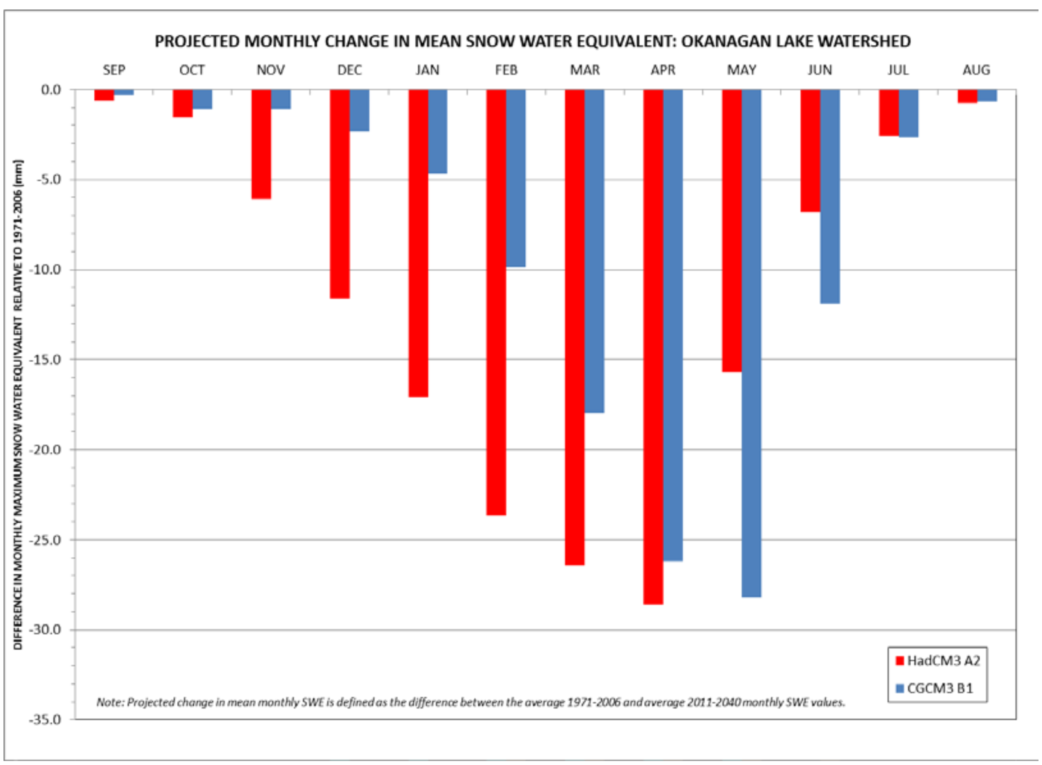


Figure 4.4 Projected change in monthly maximum snow water equivalent (SWE): a) based on the HadCM3 A2 model (Scenario 28), and b) based on the CGCM3 B1 model.

4.2 SURFACE WATER SUPPLY (NATURAL RUNOFF)

Future projections for Okanagan's water supply were made using the Okanagan Basin Hydrology Model (OBHM) (described in Summit, 2010). The model was run for the period 1971-2006 (baseline period) and 2012-2040 (future period) using two climate models (HadCM3 A2 and CGCM3 B1). Some of the key findings are provided below.

4.2.1 Overall Okanagan Basin Water Supply

Overall, total annual (natural) runoff from the Okanagan Basin is highly variable from year to year (Figure 4.5). Between 1996 and 2006, annual runoff averaged about 886,000 ML (117 mm) (Summit, 2010). Based on the OBHM, annual runoff between 1971 and 2040 ranged from about 400,000 ML to nearly 1,900,000 ML (a difference of 4.75 times). The projections suggest a general trend towards increasing annual runoff in the future; however this is not *statistically* significant. The trend is slightly stronger under the CGCM3 B1 climate, which is projected to have increasing precipitation. Interestingly, despite relatively uniform annual precipitation under the HadCM3 A2 climate (Figure 3.3), there is a slight runoff increase over time.

Long-term annual runoff statistics for the Okanagan Basin are presented as box plots in Figure 4.6; these data are organized by the four (4) main reporting zones (refer to Section 5.0 and Appendix B), as well as for "Okanagan Lake" and "Okanagan River"[2]. Separate box plots are shown for the OBHM results with the HadCM3 A2 climate (a) and with the CGCM3 B1 climate (b). These plots effectively show the expected value in terms of the median[3] annual flow (horizontal line through each box), as well as the variability as indicated by the inter-quartile range (IQR) (i.e. the spread between the 25th percentile and the 75th percentile). The "whiskers" include the maximum and minimum projections.

[2] "Okanagan Lake" in this context refers to the drainage area above Okanagan Lake at Penticton. "Okanagan River" refers to the drainage area feeding Okanagan River between the outlet of Okanagan Lake and outlet of Osoyoos Lake.

[3] The median is generally preferred over the mean as it is less biased by extreme high or low values.

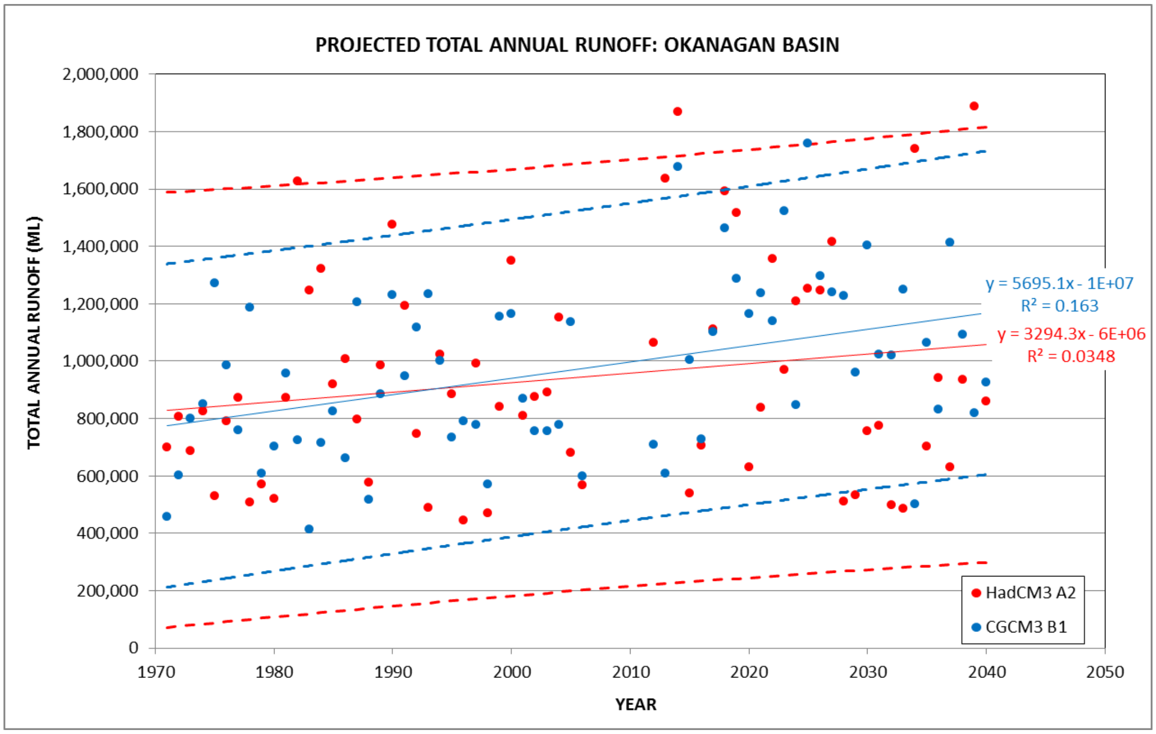


Figure 4.5 Projected total annual natural runoff in the Okanagan Basin based on the HadCM3 A2 climate projections (red) and CGCM3 B1 climate projections (blue). Annual runoff displays large year-to-year variability, with trends towards increasing values in the future; however these trends are not statistically significant.

Based on Figure 4.6, there is an indication that in all areas, the median annual runoff is expected to increase into the future (2012-2040), similar to the increase suggested on Figure 4.5. Perhaps more striking is that the variability in natural runoff is projected to dramatically increase into the future; something that may prove to be challenging to water management in the Basin.

To provide some insight at finer time scales, the projected long-term monthly natural runoff for the Okanagan Basin is provided in Table C.1 (Appendix C) and shown in Figure 4.7. In both Appendix C and Figure 4.7, projections for both climate models are provided. On Figure 4.7, the white boxes represent the modelled baseline (1971-2006) period, while the colored boxes represent the future (2011-2040) period. Note that the median monthly runoff is identified by the horizontal line that bisects each box. The inter-quartile range (IQR), is represented by difference between the top and bottom of the box. The IQR provides an indication of the variability in the runoff projections.

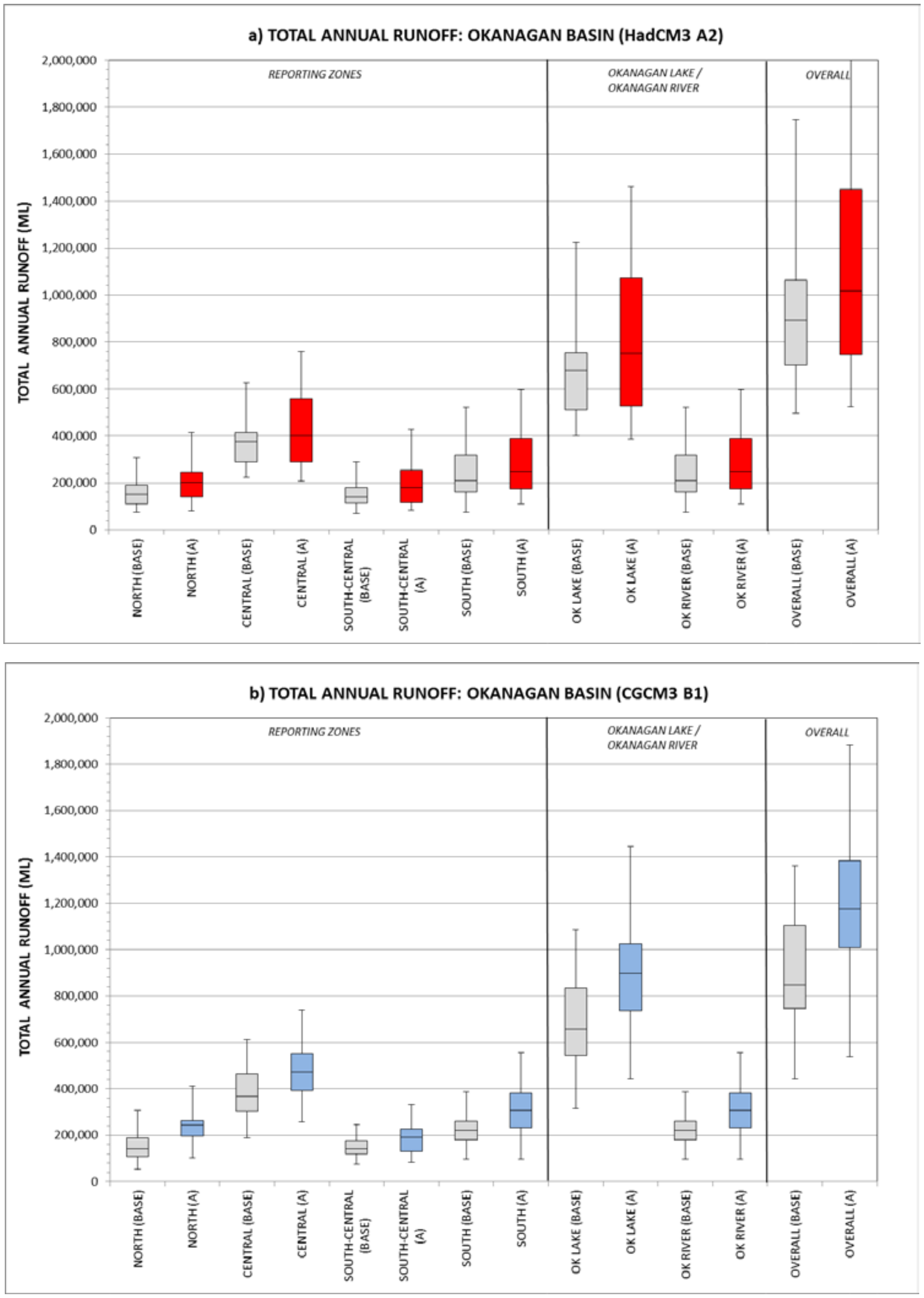
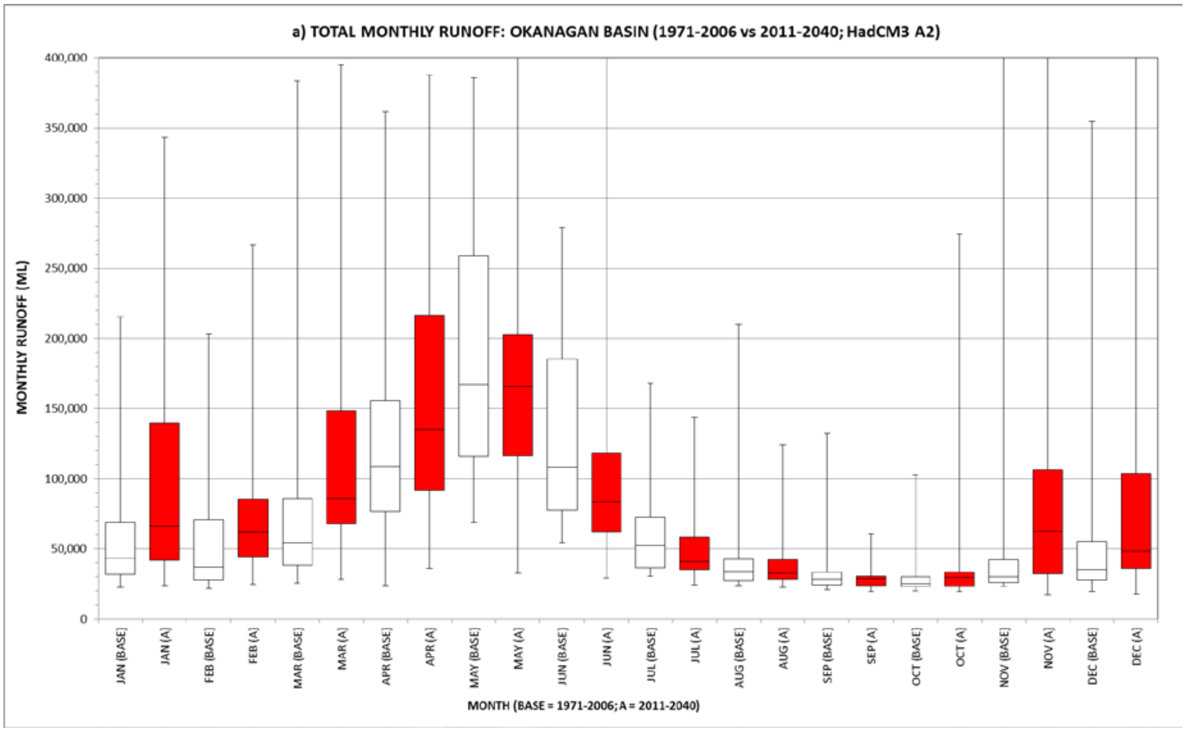


Figure 4.6 Projected change in natural annual runoff in the Okanagan Basin between the modeled baseline (1971-2006, "BASE") and modeled future (2011-2040, Scenario Group "A") periods: Fig. a) HadCM3 A2; Fig. b) CGCM3 B1. The results are organized by i) the four reporting zones (North, Central, South-Central, and South), ii) Okanagan Lake watershed vs. Okanagan River watershed (below Okanagan Lake), and iii) Overall. Each box identifies the first quartile (lower edge of box), median (horizontal line through box), and third quartile (upper edge of box). The upper and lower "whiskers" identify the maximum and minimum projections, respectively.



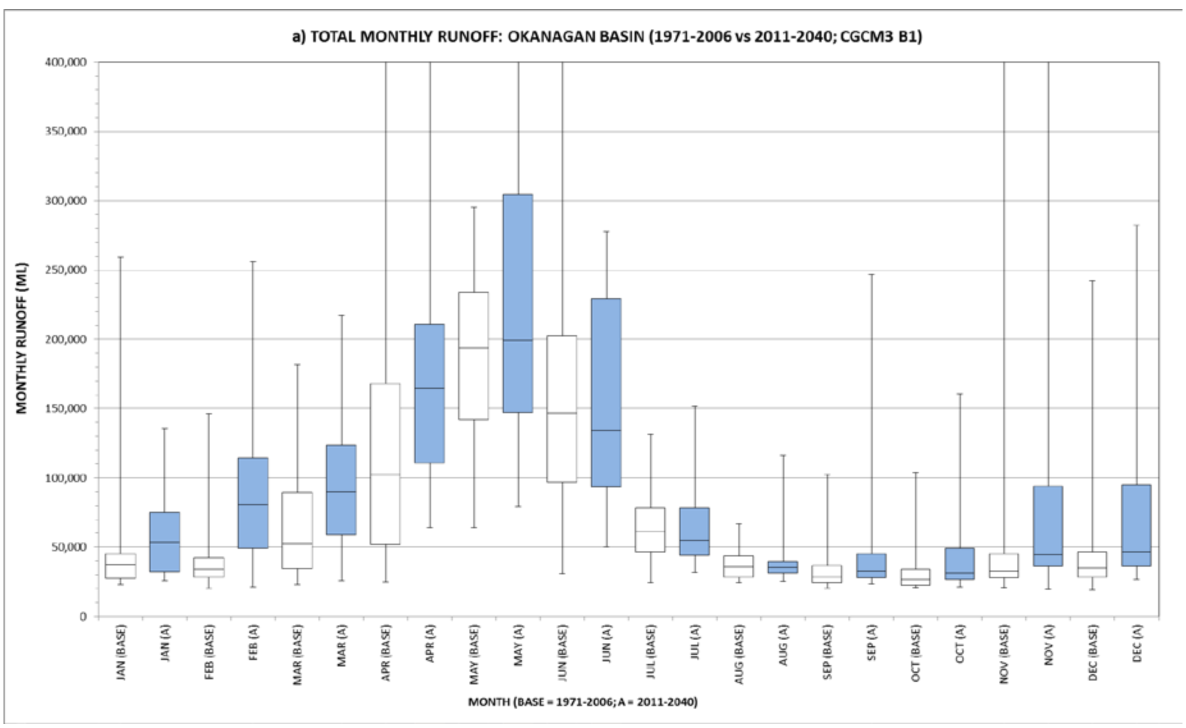


Figure 4.7 Projected change in monthly runoff in the Okanagan Basin between the baseline (1971-2006) and modeled future (2011-2040) periods: a) HadCM3 A2 (white and red); b) CGCM3 B1 (white and blue). Each box identifies the first quartile (lower edge of box), median (horizontal line through box), and third quartile (upper edge of box). The upper and lower "whiskers" identify the maximum and minimum projections, respectively.

Based on these plots, another picture emerges. Between late fall and early spring (October to March), there is a marked increase in the monthly runoff in the future (Figure 4.8). However this is also accompanied by considerably more variability (Figure 4.9), which is likely a result of the increase in precipitation in the winter and early spring and especially an increase in the proportion of rain to snow. Some of the increased runoff may result from mid-winter melt periods as well as advancement in the timing of the spring freshet. By May or June, a shift towards decreased monthly runoff occurs. This possibly reflects the earlier depletion of the snowpack and drier and warmer summer conditions.

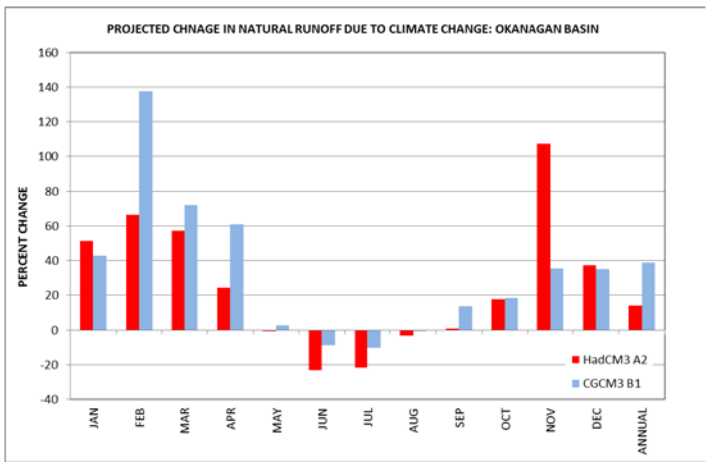


Figure 4.8 Projected % change in median monthly runoff due to climate change in the Okanagan Basin.

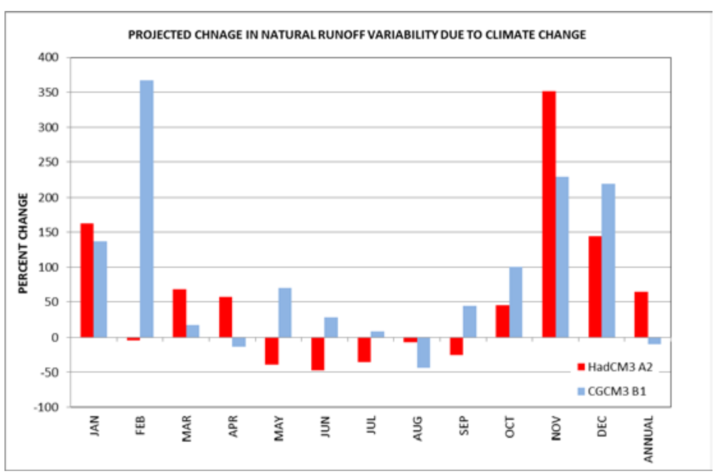


Figure 4.9 Projected % change in the variability of monthly runoff as indicated by the IQR due to climate change in the Okanagan Basin.

The pattern of increasing winter and spring flows and decreased summer flows appears not only at the Basin-scale but at the sub-basin level as well (see below) and is generally consistent with the findings of other regional studies of climate change effects on the hydrology of interior streams [e.g. Pike et al. (2010), Rodenhuis et al. (2009), Schnorbus and Rodenhuis (2010)].

4.2.2 Tributary Water Supply

The Okanagan Basin is divided into 31 principal stream catchments or "sub-basins"; these catchments generate the bulk of the surface water runoff in the Okanagan. Figure 4.10 shows the typical distribution of annual surface runoff between the 31 streams in the Okanagan. This figure excludes the 40 "residual areas" (i.e. areas within the Okanagan that are not defined as stream catchments) that typically supply only a very small fraction of the total Basin's surface water.

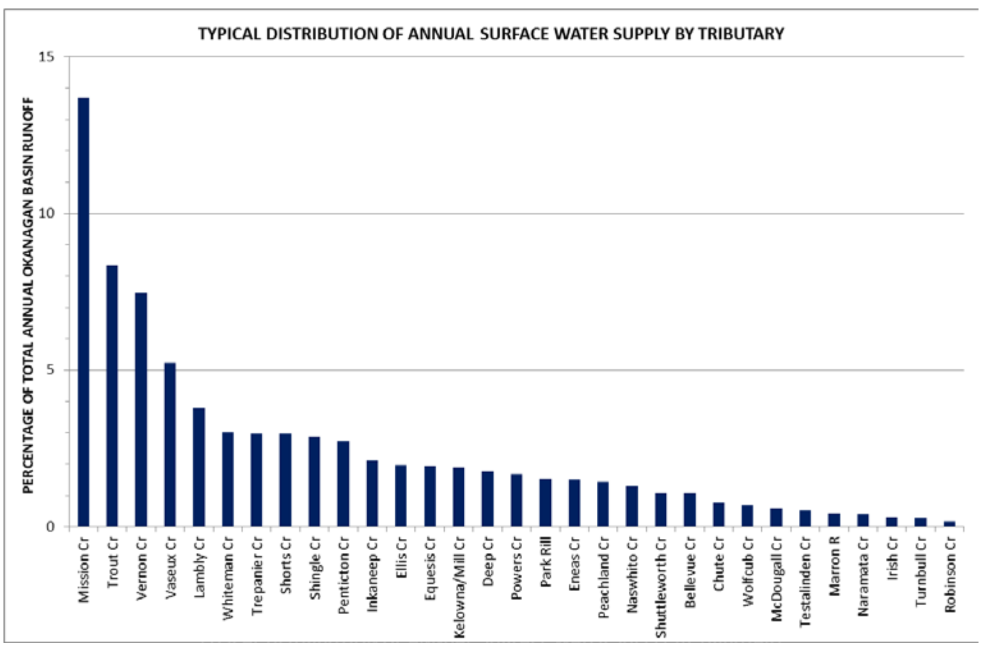


Figure 4.10 Typical distribution of annual surface runoff by stream in the Okanagan Basin. Values are in percentage of total Basin runoff over the period 1996-2006.

To demonstrate the patterns and future projections of natural runoff in the Okanagan, selected stream catchments from north to south were assessed in greater detail. Runoff projections for Mission Creek, the largest single contributor of runoff in the Basin, along with Trout Creek and

Vaseux Creek are provided in Table C.2 (Appendix C) and are plotted in Figures 4.11 to 4.13. Despite their different size and location, these streams reflect remarkably similar patterns to the Basin overall, specifically, increased runoff in winter and early spring and reduced summer runoff. In many (but not all) cases this is accompanied by increased variability, particularly during winter.

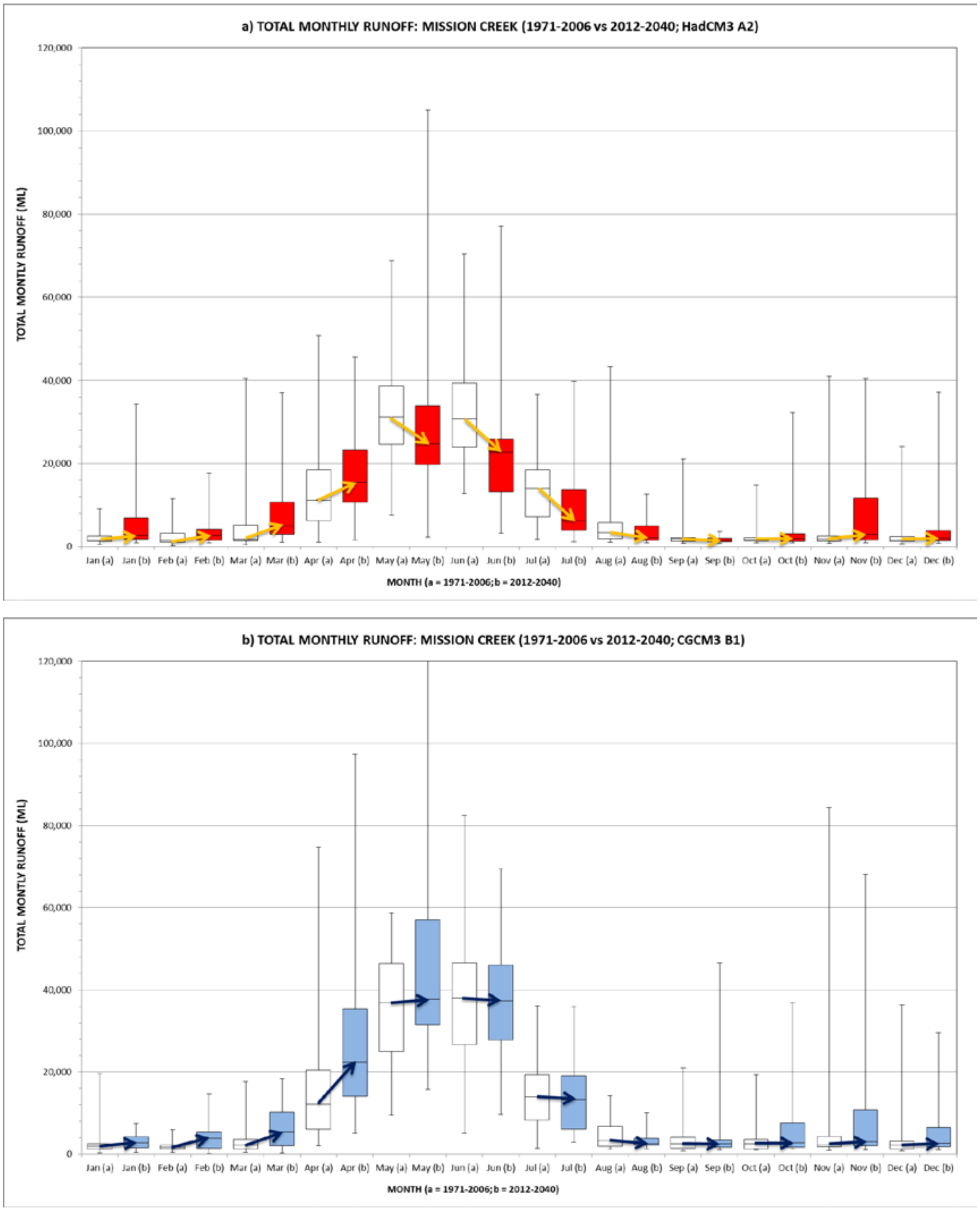


Figure 4.11 Projected change in natural monthly runoff in Mission Creek (at the mouth) between the modeled baseline (1971-2006) and modeled future (2012-2040) periods: a) HadCM3 A2 (white and red); b) CGCM3 B1 (white and blue). Each box identifies the first quartile (lower edge of box), median (horizontal line through box), and third quartile (upper edge of box). The upper and lower "whiskers" identify the maximum and minimum projections, respectively. The arrows indicate the change in median monthly runoff.

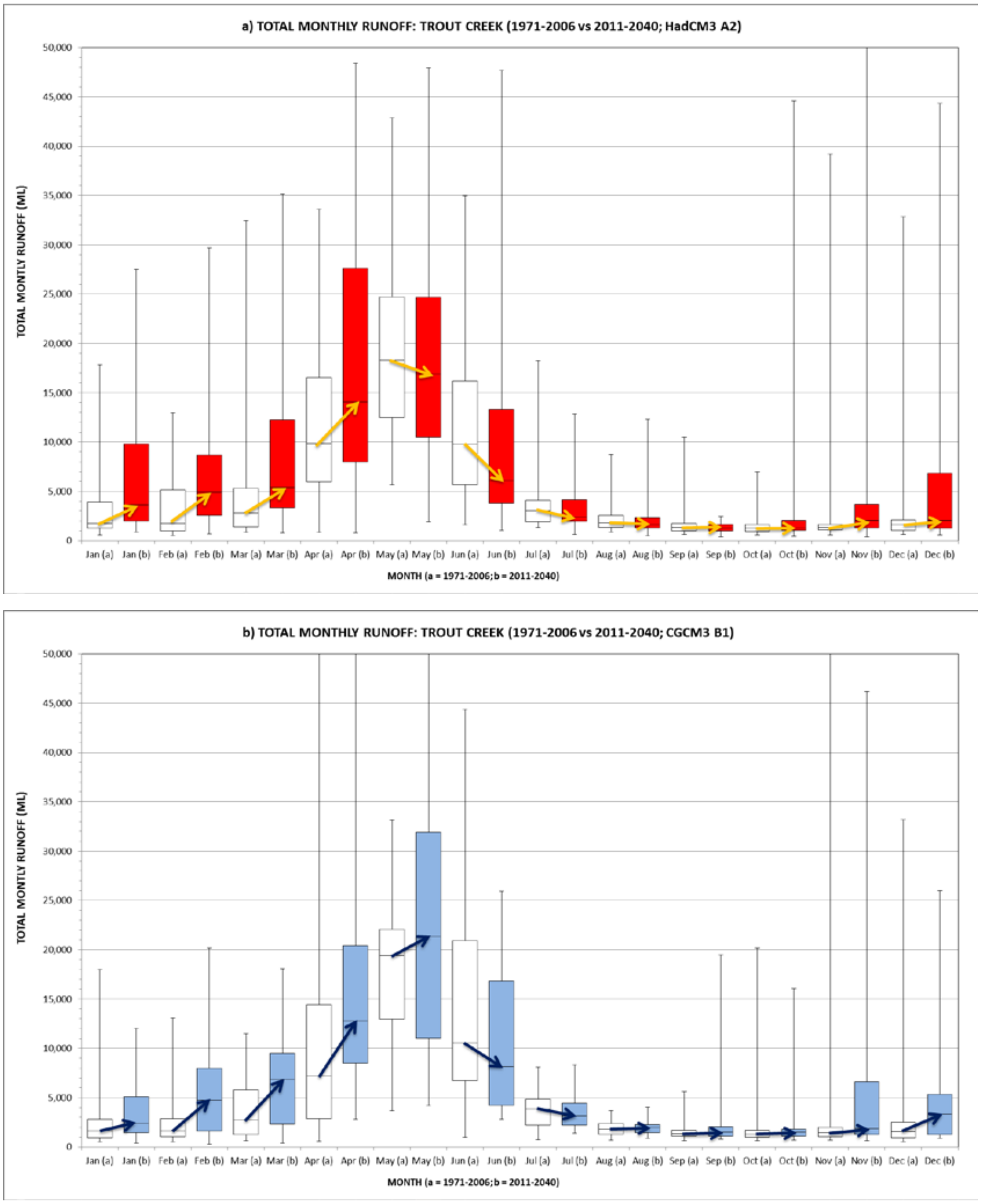


Figure 4.12 Projected change in natural monthly runoff in Trout Creek (at the mouth) between the modeled baseline (1971-2006) and modeled future (2012-2040) periods: a) HadCM3 A2 (white and red); b) CGCM3 B1 (white and blue). Each box identifies the first quartile (lower edge of box), median (horizontal line through box), and third quartile (upper edge of box). The upper and lower "whiskers" identify the maximum and minimum projections, respectively. The arrows indicate the change in median monthly runoff.

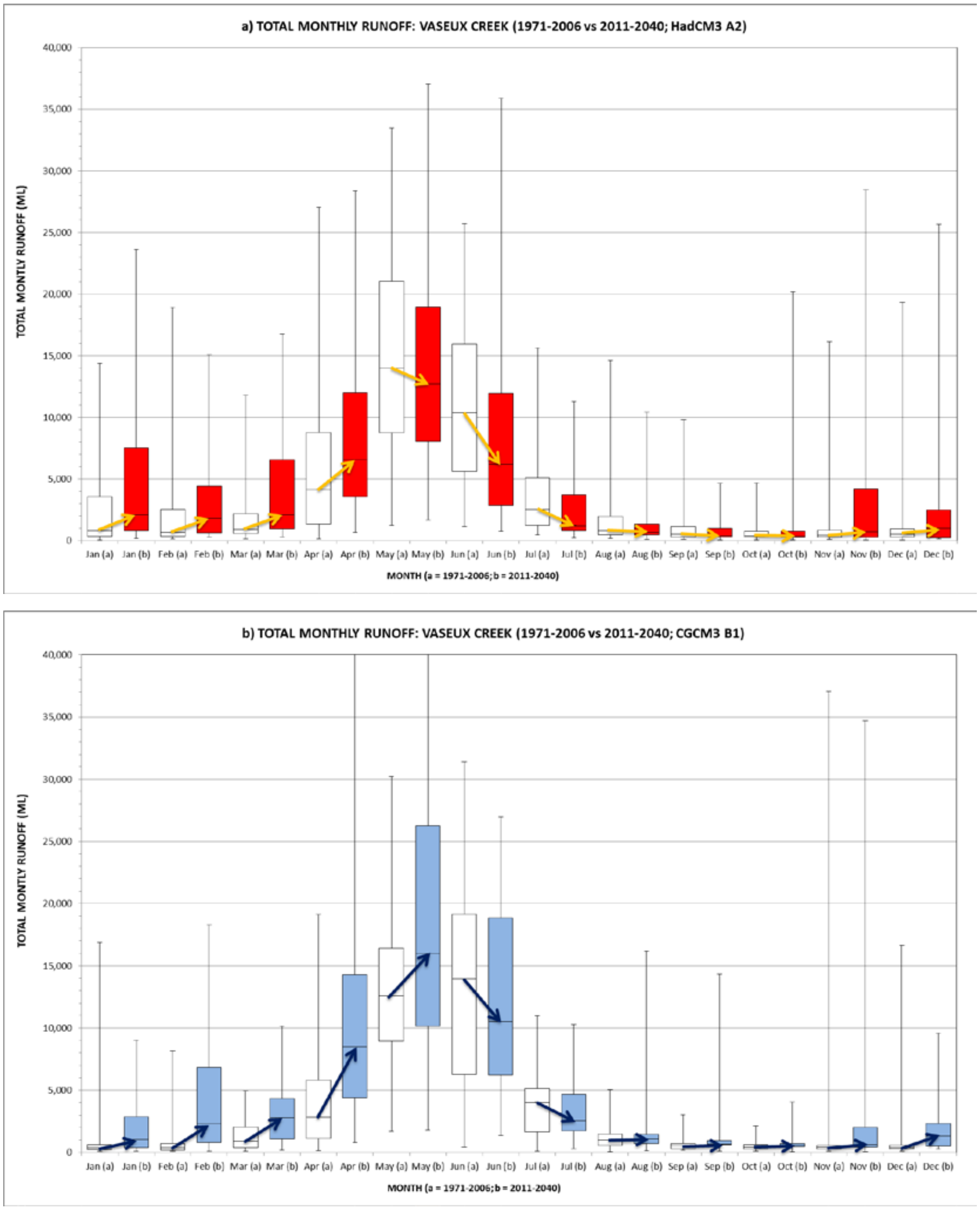


Figure 4.13 Projected change in natural monthly runoff in Vaseux Creek (at the mouth) between the modeled baseline (1971-2006) and modeled future (2012-2040) periods: a) HadCM3 A2 (white and red); b) CGCM3 B1 (white and blue). Each box identifies the first quartile (lower edge of box), median (horizontal line through box), and third quartile (upper edge of box). The upper and lower "whiskers" identify the maximum and minimum projections, respectively. The arrows indicate the change in median monthly runoff.

4.2.3 During Extended Drought

An extended drought typically poses the most challenging conditions to the management of the Okanagan's water supply. With each year under an extended drought, the water supply is taxed during summer and fall, but unlike normal years, reservoir storage does not necessarily get replenished over winter and spring. To illustrate the effect of a simulated 5-year drought of similar climatic conditions to the 1929-1931 drought of record, the OBHM was run using a synthesized climatic dataset from Environment Canada. The overall runoff projected for the Okanagan Basin during drought is shown in Figure 4.14. For reference, the drought projections are plotted against a suite of natural runoff time-series for the baseline period (1996-2006). The divergence of the red and grey lines indicates the effect of drought on the natural water supply. By the end of the 5-year period, the cumulative runoff during the baseline period ranges from 4,700,000 to 6,200,000 ML. By contrast the drought period cumulative runoff is 3,100,000 ML, or 35 to 50% lower. Trends similar to this during extended drought are also projected for individual streams in the Okanagan.

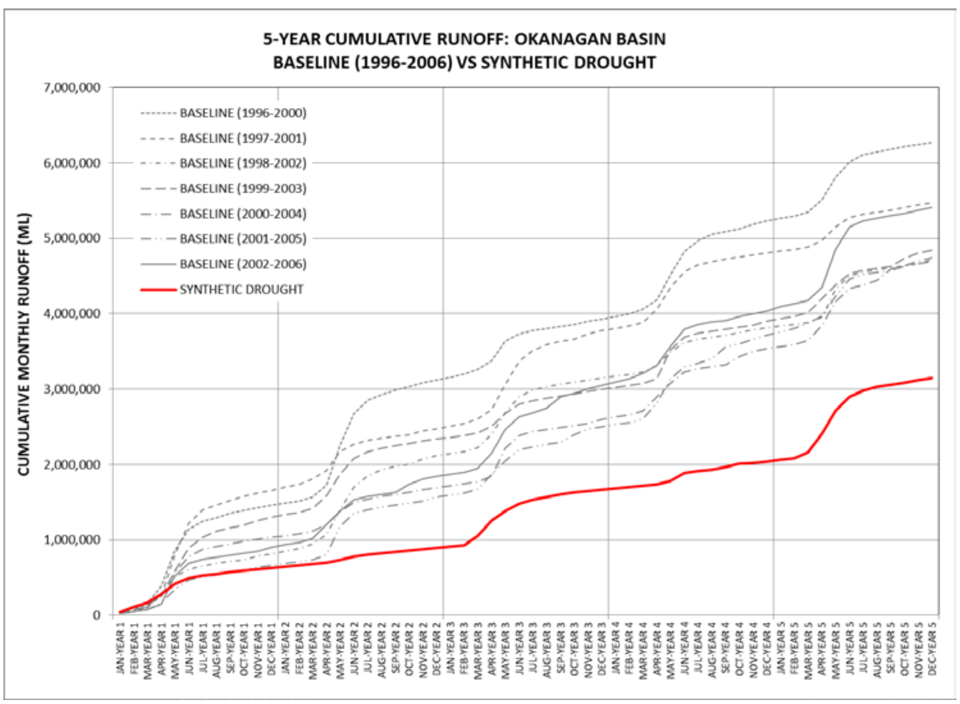


Figure 4.14 Overall cumulative (natural) runoff in the Okanagan under normal conditions between 1996 and 2006 (grey) and under an extended drought. The drought was synthesized by Environment Canada to mimic climatic conditions similar to the 1929-1931 drought of record in the Okanagan.

5.0 PROJECTED WATER USE AND EXTRACTION

The Okanagan Basin Water Demand Model is described in Summit (2010). The model provides detailed estimates of the water use for nine (9) end-uses (including losses) organized by water use area (i.e. areas serviced by water utilities) (Appendix B). The principal end-uses are:

- Agriculture,
- Domestic (indoor),
- Domestic (outdoor),
- Golf courses,
- Parks and open spaces,
- Industrial,
- Commercial,
- Institutional, and
- Lost or unaccounted for water.

Water use estimates were developed by RHF Systems at a weekly time-scale; however, for the purposes of this study, we have reduced this data to monthly and annual time-steps by developing Microsoft Access and Excel-based macros. Furthermore, we have organized the water use data into spreadsheets organized by water purveyor and reporting zone (Table 5.1, Appendix B). These spreadsheets will be supplied digitally to the OBWB. The four (4) reporting zones (North Okanagan, Central Okanagan, South-Central Okanagan, and South Okanagan) were chosen in consultation with members of the Technical Working Group to provide a means to assess broad spatial water supply and use patterns. These zones approximate some of the regional district boundaries and avoid splitting water utility service areas. Where possible these boundaries follow watershed and sub-basin boundaries.

The source(s) of water (and approximate distribution) used by each water utility listed in Table 5.1 was determined in Phase 2. This information was used to estimate the volume of water extracted from each surface water source (Table 5.2), from groundwater, from sources outside the Okanagan Basin (i.e. imports), as well as reclaimed water within the Basin.

Table 5.1 List of water utilities, by reporting zone, for which water use estimates were compiled.

North Okanagan		Central Okanagan		South-Central Okanagan		South Okanagan	
Water Use Area	**Description**	**Water Use Area**	**Description**	**Water Use Area**	**Description**	**Water Use Area**	**Description**
427	Canadian Lakeside Developments	407	Alto Utility	436 - 440	City of Penticton	413	Bobtail Ranch
428	Canyon Waterworks District	408	Antler Beach	442, 443	Corp. of the District of Summerland	415	Boundary Line Irrigation District_1
431, 432	City of Armstrong	409	Belair Estates Mobile Home Park	450	Faulder Community System	416, 417	Burrowing Owl Vineyards
441	Claremont Utilities	410, 411, 412	Black Mountain Irrigation District	453-455	Former Naramata Irrigation District	426	Cabana Beach Campground
445	Crown Villa	414	Boucherie Beach	465	Greata Ranch	444	Covert Farms
446, 447	Eagle Rock Waterworks District	418	Bylaw 1083 - Sunnyside	488	Meadow Valley Irrigation District	456	Gallaghers Lake Waterworks
463, 464	Grandview Waterworks District	419	Bylaw 369 - Falcon Ridge	549	Penticton Indian Band Reserve 1_System 2	462	Golden Arrow Trailer Park
466, 467,	Greater Vernon Water Utility	420	Bylaw 434 - Killiney Beach	554	Sage Mesa Water System	474	Idle-O-Apartments
472	Highlands Park Waterworks District	421	Bylaw 571 - Dietrich (Star Place)	584	West Bench Irrigation District	477	Kaleden Irrigation District
480	Landsdowne Waterworks District	422	Bylaw 597 - West Kelowna Estates	625-638, 640	Other_South_Central_Okanagan	482	Lakeshore Waterworks District
484, 485	Larkin Waterworks District	423	Bylaw 695 - Westshore Estates			486	Lower Nipit Improvement District
489	Meighan Creek	424	Bylaw 793 - Pritchard/Shanboolard			487	McIntyre Bluff Ranch
499-516	Okanagan Indian Band Reserve 1	425	Bylaw 981 - Sunset Ranch			498	Okanagan Falls Irrigation District
517	Okanagan Landing Utilities	429	Casaloma			518-544	Osoyoos Indian Band
547	Otter Lake Waterworks Improvement District	430	Cedar Creek Winery			545, 546	Osoyoos Irrigation District
557	Silver Star RV Park	433, 434, 435	City of Kelowna			550, 551	Penticton Indian Band Reserve 1_Systems 1 and 3
562	Stardel Waterworks District	448	Eastside Utility Ltd.			552	Rolling Hills Water Works District
564	Steele Springs Waterworks District	449	Edgewater Pines			556	Shuttleworth Creek Irrigation District
587	Whitewood Neighborhood Utility	451, 452	Fintry			558	Skaha Estates Improvement District
595-604, 606	Other_North_Okanagan	457 - 461	Glenmore Ellison Improvement District			563	St Andrews Utility
		470	Green Bay Water Utility			565	Sun Valley Improvement District
		471	Greystokes			566	Tamri Motel & Campground
		473	Holiday Park Resort			567-574	Town of Oliver
		475	Jennens			575-578	Town of Osoyoos
		476	Kal Pine Estates			580	Twin Lakes Water Utility
		478	Kelowna Springs Golf Course			581	Vaseux Lake Improvement District
		479	La Casa			582	Waltons Mountain
		481	Lake Country Irrigation District			583	Weeping Willow Mobile Home Park
		483	Lakeview Irrigation District			588	Willow Beach Utility
		490 494	Municipality of Lake Country			589	Willowbrook Water Utility
		495 - 497	Municipality of Peachland			639, 641-665	Other_South_Okanagan
		548	Peachland Ponderosa				
		553	Rutland Water Works				
		555	Shannon Lake Golf Course				
		559, 560	South East Kelowna Irrigation District				
		561	South Okanagan Mission Improvement District				
		579	Traders Cove				
		585	Westbank First Nation				
		586	Westbank Irrigation District				
		590	Wilsons Landing				
		591	Winfield Mobile Home Park				
		592	Woodsdale Utility				
		593	Woods Lake Resort				
		594, 605, 607-624	Other_Central_Okanagan				

Table 5.2 List of surface water sources by reporting zone for which water extraction estimates were compiled.

North Okanagan		Central Okanagan		South Central Okanagan		South Okanagan	
Node	**Description**	**Node**	**Description**	**Node**	**Description**	**Node**	**Description**
2	Kal-Wood Lk	1	Vernon Cr	33	W-11	48	Ok R at Penticton
3	Deep Cr	2	Kal-Wood Lk	34	Chute Cr	49	W-14
4	W-1	13	E-2	35	E-6	50	E-10
5	Irish Cr	15	W-5	36	Eneas Cr	51	Shingle Cr
6	W-2	16	Shorts Cr	37	W-12	52	Ellis Cr
7	E-1	17	W-6	38	Robinson Cr	53	W-15
8	Equesis Cr	18	Lambly Cr	39	E-7	54	E-11
9	W-3	19	W-7	40	Naramata Cr	55	Marron R
10	Naswhito Cr	20	Kelowna/Mill Cr	41	E-8	56	W-16
11	W-4	21	E-3	42	Trout Cr	57	W-17
12	Vernon Cr	22	Mission Cr	43	W-13	58	Skaha Lk
14	Whiteman Cr	23	E-4	44	Turnbull Cr	59	Ok R at Ok Falls
47	Okanagan Lk	24	Bellevue Cr	45	E-9	60	Shuttleworth Cr
-9999	Imports	25	E-5	46	Penticton Cr	61	W-18
		26	McDougall Cr	47	Okanagan Lk	62	W-19
		27	W-8			63	E-12
		28	Powers Cr			64	Vaseux Lk
		29	W-9			65	E-13
		30	Trepanier Cr			66	Vaseux Cr
		31	W-10			67	W-20
		32	Peachland Cr			68	E-14
		47	Okanagan Lk			69	Park Rill
						70	W-21
						71	Wolfcub Cr
						72	E-15
						73	Testalinden Cr
						74	W-22
						75	Ok R near Oliver
						76	E-16
						77	W-23
						78	Inkaneep Cr
						79	E-17
						80	Osoyoos Lk

Note: The surface sources identified by an alphanumeric value are *residual areas* within the Okanagan Basin watershed. They generally do not contain significant streams and given their low elevation, collectively produce only a small percentage of the annual runoff in the Okanagan watershed.

5.1 Overall Water Use

To provide an overview of the water use trends in the Okanagan, projected total annual water use throughout the Okanagan between 1996 and 2040 is presented in Figure 5.1. In this figure, total water use includes all nine (9) of the end-uses noted above regardless of source.

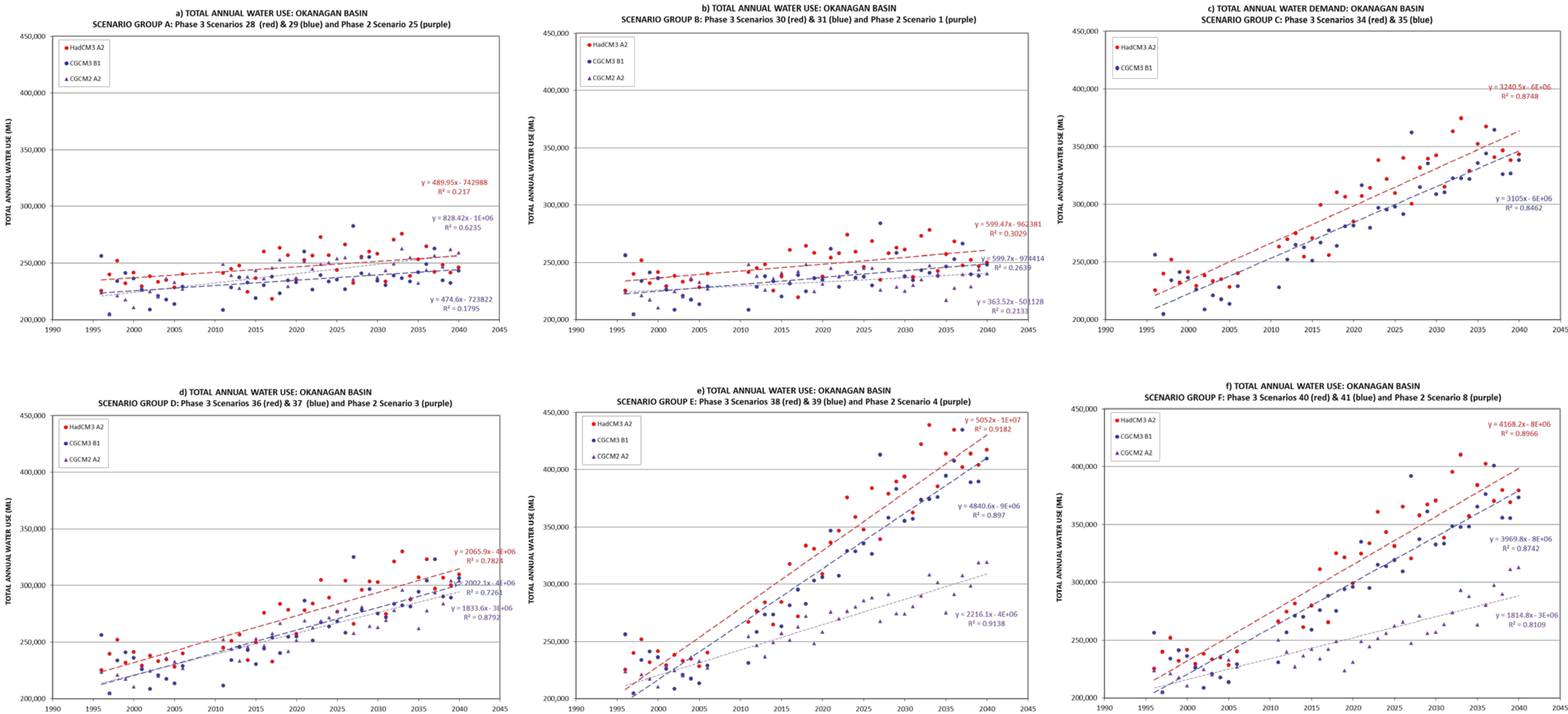


Figure 5.1 Projected total annual water use in the Okanagan Basin (from all sources) under the six (6) main scenario groups assessed in Phase 3. Red data are based on the HadCM3 A2 model, blue data are based on the CGCM3 B1 model and purple data are based on the CGCM2 A2 model results of Phase 2. Note that the Phase 2 results are not strictly comparable with the Phase 3 results given some differences in the underlying assumptions, particularly in figures e and f where Phase 2 modeling assumed population growth by infilling of currently developed areas as opposed to development of new residential areas (Phase 3). a) Group A: climate change only; b) Group B: climate change and current trends in land use and population change; c) Group C: climate change along with population boom and urban sprawl; d) Group D: climate change and increasing irrigated agricultural land; e) Group E: climate change along with population boom and increasing irrigated agricultural land (a possible worst case); f) Group F: Group E mitigated by efficiency improvements.

The six (6) separate plots shown in Figure 5.1 represent the projected total Basin-wide water use for each of the six (6) main scenario groups modeled in Phase 3 (Table 2.1). Each plot presents the water use projections as determined by the Okanagan Water Demand Model (OWDM) driven by the two climate models: HadCM3 A2 (red) and CGCM3 B1 (blue). For reference, data from Phase 2 for roughly comparable (but not necessarily the same) scenarios are plotted in purple[4]. For clarity, the best-fit linear regressions are shown.

Examination of the six (6) plots in Figure 5.1 indicates that there is considerable variability in annual water use in all scenario projections owing primarily to weather variability from year to year. In spite of this variability, there is a subtle trend towards increasing water use in the future for all scenarios. Under the effects of climate change only (Group A, Figure 5.1.a), the increase is slight, and the Phase 2 projections, as expected, are generally bounded by those based on the two climate models in Phase 3. In Group B (Figure 5.1.b), not only is the effect of climate change imposed, but also the effects of an increased population (at an expected rate of +1% per year). However, the differences between Group B and A are negligible because Group B assumes that agricultural water use efficiency will improve based on current trends, while they remain constant at 2006 levels in Group A. Group C projections (Figure 5.1.c) reflect a population "boom" that is accompanied by "urban sprawl". Given the higher rate (+2.5% per year) of population growth, and more importantly the increased domestic outdoor water requirements associated with residential development in the form of single-family homes, there is a significant rate of increase in water use in the Basin. By 2040, population boom and urban sprawl (Group C) is projected to require 30% +/- more water than under the more moderate growth scenario of Group B. Scenario D (Figure 5.1.d) represents an increase in the agricultural land base requiring irrigation. While it does not show quite as dramatic an increase in water use as the population boom scenario (Group C), water requirements by 2040 are projected to increases by about 20% +/- over current levels. Groups E (Figure 5.1.e) and F (Figure 5.1.f) represent "worst-case" conditions whereby population boom and full utilization and irrigation of available agricultural land occur in the absence of efficiency improvements and with

[4] Refer to Appendix A and Summit (2010) for a complete description of Phase 2 scenarios. Phase 2 and Phase 3 scenarios must be compared with caution given their different underlying assumptions (e.g. efficiency improvements, population growth patterns).

efficiency improvements, respectively. The increased requirements under Groups E and F by 2040 are projected to be about 60% +/- and 50% +/-, respectively.

In order to illustrate the patterns of water use within an individual utility, the projected total water use for Black Mountain Irrigation District (BMID) is presented as an example in Figure 5.2. Rather than present the raw data, only the upper and lower 95% prediction limits for each of the six (6) scenario groups are provided. The water use within the BMID reflects similar patterns identified Basin-wide, and is also characterized by relatively high inter-annual variability. The seasonal (and monthly) patterns of water use by the BMID also tend to be quite similar to the Basin-wide trends.

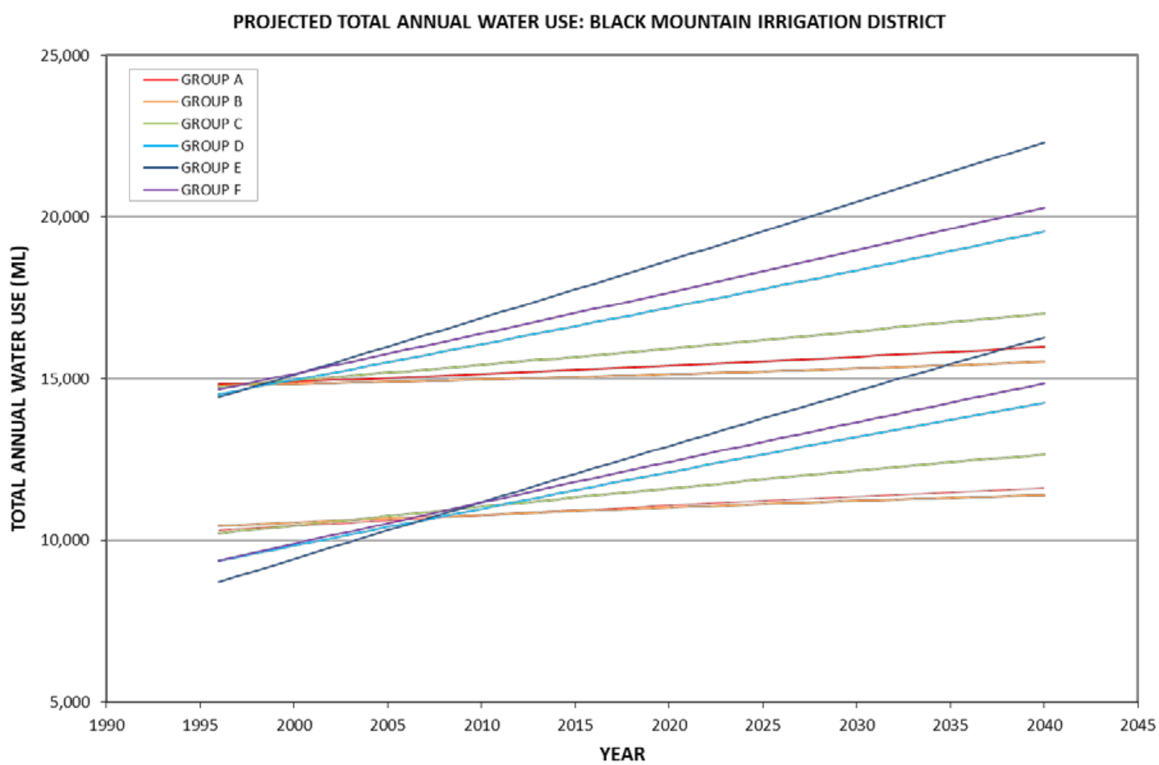


Figure 5.2 Projected total annual water use within the Black Mountain Irrigation District. Each pair of lines represents the 95% prediction limits for each of the groups of scenarios identified. For clarity, annual data are not shown. The wide spread of the prediction limits for each scenario group indicates the relatively high inter-annual variability in water use over time.

In addition to the modeling of future climate, water demands were also modeled using the OWDM based on a synthesized five-year drought. Although only one synthesized drought climate dataset was modeled, three (3) sets of assumptions on land use and population growth were examined. These assumptions are noted in Table 2.1 for Scenarios 55, 56 and 57. The water use projections for these three scenarios are plotted as duration curves in Figure 5.3. The red curve (Scenario 56) represents the "worst case" of the three drought scenarios, whereby high population growth and full utilization and irrigation of agricultural land occurs. The purple line indicates the effect of improvements in water use efficiency in both agricultural and domestic water systems. The orange curve (Scenario 55) represents the projected water use assuming a 5-year drought occurs under current land use and population.

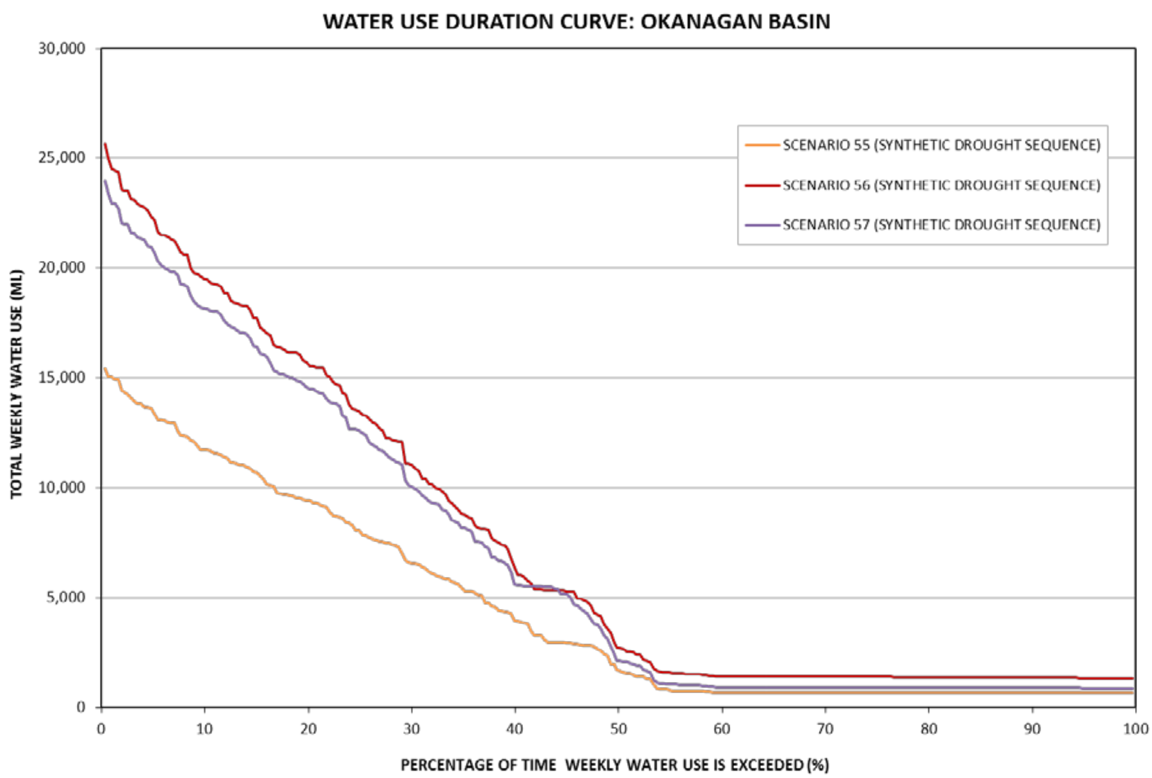


Figure 5.3 Water use duration curve for the Okanagan Basin under drought conditions. Scenario 55, 56, and 57 are shown in orange, red and purple, respectively.

5.2 WATER USE BY END-USE

As noted above, nine (9) end-use categories were modeled in the Okanagan Water Demand Model (OWDM). To illustrate how water use patterns for the main end-uses are projected to trend into the future, plots of the total Basin-wide water use by end-use is provided in Tables D.1 to D.6 (Appendix D) and in Figure 5.4.

It is well understood that the agricultural sector is the largest water user on an annual basis with 55% used by that sector annually (Summit, 2010). By comparison, domestic outdoor and indoor water use account for roughly 24% and 7%, respectively. Combined, the industrial, commercial, and institutional sectors account for 7%, while golf courses and parks/open spaces account for close to 5% and 2%, respectively. The following highlights some of the key points from the Phase 3 modeling results:

Agriculture (Figure 5.4.a and Table D.1):

- Based on climate change alone, agricultural irrigation requirements are projected to increase by up to 8% annually, however, projected monthly requirements during the irrigation season vary by the climate model used, between a modest increase (+9%) for the HadCM3 A2 and a considerable decrease (-16%) for the CGCM3 B1 model.
- Improvements in irrigation efficiency at today's rate are projected to reduce water use by about 1% annually.
- Full utilization and irrigation of the Okanagan's available agricultural land alone will result in an annual increase in agricultural water use by up to 27%, with monthly increases as much as 31%.

Golf Courses (Figure 5.4.b and Table D.2):

- Based on climate change alone, golf course irrigation requirements are projected to increase by 4% to 6% annually.

Parks and Open Spaces (Figure 5.4.c and Table D.3):

- Based on climate change alone, irrigation of parks and open spaces are projected to increase by 3% to 6% annually.

Domestic Indoor (Figure 5.4.d and Table D.4):

- At the expected rate of population growth (1% per year), indoor domestic water use is projected to increase by 25%; at the rate of 2.5% per year, indoor domestic water use is projected to increase by 67% by 2040.

Domestic Indoor (Figure 5.4.e and Table D.5):

- Based on climate change alone, domestic outdoor water use is projected to increase by up to 6% annually.
- At the expected rate of population growth (1% per year), which is accommodated by infilling or densification of existing residential areas, outdoor domestic water use is projected to increase by only 3%. If however, a population "boom" occurs with urban sprawl, by 2040, outdoor domestic water use is projected to double current levels, and approach volumes currently used by the agricultural sector.

Industrial, Commercial, & Institutional (Figure 5.4.f and Tables D.6):

- The ICI sector generally reflects the domestic water use patterns, and specifically the population in the Okanagan. As a result of climate change alone, there is a projected 7% increase in water use by the ICI sector. This is projected to increase by 24% under the expected rate of population growth, and 67% assuming population boom and urban sprawl.

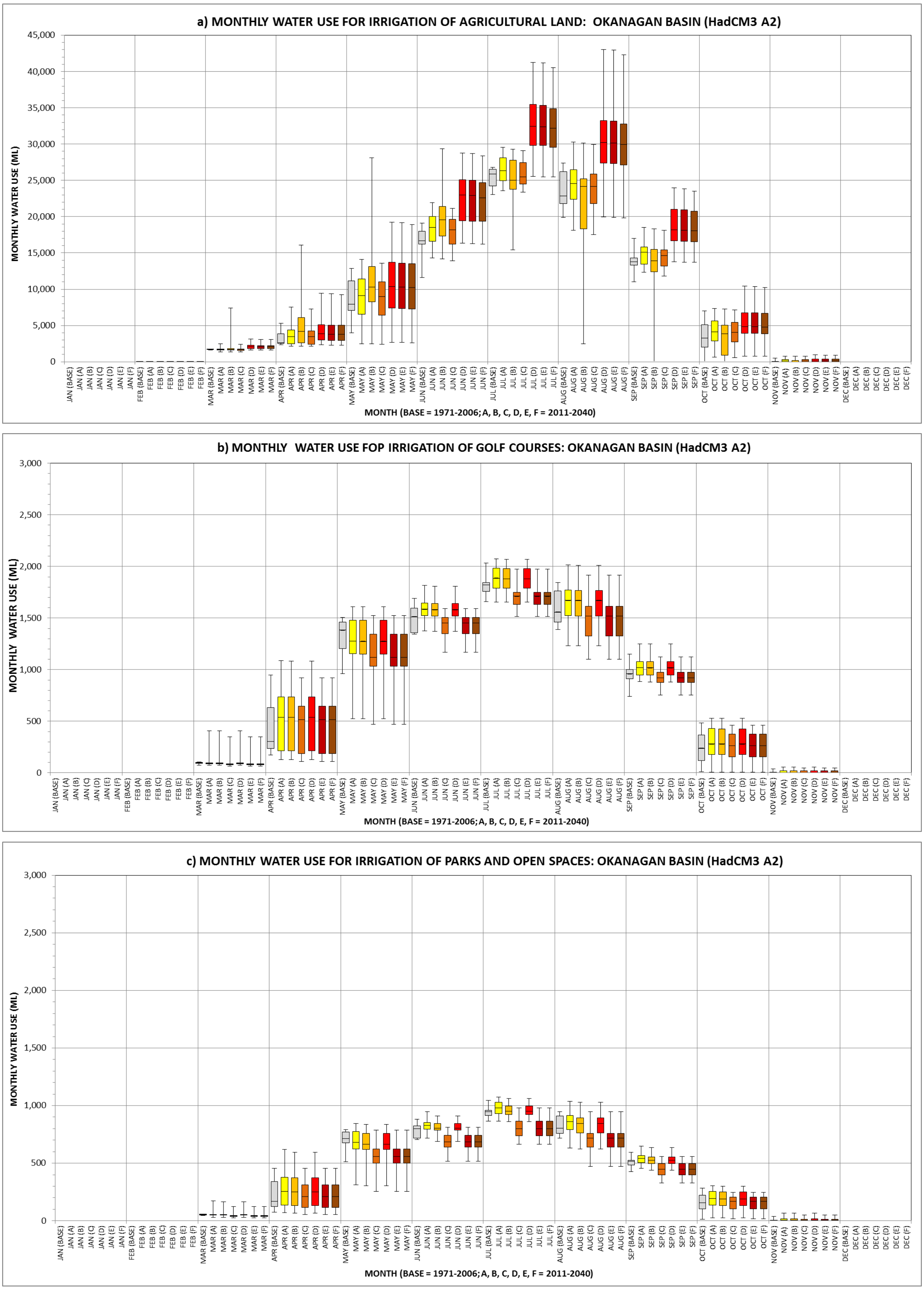
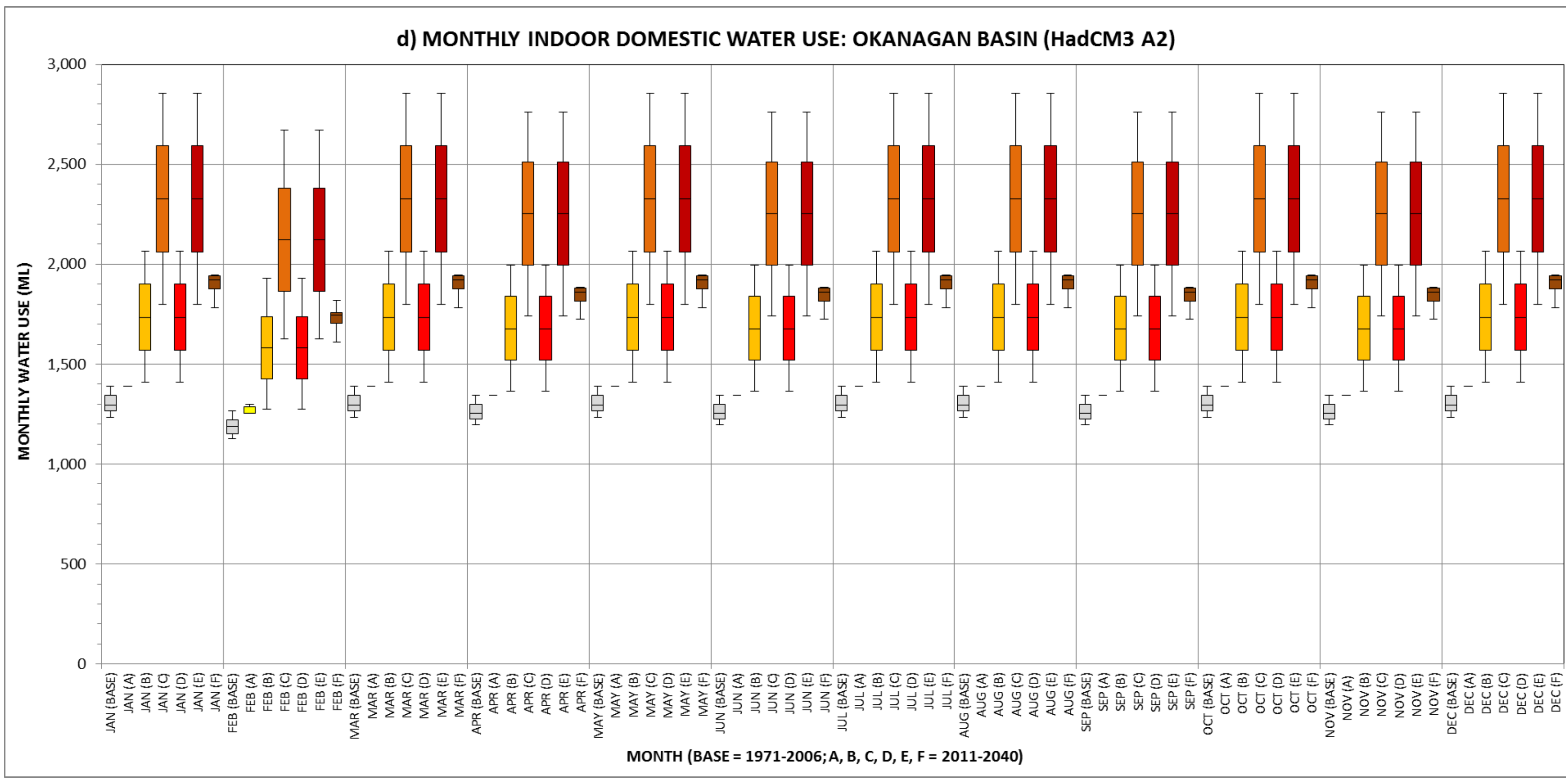
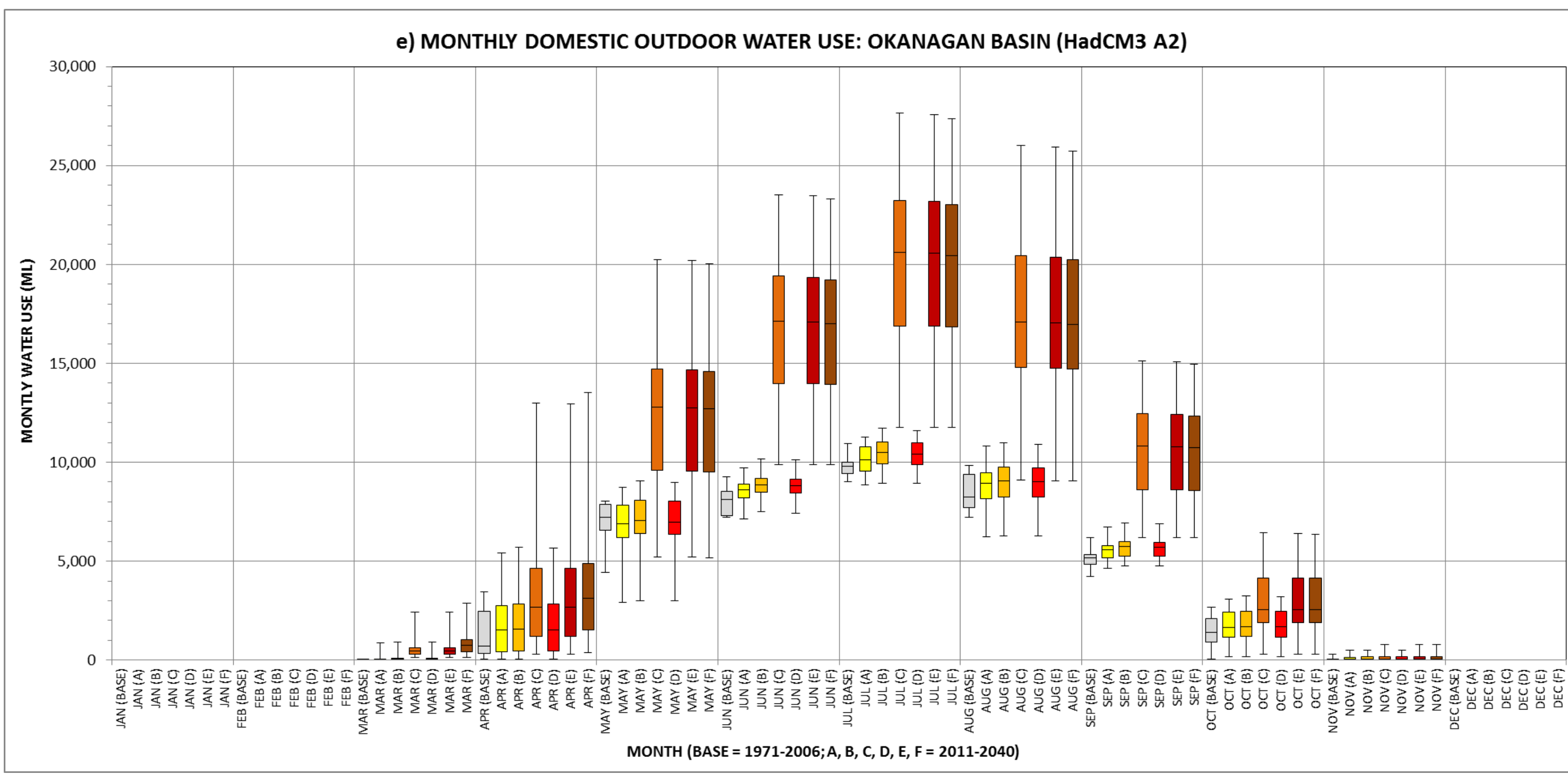


Figure 5.4 Total Okanagan water use by end-use for the baseline and future scenarios. Only the results based on the HadCM3 A2 model are shown.





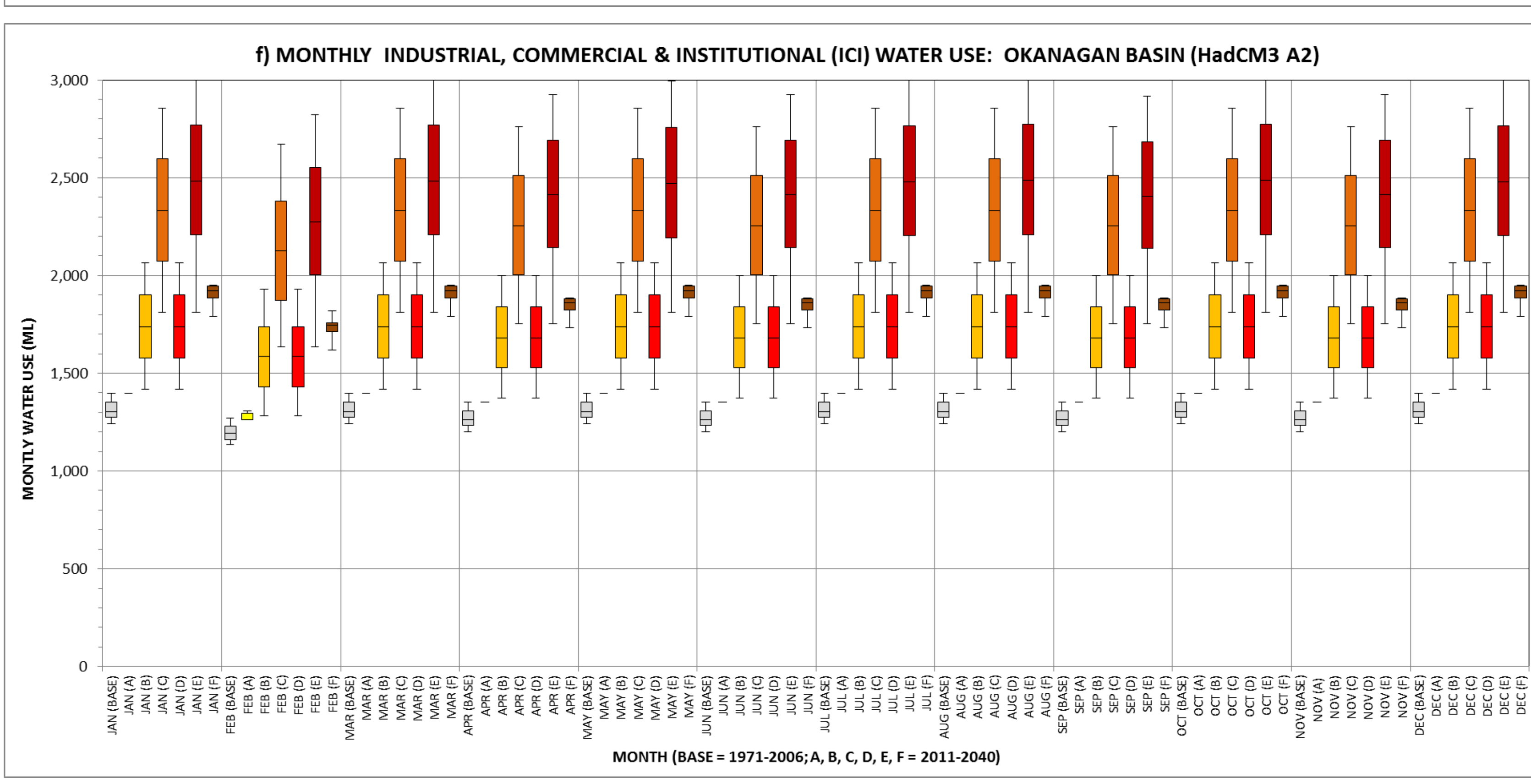


Figure 5.4 *Continued.*

5.3 WATER EXTRACTION

The water used in the Okanagan is supplied by four (4) principal sources: surface water, groundwater, imported water, and reclaimed water. Table 5.3 presents the source distribution of water used in the Basin under the baseline, future, and drought scenarios. Currently, about 68% of the water used in the Basin is sourced from surface water, including streams, lakes, and springs. Under the future scenarios, this value ranges slightly, and is projected to drop by as much as 5% during prolonged drought. Groundwater supplies 21% of the Basin's water currently, but is likely to be relied upon more in the future, particularly during times of drought (up to 28%). Water imported from outside the Okanagan Basin and reclaimed from wastewater account for 8% and 4%, respectively and change little in the future. The following focuses on the surface water component to the Okanagan's water supply.

Table 5.3 Projected distribution of Okanagan Basin average annual water use by source. The results are based on the OWDM using HadCM3 A2 climate projections.

Scenario	Total Water Use (ML)	Source			
		Surface Water (ML)	Groundwater (ML)	Imported (ML)	Reclaimed (ML)
Baseline (1996-2006)					
1	**235,934**	159,745	48,636	18,269	9,284
		68%	21%	8%	4%
Future (2011-2040)					
28	**249,936**	169,390	51,398	19,376	9,772
		68%	21%	8%	4%
30	**252,285**	171,379	51,682	19,408	9,816
		68%	20%	8%	4%
34	**316,868**	216,802	70,101	20,291	9,674
		68%	22%	6%	3%
36	**284,262**	182,984	68,371	22,482	10,425
		64%	24%	8%	4%
38	**356,113**	234,180	87,977	23,655	10,301
		66%	25%	7%	3%
40	**321,034**	219,960	67,799	23,012	10,263
		69%	21%	7%	3%
5-year Drought					
55	**228,619**	155,285	46,838	17,656	8,840
		68%	20%	8%	4%
56	**386,065**	249,365	102,501	24,476	9,723
		65%	27%	6%	3%
57	**349,233**	220,011	96,520	23,088	9,614
		63%	28%	7%	3%

Figure 5.5 illustrates the distribution of surface water extractions amongst the tributary streams in the Basin. It shows all 31 principal streams in the Basin in descending order of annual surface water

supply. Note that the vertical axis is in logarithmic units in order to display the wide range of associated supply and extraction volumes. The data is based on the 1996-2006 baseline period.

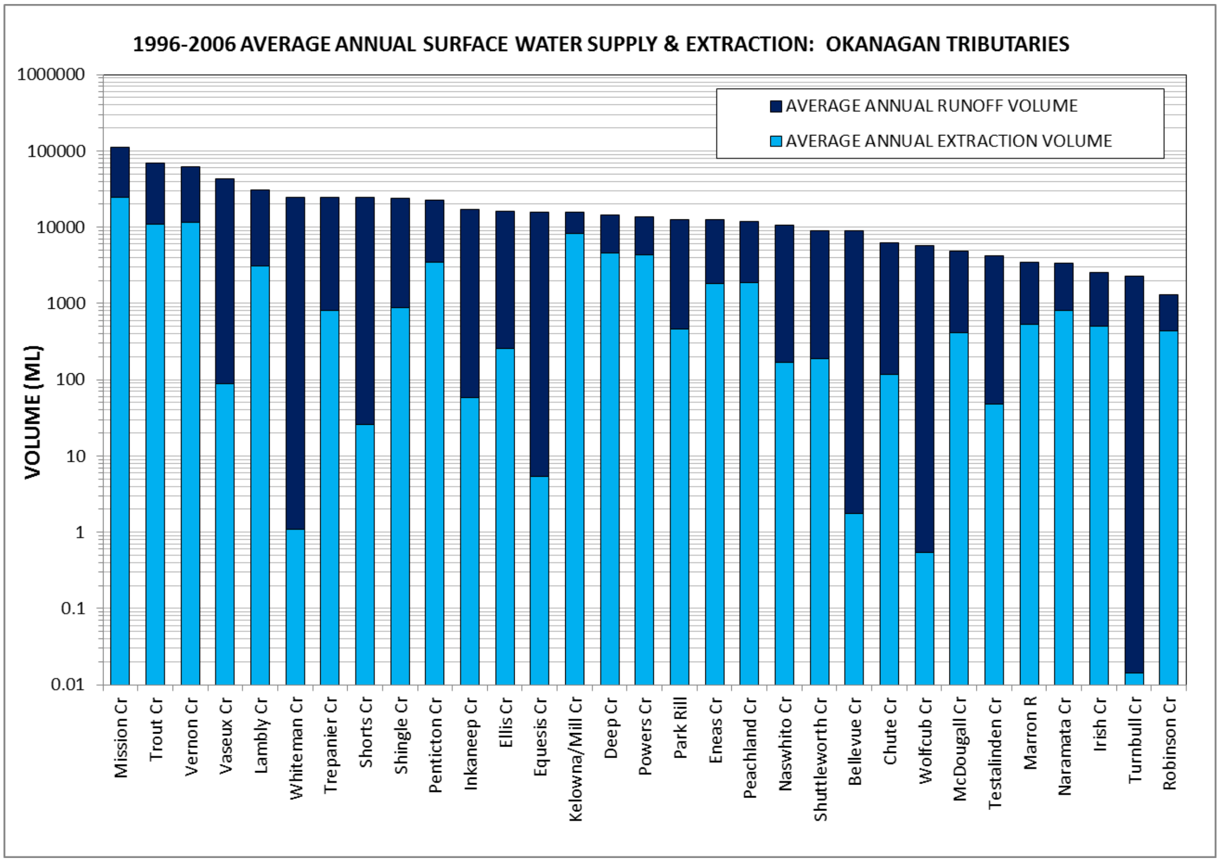


Figure 5.5 1996-2006 average annual surface water supply and extraction for each of the 31 main Okanagan tributaries. Note the logarithmic vertical axis.

Table 5.4 and Figure 5.6 demonstrates the seasonal pattern of water supply and extractions in Mission Creek. Values are presented for the baseline (1971-2006) and future (2012-2040) periods. Figure 5.7 shows the clear difference in timing between the availability of the surface water and the demands for it. Comparison of Figure 5.6.a and 5.6.b also shows that in the future, the supply is projected to decrease during the freshet period (April-June) while the demand increases in the summer. The result of this is displayed on Figure 5.6.c , which presents the monthly extractions as a percentage of the monthly surface water supply. During the months November to February, this value is 10% or less. This increases steadily during spring and summer and by September, this value is nearly 200%. In the case of Mission Creek and many of the streams in the Okanagan, this imbalance is addressed by storage of a portion of the freshet period runoff and regulated releases of that water based on downstream requirements. Nevertheless, with climate change, the percentage of extractions to supply during late summer is projected to increase by up to 280%. This means that in the future, the management of upland reservoirs will become even more important in successfully meeting water demands. Given the projections for reduced snowpacks, earlier freshet and increased rain-generated runoff in future, to successfully meet demands, water managers may have to consider modifying their current reservoir operation strategies.

Table 5.4 *Summary of median monthly and annual water extraction vs. natural runoff in Mission Creek. Estimates are for baseline (1971-2006) and future (2012-2040) scenarios assuming climate change only and are presented for the HadCM3 A2 and CGCM3 B1 climate models.*

MISSION CREEK

Parameters:	**Natural runoff vs Extraction**				Parameter:	**Natural runoff vs Extraction**		
Climate Model:	**HadCM3 A2**				Climate Model:	**CGCM3 B1**		
	Sub-Basin Name:	**MISSION CREEK**				Sub-Basin Name:	**MISSION CREEK**	
	Scenario Group:	**BASELINE**	**A**			Scenario Group:	**BASELINE**	**A**
	Scenario Number:	65	28			Scenario Number:	66	29
JAN	*Median Monthly Runoff (ML):*	1,590	2,585		JAN	*Median Monthly Runoff (ML):*	1,876	2,801
	Median Monthly Extraction (ML):	142	153			*Median Monthly Extraction (ML):*	142	153
FEB	*Median Monthly Runoff (ML):*	1,385	2,673		FEB	*Median Monthly Runoff (ML):*	1,630	3,893
	Median Monthly Extraction (ML):	134	142			*Median Monthly Extraction (ML):*	134	142
MAR	*Median Monthly Runoff (ML):*	1,800	5,098		MAR	*Median Monthly Runoff (ML):*	2,167	5,476
	Median Monthly Extraction (ML):	389	401			*Median Monthly Extraction (ML):*	387	402
APR	*Median Monthly Runoff (ML):*	11,211	15,517		APR	*Median Monthly Runoff (ML):*	12,146	22,373
	Median Monthly Extraction (ML):	627	849			*Median Monthly Extraction (ML):*	658	927
MAY	*Median Monthly Runoff (ML):*	31,165	24,716		MAY	*Median Monthly Runoff (ML):*	36,896	37,712
	Median Monthly Extraction (ML):	2,272	2,519			*Median Monthly Extraction (ML):*	1,944	2,469
JUN	*Median Monthly Runoff (ML):*	30,690	22,667		JUN	*Median Monthly Runoff (ML):*	37,989	37,331
	Median Monthly Extraction (ML):	4,246	4,652			*Median Monthly Extraction (ML):*	4,304	4,271
JUL	*Median Monthly Runoff (ML):*	13,952	6,152		JUL	*Median Monthly Runoff (ML):*	13,904	13,257
	Median Monthly Extraction (ML):	6,070	6,333			*Median Monthly Extraction (ML):*	6,171	6,038
AUG	*Median Monthly Runoff (ML):*	3,375	2,115		AUG	*Median Monthly Runoff (ML):*	3,388	2,565
	Median Monthly Extraction (ML):	5,566	5,949			*Median Monthly Extraction (ML):*	6,007	5,652
SEP	*Median Monthly Runoff (ML):*	1,864	1,409		SEP	*Median Monthly Runoff (ML):*	2,500	2,481
	Median Monthly Extraction (ML):	3,661	3,950			*Median Monthly Extraction (ML):*	3,315	3,681
OCT	*Median Monthly Runoff (ML):*	1,576	1,913		OCT	*Median Monthly Runoff (ML):*	2,532	2,717
	Median Monthly Extraction (ML):	1,089	1,391			*Median Monthly Extraction (ML):*	613	1,413
NOV	*Median Monthly Runoff (ML):*	1,833	3,055		NOV	*Median Monthly Runoff (ML):*	2,285	3,040
	Median Monthly Extraction (ML):	142	148			*Median Monthly Extraction (ML):*	138	148
DEC	*Median Monthly Runoff (ML):*	1,670	2,049		DEC	*Median Monthly Runoff (ML):*	2,168	2,650
	Median Monthly Extraction (ML):	142	153			*Median Monthly Extraction (ML):*	142	153
ANNUAL	*Median Annual Runoff (ML):*	118,275	124,609		ANNUAL	*Median Annual Runoff (ML):*	130,796	167,603
	Median Annual Extraction (ML):	24,876	26,464			*Median Annual Extraction (ML):*	23,445	24,843

Parameter:	**Water extraction as % of natural runoff**				Parameter:	**Water extraction as % of natural runoff**		
Climate Model:	**HadCM3 A2**				Climate Model:	**CGCM3 B1**		
	Sub-Basin Name:	**MISSION CREEK**				Sub-Basin Name:	**MISSION CREEK**	
	Scenario Group:	**BASELINE**	**A**			Scenario Group:	**BASELINE**	**A**
	Scenario Number:	65	28			Scenario Number:	66	29
JAN		9%	6%		JAN		8%	5%
FEB		10%	5%		FEB		8%	4%
MAR		22%	8%		MAR		18%	7%
APR		6%	5%		APR		5%	4%
MAY		7%	10%		MAY		5%	7%
JUN		14%	21%		JUN		11%	11%
JUL		44%	103%		JUL		44%	46%
AUG		165%	281%		AUG		177%	220%
SEP		196%	280%		SEP		133%	148%
OCT		69%	73%		OCT		24%	52%
NOV		8%	5%		NOV		6%	5%
DEC		9%	7%		DEC		7%	6%
ANNUAL		21%	21%		ANNUAL		18%	15%

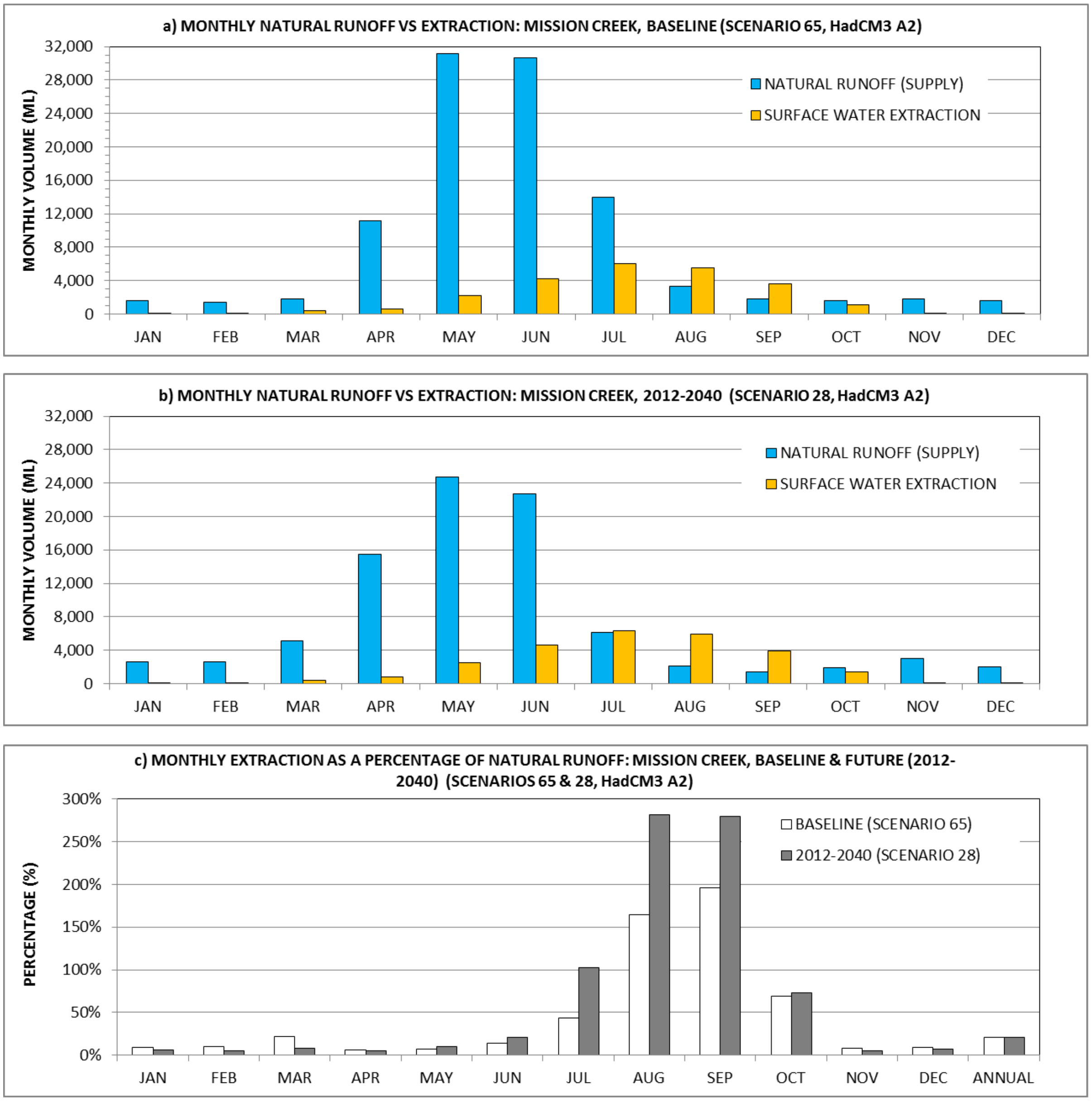


Figure 5.6 Monthly median natural runoff versus extraction for Mission Creek: a) Baseline period (Scenario 65), b) 2012-2040 (Scenario 28), and c) extractions as a percentage of the natural runoff for baseline and 2012-2040 periods. Results for the HadCM3 A2 model are shown; refer to Table 5.4 for results based on the CGCM3 B1 climate model. Note that extractions in excess of available natural runoff are supported by storage in Mission Creek

To illustrate the effect of the various future scenarios on seasonal surface water extraction, a series of box plots are presented in Figures 5.7 and 5.8. Figure 5.7 presents the total monthly surface water extractions for the Okanagan Lake drainage area, the Okanagan River drainage area (downstream of Okanagan Lake), and the Okanagan Basin overall. Figure 5.8 shows the same plots but for a selection of streams: Mission Creek, Trout Creek and Vaseux Creek. For each month and each scenario, the median, upper and lower quartile, and minimum and maximum extractions are shown. It is evident that the patterns in extraction are similar in most cases. Details on the projected water extractions for each scenario are provided in Appendix E. The following summarizes the key points with a focus on the Okanagan Basin overall.

Okanagan Basin (overall):

- Assuming climate change alone (Scenario Group A), water extractions in most months will increase modestly (5-10%), except in April when it will increase by 40% and in late fall when it will increase by up to 20%.
- If the population increases at the expected 1% per year and if agricultural water use efficiency improved at its expected rate (Scenario Group B), surface water extraction should not dramatically change.
- A population boom with urban sprawl (Scenario Group C) is projected to increase surface water requirements by 20-30% throughout the year.
- An increase in the agricultural land base under irrigation (Scenario Group D) is expected to increase water extractions by 5-10% throughout the irrigation months.
- A worst case scenario of population boom and agricultural expansion (Scenario Group E) is projected to increase water extractions by 30-40% during spring and summer, and by 50-70% during the winter.
- Improvements in water use efficiency (Scenario Group F), will mitigate the worst-case scenario (Scenario Group E) by roughly 5% during spring and summer, and up to 20% in the winter.

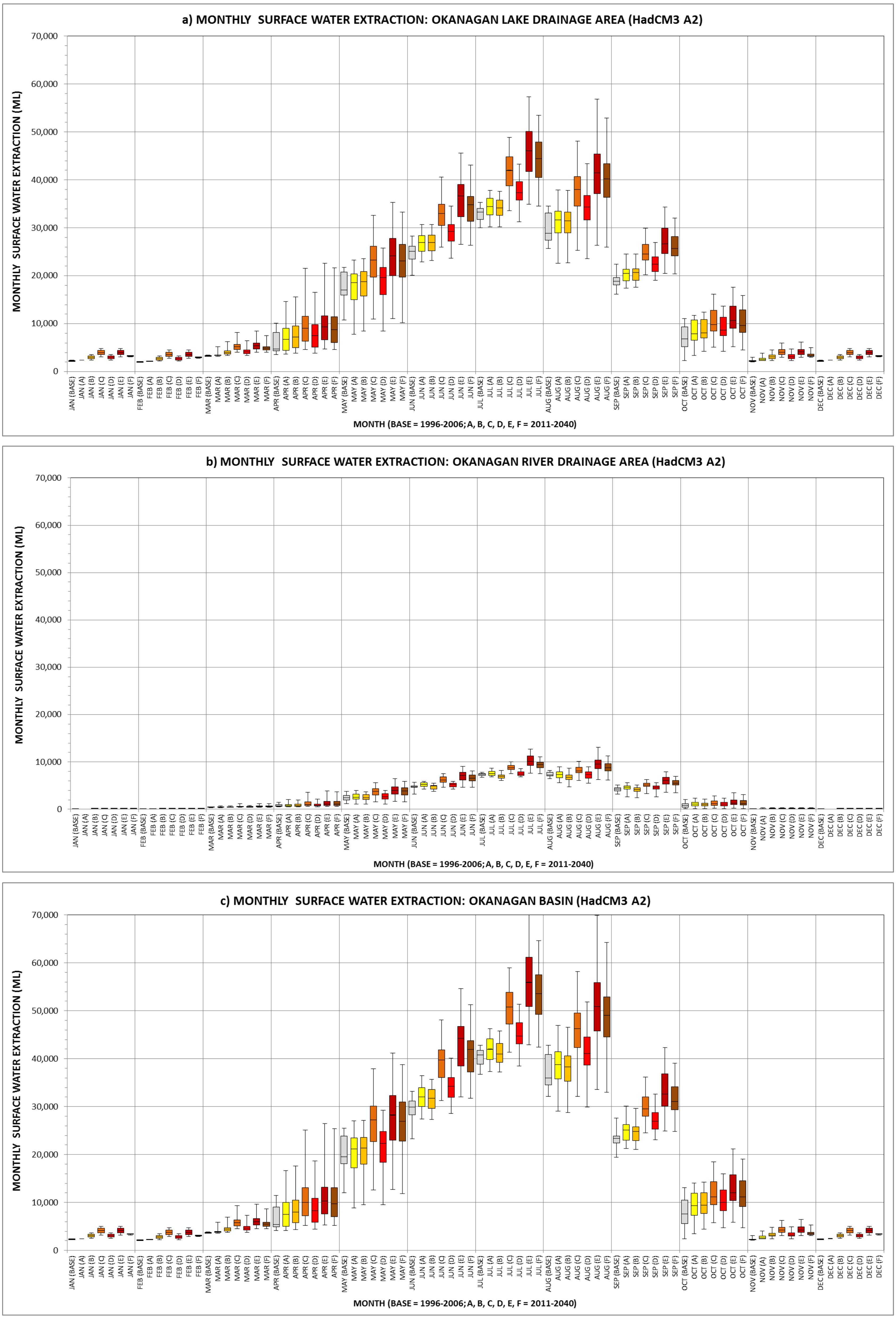


Figure 5.7 *Projected monthly surface water extraction from: a) Okanagan Lake drainage area (including Okanagan Lake), b) Okanagan River drainage area below Okanagan Lake (including Okanagan River), and c) Okanagan Basin overall. The results are based on the HadCM3 A2 climate model. Data based on the CGCM3 B1 model are provided in Appendix E.*

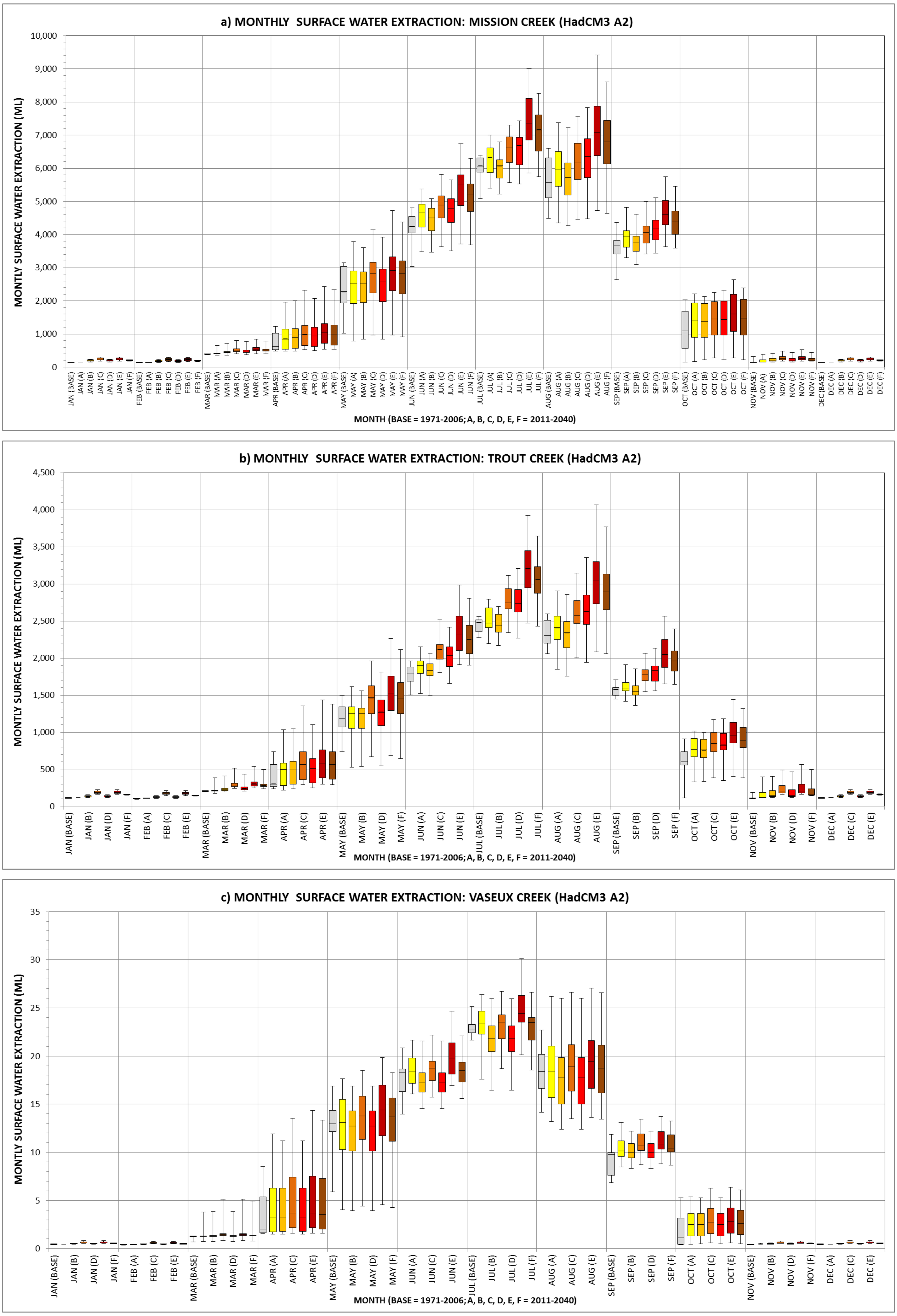


Figure 5.8 Projected monthly surface water extraction from: a) Mission Creek, b) Trout Creek, and c) Vaseux Creek. Note the vertical scales for each plot is different. The results are based on the HadCM3 A2 climate model. Data based on the CGCM3 B1 model are provided in Appendix E.

6.0 NET RUNOFF/INFLOW

The OBWAM is an accounting tool that, in simple terms, accounts for the water supply projections (outlined in Section 4.0) and the water extraction estimates (outlined in Section 5.0) and considers several other parameters that describe the movement and regulation of water in the Basin (e.g. groundwater movement, reservoir regulation, water imports). One of the key outputs of the OBWAM is net runoff (with respect to a stream) or net inflow (with respect to a lake), which refers to the volume of water flowing past a point or received by a water body during a given period, respectively. It accounts for all sources of incoming water plus human additions and withdrawals, and with respect to lakes includes additions from precipitation and losses from evaporation. With the huge volume of model output available, there are many possible assessments that could be made. For example, it can be used to evaluate the availability of water in a specific stream for conservation or licensing purposes. To facilitate future assessments, spreadsheet summaries will be provided digitally to the OBWB.

6.1 NET LAKE INFLOWS

For the purposes of this report and to illustrate the available dataset, the net inflow to each of the main-stem lakes (based on the HadCM3 A2 climate model) is presented in Figure 5.10. The data based on the HadCM3 A2 model as well as the CGCM3 B1 model are provided in Appendix F. For clarity, only the median monthly net inflows are presented for the baseline and each of the scenarios.

The lakes presented in Figure 5.10 are organized in downstream order and scaled identically to show the pattern of seasonal inflows to each of the main-stem lakes as well as to show the projected effects of each of the future scenarios. Kalamalka-Wood Lake is the upstream-most waterbody, which receives runoff from a relatively smaller area than the others and thus has net inflows generally less than 10,000 ML per month. Between June and October, net inflows are negative indicating that losses by evaporation and extractions outweigh natural inflow. Okanagan Lake, the next lake "down the valley", shows a similar pattern yet with larger values owing to its greater drainage area. With respect to the baseline conditions (grey bars), there is a distinct rise in net inflow to Okanagan Lake until May, than a sudden drop following freshet. Similar to Kalamalka-

Wood Lake, Okanagan Lake experiences a negative net inflow between July and September. As a result of the regulation of Okanagan Lake and Okanagan River by the dam at Penticton, downstream flows are significantly buffered from the spring freshet. This is evident in the net inflows to Skaha Lake as well as Vaseux Lake and Osoyoos Lake, however additional tributary flow can affect inflows to downstream lakes.

Future net inflow projections are a direct reflection of the future natural runoff as well as the future surface water extractions. It is not surprising therefore that the net inflows are projected to increase considerably between November and April. During these months the effect of climate change is dominant over the land use and population factors. By May, climate change is responsible for slight reductions in net inflow to Kalamalka-Wood and Okanagan Lakes, however these are not universally projected downstream, given the regulation of Okanagan Lake and River. By June, climate change is projected to decrease net inflows to Okanagan Lake by 38%, and under the worst-case scenario (Scenario Group E), a further 18% reduction is projected. Reduced runoff and increased extractions in July, August and September further exacerbate conditions maintaining negative net inflows to Okanagan Lake under all future scenarios. Fortunately, with Okanagan Lake and Okanagan River regulation, downstream lakes are projected to maintain positive, albeit modestly lower, net inflows over the summer months.

6.2 NET LAKE INFLOW DURING EXTENDED DROUGHT

In Section 6.1, the expected (or median) net lake inflows over the long-term baseline and future periods were presented. To illustrate the effect of an extended drought, the net inflows to Okanagan Lake during a 5-year arbitrary period are shown in Figure 5.11 for Scenarios 55, 56, and 57. To provide context, the annual net inflows for each year are provided in Table 5.5. For reference, the mean annual net inflow over the historical period of record (1922-2006) is 484,228 ML (Summit, 2009).

Table 5.5 Projected annual net inflows to Okanagan Lake under drought scenarios 55, 56, and 57.

	SCENARIO		
	55	**56**	**57**
Year 1	290,405	257,606	264,273
Year 2	58,027	32,886	37,208
Year 3	388,763	331,874	343,742
Year 4	145,786	115,930	120,144
Year 5	646,170	573,409	586,920

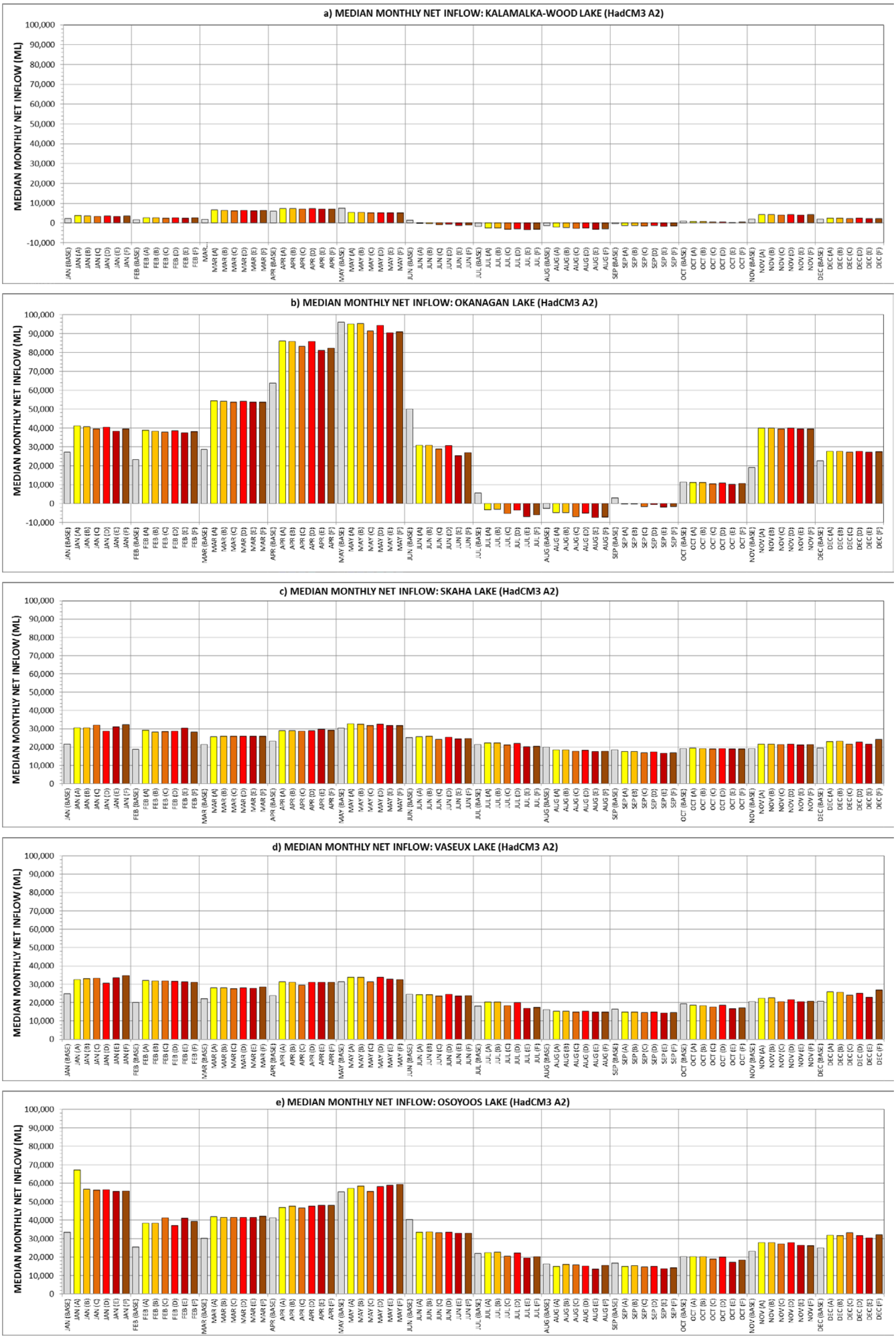


Figure 5.10 Projected median monthly net inflow to: a) Kalamalka-Wood Lake, b) Okanagan Lake, and c) Skaha Lake, d) Vaseux Lake, and e) Osoyoos Lake. Note the vertical scales for each plot is different. The results are based on the HadCM3 A2 climate model. Refer to Table 2.1 for description of the scenario groups.

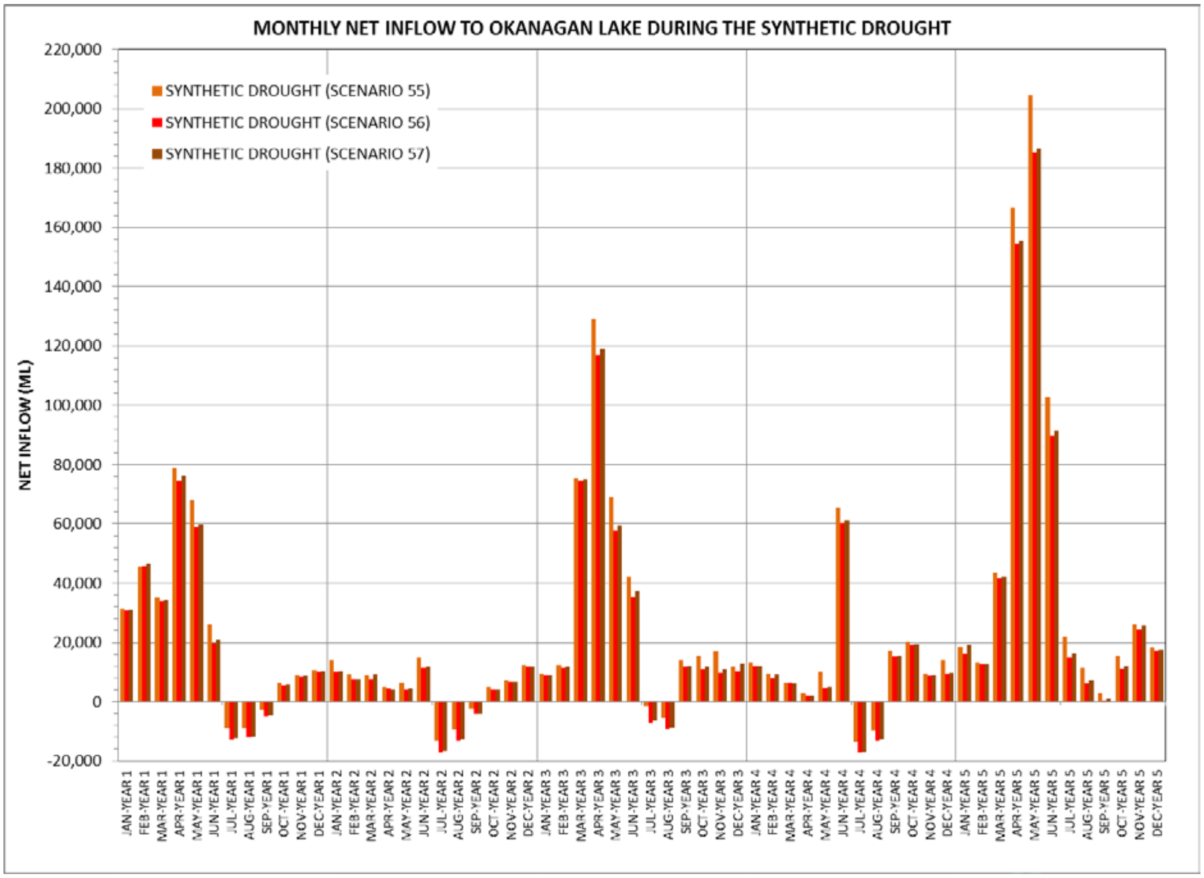


Figure 5.11 5-year cumulative net inflow to Okanagan Lake under extended drought scenarios (55, 56, and 57).

The modeled net inflows to Okanagan Lake based on the three synthesized drought scenarios in any given year vary from an extremely low value of 33,000 ML to above-average values of 646,000 ML. Despite this, the consecutive years of drought will have an effect on replenishing storage reservoirs in the uplands and main-stem lakes. At the end of five years, only about half of the normal net inflow volume will be received during drought (Figure 5.12).

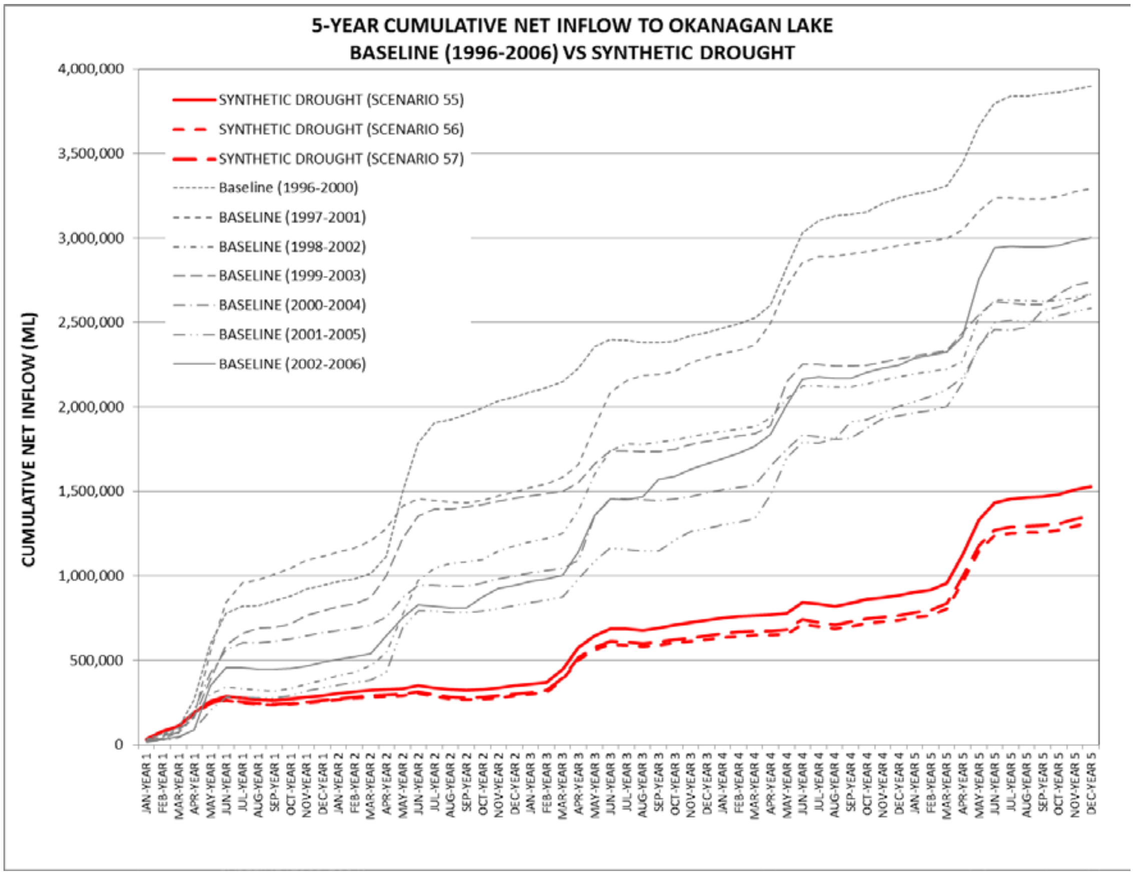


Figure 5.12 5-year cumulative net inflow to Okanagan Lake under normal conditions between 1996 and 2006 (grey) and under extended drought scenarios (55, 56, and 57).

7.0 SUMMARY AND CONCLUSIONS

Based on the Phase 3 projections for the 2011-2040 period using the Okanagan Basin Water Accounting Model (OBWAM) and its supporting models the Okanagan Water Demand Model (OWDM) and Okanagan Basin Hydrology Model (OBHM), the following key points are made:

Future climate:

- Temperatures in the Okanagan are projected to generally increase throughout the year, however, year to year variability is high.
- Precipitation projections are mixed and highly variable but tend to suggest increases during winter.
- The proportion of rain to snow is expected to generally increase, resulting in reduced snowpacks, particularly at lower elevations. These snowpacks may also be subject to increased mid-winter melt periods.
- Snowmelt is projected to occur earlier and because of reduced snowpacks, runoff from meltwater is expected to decrease. However, this is offset by rain-generated runoff that is expected to increase considerably over the winter.

Surface water supply:

- Annual runoff is expected to increase overall, with much of this resulting from the increased runoff between October and March due to increased rain and mid-winter meltwater. Decreased runoff is expected between May and July as a result of the advancement of the freshet period. Runoff is expected to be about the same in August and September.
- Year to year variability in runoff is expected to increase, particularly in winter.
- Prolonged drought has a dramatic impact on surface water availability. After five consecutive years, up to 50% less surface water runoff in total is produced relative to normal conditions.

Surface water extraction

- Surface water extractions represent about 68% of the total water used in the Okanagan.

- During late summer, surface water extractions from the tributary streams generally exceed the natural supply, and in Mission Creek for example, extractions in late summer are double the available natural supply; in future they may be nearly triple. In order to meet water demands, regulation of the available water supply through upland and main-stem reservoirs is and will continue to be paramount. Given the projections for reduced snowpacks, earlier freshet and increased rain-generated runoff in future, water managers may have to consider modifying their storage capabilities and current reservoir operation strategies in order to successfully meet future demands.
- Assuming climate change alone (Scenario Group A), water extractions in most months will increase modestly (5-10%), except in April when it will increase by 40%, and in late fall when it will increase by up to 20%.
- If the population increases at the expected 1% per year and if agricultural water use efficiency improved at its expected rate (Scenario Group B), surface water extraction should not dramatically change in future.
- A population boom with urban sprawl (Scenario Group C) is projected to increase overall surface water requirements by 20-30% throughout the year.
- An increase in the agricultural land base under irrigation (Scenario Group D) is expected to increase overall water extractions by 5-10% throughout the irrigation months.
- A worst case scenario of population boom and agricultural expansion (Scenario Group E) is projected to increase overall water extractions by 30-40% during spring and summer and by 50-70% during the winter.
- Improvements in water use efficiency (Scenario Group F) will mitigate the worst-case scenario (Scenario Group E) by roughly 5% during spring and summer, and up to 20% in the winter.

Net inflows to main-stem lakes:

- Net inflows to the main-stem lakes are projected to increase considerably between November and April. During these months the effect of climate change is dominant over the land use and population factors. By May, climate change is responsible for slight reductions in net inflow to Kalamalka-Wood and Okanagan Lakes, however these are not universally projected downstream, given the regulation of Okanagan Lake and River. By June, climate change is projected to decrease net inflows to Okanagan Lake by 38%, and under the worst-case scenario (Scenario Group E), a further 18% reduction is projected. Projected reductions in runoff and increased extractions in July, August and September further exacerbate conditions and maintain negative net inflows to Okanagan Lake under all future scenarios. Fortunately, with Okanagan Lake and Okanagan River regulation, downstream lakes are projected to maintain positive, albeit modestly lower, net inflows over the summer months.

8.0 RECOMMENDATIONS

Based on the findings of this study the following recommendations are made:

- Given the huge volume of information produced during Phase 3 modeling, there is an opportunity to further examine and assess water supply and use conditions throughout the Okanagan at various temporal and spatial scales. We encourage the OBWB and its partners to examine and utilize this available data in future investigations, including those involving the Water Evaluation and Planning System (WEAP).
- Some technical issues were identified during the review of the Phase 3 model data. A specific issue involves some modeling irregularities for the natural runoff in the Vernon Creek sub-basin. While we made a best effort to ensure that the results from Vernon Creek would not affect overall water supply estimates, we have some reservations on the accuracy of the data. We recommend that the modeling team, led by RHF Systems, examine the Vernon Creek sub-basin and update the model code to improve the model overall.
- Moving forward, there is a an opportunity to merge the abilities of the OBWAM and the WEAP models and develop a solid and comprehensive modeling platform for the Okanagan. To improve the OBWAM, we suggest that the spatial domain be expanded to account for all water source areas outside the physical boundaries of the Okanagan Basin. This includes for example Duteau Creek and Fortune Creek, both of which supply water to users in the Okanagan.

9.0 REFERENCES

DHI Water & Environment (Canada) (DHI). 2010. Okanagan Basin Water Accounting Model, Final Report. Prepared for Okanagan Basin Water Board. May 2010.

Pike, R.G., T.E. Redding, R.D. Moore, R.D. Winker and K.D. Bladon (editors). 2010. Compendium of forest hydrology and geomorphology in British Columbia. B.C. Ministry of Forests and Range, Forest Science Program, Victoria, B.C. and FORREX Forum for Research and Extension in Natural Resources, Kamloops, B.C. Land Management Handbook 66. www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh66.htm.

Rodenhuis, D.R., Bennett, K.E., Werner, A.T., Murdock, T.Q., Bronaugh, D. 2009. Hydro-climatology and future climate impacts in British Columbia. Pacific Climate Impacts Consortium, University of Victoria, Victoria BC, 132 pp.

Schnorbus, M. and D. Rodenhuis. 2010. Assessing Hydrologic Impacts on Water Resources in BC – Summary Report Joint Workshop BC Hydro, 20 April 2010, Pacific Climate Impacts Consortium, 37 pp.

Summit Environmental Consultants Ltd. 2010. Okanagan Water Supply and Demand Project: Phase 2 Summary Report. Prepared for the Okanagan Basin Water Board, July 2010.

Summit Environmental Consultants Ltd. 2009. Okanagan Water Supply and Demand Project: Surface Water Hydrology and Hydrologic Modeling Study “State of the Basin” Report, September 2009.

APPENDIX A: PHASE 2 SCENARIOS

Table A.1 List of future scenarios modeled in Phase 2.

Scenario number	Time Period	CO_2 Emission scenario	Mountain Pine Beetle	Efficiency	Agricultural Land Base	Population growth	Description	Acronym
1	2011-2040	Expected	Expected	Current use patterns and current trends	Present conditions	Expected rate	2011-2040 - current trends continued	T1C1M1E1A1P1
2	2011-2040	Expected	Expected	Current use patterns and current trends	Present conditions	High rate	2011-2040 - current trends, except rapid population growth	T1C1M1E1A1P2
3	2011-2040	Expected	Expected	Current use patterns and current trends	Irrigate all	Expected rate	2011-2040 - current trends except expanded agriculture	T1C1M1E1A2P1
4	2011-2040	Expected	Expected	Current use patterns and current trends	Irrigate all	High rate	2011-2040 - current trends except rapid population growth and expanded agriculture	T1C1M1E1A2P2
5	2011-2040	Expected	Expected	33% Efficiency	Present conditions	Expected rate	2011-2040 - efficient water use, otherwise current trends continued	T1C1M1E2A1P1
6	2011-2040	Expected	Expected	33% Efficiency	Present conditions	High rate	2011-2040 - efficient water use, rapid population growth, otherwise current trends	T1C1M1E2A1P2
7	2011-2040	Expected	Expected	33% Efficiency	Irrigate all	Expected rate	2011-2040 - efficient water use, expanded agriculture, otherwise current trends	T1C1M1E2A2P1
8	2011-2040	Expected	Expected	33% Efficiency	Irrigate all	High rate	2011-2040 - efficient water use, rapid population growth, expanded agriculture, expected climate and pattern of Mountain Pine Beetle	T1C1M1E2A2P2
17	3 driest years 2011-2100	Expected	Expected	Current use patterns and current trends	Present conditions	Expected rate	3 successive drought years - current trends continued	T2C1M1E1A1P1
18	3 driest years 2011-2100	Expected	Expected	Current use patterns and current trends	Present conditions	High rate	3 successive drought years - current trends, except rapid population growth	T2C1M1E1A1P2
19	3 driest years 2011-2100	Expected	Expected	Current use patterns and current trends	Irrigate all	Expected rate	3 successive drought years - current trends except expanded agriculture	T2C1M1E1A2P1
20	3 driest years 2011-2100	Expected	Expected	Current use patterns and current trends	Irrigate all	High rate	3 successive drought years - current trends except rapid population growth and expanded agriculture	T2C1M1E1A2P2
25	2011-2040	Expected	Expected	Present conditions	Present conditions	Present conditions	2011-2040 - effect of climate change alone	T1C1M1E3A3P3
26	2041-2070	Expected	Expected	Present conditions	Present conditions	Present conditions	2041-2070 - effect of climate change alone	T3C1M1E3A3P3
27	3 driest years 2011-2100	Expected	Present	Present conditions	Present conditions	Present conditions	3 successive drought years starting 2011	T2C1M2E3A3P3

Notes:

- 3 driest years 2010-2100 occur in 2076, 2033, 2026.
- CO_2 emissions: 1. Expected = CGCM2 A2.
- Mountain Pine Beetle: 1. Expected pattern of current MPB infestation and associated vegetation changes; 2. Present conditions (assume 2011, 2012, 2013).
- Efficiency: 1. Current use patterns and current trends, based on current use patterns and current trends in efficiencies (both irrigation and non-irrigation water uses); irrigation demand driven by climate; 2. 33% Efficiency improvement in all water use by 2020, no reductions past 2020; irrigation demand driven by climate
- Agricultural Land Base: 1. Present conditions for current crops and systems; 2. Irrigation of all reasonable possible irrigable land.
- Population growth: 1. Expected rate; 2. High rate

APPENDIX B: WATER USE AREAS IN THE OKANAGAN

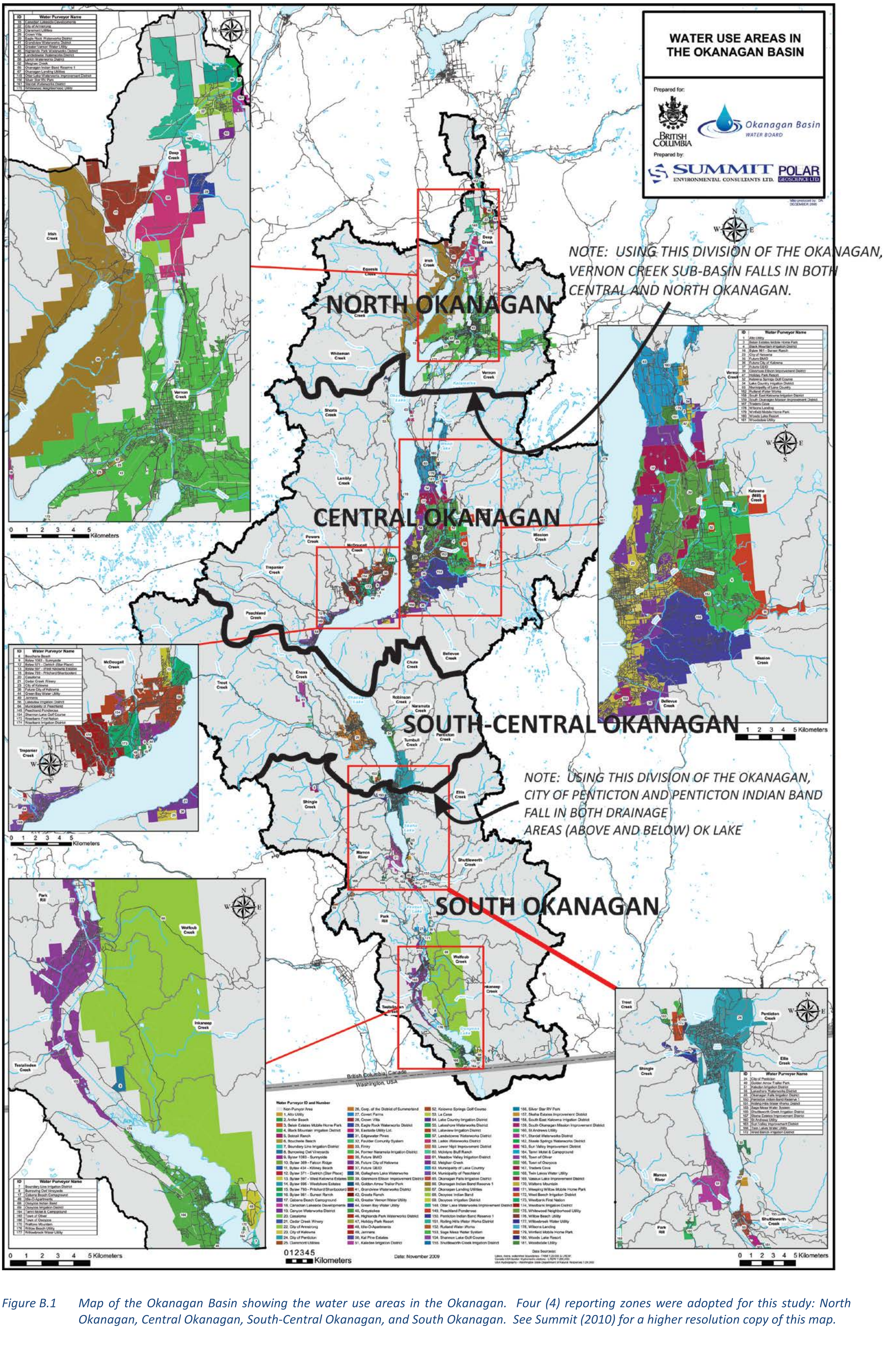


Figure B.1 Map of the Okanagan Basin showing the water use areas in the Okanagan. Four (4) reporting zones were adopted for this study: North Okanagan, Central Okanagan, South-Central Okanagan, and South Okanagan. See Summit (2010) for a higher resolution copy of this map.

APPENDIX C: SELECTED SUMMARIES OF PROJECTED NATURAL RUNOFF

Table C.1 *Projected Okanagan Basin median monthly and median annual runoff based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1971 to 2006. Scenario Group A is based on 2012 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: OKANAGAN BASIN

Parameter:	**Total (natural) runoff (ML)**			Parameter:	**Total (natural) runoff (ML)**		
Climate Model:	**HadCM3 A2**			Climate Model:	**CGCM3 B1**		
	Scenario Group:	**BASELINE**	**A**		Scenario Group:	**BASELINE**	**A**
	Scenario Number:	**65**	**28**		Scenario Number:	**66**	**29**
JAN	*Median*	43,787	66,318	JAN	*Median*	37,661	53,747
	IQR	37,328	97,897		*IQR*	18,124	42,882
FEB	*Median*	37,145	61,847	FEB	*Median*	33,993	80,773
	IQR	43,112	41,229		*IQR*	13,892	64,796
MAR	*Median*	54,595	85,823	MAR	*Median*	52,276	89,822
	IQR	47,602	80,307		*IQR*	55,079	64,668
APR	*Median*	108,826	135,181	APR	*Median*	102,378	164,499
	IQR	79,446	124,715		*IQR*	116,219	99,955
MAY	*Median*	167,035	165,842	MAY	*Median*	193,708	199,032
	IQR	142,773	85,693		*IQR*	92,210	157,146
JUN	*Median*	108,278	83,151	JUN	*Median*	146,835	134,137
	IQR	107,292	56,052		*IQR*	106,074	136,050
JUL	*Median*	52,484	41,135	JUL	*Median*	61,289	55,006
	IQR	35,840	23,146		*IQR*	31,775	34,342
AUG	*Median*	33,928	32,871	AUG	*Median*	35,591	35,304
	IQR	15,075	13,969		*IQR*	15,165	8,442
SEP	*Median*	28,313	28,583	SEP	*Median*	28,694	32,657
	IQR	9,153	6,821		*IQR*	12,236	17,675
OCT	*Median*	25,140	29,598	OCT	*Median*	26,390	31,302
	IQR	7,107	10,320		*IQR*	11,316	22,718
NOV	*Median*	30,071	62,340	NOV	*Median*	32,897	44,601
	IQR	16,403	74,034		*IQR*	17,517	57,805
DEC	*Median*	35,309	48,422	DEC	*Median*	34,710	46,859
	IQR	27,526	67,055		*IQR*	18,391	58,664
ANNUAL	*Median*	890,963	1,017,622	ANNUAL	*Median*	847,839	1,177,815
	IQR	428,671	704,546		*IQR*	418,313	375,456

Parameter:	**Ratio of total (natural) runoff between indicated scenarios**		Parameter:	**Ratio of total (natural) runoff between indicated scenarios**	
Climate Model:	**HadCM3 A2**		Climate Model:	**CGCM3 B1**	
	Ratio:	**A:BASLINE**		Ratio:	**A:BASLINE**
JAN	*Median*	1.51	JAN	*Median*	1.43
	IQR	2.62		*IQR*	2.37
FEB	*Median*	1.67	FEB	*Median*	2.38
	IQR	0.96		*IQR*	4.66
MAR	*Median*	1.57	MAR	*Median*	1.72
	IQR	1.69		*IQR*	1.17
APR	*Median*	1.24	APR	*Median*	1.61
	IQR	1.57		*IQR*	0.86
MAY	*Median*	0.99	MAY	*Median*	1.03
	IQR	0.60		*IQR*	1.70
JUN	*Median*	0.77	JUN	*Median*	0.91
	IQR	0.52		*IQR*	1.28
JUL	*Median*	0.78	JUL	*Median*	0.90
	IQR	0.65		*IQR*	1.08
AUG	*Median*	0.97	AUG	*Median*	0.99
	IQR	0.93		*IQR*	0.56
SEP	*Median*	1.01	SEP	*Median*	1.14
	IQR	0.75		*IQR*	1.44
OCT	*Median*	1.18	OCT	*Median*	1.19
	IQR	1.45		*IQR*	2.01
NOV	*Median*	2.07	NOV	*Median*	1.36
	IQR	4.51		*IQR*	3.30
DEC	*Median*	1.37	DEC	*Median*	1.35
	IQR	2.44		*IQR*	3.19
ANNUAL	*Median*	1.14	ANNUAL	*Median*	1.39
	IQR	1.64		*IQR*	0.90

Table C.2 Projected natural runoff for Mission, Trout and Vaseux Creeks based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1971 to 2006. Scenario Group A is based on 2012 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.

Drainage Area: SELECTED STREAMS

Parameter: **Total natural run-off (ML)**
Climate Model: **HadCM3 A2**

Sub-Basin Name:		MISSION CREEK		TROUT CREEK		VASEUX CREEK	
Scenario Group:		BASELINE	A	BASELINE	A	BASELINE	A
Scenario Number:		65	28	65	28	65	28
JAN	*Median*	1,590	2,585	1,755	3,612	786	2,087
	IQR	1,173	5,031	2,700	7,810	3,203	6,710
FEB	*Median*	1,385	2,673	1,759	4,893	692	1,819
	IQR	2,269	2,734	4,162	6,160	2,208	3,793
MAR	*Median*	1,800	5,098	2,807	5,385	915	2,107
	IQR	3,753	7,681	3,893	8,934	1,595	5,588
APR	*Median*	11,211	15,517	9,890	14,088	4,121	6,554
	IQR	12,173	12,626	10,621	19,652	7,480	8,425
MAY	*Median*	31,165	24,716	18,263	16,914	13,979	12,711
	IQR	14,045	14,121	12,213	14,212	12,272	10,900
JUN	*Median*	30,690	22,667	9,744	6,079	10,386	6,177
	IQR	15,458	12,623	10,568	9,531	10,361	9,048
JUL	*Median*	13,952	6,152	3,016	2,349	2,525	1,223
	IQR	11,279	9,748	2,175	2,194	3,869	2,921
AUG	*Median*	3,375	2,115	1,789	1,656	802	674
	IQR	3,896	3,421	1,214	1,058	1,493	859
SEP	*Median*	1,864	1,409	1,344	1,312	523	395
	IQR	925	831	774	645	846	689
OCT	*Median*	1,576	1,913	1,273	1,271	385	345
	IQR	764	1,805	713	1,052	458	493
NOV	*Median*	1,833	3,055	1,361	2,057	439	703
	IQR	1,221	9,973	532	2,419	544	3,944
DEC	*Median*	1,670	2,049	1,591	2,077	512	993
	IQR	1,069	2,444	1,032	5,554	645	2,300
ANNUAL	*Median*	118,275	124,609	60,404	84,944	44,643	42,222
	IQR	41,649	79,459	40,057	73,066	34,664	44,916

Parameter: **Total natural run-off (ML)**
Climate Model: **CGCM3 B1**

Sub-Basin Name:		MISSION CREEK		TROUT CREEK		VASEUX CREEK	
Scenario Group:		BASELINE	A	BASELINE	A	BASELINE	A
Scenario Number:		66	29	66	29	66	29
JAN	*Median*	1,876	2,801	1,670	2,372	387	1,048
	IQR	1,321	2,574	1,901	3,611	425	2,449
FEB	*Median*	1,630	3,893	1,608	4,771	384	2,285
	IQR	1,066	3,977	1,829	6,390	528	6,049
MAR	*Median*	2,167	5,476	2,762	6,873	925	2,799
	IQR	2,321	8,122	4,563	7,176	1,662	3,246
APR	*Median*	12,146	22,373	7,199	12,761	2,823	8,500
	IQR	14,282	21,253	11,521	11,938	4,710	9,904
MAY	*Median*	36,896	37,712	19,387	21,382	12,611	16,019
	IQR	21,381	25,498	9,123	20,912	7,446	16,084
JUN	*Median*	37,989	37,331	10,543	8,146	13,995	10,519
	IQR	19,765	18,280	14,235	12,601	12,900	12,604
JUL	*Median*	13,904	13,257	3,820	3,158	4,020	2,522
	IQR	11,059	12,974	2,611	2,258	3,505	2,938
AUG	*Median*	3,388	2,565	1,794	1,982	1,000	1,070
	IQR	4,931	1,726	1,057	852	966	718
SEP	*Median*	2,500	2,481	1,331	1,520	563	692
	IQR	2,664	1,919	586	945	405	348
OCT	*Median*	2,532	2,717	1,284	1,489	437	590
	IQR	2,292	5,880	678	705	325	242
NOV	*Median*	2,285	3,040	1,446	1,853	421	636
	IQR	2,548	8,770	961	5,402	303	1,555
DEC	*Median*	2,168	2,650	1,534	3,329	387	1,311
	IQR	1,859	4,804	1,585	4,109	324	1,836
ANNUAL	*Median*	130,796	167,603	64,582	84,159	43,665	63,085
	IQR	55,198	48,269	40,398	46,445	21,186	38,750

Parameter: **Ratio of total natural run-off between indicated scenarios**
Climate Model: **HadCM3 A2**

Sub-Basin Name:		MISSION CREEK	TROUT CREEK	VASEUX CREEK
Ratio:		A:BASELINE	A:BASELINE	A:BASELINE
JAN	*Median*	1.63	2.06	2.66
	IQR	4.29	2.89	2.09
FEB	*Median*	1.93	2.78	2.63
	IQR	1.20	1.48	1.72
MAR	*Median*	2.83	1.92	2.30
	IQR	2.05	2.29	3.50
APR	*Median*	1.38	1.42	1.59
	IQR	1.04	1.85	1.13
MAY	*Median*	0.79	0.93	0.91
	IQR	1.01	1.16	0.89
JUN	*Median*	0.74	0.62	0.59
	IQR	0.82	0.90	0.87
JUL	*Median*	0.44	0.78	0.48
	IQR	0.86	1.01	0.75
AUG	*Median*	0.63	0.93	0.84
	IQR	0.88	0.87	0.58
SEP	*Median*	0.76	0.98	0.76
	IQR	0.90	0.83	0.81
OCT	*Median*	1.21	1.00	0.90
	IQR	2.36	1.48	1.08
NOV	*Median*	1.67	1.51	1.60
	IQR	8.17	4.55	7.25
DEC	*Median*	1.23	1.31	1.94
	IQR	2.29	5.38	3.57
ANNUAL	*Median*	1.05	1.41	0.95
	IQR	1.91	1.82	1.30

Parameter: **Ratio of total natural run-off between indicated scenarios**
Climate Model: **CGCM3 B1**

Sub-Basin Name:		MISSION CREEK	TROUT CREEK	VASEUX CREEK
Ratio:		A:BASELINE	A:BASELINE	A:BASELINE
JAN	*Median*	1.49	1.42	2.71
	IQR	1.95	1.90	5.76
FEB	*Median*	2.39	2.97	5.95
	IQR	3.73	3.49	11.46
MAR	*Median*	2.53	2.49	3.03
	IQR	3.50	1.57	1.95
APR	*Median*	1.84	1.77	3.01
	IQR	1.49	1.04	2.10
MAY	*Median*	1.02	1.10	1.27
	IQR	1.19	2.29	2.16
JUN	*Median*	0.98	0.77	0.75
	IQR	0.92	0.89	0.98
JUL	*Median*	0.95	0.83	0.63
	IQR	1.17	0.86	0.84
AUG	*Median*	0.76	1.10	1.07
	IQR	0.35	0.81	0.74
SEP	*Median*	0.99	1.14	1.23
	IQR	0.72	1.61	0.86
OCT	*Median*	1.07	1.16	1.35
	IQR	2.57	1.04	0.74
NOV	*Median*	1.33	1.28	1.51
	IQR	3.44	5.62	5.13
DEC	*Median*	1.22	2.17	3.39
	IQR	2.58	2.59	5.67
ANNUAL	*Median*	1.28	1.30	1.44
	IQR	0.87	1.15	1.83

APPENDIX D: SELECTED SUMMARIES OF PROJECTED WATER USE

Table D.1 Projected median monthly and median annual water use for <u>agricultural irrigation</u> in the Okanagan Basin. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.

WATER USE FOR IRRIGATION OF AGRICULTURAL LAND

Parameter: **Total monthly water use (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
FEB	*Median*	10	11	11	11	11	11	11
	IQR	1	2	4	2	2	2	2
MAR	*Median*	1,711	1,687	1,697	1,669	2,097	2,072	2,072
	IQR	25	111	163	104	420	397	397
APR	*Median*	2,627	3,492	4,198	3,463	3,844	3,795	3,791
	IQR	1,345	1,918	3,469	1,838	2,151	2,119	2,108
MAY	*Median*	7,948	9,128	10,285	9,012	10,382	10,318	10,235
	IQR	4,105	4,828	4,851	4,608	6,262	6,251	6,226
JUN	*Median*	16,680	18,536	19,568	18,181	22,971	22,913	22,599
	IQR	1,765	3,407	4,033	3,423	5,604	5,615	5,318
JUL	*Median*	25,864	26,336	25,010	25,462	32,432	32,359	32,212
	IQR	2,315	3,182	4,012	2,983	5,643	5,560	5,326
AUG	*Median*	22,861	24,589	24,156	24,177	30,196	30,145	29,923
	IQR	4,407	4,090	6,889	4,057	5,874	5,851	5,635
SEP	*Median*	13,804	15,076	13,906	14,621	18,165	18,111	18,028
	IQR	1,025	2,320	3,112	2,216	4,337	4,341	4,195
OCT	*Median*	3,245	4,149	3,876	4,056	4,845	4,823	4,793
	IQR	3,074	2,786	4,178	2,734	2,855	2,831	2,771
NOV	*Median*	1	93	6	89	100	98	97
	IQR	1	336	149	318	360	358	358
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	95,997	103,392	101,993	100,669	126,942	126,605	125,672
	IQR	4,629	9,728	9,553	9,616	19,242	19,085	18,533

Parameter: **Total monthly water use (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	0	5	0	0	0	0	0
	IQR	0	1	0	0	0	0	0
FEB	*Median*	10	550	11	11	11	11	11
	IQR	1	34	2	2	2	2	2
MAR	*Median*	1,662	2,207	1,668	1,646	2,020	2,002	2,002
	IQR	106	409	136	141	435	415	415
APR	*Median*	2,780	5,329	3,601	3,539	4,063	4,012	4,011
	IQR	561	1,623	1,148	1,093	941	924	921
MAY	*Median*	6,140	11,614	9,296	9,147	10,897	10,843	10,819
	IQR	2,758	2,250	3,462	3,413	4,622	4,582	4,550
JUN	*Median*	16,571	19,185	16,414	16,175	20,581	20,524	20,358
	IQR	2,564	2,206	2,813	2,766	5,692	5,709	5,557
JUL	*Median*	25,565	24,321	24,675	24,354	30,028	29,981	29,680
	IQR	3,057	2,600	2,554	2,678	4,151	4,138	3,831
AUG	*Median*	24,580	20,438	22,815	22,632	28,270	28,176	27,798
	IQR	3,060	2,597	2,973	2,832	7,390	7,359	7,142
SEP	*Median*	12,668	10,704	13,698	13,517	17,287	17,228	17,102
	IQR	3,051	1,934	2,064	1,997	3,174	3,149	2,943
OCT	*Median*	2,392	3,137	4,957	4,874	5,727	5,703	5,674
	IQR	1,501	1,769	2,602	2,529	3,298	3,273	3,212
NOV	*Median*	2	14	34	33	38	37	37
	IQR	16	182	288	278	371	363	358
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	91,991	95,987	94,569	93,449	119,697	119,364	118,199
	IQR	10,302	4,322	4,241	3,960	22,915	22,739	21,587

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	1.06	1.03	0.95	0.97	0.98	1.00
	IQR	2.00	2.00	0.50	0.50	1.00	1.00
MAR	*Median*	0.99	1.01	0.98	1.24	1.23	1.00
	IQR	4.44	1.47	0.64	2.58	3.58	1.00
APR	*Median*	1.33	1.20	0.82	0.92	1.09	1.00
	IQR	1.43	1.81	0.53	0.62	1.10	0.99
MAY	*Median*	1.15	1.13	0.88	1.01	1.13	0.99
	IQR	1.18	1.00	0.95	1.29	1.29	1.00
JUN	*Median*	1.11	1.06	0.93	1.17	1.24	0.99
	IQR	1.93	1.18	0.85	1.39	1.65	0.95
JUL	*Median*	1.02	0.95	1.02	1.30	1.23	1.00
	IQR	1.37	1.26	0.74	1.41	1.75	0.96
AUG	*Median*	1.08	0.98	1.00	1.25	1.23	0.99
	IQR	0.93	1.68	0.59	0.85	1.43	0.96
SEP	*Median*	1.09	0.92	1.05	1.31	1.20	1.00
	IQR	2.26	1.34	0.71	1.39	1.87	0.97
OCT	*Median*	1.28	0.93	1.05	1.25	1.16	0.99
	IQR	0.91	1.50	0.65	0.68	1.02	0.98
NOV	*Median*	71.10	0.06	15.93	17.81	1.06	0.99
	IQR	336.00	0.44	2.13	2.42	1.07	1.00
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.08	0.99	0.99	1.24	1.22	0.99
	IQR	2.10	0.98	1.01	2.01	1.96	0.97

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	52.62	0.02	0.99	1.00	0.02	1.00
	IQR	34.00	0.06	1.00	1.00	0.06	1.00
MAR	*Median*	1.33	0.76	0.99	1.21	0.91	1.00
	IQR	3.86	0.33	1.04	3.20	1.01	1.00
APR	*Median*	1.92	0.68	0.98	1.13	0.75	1.00
	IQR	2.89	0.71	0.95	0.82	0.57	1.00
MAY	*Median*	1.89	0.80	0.98	1.17	0.93	1.00
	IQR	0.82	1.54	0.99	1.34	2.04	0.99
JUN	*Median*	1.16	0.86	0.99	1.25	1.07	0.99
	IQR	0.86	1.28	0.98	2.02	2.59	0.97
JUL	*Median*	0.95	1.01	0.99	1.22	1.23	0.99
	IQR	0.85	0.98	1.05	1.63	1.59	0.93
AUG	*Median*	0.83	1.12	0.99	1.24	1.38	0.99
	IQR	0.85	1.14	0.95	2.49	2.83	0.97
SEP	*Median*	0.84	1.28	0.99	1.26	1.61	0.99
	IQR	0.63	1.07	0.97	1.54	1.63	0.93
OCT	*Median*	1.31	1.58	0.98	1.16	1.82	0.99
	IQR	1.18	1.47	0.97	1.27	1.85	0.98
NOV	*Median*	7.27	2.43	0.95	1.12	2.61	0.99
	IQR	11.38	1.58	0.97	1.29	1.99	0.99
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.04	0.99	0.99	1.27	1.24	0.99
	IQR	0.42	0.98	0.93	5.40	5.26	0.95

Table D.2 *Projected median monthly and median annual water use for <u>golf course irrigation</u> in the Okanagan Basin. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

WATER USE FOR IRRIGATION OF GOLF COURSES

Parameter: **Total monthly water use (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
FEB	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
MAR	*Median*	94	93	93	83	93	83	83
	IQR	2	7	7	6	7	6	6
APR	*Median*	303	538	537	514	537	514	514
	IQR	397	525	523	459	523	459	459
MAY	*Median*	1,383	1,276	1,274	1,120	1,274	1,120	1,120
	IQR	258	326	326	309	326	309	309
JUN	*Median*	1,513	1,585	1,581	1,452	1,581	1,452	1,452
	IQR	242	121	122	156	122	156	156
JUL	*Median*	1,822	1,886	1,880	1,711	1,880	1,711	1,711
	IQR	88	195	191	121	191	121	121
AUG	*Median*	1,558	1,671	1,669	1,520	1,669	1,520	1,520
	IQR	301	247	247	289	247	289	289
SEP	*Median*	960	1,021	1,018	922	1,018	922	922
	IQR	89	129	128	98	128	98	98
OCT	*Median*	238	280	279	263	279	263	263
	IQR	250	252	251	220	251	220	220
NOV	*Median*	0	3	3	2	3	2	2
	IQR	0	20	20	18	20	18	18
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	7,864	8,316	8,308	7,644	8,308	7,644	7,644
	IQR	319	834	835	868	835	868	868

Parameter: **Total monthly water use (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
FEB	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
MAR	*Median*	92	93	92	83	92	83	83
	IQR	3	8	8	10	8	10	10
APR	*Median*	337	604	602	520	602	520	520
	IQR	131	264	264	231	264	231	231
MAY	*Median*	1,057	1,309	1,306	1,166	1,306	1,166	1,166
	IQR	323	241	238	231	238	231	231
JUN	*Median*	1,504	1,447	1,444	1,311	1,444	1,311	1,311
	IQR	165	222	225	248	225	248	248
JUL	*Median*	1,801	1,756	1,753	1,627	1,753	1,627	1,627
	IQR	200	125	128	249	128	249	249
AUG	*Median*	1,645	1,531	1,528	1,371	1,528	1,371	1,371
	IQR	174	230	227	123	227	123	123
SEP	*Median*	873	943	939	834	939	834	834
	IQR	186	125	123	132	123	132	132
OCT	*Median*	154	327	327	288	327	288	288
	IQR	118	181	180	163	180	163	163
NOV	*Median*	0	1	1	1	1	1	1
	IQR	1	18	18	16	18	16	16
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	7,520	7,816	7,800	7,024	7,800	7,024	7,024
	IQR	629	488	485	477	485	477	477

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
MAR	*Median*	0.99	1.00	0.89	1.00	0.89	1.00
	IQR	3.50	1.00	0.86	1.00	0.86	1.00
APR	*Median*	1.78	1.00	0.96	1.00	0.96	1.00
	IQR	1.32	1.00	0.88	1.00	0.87	1.00
MAY	*Median*	0.92	1.00	0.88	1.00	0.88	1.00
	IQR	1.26	1.00	0.95	1.00	0.95	1.00
JUN	*Median*	1.05	1.00	0.92	1.00	0.92	1.00
	IQR	0.50	1.01	1.28	1.00	1.29	1.00
JUL	*Median*	1.04	1.00	0.91	1.00	0.91	1.00
	IQR	2.22	0.98	0.63	1.00	0.62	1.00
AUG	*Median*	1.07	1.00	0.91	1.00	0.91	1.00
	IQR	0.82	1.00	1.17	1.00	1.17	1.00
SEP	*Median*	1.06	1.00	0.91	1.00	0.90	1.00
	IQR	1.45	0.99	0.77	1.00	0.76	1.00
OCT	*Median*	1.17	1.00	0.94	1.00	0.94	1.00
	IQR	1.01	1.00	0.88	1.00	0.87	1.00
NOV	*Median*	-	1.00	0.76	1.00	0.76	1.00
	IQR	-	1.00	0.90	1.00	0.90	1.00
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.06	1.00	0.92	1.00	0.92	1.00
	IQR	2.61	1.00	1.04	1.00	1.04	1.00

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
MAR	*Median*	1.01	1.00	0.89	1.00	0.89	1.00
	IQR	2.67	1.00	1.25	1.00	1.25	1.00
APR	*Median*	1.79	1.00	0.86	1.00	0.86	1.00
	IQR	2.02	1.00	0.88	1.00	0.88	1.00
MAY	*Median*	1.24	1.00	0.89	1.00	0.89	1.00
	IQR	0.75	0.99	0.97	1.00	0.96	1.00
JUN	*Median*	0.96	1.00	0.91	1.00	0.91	1.00
	IQR	1.35	1.01	1.10	1.00	1.12	1.00
JUL	*Median*	0.98	1.00	0.93	1.00	0.93	1.00
	IQR	0.63	1.02	1.95	1.00	1.99	1.00
AUG	*Median*	0.93	1.00	0.90	1.00	0.90	1.00
	IQR	1.32	0.99	0.54	1.00	0.53	1.00
SEP	*Median*	1.08	1.00	0.89	1.00	0.88	1.00
	IQR	0.67	0.98	1.07	1.00	1.06	1.00
OCT	*Median*	2.13	1.00	0.88	1.00	0.88	1.00
	IQR	1.53	0.99	0.91	1.00	0.90	1.00
NOV	*Median*	-	1.00	0.95	1.00	0.95	1.00
	IQR	-	1.00	0.89	1.00	0.89	1.00
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.04	1.00	0.90	1.00	0.90	1.00
	IQR	0.78	0.99	0.98	1.00	0.98	1.00

Table D.3 *Projected median monthly and median annual water use for <u>parks and open space irrigation</u> in the Okanagan Basin. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

WATER USE FOR IRRIGATION OF PARKS AND OPEN SPACES

Parameter: **Total monthly water use (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
FEB	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
MAR	*Median*	53	52	51	43	51	43	43
	IQR	3	3	3	8	3	8	8
APR	*Median*	168	253	252	209	252	209	209
	IQR	217	244	239	199	239	199	199
MAY	*Median*	712	682	664	558	664	558	558
	IQR	95	149	142	122	142	122	122
JUN	*Median*	801	828	805	684	805	684	684
	IQR	104	60	59	102	59	102	102
JUL	*Median*	947	980	950	801	950	801	801
	IQR	47	96	74	124	74	124	124
AUG	*Median*	804	862	847	719	847	719	719
	IQR	153	124	131	120	131	120	120
SEP	*Median*	519	543	526	448	526	448	448
	IQR	41	59	57	99	57	99	99
OCT	*Median*	155	195	190	169	190	169	169
	IQR	116	120	118	104	118	104	104
NOV	*Median*	0	6	6	4	6	4	4
	IQR	0	17	17	15	17	15	15
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	4,160	4,426	4,343	3,608	4,343	3,608	3,608
	IQR	141	296	397	577	397	577	577

Parameter: **Total monthly water use (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
FEB	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
MAR	*Median*	51	52	50	41	50	41	41
	IQR	2	2	2	7	2	7	7
APR	*Median*	201	320	308	252	308	252	252
	IQR	104	117	112	94	112	94	94
MAY	*Median*	597	693	682	537	682	537	537
	IQR	141	133	124	102	124	102	102
JUN	*Median*	798	764	748	643	748	643	643
	IQR	83	121	133	180	133	180	180
JUL	*Median*	937	918	897	775	897	775	775
	IQR	104	57	74	145	74	145	145
AUG	*Median*	856	796	785	637	785	637	637
	IQR	95	111	100	106	100	106	106
SEP	*Median*	456	500	488	391	488	391	391
	IQR	96	76	68	59	68	59	59
OCT	*Median*	95	215	209	160	209	160	160
	IQR	55	88	82	84	82	84	84
NOV	*Median*	0	3	3	3	3	3	3
	IQR	1	17	17	13	17	13	13
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	4,011	4,123	4,042	4,042	4,042	3,445	3,445
	IQR	396	186	208	208	208	511	511

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
MAR	*Median*	0.99	0.98	0.86	1.00	0.84	1.00
	IQR	1.00	1.00	2.67	1.00	2.67	1.00
APR	*Median*	1.51	0.99	0.83	1.00	0.83	1.00
	IQR	1.12	0.98	0.83	1.00	0.82	1.00
MAY	*Median*	0.96	0.97	0.84	1.00	0.82	1.00
	IQR	1.57	0.95	0.86	1.00	0.82	1.00
JUN	*Median*	1.03	0.97	0.85	1.00	0.83	1.00
	IQR	0.58	0.98	1.73	1.00	1.70	1.00
JUL	*Median*	1.03	0.97	0.84	1.00	0.82	1.00
	IQR	2.04	0.77	1.68	1.00	1.29	1.00
AUG	*Median*	1.07	0.98	0.85	1.00	0.83	1.00
	IQR	0.81	1.06	0.92	1.00	0.97	1.00
SEP	*Median*	1.05	0.97	0.85	1.00	0.83	1.00
	IQR	1.44	0.97	1.74	1.00	1.68	1.00
OCT	*Median*	1.26	0.98	0.89	1.00	0.87	1.00
	IQR	1.03	0.98	0.88	1.00	0.87	1.00
NOV	*Median*	34.21	0.99	0.74	1.00	0.74	1.00
	IQR	-	1.00	0.88	1.00	0.88	1.00
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.06	0.98	0.83	1.00	0.82	1.00
	IQR	2.10	1.34	1.45	1.00	1.95	1.00

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
MAR	*Median*	1.01	0.98	0.81	1.00	0.79	1.00
	IQR	1.41	0.94	3.38	1.00	3.17	1.00
APR	*Median*	1.59	0.96	0.82	1.00	0.79	1.00
	IQR	1.13	0.96	0.83	1.00	0.80	1.00
MAY	*Median*	1.16	0.98	0.79	1.00	0.77	1.00
	IQR	0.94	0.93	0.82	1.00	0.77	1.00
JUN	*Median*	0.96	0.98	0.86	1.00	0.84	1.00
	IQR	1.47	1.09	1.36	1.00	1.48	1.00
JUL	*Median*	0.98	0.98	0.86	1.00	0.84	1.00
	IQR	0.55	1.30	1.95	1.00	2.53	1.00
AUG	*Median*	0.93	0.99	0.81	1.00	0.80	1.00
	IQR	1.18	0.90	1.06	1.00	0.96	1.00
SEP	*Median*	1.10	0.98	0.80	1.00	0.78	1.00
	IQR	0.79	0.90	0.86	1.00	0.77	1.00
OCT	*Median*	2.26	0.98	0.76	1.00	0.74	1.00
	IQR	1.59	0.94	1.02	1.00	0.96	1.00
NOV	*Median*	55.74	1.00	0.84	1.00	0.84	1.00
	IQR	12.25	0.96	0.77	1.00	0.74	1.00
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.03	0.98	1.00	1.00	0.84	1.00
	IQR	0.47	1.12	1.00	1.00	2.75	1.00

Table D.4 *Projected median monthly and median annual water use for domestic indoor purposes in the Okanagan Basin. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

INDOOR DOMESTIC WATER USE

Parameter: **Total monthly water use (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**1**	28	30	34	36	38	40
JAN	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
FEB	*Median*	1187	1255	1583	2121	1583	2121	1744
	IQR	69	34	313	516	313	516	53
MAR	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
APR	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
MAY	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
JUN	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
JUL	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
AUG	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
SEP	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
OCT	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
NOV	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
DEC	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
ANNUAL	*Median*	15251	16360	20414	27393	20414	27393	22649
	IQR	930	34	3883	6284	3883	6284	820

Parameter: **Total monthly water use (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**2**	29	31	35	37	39	41
JAN	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
FEB	*Median*	1187	1255	1583	2121	1583	2121	1744
	IQR	69	34	313	516	313	516	53
MAR	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
APR	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
MAY	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
JUN	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
JUL	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
AUG	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
SEP	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
OCT	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
NOV	*Median*	1254	1345	1678	2251	1678	2251	1859
	IQR	75	0	318	515	318	515	65
DEC	*Median*	1295	1390	1734	2326	1734	2326	1921
	IQR	77	0	328	532	328	532	68
ANNUAL	*Median*	15251	16360	20414	27393	20414	27393	22649
	IQR	930	34	3883	6284	3883	6284	820

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
FEB	*Median*	1.06	1.26	1.34	1.00	1.69	0.82
	IQR	0.49	9.32	1.65	1.00	15.36	0.10
MAR	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
APR	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
MAY	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
JUN	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
JUL	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
AUG	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
SEP	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
OCT	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
NOV	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
DEC	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
ANNUAL	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.04	114.21	1.62	1.00	184.82	0.13

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
FEB	*Median*	1.06	1.26	1.34	1.00	1.69	0.82
	IQR	0.49	9.32	1.65	1.00	15.36	0.10
MAR	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
APR	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
MAY	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
JUN	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
JUL	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
AUG	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
SEP	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
OCT	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
NOV	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
DEC	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.00	-	1.62	1.00	-	0.13
ANNUAL	*Median*	1.07	1.25	1.34	1.00	1.67	0.83
	IQR	0.04	114.21	1.62	1.00	184.82	0.13

Table D.5 *Projected median monthly and median annual water use for <u>domestic outdoor purposes</u> in the Okanagan Basin. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

OUTDOOR DOMESTIC WATER USE

Parameter: **Total monthly water use (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
FEB	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
MAR	*Median*	23	23	36	470	36	470	733
	IQR	1	2	14	338	14	338	629
APR	*Median*	714	1,511	1,548	2,675	1,542	2,668	3,129
	IQR	2,139	2,330	2,393	3,457	2,384	3,448	3,356
MAY	*Median*	7,217	6,872	7,038	12,783	6,988	12,748	12,691
	IQR	1,321	1,635	1,682	5,132	1,672	5,110	5,073
JUN	*Median*	8,121	8,617	8,875	17,137	8,812	17,089	17,010
	IQR	1,231	666	677	5,413	686	5,383	5,313
JUL	*Median*	9,784	10,141	10,511	20,607	10,427	20,550	20,459
	IQR	573	1,233	1,083	6,332	1,107	6,297	6,193
AUG	*Median*	8,257	8,943	9,051	17,094	9,033	17,046	16,964
	IQR	1,683	1,315	1,507	5,626	1,469	5,596	5,517
SEP	*Median*	5,155	5,563	5,725	10,830	5,700	10,797	10,739
	IQR	494	623	742	3,851	711	3,831	3,778
OCT	*Median*	1,395	1,666	1,688	2,560	1,677	2,556	2,548
	IQR	1,192	1,287	1,298	2,260	1,294	2,254	2,249
NOV	*Median*	2	44	45	67	45	67	66
	IQR	4	155	157	190	156	190	189
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	0	0	0	0	0	0
ANNUAL	*Median*	41,035	43,479	44,894	86,755	44,580	86,525	86,611
	IQR	1,804	3,435	3,648	30,680	3,692	30,495	30,719

Parameter: **Total monthly water use (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	0	0	0	0	0	0	0
	IQR	0	523	0	0	0	0	0
FEB	*Median*	0	0	0	0	0	0	0
	IQR	0	580	0	0	0	0	0
MAR	*Median*	23	22	34	452	34	452	685
	IQR	1	539	14	362	13	362	659
APR	*Median*	937	2,009	2,046	3,261	2,040	3,252	3,555
	IQR	894	700	884	2,074	876	2,066	2,473
MAY	*Median*	5,760	7,018	7,250	13,474	7,217	13,433	13,350
	IQR	1,671	5,231	1,509	5,107	1,490	5,080	5,026
JUN	*Median*	8,317	7,837	7,971	14,700	7,925	14,661	14,586
	IQR	937	7,513	1,187	5,945	1,203	5,908	5,817
JUL	*Median*	9,738	9,461	9,663	18,896	9,610	18,845	18,756
	IQR	1,128	9,061	744	7,355	713	7,312	7,201
AUG	*Median*	8,958	8,236	8,480	16,588	8,432	16,546	16,481
	IQR	1,065	7,879	1,366	7,813	1,332	7,778	7,694
SEP	*Median*	4,606	5,120	5,280	9,289	5,252	9,263	9,215
	IQR	1,127	4,133	808	3,914	782	3,892	3,826
OCT	*Median*	914	2,008	2,058	2,886	2,049	2,877	2,859
	IQR	510	757	806	1,646	807	1,640	1,618
NOV	*Median*	0	19	19	24	19	24	24
	IQR	9	579	142	234	140	233	232
DEC	*Median*	0	0	0	0	0	0	0
	IQR	0	559	0	0	0	0	0
ANNUAL	*Median*	39,222	40,464	41,777	78,866	41,473	78,656	78,733
	IQR	4,609	32,409	2,415	30,652	2,354	30,481	30,692

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
MAR	*Median*	1.00	1.57	13.14	1.00	20.60	1.56
	IQR	2.63	9.00	23.84	0.99	214.43	1.86
APR	*Median*	2.12	1.02	1.73	1.00	1.77	1.17
	IQR	1.09	1.03	1.44	1.00	1.48	0.97
MAY	*Median*	0.95	1.02	1.82	0.99	1.86	1.00
	IQR	1.24	1.03	3.05	0.99	3.13	0.99
JUN	*Median*	1.06	1.03	1.93	0.99	1.98	1.00
	IQR	0.54	1.02	8.00	1.01	8.09	0.99
JUL	*Median*	1.04	1.04	1.96	0.99	2.03	1.00
	IQR	2.15	0.88	5.85	1.02	5.11	0.98
AUG	*Median*	1.08	1.01	1.89	1.00	1.91	1.00
	IQR	0.78	1.15	3.73	0.97	4.25	0.99
SEP	*Median*	1.08	1.03	1.89	1.00	1.94	0.99
	IQR	1.26	1.19	5.19	0.96	6.15	0.99
OCT	*Median*	1.19	1.01	1.52	0.99	1.53	1.00
	IQR	1.08	1.01	1.74	1.00	1.75	1.00
NOV	*Median*	20.42	1.01	1.50	1.00	1.51	0.99
	IQR	36.30	1.01	1.21	1.00	1.23	0.99
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.06	1.03	1.93	0.99	1.99	1.00
	IQR	1.90	1.06	8.41	1.01	8.88	1.01

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
FEB	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
MAR	*Median*	0.98	1.52	13.39	0.99	20.33	1.52
	IQR	628.26	0.03	26.80	0.99	0.67	1.82
APR	*Median*	2.14	1.02	1.59	1.00	1.62	1.09
	IQR	0.78	1.26	2.35	0.99	2.95	1.20
MAY	*Median*	1.22	1.03	1.86	1.00	1.91	0.99
	IQR	3.13	0.29	3.39	0.99	0.97	0.99
JUN	*Median*	0.94	1.02	1.84	0.99	1.87	0.99
	IQR	8.02	0.16	5.01	1.01	0.79	0.98
JUL	*Median*	0.97	1.02	1.96	0.99	1.99	1.00
	IQR	8.04	0.08	9.89	0.96	0.81	0.98
AUG	*Median*	0.92	1.03	1.96	0.99	2.01	1.00
	IQR	7.40	0.17	5.72	0.98	0.99	0.99
SEP	*Median*	1.11	1.03	1.76	0.99	1.81	0.99
	IQR	3.67	0.20	4.85	0.97	0.94	0.98
OCT	*Median*	2.20	1.03	1.40	1.00	1.43	0.99
	IQR	1.48	1.07	2.04	1.00	2.17	0.99
NOV	*Median*	64.41	1.00	1.24	1.00	1.24	0.99
	IQR	65.40	0.25	1.65	0.99	0.40	1.00
DEC	*Median*	-	-	-	-	-	-
	IQR	-	-	-	-	-	-
ANNUAL	*Median*	1.03	1.03	1.89	0.99	1.94	1.00
	IQR	7.03	0.07	12.69	0.97	0.94	1.01

Table D.6 *Projected median monthly and median annual water use for* ***institutional, commercial, and industrial purposes*** *in the Okanagan Basin. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

INDUSTRIAL, COMMERCIAL & INSTITUTIONAL WATER USE

Parameter: **Total monthly water use (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	1,303	1,398	1,737	2,330	1,737	2,483	1,923
	IQR	78	0	322	524	322	563	61
FEB	*Median*	1,194	1,263	1,586	2,124	1,586	2,274	1,746
	IQR	69	34	307	508	307	549	48
MAR	*Median*	1,303	1,398	1,737	2,330	1,737	2,483	1,923
	IQR	78	0	322	524	322	563	61
APR	*Median*	1,261	1,353	1,681	2,255	1,681	2,413	1,861
	IQR	75	0	312	507	312	546	59
MAY	*Median*	1,303	1,398	1,737	2,330	1,737	2,471	1,923
	IQR	78	0	322	524	322	563	61
JUN	*Median*	1,261	1,353	1,681	2,255	1,681	2,413	1,861
	IQR	75	0	312	507	312	546	59
JUL	*Median*	1,303	1,398	1,737	2,330	1,737	2,480	1,923
	IQR	78	0	322	524	322	561	61
AUG	*Median*	1,303	1,398	1,737	2,330	1,737	2,487	1,923
	IQR	78	0	322	524	322	563	61
SEP	*Median*	1,261	1,353	1,681	2,255	1,681	2,406	1,861
	IQR	75	0	312	507	312	544	59
OCT	*Median*	1,303	1,398	1,737	2,330	1,737	2,487	1,923
	IQR	78	0	322	524	322	563	61
NOV	*Median*	1,261	1,353	1,681	2,255	1,681	2,413	1,861
	IQR	75	0	312	507	312	546	59
DEC	*Median*	1,303	1,398	1,737	2,330	1,737	2,480	1,923
	IQR	78	0	322	524	322	561	61
ANNUAL	*Median*	15,343	16,458	20,449	27,432	20,449	29,272	22,671
	IQR	935	34	3,809	6,187	3,809	6,650	735

Parameter: **Total monthly water use (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
FEB	*Median*	1,194	1,263	1,586	2,124	1,586	2,140	1,746
	IQR	69	34	307	508	307	539	48
MAR	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
APR	*Median*	1,261	1,353	1,681	2,255	1,681	2,272	1,861
	IQR	75	0	312	507	312	538	59
MAY	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
JUN	*Median*	1,261	1,353	1,681	2,255	1,681	2,272	1,861
	IQR	75	0	312	507	312	538	59
JUL	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
AUG	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
SEP	*Median*	1,261	1,353	1,681	2,255	1,681	2,272	1,861
	IQR	75	0	312	507	312	538	59
OCT	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
NOV	*Median*	1,261	1,353	1,681	2,255	1,681	2,272	1,861
	IQR	75	0	312	507	312	538	59
DEC	*Median*	1,303	1,398	1,737	2,330	1,737	2,348	1,923
	IQR	78	0	322	524	322	556	61
ANNUAL	*Median*	15,343	16,458	20,449	27,432	20,449	27,645	22,671
	IQR	935	34	3,809	6,187	3,809	6,564	735

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
FEB	*Median*	1.06	1.26	1.34	1.00	1.80	0.77
	IQR	0.49	9.08	1.65	1.00	16.24	0.09
MAR	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
APR	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
MAY	*Median*	1.07	1.24	1.34	1.00	1.77	0.78
	IQR	0.00	-	1.63	1.00	-	0.11
JUN	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
JUL	*Median*	1.07	1.24	1.34	1.00	1.77	0.78
	IQR	0.00	-	1.63	1.00	-	0.11
AUG	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
SEP	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
OCT	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
NOV	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.00	-	1.63	1.00	-	0.11
DEC	*Median*	1.07	1.24	1.34	1.00	1.77	0.78
	IQR	0.00	-	1.63	1.00	-	0.11
ANNUAL	*Median*	1.07	1.24	1.34	1.00	1.78	0.77
	IQR	0.04	112.03	1.62	1.00	195.59	0.11

Parameter: **Ratio of total water use between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
FEB	*Median*	1.06	1.26	1.34	1.00	1.69	0.82
	IQR	0.49	9.08	1.65	1.00	15.95	0.09
MAR	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
APR	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
MAY	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
JUN	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
JUL	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
AUG	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
SEP	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
OCT	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
NOV	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
DEC	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.00	-	1.63	1.00	-	0.11
ANNUAL	*Median*	1.07	1.24	1.34	1.00	1.68	0.82
	IQR	0.04	112.03	1.62	1.00	193.06	0.11

APPENDIX E: SELECTED SUMMARIES OF PROJECTED SURFACE WATER EXTRACTIONS

Table E.1 *Projected median monthly and median annual surface water extraction for the <u>Okanagan Basin overall.</u> The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: TOTAL OKANAGAN BASIN

Parameter: **Total surface water extraction (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**1**	28	30	34	36	38	40
JAN	*Median*	2,294	2,460	3,065	4,117	3,065	4,117	3,395
	IQR	137	0	576	918	576	918	101
FEB	*Median*	2,111	2,233	2,811	3,766	2,811	3,766	3,093
	IQR	121	61	550	890	550	890	80
MAR	*Median*	3,636	3,828	4,421	5,755	4,639	5,973	5,484
	IQR	155	90	689	1,199	857	1,380	836
APR	*Median*	5,356	7,544	7,969	9,999	8,265	10,302	9,726
	IQR	4,175	4,957	4,765	5,789	5,003	5,595	6,012
MAY	*Median*	19,505	21,203	21,348	27,194	22,289	28,241	26,980
	IQR	5,786	6,257	5,656	7,411	6,484	9,351	8,136
JUN	*Median*	29,897	32,017	31,777	39,738	34,289	44,271	41,955
	IQR	2,899	3,933	3,908	5,717	4,112	8,299	6,539
JUL	*Median*	40,760	41,994	40,955	50,837	44,732	55,941	53,587
	IQR	2,847	4,342	3,925	6,710	4,419	10,301	8,261
AUG	*Median*	36,011	38,790	38,301	46,268	41,078	50,854	49,020
	IQR	6,416	5,731	5,358	7,268	5,809	10,074	8,320
SEP	*Median*	23,365	25,146	24,843	29,515	26,913	32,589	31,097
	IQR	1,480	3,267	2,932	4,071	3,478	6,731	4,847
OCT	*Median*	7,612	9,320	9,474	11,210	10,001	12,039	11,202
	IQR	4,887	4,651	4,302	4,845	4,305	5,412	5,323
NOV	*Median*	2,256	2,561	3,181	4,259	3,182	4,270	3,480
	IQR	136	588	647	1,134	684	1,135	470
DEC	*Median*	2,294	2,460	3,065	4,117	3,065	4,117	3,395
	IQR	137	0	577	919	577	919	101
ANNUAL	*Median*	177,987	189,187	191,674	238,186	207,796	259,818	244,624
	IQR	6,792	13,638	12,567	29,281	22,481	47,088	32,666

Parameter: **Total surface water extraction (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**2**	29	31	35	37	39	41
JAN	*Median*	2,327	2,460	3,065	4,117	3,065	4,161	3,395
	IQR	149	0	576	918	576	954	101
FEB	*Median*	2,112	2,233	2,809	3,764	2,816	3,804	3,095
	IQR	123	59	547	887	547	924	80
MAR	*Median*	3,644	3,824	4,378	5,705	4,575	5,943	5,353
	IQR	102	92	662	1,271	859	1,506	782
APR	*Median*	5,987	8,345	8,789	10,758	9,013	11,089	10,713
	IQR	1,733	1,999	2,028	3,269	2,129	3,413	3,076
MAY	*Median*	16,158	21,262	21,848	26,418	22,759	27,557	26,383
	IQR	4,908	5,132	4,712	8,831	5,890	9,695	9,212
JUN	*Median*	29,528	29,398	28,834	36,865	31,790	40,029	38,228
	IQR	3,923	4,976	4,871	7,702	5,003	10,389	8,711
JUL	*Median*	40,595	39,722	39,018	46,721	41,728	52,896	49,378
	IQR	4,474	3,158	3,288	4,703	3,787	9,232	6,380
AUG	*Median*	38,869	36,414	35,930	43,069	38,669	49,128	45,492
	IQR	4,297	4,840	4,062	9,057	6,475	13,445	11,098
SEP	*Median*	21,554	23,367	23,104	28,150	25,426	30,886	29,342
	IQR	4,499	2,968	2,857	3,376	3,307	6,519	3,970
OCT	*Median*	5,922	10,513	10,747	12,350	11,204	13,035	12,475
	IQR	2,310	3,884	3,727	4,145	4,035	5,268	4,346
NOV	*Median*	2,221	2,452	3,226	4,313	3,228	4,377	3,378
	IQR	212	524	748	1,042	784	1,045	627
DEC	*Median*	2,294	2,460	3,065	4,117	3,065	4,161	3,395
	IQR	137	0	576	918	576	954	104
ANNUAL	*Median*	170,749	177,876	180,229	228,084	194,994	249,540	234,021
	IQR	14,532	6,721	7,438	33,092	19,142	54,166	33,920

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.25	1.34	1.00	1.67	0.82
	IQR	0.00	-	1.59	1.00	-	0.11
FEB	*Median*	1.06	1.26	1.34	1.00	1.69	0.82
	IQR	0.50	9.02	1.62	1.00	14.59	0.09
MAR	*Median*	1.05	1.15	1.30	1.05	1.56	0.92
	IQR	0.58	7.66	1.74	1.24	15.33	0.61
APR	*Median*	1.41	1.06	1.25	1.04	1.37	0.94
	IQR	1.19	0.96	1.21	1.05	1.13	1.07
MAY	*Median*	1.09	1.01	1.27	1.04	1.33	0.96
	IQR	1.08	0.90	1.31	1.15	1.49	0.87
JUN	*Median*	1.07	0.99	1.25	1.08	1.38	0.95
	IQR	1.36	0.99	1.46	1.05	2.11	0.79
JUL	*Median*	1.03	0.98	1.24	1.09	1.33	0.96
	IQR	1.53	0.90	1.71	1.13	2.37	0.80
AUG	*Median*	1.08	0.99	1.21	1.07	1.31	0.96
	IQR	0.89	0.93	1.36	1.08	1.76	0.83
SEP	*Median*	1.08	0.99	1.19	1.08	1.30	0.95
	IQR	2.21	0.90	1.39	1.19	2.06	0.72
OCT	*Median*	1.22	1.02	1.18	1.06	1.29	0.93
	IQR	0.95	0.92	1.13	1.00	1.16	0.98
NOV	*Median*	1.14	1.24	1.34	1.00	1.67	0.81
	IQR	4.32	1.10	1.75	1.06	1.93	0.41
DEC	*Median*	1.07	1.25	1.34	1.00	1.67	0.82
	IQR	0.00	-	1.59	1.00	-	0.11
ANNUAL	*Median*	1.06	1.01	1.24	1.08	1.37	0.94
	IQR	2.01	0.92	2.33	1.79	3.45	0.69

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.06	1.25	1.34	1.00	1.69	0.82
	IQR	0.00	-	1.59	1.00	-	0.11
FEB	*Median*	1.06	1.26	1.34	1.00	1.70	0.81
	IQR	0.48	9.27	1.62	1.00	15.66	0.09
MAR	*Median*	1.05	1.15	1.30	1.04	1.55	0.90
	IQR	0.90	7.20	1.92	1.30	16.37	0.52
APR	*Median*	1.39	1.05	1.22	1.03	1.33	0.97
	IQR	1.15	1.01	1.61	1.05	1.71	0.90
MAY	*Median*	1.32	1.03	1.21	1.04	1.30	0.96
	IQR	1.05	0.92	1.87	1.25	1.89	0.95
JUN	*Median*	1.00	0.98	1.28	1.10	1.36	0.96
	IQR	1.27	0.98	1.58	1.03	2.09	0.84
JUL	*Median*	0.98	0.98	1.20	1.07	1.33	0.93
	IQR	0.71	1.04	1.43	1.15	2.92	0.69
AUG	*Median*	0.94	0.99	1.20	1.08	1.35	0.93
	IQR	1.13	0.84	2.23	1.59	2.78	0.83
SEP	*Median*	1.08	0.99	1.22	1.10	1.32	0.95
	IQR	0.66	0.96	1.18	1.16	2.20	0.61
OCT	*Median*	1.78	1.02	1.15	1.04	1.24	0.96
	IQR	1.68	0.96	1.11	1.08	1.36	0.82
NOV	*Median*	1.10	1.32	1.34	1.00	1.79	0.77
	IQR	2.47	1.43	1.39	1.05	1.99	0.60
DEC	*Median*	1.07	1.25	1.34	1.00	1.69	0.82
	IQR	0.00	-	1.59	1.00	-	0.11
ANNUAL	*Median*	1.04	1.01	1.27	1.08	1.40	0.94
	IQR	0.46	1.11	4.45	2.57	8.06	0.63

Table E.2 *Projected median monthly and median annual surface water extraction from all sources in the <u>Okanagan Lake drainage area</u>. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: OKANAGAN LAKE

Parameter: **Total surface water extraction (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**1**	28	30	34	36	38	40
JAN	*Median*	2,213	2,374	2,960	3,952	2,960	3,952	3,258
	IQR	132	0	559	869	559	869	86
FEB	*Median*	2,035	2,152	2,712	3,613	2,712	3,613	2,967
	IQR	117	58	534	841	534	841	72
MAR	*Median*	3,257	3,401	3,997	5,211	4,185	5,398	4,929
	IQR	158	62	634	1,092	786	1,249	721
APR	*Median*	4,684	6,759	7,266	9,046	7,518	9,305	8,751
	IQR	3,870	4,614	4,545	5,171	4,671	5,016	5,409
MAY	*Median*	17,068	18,594	18,789	23,319	19,599	24,198	23,090
	IQR	4,881	5,335	5,074	6,460	5,600	7,741	6,780
JUN	*Median*	25,160	26,921	26,967	32,967	29,217	36,656	34,876
	IQR	2,656	3,276	3,207	4,429	3,487	6,692	5,260
JUL	*Median*	33,319	34,456	34,186	41,994	37,374	46,073	44,423
	IQR	2,296	3,448	3,149	6,002	3,797	8,390	7,429
AUG	*Median*	28,908	31,617	31,476	37,956	34,384	41,484	40,200
	IQR	5,613	4,546	4,395	6,196	5,052	8,293	6,981
SEP	*Median*	18,864	20,529	20,660	24,563	22,435	26,672	25,660
	IQR	1,488	2,385	2,385	3,304	3,009	5,315	4,071
OCT	*Median*	6,842	7,909	8,134	9,821	8,667	10,666	9,601
	IQR	4,077	4,183	3,849	4,307	3,889	4,650	4,668
NOV	*Median*	2,177	2,477	3,075	4,095	3,077	4,105	3,300
	IQR	131	533	765	1,101	803	1,108	474
DEC	*Median*	2,213	2,374	2,960	3,952	2,960	3,952	3,258
	IQR	132	0	560	869	560	869	86
ANNUAL	*Median*	149,700	158,562	164,385	202,296	176,260	217,762	207,038
	IQR	5,190	11,159	10,221	26,078	20,572	38,924	26,723

Parameter: **Total surface water extraction (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**2**	29	31	35	37	39	41
JAN	*Median*	2,213	2,374	2,960	3,952	2,960	4,005	3,258
	IQR	132	0	559	869	559	905	86
FEB	*Median*	2,035	2,152	2,710	3,612	2,710	3,660	2,968
	IQR	118	57	532	838	532	871	71
MAR	*Median*	3,253	3,397	3,941	5,142	4,103	5,359	4,801
	IQR	99	63	638	1,156	807	1,364	681
APR	*Median*	4,684	6,759	7,266	9,046	7,518	9,305	8,751
	IQR	3,870	4,614	4,545	5,171	4,671	5,016	5,409
MAY	*Median*	14,251	18,472	19,271	23,061	19,748	24,161	22,835
	IQR	4,489	3,988	4,029	6,978	4,994	8,070	7,189
JUN	*Median*	24,925	24,178	24,377	31,064	27,079	33,506	32,136
	IQR	3,515	4,219	3,943	6,470	4,432	7,890	7,169
JUL	*Median*	33,210	32,289	32,123	38,656	34,568	43,090	40,950
	IQR	3,938	2,283	2,123	4,144	3,314	7,671	5,687
AUG	*Median*	31,570	29,510	29,480	35,299	31,810	39,849	37,578
	IQR	3,505	4,069	3,967	7,902	6,002	11,021	9,443
SEP	*Median*	17,457	18,845	19,021	23,347	21,189	25,489	24,174
	IQR	3,784	2,880	2,813	3,031	2,832	5,433	3,570
OCT	*Median*	5,055	8,924	9,284	10,800	9,685	11,438	10,772
	IQR	1,559	2,900	2,875	3,612	3,239	4,530	3,627
NOV	*Median*	2,142	2,368	3,118	4,113	3,119	4,179	3,243
	IQR	204	468	742	990	777	1,008	560
DEC	*Median*	2,213	2,374	2,960	3,952	2,960	4,005	3,258
	IQR	132	0	559	869	559	905	88
ANNUAL	*Median*	142,162	149,173	154,483	193,858	166,997	210,634	197,585
	IQR	12,936	5,289	8,884	30,149	20,498	45,770	30,140

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.25	1.34	1.00	1.66	0.82
	IQR	0.00	-	1.55	1.00	-	0.10
FEB	*Median*	1.06	1.26	1.33	1.00	1.68	0.82
	IQR	0.50	9.21	1.57	1.00	14.50	0.09
MAR	*Median*	1.04	1.18	1.30	1.05	1.59	0.91
	IQR	0.39	10.23	1.72	1.24	20.15	0.58
APR	*Median*	1.44	1.07	1.24	1.03	1.38	0.94
	IQR	1.19	0.99	1.14	1.03	1.09	1.08
MAY	*Median*	1.09	1.01	1.24	1.04	1.30	0.95
	IQR	1.09	0.95	1.27	1.10	1.45	0.88
JUN	*Median*	1.07	1.00	1.22	1.08	1.36	0.95
	IQR	1.23	0.98	1.38	1.09	2.04	0.79
JUL	*Median*	1.03	0.99	1.23	1.09	1.34	0.96
	IQR	1.50	0.91	1.91	1.21	2.43	0.89
AUG	*Median*	1.09	1.00	1.21	1.09	1.31	0.97
	IQR	0.81	0.97	1.41	1.15	1.82	0.84
SEP	*Median*	1.09	1.01	1.19	1.09	1.30	0.96
	IQR	1.60	1.00	1.39	1.26	2.23	0.77
OCT	*Median*	1.16	1.03	1.21	1.07	1.35	0.90
	IQR	1.03	0.92	1.12	1.01	1.11	1.00
NOV	*Median*	1.14	1.24	1.33	1.00	1.66	0.80
	IQR	4.07	1.44	1.44	1.05	2.08	0.43
DEC	*Median*	1.07	1.25	1.34	1.00	1.66	0.82
	IQR	0.00	-	1.55	1.00	-	0.10
ANNUAL	*Median*	1.06	1.04	1.23	1.07	1.37	0.95
	IQR	2.15	0.92	2.55	2.01	3.49	0.69

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.25	1.34	1.00	1.69	0.81
	IQR	0.00	-	1.55	1.00	-	0.10
FEB	*Median*	1.06	1.26	1.33	1.00	1.70	0.81
	IQR	0.48	9.33	1.58	1.00	15.28	0.08
MAR	*Median*	1.04	1.16	1.30	1.04	1.58	0.90
	IQR	0.64	10.13	1.81	1.26	21.65	0.50
APR	*Median*	1.44	1.07	1.24	1.03	1.38	0.94
	IQR	1.19	0.99	1.14	1.03	1.09	1.08
MAY	*Median*	1.30	1.04	1.20	1.02	1.31	0.95
	IQR	0.89	1.01	1.73	1.24	2.02	0.89
JUN	*Median*	0.97	1.01	1.27	1.11	1.39	0.96
	IQR	1.20	0.93	1.64	1.12	1.87	0.91
JUL	*Median*	0.97	0.99	1.20	1.08	1.33	0.95
	IQR	0.58	0.93	1.95	1.56	3.36	0.74
AUG	*Median*	0.93	1.00	1.20	1.08	1.35	0.94
	IQR	1.16	0.97	1.99	1.51	2.71	0.86
SEP	*Median*	1.08	1.01	1.23	1.11	1.35	0.95
	IQR	0.76	0.98	1.08	1.01	1.89	0.66
OCT	*Median*	1.77	1.04	1.16	1.04	1.28	0.94
	IQR	1.86	0.99	1.26	1.13	1.56	0.80
NOV	*Median*	1.11	1.32	1.32	1.00	1.76	0.78
	IQR	2.29	1.59	1.33	1.05	2.15	0.56
DEC	*Median*	1.07	1.25	1.34	1.00	1.69	0.81
	IQR	0.00	-	1.55	1.00	-	0.10
ANNUAL	*Median*	1.05	1.04	1.25	1.08	1.41	0.94
	IQR	0.41	1.68	3.39	2.31	8.65	0.66

Table E.3 *Projected median monthly and median annual surface water extraction from all sources in the Okanagan River drainage area (downstream of Okanagan Lake). The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: OKANAGAN RIVER (DOWNSTREAM OF OKANAGAN LAKE)

Parameter: **Total surface water extraction (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**1**	28	30	34	36	38	40
JAN	*Median*	81	86	105	165	105	165	137
	IQR	5	0	17	50	17	50	14
FEB	*Median*	76	81	99	153	99	153	127
	IQR	4	2	16	48	16	48	12
MAR	*Median*	424	431	447	564	473	591	575
	IQR	5	10	27	111	56	136	110
APR	*Median*	672	786	809	1,036	838	1,060	1,053
	IQR	368	439	446	798	435	811	803
MAY	*Median*	2,437	2,567	2,430	3,759	2,622	3,983	3,850
	IQR	954	1,107	1,014	1,376	1,070	1,607	1,472
JUN	*Median*	4,737	5,193	4,925	6,212	5,213	7,107	6,579
	IQR	342	762	740	1,143	792	1,634	1,276
JUL	*Median*	7,441	7,568	6,970	8,823	7,434	10,150	9,425
	IQR	374	849	633	875	726	2,005	1,117
AUG	*Median*	7,254	7,304	6,768	8,094	7,305	9,557	8,731
	IQR	823	1,296	982	1,154	1,331	1,765	1,486
SEP	*Median*	4,268	4,650	4,169	5,153	4,640	6,081	5,479
	IQR	606	694	708	687	669	1,471	916
OCT	*Median*	847	1,057	1,042	1,198	1,072	1,320	1,236
	IQR	741	766	640	944	814	1,006	1,000
NOV	*Median*	81	84	107	175	107	175	136
	IQR	6	11	21	55	22	55	15
DEC	*Median*	81	86	105	165	105	165	137
	IQR	5	0	17	50	17	50	14
ANNUAL	*Median*	28,925	30,484	28,195	36,432	30,314	41,786	38,387
	IQR	1,133	2,640	2,408	4,634	2,818	8,897	5,879

Parameter: **Total surface water extraction (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	**BASELINE**	**A**	**B**	**C**	**D**	**E**	**F**
	Scenario Number:	**2**	29	31	35	37	39	41
JAN	*Median*	81	86	105	165	105	156	137
	IQR	5	0	17	50	17	49	14
FEB	*Median*	77	81	98	152	100	144	127
	IQR	4	2	16	48	18	47	12
MAR	*Median*	422	428	443	554	469	576	565
	IQR	11	23	22	100	48	135	102
APR	*Median*	670	903	927	1,255	963	1,306	1,281
	IQR	199	276	282	515	302	508	512
MAY	*Median*	1,967	2,624	2,549	3,727	2,665	3,967	3,791
	IQR	613	1,034	949	1,375	1,055	1,630	1,495
JUN	*Median*	4,386	4,923	4,465	5,880	4,852	6,576	6,128
	IQR	835	968	809	1,376	872	1,974	1,459
JUL	*Median*	7,386	7,352	6,806	8,277	7,292	9,724	8,898
	IQR	657	824	1,096	572	946	1,556	963
AUG	*Median*	7,209	6,909	6,187	7,778	6,817	9,017	8,365
	IQR	1,046	689	795	1,068	572	2,374	1,572
SEP	*Median*	4,136	4,301	3,944	4,844	4,347	5,561	5,141
	IQR	832	654	634	761	702	1,025	576
OCT	*Median*	679	1,441	1,370	1,587	1,461	1,829	1,652
	IQR	552	1,125	954	1,190	1,115	1,329	1,221
NOV	*Median*	78	84	108	173	108	165	137
	IQR	5	43	38	49	38	58	34
DEC	*Median*	81	86	105	165	105	156	137
	IQR	5	0	17	50	17	49	14
ANNUAL	*Median*	27,149	28,696	26,777	34,162	28,756	38,906	36,008
	IQR	2,338	1,737	2,335	4,103	1,504	9,113	5,338

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.21	1.57	1.00	1.90	0.83
	IQR	0.00	-	2.94	1.00	-	0.28
FEB	*Median*	1.07	1.22	1.55	1.00	1.89	0.83
	IQR	0.50	8.00	3.00	1.00	24.00	0.25
MAR	*Median*	1.02	1.04	1.26	1.06	1.37	0.97
	IQR	2.00	2.70	4.11	2.07	13.60	0.81
APR	*Median*	1.17	1.03	1.28	1.04	1.35	0.99
	IQR	1.19	1.02	1.79	0.98	1.85	0.99
MAY	*Median*	1.05	0.95	1.55	1.08	1.55	0.97
	IQR	1.16	0.92	1.36	1.06	1.45	0.92
JUN	*Median*	1.10	0.95	1.26	1.06	1.37	0.93
	IQR	2.23	0.97	1.54	1.07	2.14	0.78
JUL	*Median*	1.02	0.92	1.27	1.07	1.34	0.93
	IQR	2.27	0.75	1.38	1.15	2.36	0.56
AUG	*Median*	1.01	0.93	1.20	1.08	1.31	0.91
	IQR	1.57	0.76	1.18	1.36	1.36	0.84
SEP	*Median*	1.09	0.90	1.24	1.11	1.31	0.90
	IQR	1.15	1.02	0.97	0.94	2.12	0.62
OCT	*Median*	1.25	0.99	1.15	1.03	1.25	0.94
	IQR	1.03	0.84	1.48	1.27	1.31	0.99
NOV	*Median*	1.04	1.28	1.64	1.00	2.09	0.77
	IQR	1.83	1.91	2.62	1.05	5.00	0.27
DEC	*Median*	1.07	1.21	1.57	1.00	1.90	0.83
	IQR	0.00	-	2.94	1.00	-	0.28
ANNUAL	*Median*	1.05	0.92	1.29	1.08	1.37	0.92
	IQR	2.33	0.91	1.92	1.17	3.37	0.66

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	**A:BASLINE**	**B:A**	**C:B**	**D:B**	**E:A**	**F:E**
JAN	*Median*	1.07	1.21	1.57	1.00	1.80	0.88
	IQR	0.00	-	2.94	1.00	-	0.29
FEB	*Median*	1.06	1.22	1.55	1.02	1.78	0.88
	IQR	0.50	8.00	3.00	1.13	23.50	0.26
MAR	*Median*	1.02	1.04	1.25	1.06	1.35	0.98
	IQR	2.09	0.96	4.55	2.18	5.87	0.76
APR	*Median*	1.35	1.03	1.35	1.04	1.45	0.98
	IQR	1.39	1.02	1.83	1.07	1.84	1.01
MAY	*Median*	1.33	0.97	1.46	1.05	1.51	0.96
	IQR	1.69	0.92	1.45	1.11	1.58	0.92
JUN	*Median*	1.12	0.91	1.32	1.09	1.34	0.93
	IQR	1.16	0.84	1.70	1.08	2.04	0.74
JUL	*Median*	1.00	0.93	1.22	1.07	1.32	0.92
	IQR	1.25	1.33	0.52	0.86	1.89	0.62
AUG	*Median*	0.96	0.90	1.26	1.10	1.31	0.93
	IQR	0.66	1.15	1.34	0.72	3.45	0.66
SEP	*Median*	1.04	0.92	1.23	1.10	1.29	0.92
	IQR	0.79	0.97	1.20	1.11	1.57	0.56
OCT	*Median*	2.12	0.95	1.16	1.07	1.27	0.90
	IQR	2.04	0.85	1.25	1.17	1.18	0.92
NOV	*Median*	1.07	1.29	1.60	1.00	1.96	0.83
	IQR	8.60	0.88	1.29	1.00	1.35	0.59
DEC	*Median*	1.07	1.21	1.57	1.00	1.80	0.88
	IQR	0.00	-	2.94	1.00	-	0.29
ANNUAL	*Median*	1.06	0.93	1.28	1.07	1.36	0.93
	IQR	0.74	1.34	1.76	0.64	5.25	0.59

Table E.4 *Projected median monthly and median annual surface water extraction from all sources in the Mission Creek drainage area. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: MISSION CREEK

Parameter: **Total surface water extraction (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	142	153	198	245	198	245	203
	IQR	8	0	42	59	42	59	10
FEB	*Median*	134	142	185	228	185	228	189
	IQR	7	4	41	58	41	58	8
MAR	*Median*	389	401	448	512	479	544	513
	IQR	15	8	50	75	71	98	59
APR	*Median*	627	849	902	988	945	1,032	995
	IQR	502	604	593	612	578	597	613
MAY	*Median*	2,272	2,519	2,513	2,823	2,572	2,918	2,816
	IQR	1,095	978	929	925	974	1,020	988
JUN	*Median*	4,246	4,652	4,504	4,887	4,779	5,493	5,219
	IQR	495	700	674	664	717	920	819
JUL	*Median*	6,070	6,333	6,070	6,621	6,692	7,364	7,161
	IQR	426	758	548	774	833	1,266	1,092
AUG	*Median*	5,566	5,949	5,721	6,162	6,349	7,087	6,790
	IQR	1,194	1,060	958	1,104	1,181	1,485	1,312
SEP	*Median*	3,661	3,950	3,771	4,063	4,169	4,597	4,405
	IQR	409	501	463	508	591	733	710
OCT	*Median*	1,089	1,391	1,375	1,450	1,439	1,597	1,481
	IQR	1,122	1,037	1,012	1,014	1,025	1,122	1,084
NOV	*Median*	142	148	210	263	210	263	199
	IQR	8	76	83	102	85	107	69
DEC	*Median*	142	153	198	245	198	245	203
	IQR	8	0	42	59	42	59	10
ANNUAL	*Median*	24,876	26,464	25,774	28,444	28,279	32,047	30,188
	IQR	1,331	2,476	2,660	2,052	2,038	4,486	3,324

Parameter: **Total surface water extraction (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	142	153	198	245	198	228	203
	IQR	8	0	42	59	42	57	10
FEB	*Median*	134	142	185	227	185	212	188
	IQR	8	4	40	57	40	54	8
MAR	*Median*	387	402	441	503	471	518	506
	IQR	6	15	48	83	79	111	69
APR	*Median*	658	927	965	1,029	993	1,034	1,040
	IQR	249	299	317	360	345	368	367
MAY	*Median*	1,944	2,469	2,467	2,734	2,496	2,818	2,726
	IQR	775	978	906	965	968	1,022	1,083
JUN	*Median*	4,304	4,271	4,057	4,623	4,414	5,104	4,889
	IQR	636	676	654	812	740	1,171	909
JUL	*Median*	6,171	6,038	5,841	6,267	6,261	7,070	6,732
	IQR	1,000	582	631	632	678	884	828
AUG	*Median*	6,007	5,652	5,366	5,873	5,913	6,515	6,241
	IQR	641	816	621	947	1,059	1,707	1,246
SEP	*Median*	3,315	3,681	3,454	3,781	3,899	4,300	4,100
	IQR	725	541	568	528	463	525	555
OCT	*Median*	613	1,413	1,381	1,475	1,499	1,665	1,522
	IQR	471	758	699	755	810	788	827
NOV	*Median*	138	148	206	257	206	240	199
	IQR	10	50	92	112	94	129	52
DEC	*Median*	142	153	198	245	198	228	203
	IQR	8	0	42	59	42	57	10
ANNUAL	*Median*	23,445	24,843	24,471	26,691	26,215	29,792	28,312
	IQR	2,555	1,286	1,283	2,135	2,397	4,693	3,043

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.30	1.24	1.00	1.61	0.83
	IQR	0.00	-	1.40	1.00	-	0.17
FEB	*Median*	1.06	1.30	1.23	1.00	1.60	0.83
	IQR	0.57	10.25	1.41	1.00	14.50	0.14
MAR	*Median*	1.03	1.12	1.14	1.07	1.36	0.94
	IQR	0.53	6.25	1.50	1.42	12.25	0.60
APR	*Median*	1.35	1.06	1.10	1.05	1.22	0.96
	IQR	1.20	0.98	1.03	0.97	0.99	1.03
MAY	*Median*	1.11	1.00	1.12	1.02	1.16	0.96
	IQR	0.89	0.95	1.00	1.05	1.04	0.97
JUN	*Median*	1.10	0.97	1.08	1.06	1.18	0.95
	IQR	1.41	0.96	0.99	1.06	1.31	0.89
JUL	*Median*	1.04	0.96	1.09	1.10	1.16	0.97
	IQR	1.78	0.72	1.41	1.52	1.67	0.86
AUG	*Median*	1.07	0.96	1.08	1.11	1.19	0.96
	IQR	0.89	0.90	1.15	1.23	1.40	0.88
SEP	*Median*	1.08	0.95	1.08	1.11	1.16	0.96
	IQR	1.22	0.92	1.10	1.28	1.46	0.97
OCT	*Median*	1.28	0.99	1.05	1.05	1.15	0.93
	IQR	0.92	0.98	1.00	1.01	1.08	0.97
NOV	*Median*	1.04	1.42	1.25	1.00	1.78	0.76
	IQR	9.50	1.09	1.23	1.02	1.41	0.64
DEC	*Median*	1.07	1.30	1.24	1.00	1.61	0.83
	IQR	0.00	-	1.43	1.00	-	0.16
ANNUAL	*Median*	1.06	0.97	1.10	1.10	1.21	0.94
	IQR	1.86	1.07	0.77	0.77	1.81	0.74

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.30	1.24	1.00	1.49	0.89
	IQR	0.00	-	1.40	1.00	-	0.18
FEB	*Median*	1.06	1.30	1.23	1.00	1.49	0.89
	IQR	0.50	10.00	1.43	1.00	13.50	0.15
MAR	*Median*	1.04	1.10	1.14	1.07	1.29	0.98
	IQR	2.50	3.20	1.73	1.65	7.40	0.62
APR	*Median*	1.41	1.04	1.07	1.03	1.12	1.01
	IQR	1.20	1.06	1.14	1.09	1.23	1.00
MAY	*Median*	1.27	1.00	1.11	1.01	1.14	0.97
	IQR	1.26	0.93	1.07	1.07	1.04	1.06
JUN	*Median*	0.99	0.95	1.14	1.09	1.20	0.96
	IQR	1.06	0.97	1.24	1.13	1.73	0.78
JUL	*Median*	0.98	0.97	1.07	1.07	1.17	0.95
	IQR	0.58	1.08	1.00	1.07	1.52	0.94
AUG	*Median*	0.94	0.95	1.09	1.10	1.15	0.96
	IQR	1.27	0.76	1.52	1.71	2.09	0.73
SEP	*Median*	1.11	0.94	1.09	1.13	1.17	0.95
	IQR	0.75	1.05	0.93	0.82	0.97	1.06
OCT	*Median*	2.30	0.98	1.07	1.09	1.18	0.91
	IQR	1.61	0.92	1.08	1.16	1.04	1.05
NOV	*Median*	1.07	1.39	1.25	1.00	1.62	0.83
	IQR	5.00	1.84	1.22	1.02	2.58	0.40
DEC	*Median*	1.07	1.30	1.24	1.00	1.49	0.89
	IQR	0.00	-	1.43	1.00	-	0.17
ANNUAL	*Median*	1.06	0.99	1.09	1.07	1.20	0.95
	IQR	0.50	1.00	1.66	1.87	3.65	0.65

Table E.5 *Projected median monthly and median annual surface water extraction from all sources in the <u>Trout Creek</u> drainage area. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: TROUT CREEK

Parameter: **Total surface water extraction (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	110	118	135	190	135	190	158
	IQR	7	0	16	30	16	30	5
FEB	*Median*	102	108	124	175	124	175	145
	IQR	6	3	15	28	15	28	4
MAR	*Median*	203	212	223	287	239	301	276
	IQR	10	10	25	45	39	56	35
APR	*Median*	301	496	502	564	509	584	563
	IQR	293	302	313	377	328	380	372
MAY	*Median*	1,184	1,251	1,250	1,464	1,272	1,529	1,461
	IQR	276	292	274	373	346	466	419
JUN	*Median*	1,789	1,901	1,833	2,119	2,034	2,324	2,256
	IQR	191	170	162	197	265	466	380
JUL	*Median*	2,484	2,474	2,435	2,747	2,739	3,213	3,058
	IQR	158	267	241	267	306	501	362
AUG	*Median*	2,308	2,409	2,342	2,574	2,632	3,043	2,893
	IQR	308	313	355	310	395	570	482
SEP	*Median*	1,574	1,595	1,546	1,775	1,830	2,050	1,959
	IQR	103	112	126	146	204	378	276
OCT	*Median*	602	770	760	847	826	960	893
	IQR	182	246	247	261	224	276	270
NOV	*Median*	110	118	142	204	142	204	158
	IQR	6	73	78	98	93	118	83
DEC	*Median*	110	118	135	190	135	190	158
	IQR	7	0	17	32	17	32	5
ANNUAL	*Median*	10,890	11,622	11,534	13,430	12,833	14,693	14,145
	IQR	610	995	1,111	1,429	1,513	2,747	1,921

Parameter: **Total surface water extraction (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	110	118	135	190	135	209	158
	IQR	7	0	16	30	16	27	5
FEB	*Median*	102	108	124	175	124	191	145
	IQR	6	3	14	28	14	25	4
MAR	*Median*	205	213	228	289	243	326	283
	IQR	8	4	20	40	34	50	26
APR	*Median*	380	539	555	665	578	692	665
	IQR	77	184	165	174	153	164	177
MAY	*Median*	947	1,218	1,214	1,461	1,259	1,553	1,463
	IQR	243	329	316	331	352	370	372
JUN	*Median*	1,758	1,740	1,703	1,944	1,843	2,122	2,052
	IQR	235	321	323	312	338	463	393
JUL	*Median*	2,271	2,362	2,291	2,552	2,551	2,941	2,803
	IQR	304	184	215	237	303	525	409
AUG	*Median*	2,308	2,213	2,139	2,404	2,434	2,807	2,645
	IQR	248	314	259	385	502	696	570
SEP	*Median*	1,536	1,495	1,460	1,652	1,665	1,888	1,797
	IQR	288	232	205	214	193	328	233
OCT	*Median*	422	770	761	843	852	998	899
	IQR	179	153	151	170	201	256	208
NOV	*Median*	107	127	148	211	149	225	166
	IQR	11	65	67	66	74	77	69
DEC	*Median*	110	118	135	190	135	209	158
	IQR	7	0	16	30	16	28	5
ANNUAL	*Median*	10,378	10,795	10,713	12,449	11,873	14,064	13,095
	IQR	989	573	574	1,280	1,450	2,308	1,768

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.08	1.14	1.41	1.00	1.61	0.83
	IQR	0.00	-	1.88	1.00	-	0.17
FEB	*Median*	1.06	1.15	1.41	1.00	1.62	0.83
	IQR	0.50	5.00	1.87	1.00	9.33	0.14
MAR	*Median*	1.04	1.05	1.29	1.07	1.42	0.92
	IQR	1.00	2.50	1.80	1.56	5.60	0.63
APR	*Median*	1.65	1.01	1.12	1.01	1.18	0.96
	IQR	1.03	1.04	1.20	1.05	1.26	0.98
MAY	*Median*	1.06	1.00	1.17	1.02	1.22	0.96
	IQR	1.06	0.94	1.36	1.26	1.60	0.90
JUN	*Median*	1.06	0.96	1.16	1.11	1.22	0.97
	IQR	0.89	0.95	1.22	1.64	2.74	0.82
JUL	*Median*	1.00	0.98	1.13	1.12	1.30	0.95
	IQR	1.69	0.90	1.11	1.27	1.88	0.72
AUG	*Median*	1.04	0.97	1.10	1.12	1.26	0.95
	IQR	1.02	1.13	0.87	1.11	1.82	0.85
SEP	*Median*	1.01	0.97	1.15	1.18	1.29	0.96
	IQR	1.09	1.13	1.16	1.62	3.38	0.73
OCT	*Median*	1.28	0.99	1.11	1.09	1.25	0.93
	IQR	1.35	1.00	1.06	0.91	1.12	0.98
NOV	*Median*	1.07	1.20	1.44	1.00	1.73	0.77
	IQR	12.17	1.07	1.26	1.19	1.62	0.70
DEC	*Median*	1.07	1.14	1.41	1.00	1.61	0.83
	IQR	0.00	-	1.87	1.00	-	0.16
ANNUAL	*Median*	1.07	0.99	1.16	1.11	1.26	0.96
	IQR	1.63	1.12	1.29	1.36	2.76	0.70

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.14	1.41	1.00	1.77	0.75
	IQR	0.00	-	1.88	1.00	-	0.19
FEB	*Median*	1.06	1.15	1.41	1.00	1.77	0.76
	IQR	0.50	4.67	2.00	1.00	8.33	0.16
MAR	*Median*	1.04	1.07	1.27	1.07	1.53	0.87
	IQR	0.50	5.00	2.00	1.70	12.50	0.52
APR	*Median*	1.42	1.03	1.20	1.04	1.28	0.96
	IQR	2.39	0.90	1.05	0.93	0.89	1.08
MAY	*Median*	1.29	1.00	1.20	1.04	1.27	0.94
	IQR	1.35	0.96	1.05	1.11	1.12	1.01
JUN	*Median*	0.99	0.98	1.14	1.08	1.22	0.97
	IQR	1.37	1.01	0.97	1.05	1.44	0.85
JUL	*Median*	1.04	0.97	1.11	1.11	1.25	0.95
	IQR	0.61	1.17	1.10	1.41	2.85	0.78
AUG	*Median*	0.96	0.97	1.12	1.14	1.27	0.94
	IQR	1.27	0.82	1.49	1.94	2.22	0.82
SEP	*Median*	0.97	0.98	1.13	1.14	1.26	0.95
	IQR	0.81	0.88	1.04	0.94	1.41	0.71
OCT	*Median*	1.82	0.99	1.11	1.12	1.30	0.90
	IQR	0.85	0.99	1.13	1.33	1.67	0.81
NOV	*Median*	1.19	1.16	1.43	1.01	1.77	0.74
	IQR	5.91	1.03	0.99	1.10	1.18	0.90
DEC	*Median*	1.07	1.14	1.41	1.00	1.77	0.76
	IQR	0.00	-	1.86	1.01	-	0.19
ANNUAL	*Median*	1.04	0.99	1.16	1.11	1.30	0.93
	IQR	0.58	1.00	2.23	2.53	4.03	0.77

Table E.6 *Projected median monthly and median annual surface water extraction from all sources in the Vaseux Creek drainage area. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

Drainage Area: VASEUX CREEK

Parameter: **Total surface water extraction (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	1	28	30	34	36	38	40
JAN	*Median*	0.4	0.5	0.5	0.6	0.5	0.6	0.5
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEB	*Median*	0.4	0.4	0.4	0.6	0.4	0.6	0.5
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAR	*Median*	1.2	1.3	1.3	1.4	1.3	1.4	1.4
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APR	*Median*	2.0	3.3	3.3	3.7	3.3	3.7	3.5
	IQR	4.0	5.0	4.0	5.0	4.0	5.0	5.0
MAY	*Median*	13.0	13.1	12.7	13.8	12.7	14.4	13.7
	IQR	2.0	5.0	4.0	4.0	4.0	5.0	4.0
JUN	*Median*	18.3	18.3	17.2	18.7	17.2	19.7	18.5
	IQR	2.0	3.0	2.0	2.0	2.0	3.0	2.0
JUL	*Median*	22.8	23.4	21.8	23.5	21.8	24.4	23.5
	IQR	1.0	2.0	3.0	2.0	3.0	3.0	2.0
AUG	*Median*	18.4	18.4	17.7	18.9	17.7	19.4	18.8
	IQR	4.0	5.0	5.0	5.0	5.0	5.0	5.0
SEP	*Median*	9.8	10.1	10.0	10.7	10.0	10.9	10.5
	IQR	2.0	2.0	2.0	2.0	2.0	2.0	2.0
OCT	*Median*	1.1	2.5	2.5	2.7	2.5	2.8	2.6
	IQR	3.0	2.0	2.0	3.0	2.0	3.0	3.0
NOV	*Median*	0.4	0.4	0.5	0.6	0.5	0.6	0.5
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEC	*Median*	0.4	0.5	0.5	0.6	0.5	0.6	0.5
	IQR	0.0	0.0	0.0	0.1	0.0	0.1	0.0
ANNUAL	*Median*	89.0	93.0	90.0	96.0	90.0	102.0	95.0
	IQR	2.0	6.0	7.0	9.0	7.0	13.0	7.0

Parameter: **Total surface water extraction (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	2	29	31	35	37	39	41
JAN	*Median*	0.4	0.5	0.5	0.6	0.5	0.6	0.5
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEB	*Median*	0.4	0.4	0.4	0.6	0.4	0.5	0.5
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAR	*Median*	1.2	1.3	1.3	1.4	1.3	1.4	1.3
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APR	*Median*	1.8	3.2	3.2	4.4	3.2	4.4	4.2
	IQR	2.0	3.0	3.0	3.0	3.0	3.0	3.0
MAY	*Median*	10.4	12.5	12.4	13.2	12.4	13.6	13.0
	IQR	6.0	4.0	3.0	4.0	3.0	5.0	4.0
JUN	*Median*	16.0	16.8	15.6	17.6	15.6	18.8	17.4
	IQR	4.0	3.0	3.0	4.0	3.0	5.0	3.0
JUL	*Median*	22.6	22.0	21.5	22.3	21.5	23.5	22.1
	IQR	2.0	2.0	4.0	3.0	4.0	2.0	3.0
AUG	*Median*	18.4	17.7	16.7	17.8	16.7	18.7	17.6
	IQR	2.0	3.0	2.0	3.0	2.0	3.0	3.0
SEP	*Median*	9.2	9.5	9.4	10.2	9.4	10.4	10.1
	IQR	3.0	2.0	2.0	2.0	2.0	2.0	2.0
OCT	*Median*	1.6	2.5	2.4	2.8	2.4	2.8	2.7
	IQR	1.0	3.0	3.0	3.0	3.0	3.0	3.0
NOV	*Median*	0.4	0.4	0.5	0.6	0.5	0.6	0.5
	IQR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEC	*Median*	0.4	0.5	0.5	0.6	0.5	0.6	0.5
	IQR	0.0	0.0	0.0	0.1	0.0	0.1	0.0
ANNUAL	*Median*	84.0	86.0	84.0	90.0	84.0	94.0	89.0
	IQR	10.0	6.0	8.0	9.0	8.0	12.0	8.0

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.07	1.24	1.00	1.33	0.86
	IQR	-	-	-	-	-	-
FEB	*Median*	1.06	1.08	1.24	1.00	1.34	0.86
	IQR	-	-	-	-	-	-
MAR	*Median*	1.03	1.02	1.10	1.00	1.12	0.95
	IQR	-	-	-	-	-	-
APR	*Median*	1.61	1.00	1.12	1.00	1.12	0.96
	IQR	1.25	0.80	1.25	1.00	1.00	1.00
MAY	*Median*	1.01	0.97	1.08	1.00	1.10	0.95
	IQR	2.50	0.80	1.00	1.00	1.00	0.80
JUN	*Median*	1.00	0.94	1.09	1.00	1.07	0.94
	IQR	1.50	0.67	1.00	1.00	1.00	0.67
JUL	*Median*	1.03	0.93	1.08	1.00	1.04	0.96
	IQR	2.00	1.50	0.67	1.00	1.50	0.67
AUG	*Median*	1.00	0.97	1.06	1.00	1.06	0.97
	IQR	1.25	1.00	1.00	1.00	1.00	1.00
SEP	*Median*	1.04	0.99	1.06	1.00	1.07	0.96
	IQR	1.00	1.00	1.00	1.00	1.00	1.00
OCT	*Median*	2.23	0.99	1.10	1.00	1.10	0.94
	IQR	0.67	1.00	1.50	1.00	1.50	1.00
NOV	*Median*	1.07	1.08	1.25	1.00	1.35	0.85
	IQR	-	-	-	-	-	-
DEC	*Median*	1.07	1.07	1.24	1.00	1.33	0.86
	IQR	-	-	3.56	1.00	-	0.27
ANNUAL	*Median*	1.04	0.97	1.07	1.00	1.10	0.93
	IQR	3.00	1.17	1.29	1.00	2.17	0.54

Parameter: **Ratio of total surface water extraction between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.07	1.07	1.24	1.00	1.28	0.89
	IQR	-	-	-	-	-	-
FEB	*Median*	1.06	1.08	1.24	1.00	1.29	0.89
	IQR	-	-	-	-	-	-
MAR	*Median*	1.03	1.02	1.09	1.00	1.09	0.97
	IQR	-	-	-	-	-	-
APR	*Median*	1.78	1.02	1.34	1.00	1.37	0.96
	IQR	1.50	1.00	1.00	1.00	1.00	1.00
MAY	*Median*	1.20	0.99	1.07	1.00	1.10	0.95
	IQR	0.67	0.75	1.33	1.00	1.25	0.80
JUN	*Median*	1.05	0.93	1.13	1.00	1.12	0.93
	IQR	0.75	1.00	1.33	1.00	1.67	0.60
JUL	*Median*	0.97	0.98	1.03	1.00	1.07	0.94
	IQR	1.00	2.00	0.75	1.00	1.00	1.50
AUG	*Median*	0.96	0.94	1.06	1.00	1.06	0.94
	IQR	1.50	0.67	1.50	1.00	1.00	1.00
SEP	*Median*	1.04	0.98	1.09	1.00	1.09	0.97
	IQR	0.67	1.00	1.00	1.00	1.00	1.00
OCT	*Median*	1.55	0.99	1.15	1.00	1.14	0.97
	IQR	3.00	1.00	1.00	1.00	1.00	1.00
NOV	*Median*	1.07	1.09	1.27	1.00	1.34	0.85
	IQR	-	-	-	-	-	-
DEC	*Median*	1.07	1.07	1.24	1.00	1.28	0.89
	IQR	-	-	3.56	1.00	-	0.27
ANNUAL	*Median*	1.02	0.98	1.07	1.00	1.09	0.95
	IQR	0.60	1.33	1.13	1.00	2.00	0.67

APPENDIX F: SELECTED SUMMARIES OF PROJECTED NET RUNOFF

Table F.1 *Projected median monthly and median annual net inflow to Kalamalka-Wood Lake. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

KALAMALKA-WOOD LAKE

Parameter: **Net Inflow (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	65	28	30	34	36	38	40
JAN	*Median*	2,129	3,690	3,591	3,392	3,596	3,396	3,560
	IQR	2,027	5,002	5,014	5,023	5,015	5,022	5,002
FEB	*Median*	1,669	2,725	2,638	2,458	2,639	2,456	2,609
	IQR	2,296	2,714	2,748	2,727	2,748	2,727	2,712
MAR	*Median*	1,859	6,507	6,442	6,246	6,423	6,228	6,304
	IQR	5,085	5,245	5,248	5,252	5,249	5,253	5,249
APR	*Median*	5,984	7,337	7,237	7,010	7,197	6,963	7,083
	IQR	5,638	10,030	9,933	9,935	9,927	9,972	10,031
MAY	*Median*	7,533	5,219	5,192	4,982	5,179	4,971	5,020
	IQR	7,653	6,133	6,112	6,115	6,151	6,251	6,272
JUN	*Median*	1,355	-256	-290	-859	-572	-1,192	-1,040
	IQR	4,414	3,185	3,167	2,921	2,930	2,678	2,860
JUL	*Median*	-1,800	-2,485	-2,534	-3,205	-2,940	-3,512	-3,298
	IQR	1,650	1,216	1,190	1,552	1,401	1,597	1,565
AUG	*Median*	-1,326	-2,223	-2,257	-2,766	-2,476	-3,156	-2,956
	IQR	1,561	1,681	1,690	1,928	1,812	1,956	1,935
SEP	*Median*	-386	-1,299	-1,306	-1,503	-1,353	-1,798	-1,600
	IQR	735	986	982	919	919	921	957
OCT	*Median*	876	602	597	439	571	350	481
	IQR	783	1,463	1,524	1,605	1,586	1,701	1,572
NOV	*Median*	1,980	4,242	4,182	4,009	4,181	4,012	4,112
	IQR	2,226	6,950	6,961	6,967	6,962	6,969	6,946
DEC	*Median*	1,936	2,397	2,349	2,187	2,350	2,186	2,264
	IQR	1,328	4,008	3,987	4,015	3,987	4,015	4,009
ANNUAL	*Median*	32,968	36,911	35,995	31,743	34,527	30,155	32,096
	IQR	25,396	38,317	39,412	42,133	41,071	43,734	41,400

Parameter: **Net Inflow (ML)**
Climate Model **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	66	29	31	35	37	39	41
JAN	*Median*	1,740	2,338	2,301	2,141	2,301	2,104	2,200
	IQR	1,073	1,966	1,923	1,902	1,924	1,893	1,970
FEB	*Median*	1,443	3,115	3,072	2,919	3,072	2,882	2,992
	IQR	1,026	4,213	4,173	4,146	4,172	4,138	4,217
MAR	*Median*	2,007	5,150	5,030	4,798	4,999	4,766	4,921
	IQR	2,820	5,842	5,927	5,994	5,950	5,980	5,898
APR	*Median*	5,422	10,118	10,060	9,917	10,053	9,881	9,917
	IQR	5,753	11,016	11,026	11,048	11,031	11,054	11,035
MAY	*Median*	10,104	10,281	10,232	9,823	10,070	9,612	9,766
	IQR	9,175	10,397	10,323	9,913	9,919	10,063	9,917
JUN	*Median*	3,240	3,874	3,856	3,317	3,578	2,938	3,164
	IQR	7,932	6,963	6,971	7,045	7,002	7,178	7,072
JUL	*Median*	-1,032	-1,603	-1,678	-2,187	-1,940	-2,404	-2,290
	IQR	1,093	1,382	1,391	1,297	1,329	1,320	1,304
AUG	*Median*	-1,120	-1,915	-1,926	-2,368	-2,060	-2,571	-2,466
	IQR	1,509	1,289	1,277	1,319	1,335	1,502	1,428
SEP	*Median*	-222	-32	-97	-546	-325	-833	-611
	IQR	2,073	1,979	2,020	2,146	2,108	2,200	2,198
OCT	*Median*	773	1,129	1,018	763	901	667	827
	IQR	1,504	1,955	1,948	1,924	1,937	1,904	2,035
NOV	*Median*	2,553	2,397	2,353	2,190	2,353	2,151	2,270
	IQR	2,440	5,496	5,506	5,508	5,503	5,510	5,498
DEC	*Median*	1,633	2,405	2,313	2,098	2,313	2,098	2,273
	IQR	1,714	2,966	2,993	2,973	2,993	2,966	2,964
ANNUAL	*Median*	33,862	55,587	54,585	49,875	52,634	47,823	50,176
	IQR	21,396	20,800	20,486	20,442	20,291	20,722	20,379

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.73	0.97	0.94	1.00	0.92	1.05
	IQR	2.47	1.00	1.00	1.00	1.00	1.00
FEB	*Median*	1.63	0.97	0.93	1.00	0.90	1.06
	IQR	1.18	1.01	0.99	1.00	1.00	0.99
MAR	*Median*	3.50	0.99	0.97	1.00	0.96	1.01
	IQR	1.03	1.00	1.00	1.00	1.00	1.00
APR	*Median*	1.23	0.99	0.97	0.99	0.95	1.02
	IQR	1.78	0.99	1.00	1.00	0.99	1.01
MAY	*Median*	0.69	0.99	0.96	1.00	0.95	1.01
	IQR	0.80	1.00	1.00	1.01	1.02	1.00
JUN	*Median*	-0.19	1.13	2.97	1.98	4.65	0.87
	IQR	0.72	0.99	0.92	0.93	0.84	1.07
JUL	*Median*	1.38	1.02	1.26	1.16	1.41	0.94
	IQR	0.74	0.98	1.30	1.18	1.31	0.98
AUG	*Median*	1.68	1.02	1.23	1.10	1.42	0.94
	IQR	1.08	1.01	1.14	1.07	1.16	0.99
SEP	*Median*	3.37	1.01	1.15	1.04	1.38	0.89
	IQR	1.34	1.00	0.94	0.94	0.93	1.04
OCT	*Median*	0.69	0.99	0.74	0.96	0.58	1.37
	IQR	1.87	1.04	1.05	1.04	1.16	0.92
NOV	*Median*	2.14	0.99	0.96	1.00	0.95	1.02
	IQR	3.12	1.00	1.00	1.00	1.00	1.00
DEC	*Median*	1.24	0.98	0.93	1.00	0.91	1.04
	IQR	3.02	0.99	1.01	1.00	1.00	1.00
ANNUAL	*Median*	1.12	0.98	0.88	0.96	0.82	1.06
	IQR	1.51	1.03	1.07	1.04	1.14	0.95

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.34	0.98	0.93	1.00	0.90	1.05
	IQR	1.83	0.98	0.99	1.00	0.96	1.04
FEB	*Median*	2.16	0.99	0.95	1.00	0.93	1.04
	IQR	4.11	0.99	0.99	1.00	0.98	1.02
MAR	*Median*	2.57	0.98	0.95	0.99	0.93	1.03
	IQR	2.07	1.01	1.01	1.00	1.02	0.99
APR	*Median*	1.87	0.99	0.99	1.00	0.98	1.00
	IQR	1.91	1.00	1.00	1.00	1.00	1.00
MAY	*Median*	1.02	1.00	0.96	0.98	0.93	1.02
	IQR	1.13	0.99	0.96	0.96	0.97	0.99
JUN	*Median*	1.20	1.00	0.86	0.93	0.76	1.08
	IQR	0.88	1.00	1.01	1.00	1.03	0.99
JUL	*Median*	1.55	1.05	1.30	1.16	1.50	0.95
	IQR	1.26	1.01	0.93	0.96	0.96	0.99
AUG	*Median*	1.71	1.01	1.23	1.07	1.34	0.96
	IQR	0.85	0.99	1.03	1.05	1.16	0.95
SEP	*Median*	0.15	2.98	5.65	3.36	25.67	0.73
	IQR	0.95	1.02	1.06	1.04	1.11	1.00
OCT	*Median*	1.46	0.90	0.75	0.89	0.59	1.24
	IQR	1.30	1.00	0.99	0.99	0.97	1.07
NOV	*Median*	0.94	0.98	0.93	1.00	0.90	1.06
	IQR	2.25	1.00	1.00	1.00	1.00	1.00
DEC	*Median*	1.47	0.96	0.91	1.00	0.87	1.08
	IQR	1.73	1.01	0.99	1.00	1.00	1.00
ANNUAL	*Median*	1.64	0.98	0.91	0.96	0.86	1.05
	IQR	0.97	0.98	1.00	0.99	1.00	0.98

Table F.2 *Projected median monthly and median annual net inflow to Okanagan Lake. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

OKANAGAN LAKE

Parameter: **Net Inflow (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	65	28	30	34	36	38	40
JAN	*Median*	27,133	41,195	40,684	39,418	40,416	38,451	39,452
	IQR	18,056	66,019	66,169	66,574	66,225	66,682	66,435
FEB	*Median*	23,161	38,730	38,414	37,910	38,458	37,515	38,128
	IQR	25,553	26,807	27,335	27,778	26,889	27,882	26,862
MAR	*Median*	28,678	54,331	54,204	53,691	54,108	53,643	53,652
	IQR	37,851	47,485	47,883	48,985	48,046	48,923	48,381
APR	*Median*	63,634	86,041	85,792	83,188	85,687	81,139	82,233
	IQR	55,172	99,399	99,479	101,021	99,728	100,836	100,858
MAY	*Median*	95,933	95,114	95,266	91,220	94,433	90,503	90,905
	IQR	95,169	63,265	63,415	64,218	63,508	64,659	64,725
JUN	*Median*	49,974	30,816	30,830	28,759	30,696	25,400	26,913
	IQR	71,339	46,128	45,957	46,511	46,162	45,943	46,280
JUL	*Median*	5,592	-3,180	-3,043	-5,362	-3,536	-6,898	-6,122
	IQR	23,424	17,589	17,733	17,520	17,509	17,291	17,361
AUG	*Median*	-2,670	-4,915	-4,952	-6,908	-5,175	-7,408	-7,184
	IQR	8,445	12,671	12,844	12,109	11,295	12,445	12,328
SEP	*Median*	3,088	-212	-278	-1,530	-458	-1,785	-1,687
	IQR	4,634	5,074	5,034	4,974	4,844	4,652	4,754
OCT	*Median*	11,442	11,217	11,038	10,492	10,887	10,314	10,570
	IQR	7,367	11,249	11,415	10,588	10,436	10,671	10,624
NOV	*Median*	19,115	39,997	39,870	39,452	39,866	39,468	39,583
	IQR	12,503	67,722	68,242	68,537	68,800	68,660	68,302
DEC	*Median*	-2,670	27,747	27,592	27,183	27,576	27,163	27,311
	IQR	8,445	37,453	37,221	36,637	37,217	36,098	36,588
ANNUAL	*Median*	488,670	551,288	549,534	512,711	539,553	498,630	509,147
	IQR	221,783	519,021	520,213	520,024	518,816	514,615	516,131

Parameter: **Net Inflow (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	66	29	31	35	37	39	41
JAN	*Median*	23,901	32,282	31,799	31,031	31,841	30,885	31,731
	IQR	12,092	27,878	27,349	27,176	27,556	27,510	27,272
FEB	*Median*	20,649	48,350	48,095	47,576	48,018	46,814	47,595
	IQR	9,541	42,511	42,508	44,003	42,512	43,983	42,799
MAR	*Median*	26,417	56,641	56,305	55,472	56,182	55,201	55,563
	IQR	36,126	40,921	40,890	41,255	41,312	41,365	41,175
APR	*Median*	62,866	102,114	103,875	97,950	100,907	96,384	97,531
	IQR	70,318	73,393	74,079	72,489	71,910	71,203	71,746
MAY	*Median*	128,015	122,682	122,604	120,300	122,377	119,517	120,081
	IQR	78,159	105,689	105,706	107,308	104,388	108,521	107,470
JUN	*Median*	83,503	81,899	82,128	76,254	80,312	73,617	75,127
	IQR	81,177	97,174	96,970	99,610	99,047	99,203	99,514
JUL	*Median*	11,601	6,694	6,556	4,153	6,125	3,002	3,569
	IQR	23,258	22,737	22,780	20,712	21,858	19,503	20,233
AUG	*Median*	-2,401	-4,188	-4,215	-5,471	-4,392	-5,792	-5,630
	IQR	11,481	5,731	5,741	7,451	6,293	7,471	7,649
SEP	*Median*	3,813	5,151	5,066	3,699	5,003	3,233	3,440
	IQR	10,852	12,513	12,375	11,587	11,728	10,375	11,371
OCT	*Median*	11,177	12,468	12,381	11,415	11,769	11,193	11,319
	IQR	12,794	20,235	20,547	20,005	20,392	19,541	20,016
NOV	*Median*	22,404	27,974	27,667	27,008	27,598	26,827	27,355
	IQR	15,173	49,308	49,436	49,424	49,480	49,463	49,171
DEC	*Median*	23,372	29,973	29,653	29,269	29,647	29,238	29,569
	IQR	14,091	48,578	48,743	48,571	48,344	48,253	48,516
ANNUAL	*Median*	461,575	684,758	682,553	654,153	671,847	648,065	651,527
	IQR	292,085	277,561	278,868	295,361	285,957	299,338	296,400

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.52	0.99	0.97	0.99	0.93	1.03
	IQR	3.66	1.00	1.01	1.00	1.01	1.00
FEB	*Median*	1.67	0.99	0.99	1.00	0.97	1.02
	IQR	1.05	1.02	1.02	0.98	1.04	0.96
MAR	*Median*	1.89	1.00	0.99	1.00	0.99	1.00
	IQR	1.25	1.01	1.02	1.00	1.03	0.99
APR	*Median*	1.35	1.00	0.97	1.00	0.94	1.01
	IQR	1.80	1.00	1.02	1.00	1.01	1.00
MAY	*Median*	0.99	1.00	0.96	0.99	0.95	1.00
	IQR	0.66	1.00	1.01	1.00	1.02	1.00
JUN	*Median*	0.62	1.00	0.93	1.00	0.82	1.06
	IQR	0.65	1.00	1.01	1.00	1.00	1.01
JUL	*Median*	-0.57	0.96	1.76	1.16	2.17	0.89
	IQR	0.75	1.01	0.99	0.99	0.98	1.00
AUG	*Median*	1.84	1.01	1.39	1.05	1.51	0.97
	IQR	1.50	1.01	0.94	0.88	0.98	0.99
SEP	*Median*	-0.07	1.31	5.50	1.64	8.40	0.94
	IQR	1.09	0.99	0.99	0.96	0.92	1.02
OCT	*Median*	0.98	0.98	0.95	0.99	0.92	1.02
	IQR	1.53	1.01	0.93	0.91	0.95	1.00
NOV	*Median*	2.09	1.00	0.99	1.00	0.99	1.00
	IQR	5.42	1.01	1.00	1.01	1.01	0.99
DEC	*Median*	-10.39	0.99	0.99	1.00	0.98	1.01
	IQR	4.44	0.99	0.98	1.00	0.96	1.01
ANNUAL	*Median*	1.13	1.00	0.93	0.98	0.90	1.02
	IQR	2.34	1.00	1.00	1.00	0.99	1.00

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.35	0.99	0.98	1.00	0.96	1.03
	IQR	2.31	0.98	0.99	1.01	0.99	0.99
FEB	*Median*	2.34	0.99	0.99	1.00	0.97	1.02
	IQR	4.46	1.00	1.04	1.00	1.03	0.97
MAR	*Median*	2.14	0.99	0.99	1.00	0.97	1.01
	IQR	1.13	1.00	1.01	1.01	1.01	1.00
APR	*Median*	1.62	1.02	0.94	0.97	0.94	1.01
	IQR	1.04	1.01	0.98	0.97	0.97	1.01
MAY	*Median*	0.96	1.00	0.98	1.00	0.97	1.00
	IQR	1.35	1.00	1.02	0.99	1.03	0.99
JUN	*Median*	0.98	1.00	0.93	0.98	0.90	1.02
	IQR	1.20	1.00	1.03	1.02	1.02	1.00
JUL	*Median*	0.58	0.98	0.63	0.93	0.45	1.19
	IQR	0.98	1.00	0.91	0.96	0.86	1.04
AUG	*Median*	1.74	1.01	1.30	1.04	1.38	0.97
	IQR	0.50	1.00	1.30	1.10	1.30	1.02
SEP	*Median*	1.35	0.98	0.73	0.99	0.63	1.06
	IQR	1.15	0.99	0.94	0.95	0.83	1.10
OCT	*Median*	1.12	0.99	0.92	0.95	0.90	1.01
	IQR	1.58	1.02	0.97	0.99	0.97	1.02
NOV	*Median*	1.25	0.99	0.98	1.00	0.96	1.02
	IQR	3.25	1.00	1.00	1.00	1.00	0.99
DEC	*Median*	1.28	0.99	0.99	1.00	0.98	1.01
	IQR	3.45	1.00	1.00	0.99	0.99	1.01
ANNUAL	*Median*	1.48	1.00	0.96	0.98	0.95	1.01
	IQR	0.95	1.00	1.06	1.03	1.08	0.99

Table F.3 *Projected median monthly and median annual net inflow to Skaha Lake. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.*

SKAHA LAKE

Parameter: **Net Inflow (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	65	28	30	34	36	38	40
JAN	*Median*	21,706	30,535	30,560	32,083	28,801	30,991	32,229
	IQR	7,010	130,936	130,325	122,763	125,276	94,761	95,674
FEB	*Median*	18,731	29,266	28,259	28,560	28,825	30,349	28,279
	IQR	8,773	17,244	17,333	18,009	16,102	16,973	13,506
MAR	*Median*	21,265	25,762	25,962	25,885	25,922	25,906	25,931
	IQR	5,248	15,621	15,711	14,687	15,528	15,384	14,346
APR	*Median*	23,240	29,070	29,042	28,720	29,016	29,790	29,182
	IQR	8,953	29,434	29,351	28,165	29,450	28,125	28,461
MAY	*Median*	30,454	32,709	32,524	31,755	32,497	31,924	31,709
	IQR	12,077	73,676	63,936	65,379	59,208	55,346	65,252
JUN	*Median*	25,060	25,756	25,770	24,321	25,469	24,571	24,582
	IQR	12,076	16,613	16,419	27,691	30,113	22,417	26,575
JUL	*Median*	21,355	22,283	22,260	21,138	22,160	20,309	20,414
	IQR	12,589	34,944	36,822	23,585	37,215	23,308	23,575
AUG	*Median*	19,873	18,482	18,466	17,813	18,369	17,665	17,792
	IQR	6,890	8,324	8,162	7,255	7,607	7,244	7,247
SEP	*Median*	18,583	17,557	17,558	16,805	17,289	16,671	16,797
	IQR	3,431	3,399	3,396	3,178	3,524	3,898	3,497
OCT	*Median*	19,237	19,377	19,355	18,967	19,297	19,043	19,092
	IQR	3,481	3,279	3,209	3,549	3,345	4,321	4,365
NOV	*Median*	19,214	21,689	21,683	21,296	21,655	21,214	21,290
	IQR	2,872	11,713	11,891	5,637	12,211	6,828	8,006
DEC	*Median*	19,365	23,042	23,235	21,569	22,888	21,521	24,259
	IQR	2,420	15,064	15,129	14,893	14,984	14,096	14,149
ANNUAL	*Median*	286,147	332,575	331,659	298,089	312,184	293,243	293,787
	IQR	125,054	430,371	433,261	417,215	431,476	396,921	410,444

Parameter: **Net Inflow (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	66	29	31	35	37	39	41
JAN	*Median*	20,717	51,730	49,248	48,436	39,856	34,934	38,256
	IQR	17,561	65,743	73,036	64,741	82,349	64,653	76,862
FEB	*Median*	19,174	24,938	24,780	25,300	25,758	24,822	24,890
	IQR	3,587	21,031	17,994	18,016	21,797	17,947	18,071
MAR	*Median*	21,804	27,016	26,894	26,934	26,890	26,810	26,871
	IQR	8,631	6,593	6,690	6,736	6,792	6,695	6,808
APR	*Median*	24,480	30,430	30,431	30,196	30,370	29,938	30,310
	IQR	12,353	11,593	11,603	11,573	11,417	11,027	11,816
MAY	*Median*	31,103	40,736	40,748	40,112	40,591	39,881	39,976
	IQR	8,571	80,483	69,408	70,450	69,525	65,850	67,716
JUN	*Median*	29,432	41,341	42,090	40,086	41,271	39,194	39,442
	IQR	16,558	70,215	71,214	70,565	71,244	67,365	59,164
JUL	*Median*	24,111	74,280	73,320	58,453	70,675	61,325	60,019
	IQR	42,610	82,629	84,817	74,397	82,065	74,500	75,017
AUG	*Median*	21,660	26,015	25,994	25,180	25,499	24,607	25,647
	IQR	10,283	5,883	6,380	7,116	7,398	7,849	6,904
SEP	*Median*	19,014	19,953	19,969	19,566	19,830	19,408	19,423
	IQR	3,934	3,063	3,177	2,744	2,630	2,827	2,807
OCT	*Median*	19,796	20,850	20,873	20,480	20,724	20,420	20,434
	IQR	3,909	10,992	12,607	11,022	11,511	11,345	8,389
NOV	*Median*	19,751	21,521	21,491	21,128	21,715	20,990	21,080
	IQR	3,665	12,362	12,226	8,845	12,267	8,835	8,810
DEC	*Median*	19,554	23,730	23,720	23,576	23,680	23,523	23,561
	IQR	2,640	53,216	54,948	53,180	51,078	51,193	50,990
ANNUAL	*Median*	279,728	566,380	567,008	540,756	558,771	530,488	532,635
	IQR	249,730	384,366	381,843	364,886	376,922	367,873	361,146

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.41	1.00	1.05	0.94	1.01	1.04
	IQR	18.68	1.00	0.94	0.96	0.72	1.01
FEB	*Median*	1.56	0.97	1.01	1.02	1.04	0.93
	IQR	1.97	1.01	1.04	0.93	0.98	0.80
MAR	*Median*	1.21	1.01	1.00	1.00	1.01	1.00
	IQR	2.98	1.01	0.93	0.99	0.98	0.93
APR	*Median*	1.25	1.00	0.99	1.00	1.02	0.98
	IQR	3.29	1.00	0.96	1.00	0.96	1.01
MAY	*Median*	1.07	0.99	0.98	1.00	0.98	0.99
	IQR	6.10	0.87	1.02	0.93	0.75	1.18
JUN	*Median*	1.03	1.00	0.94	0.99	0.95	1.00
	IQR	1.38	0.99	1.69	1.83	1.35	1.19
JUL	*Median*	1.04	1.00	0.95	1.00	0.91	1.01
	IQR	2.78	1.05	0.64	1.01	0.67	1.01
AUG	*Median*	0.93	1.00	0.96	0.99	0.96	1.01
	IQR	1.21	0.98	0.89	0.93	0.87	1.00
SEP	*Median*	0.94	1.00	0.96	0.98	0.95	1.01
	IQR	0.99	1.00	0.94	1.04	1.15	0.90
OCT	*Median*	1.01	1.00	0.98	1.00	0.98	1.00
	IQR	0.94	0.98	1.11	1.04	1.32	1.01
NOV	*Median*	1.13	1.00	0.98	1.00	0.98	1.00
	IQR	4.08	1.02	0.47	1.03	0.58	1.17
DEC	*Median*	1.19	1.01	0.93	0.99	0.93	1.13
	IQR	6.23	1.00	0.98	0.99	0.94	1.00
ANNUAL	*Median*	1.16	1.00	0.90	0.94	0.88	1.00
	IQR	3.44	1.01	0.96	1.00	0.92	1.03

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	2.50	0.95	0.98	0.81	0.68	1.10
	IQR	3.74	1.11	0.89	1.13	0.98	1.19
FEB	*Median*	1.30	0.99	1.02	1.04	1.00	1.00
	IQR	5.86	0.86	1.00	1.21	0.85	1.01
MAR	*Median*	1.24	1.00	1.00	1.00	0.99	1.00
	IQR	0.76	1.01	1.01	1.02	1.02	1.02
APR	*Median*	1.24	1.00	0.99	1.00	0.98	1.01
	IQR	0.94	1.00	1.00	0.98	0.95	1.07
MAY	*Median*	1.31	1.00	0.98	1.00	0.98	1.00
	IQR	9.39	0.86	1.02	1.00	0.82	1.03
JUN	*Median*	1.40	1.02	0.95	0.98	0.95	1.01
	IQR	4.24	1.01	0.99	1.00	0.96	0.88
JUL	*Median*	3.08	0.99	0.80	0.96	0.83	0.98
	IQR	1.94	1.03	0.88	0.97	0.90	1.01
AUG	*Median*	1.20	1.00	0.97	0.98	0.95	1.04
	IQR	0.57	1.08	1.12	1.16	1.33	0.88
SEP	*Median*	1.05	1.00	0.98	0.99	0.97	1.00
	IQR	0.78	1.04	0.86	0.83	0.92	0.99
OCT	*Median*	1.05	1.00	0.98	0.99	0.98	1.00
	IQR	2.81	1.15	0.87	0.91	1.03	0.74
NOV	*Median*	1.09	1.00	0.98	1.01	0.98	1.00
	IQR	3.37	0.99	0.72	1.00	0.71	1.00
DEC	*Median*	1.21	1.00	0.99	1.00	0.99	1.00
	IQR	20.16	1.03	0.97	0.93	0.96	1.00
ANNUAL	*Median*	2.02	1.00	0.95	0.99	0.94	1.00
	IQR	1.54	0.99	0.96	0.99	0.96	0.98

Table F.4 Projected median monthly and median annual net inflow to Vaseux Lake. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.

VASEUX LAKE

Parameter: **Net Inflow (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	65	28	30	34	36	38	40
JAN	*Median*	24,744	32,545	33,145	33,198	30,726	33,465	34,727
	IQR	11,045	133,623	131,485	130,054	130,722	100,726	103,169
FEB	*Median*	19,947	32,049	31,873	31,970	31,628	31,470	31,117
	IQR	11,958	19,346	19,847	15,147	18,564	14,960	12,982
MAR	*Median*	22,191	28,109	28,099	27,635	28,055	27,855	28,625
	IQR	6,003	19,357	19,542	18,027	19,450	18,934	18,298
APR	*Median*	23,866	31,487	31,239	29,455	31,240	31,098	31,273
	IQR	11,050	34,018	37,583	33,048	34,999	30,651	31,911
MAY	*Median*	31,405	33,878	33,836	31,403	33,840	32,727	32,689
	IQR	14,263	71,590	60,964	63,497	56,813	54,424	64,939
JUN	*Median*	24,417	24,241	24,372	23,667	24,534	23,586	23,723
	IQR	14,500	17,276	17,167	26,340	28,550	21,111	25,760
JUL	*Median*	18,074	20,179	20,233	18,440	20,116	17,046	17,349
	IQR	12,833	35,370	38,078	23,602	38,844	24,112	24,137
AUG	*Median*	16,302	15,221	15,268	14,917	15,224	14,776	14,878
	IQR	5,527	7,648	7,206	6,539	6,137	6,689	6,107
SEP	*Median*	16,499	14,825	14,865	14,534	14,822	14,402	14,592
	IQR	3,697	4,526	4,105	4,312	4,030	3,965	3,858
OCT	*Median*	19,247	18,531	18,373	17,646	18,510	16,625	17,207
	IQR	3,692	4,598	5,126	5,448	5,425	6,072	5,942
NOV	*Median*	20,419	22,470	22,694	20,614	21,789	20,587	20,680
	IQR	3,333	10,051	10,814	8,580	11,459	7,596	10,252
DEC	*Median*	20,836	25,924	25,776	24,083	24,970	22,854	26,926
	IQR	2,837	15,835	14,918	11,382	14,875	10,739	10,487
ANNUAL	*Median*	291,543	342,478	344,042	306,720	322,928	292,804	295,245
	IQR	136,284	465,648	465,125	439,275	464,845	415,927	431,879

Parameter: **Net Inflow (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	66	29	31	35	37	39	41
JAN	*Median*	22,590	56,371	53,825	50,718	44,529	38,941	39,420
	IQR	18,913	67,209	75,741	67,278	83,460	65,966	77,949
FEB	*Median*	20,203	27,295	27,362	27,459	27,475	27,278	27,265
	IQR	4,070	25,258	24,388	24,631	26,057	24,678	24,604
MAR	*Median*	23,054	29,620	29,462	29,148	29,128	29,020	29,290
	IQR	10,462	8,332	8,474	8,442	8,383	8,393	8,389
APR	*Median*	26,053	32,908	32,908	32,238	32,951	32,110	32,409
	IQR	17,313	14,891	14,226	15,194	14,504	14,413	14,435
MAY	*Median*	32,528	45,150	46,012	44,839	45,583	43,921	44,209
	IQR	11,201	81,098	71,845	70,626	71,098	66,772	68,485
JUN	*Median*	30,165	41,198	44,410	40,513	39,215	38,127	38,830
	IQR	18,458	71,024	71,126	71,225	72,837	69,472	58,874
JUL	*Median*	22,357	72,038	71,553	56,092	70,686	58,453	57,415
	IQR	43,754	81,833	84,239	73,347	80,566	73,250	72,750
AUG	*Median*	18,889	23,261	23,278	21,940	22,400	20,964	22,372
	IQR	10,135	8,793	9,304	7,718	9,403	8,804	7,577
SEP	*Median*	17,416	18,385	18,511	18,210	18,328	17,746	17,770
	IQR	4,635	5,036	5,517	3,730	4,927	4,155	4,033
OCT	*Median*	19,685	20,636	20,995	20,284	20,650	20,450	20,357
	IQR	4,281	11,651	13,321	12,622	13,221	12,015	10,112
NOV	*Median*	20,751	23,198	23,504	22,422	23,001	22,471	22,625
	IQR	4,515	10,836	11,566	9,647	11,032	10,225	10,230
DEC	*Median*	21,385	26,934	26,851	26,662	26,758	26,531	26,836
	IQR	3,994	53,648	57,368	55,549	53,514	53,404	53,689
ANNUAL	*Median*	285,276	587,876	588,434	553,600	579,196	542,475	550,048
	IQR	265,345	403,567	402,426	369,801	394,880	373,240	365,067

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	1.32	1.02	1.00	0.93	1.03	1.04
	IQR	12.10	0.98	0.99	0.99	0.75	1.02
FEB	*Median*	1.61	0.99	1.00	0.99	0.98	0.99
	IQR	1.62	1.03	0.76	0.94	0.77	0.87
MAR	*Median*	1.27	1.00	0.98	1.00	0.99	1.03
	IQR	3.22	1.01	0.92	1.00	0.98	0.97
APR	*Median*	1.32	0.99	0.94	1.00	0.99	1.01
	IQR	3.08	1.10	0.88	0.93	0.90	1.04
MAY	*Median*	1.08	1.00	0.93	1.00	0.97	1.00
	IQR	5.02	0.85	1.04	0.93	0.76	1.19
JUN	*Median*	0.99	1.01	0.97	1.01	0.97	1.01
	IQR	1.19	0.99	1.53	1.66	1.22	1.22
JUL	*Median*	1.12	1.00	0.91	0.99	0.84	1.02
	IQR	2.76	1.08	0.62	1.02	0.68	1.00
AUG	*Median*	0.93	1.00	0.98	1.00	0.97	1.01
	IQR	1.38	0.94	0.91	0.85	0.87	0.91
SEP	*Median*	0.90	1.00	0.98	1.00	0.97	1.01
	IQR	1.22	0.91	1.05	0.98	0.88	0.97
OCT	*Median*	0.96	0.99	0.96	1.01	0.90	1.04
	IQR	1.25	1.11	1.06	1.06	1.32	0.98
NOV	*Median*	1.10	1.01	0.91	0.96	0.92	1.00
	IQR	3.02	1.08	0.79	1.06	0.76	1.35
DEC	*Median*	1.24	0.99	0.93	0.97	0.88	1.18
	IQR	5.58	0.94	0.76	1.00	0.68	0.98
ANNUAL	*Median*	1.17	1.00	0.89	0.94	0.85	1.01
	IQR	3.42	1.00	0.94	1.00	0.89	1.04

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	2.50	0.95	0.94	0.83	0.69	1.01
	IQR	3.55	1.13	0.89	1.10	0.98	1.18
FEB	*Median*	1.35	1.00	1.00	1.00	1.00	1.00
	IQR	6.21	0.97	1.01	1.07	0.98	1.00
MAR	*Median*	1.28	0.99	0.99	0.99	0.98	1.01
	IQR	0.80	1.02	1.00	0.99	1.01	1.00
APR	*Median*	1.26	1.00	0.98	1.00	0.98	1.01
	IQR	0.86	0.96	1.07	1.02	0.97	1.00
MAY	*Median*	1.39	1.02	0.97	0.99	0.97	1.01
	IQR	7.24	0.89	0.98	0.99	0.82	1.03
JUN	*Median*	1.37	1.08	0.91	0.88	0.93	1.02
	IQR	3.85	1.00	1.00	1.02	0.98	0.85
JUL	*Median*	3.22	0.99	0.78	0.99	0.81	0.98
	IQR	1.87	1.03	0.87	0.96	0.90	0.99
AUG	*Median*	1.23	1.00	0.94	0.96	0.90	1.07
	IQR	0.87	1.06	0.83	1.01	1.00	0.86
SEP	*Median*	1.06	1.01	0.98	0.99	0.97	1.00
	IQR	1.09	1.10	0.68	0.89	0.83	0.97
OCT	*Median*	1.05	1.02	0.97	0.98	0.99	1.00
	IQR	2.72	1.14	0.95	0.99	1.03	0.84
NOV	*Median*	1.12	1.01	0.95	0.98	0.97	1.01
	IQR	2.40	1.07	0.83	0.95	0.94	1.00
DEC	*Median*	1.26	1.00	0.99	1.00	0.99	1.01
	IQR	13.43	1.07	0.97	0.93	1.00	1.01
ANNUAL	*Median*	2.06	1.00	0.94	0.98	0.92	1.01
	IQR	1.52	1.00	0.92	0.98	0.92	0.98

Table F.5 Projected median monthly and median annual net inflow to Osoyoos Lake. The results are based on the HadCM3 A2 and CGCM3 B1 climate models. Baseline results are based on the period 1996 to 2006. Future projections are based on the period 2011 to 2040. To provide an index of the variability in the projections, the inter-quartile range (IQR) is provided.

OSOYOOS LAKE

Parameter: **Net Inflow (ML)**
Climate Model: **HadCM3 A2**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	65	28	30	34	36	38	40
JAN	*Median*	33,608	67,174	56,812	56,245	56,624	55,530	55,897
	IQR	38,939	130,141	129,190	131,277	128,515	127,473	127,148
FEB	*Median*	25,553	38,456	38,506	41,157	37,004	41,042	39,475
	IQR	29,419	26,848	26,591	25,026	28,103	24,758	23,626
MAR	*Median*	30,175	41,953	41,602	41,535	41,604	41,459	42,127
	IQR	11,544	41,827	41,894	42,397	40,540	39,816	39,811
APR	*Median*	41,256	47,014	47,530	46,652	47,526	48,076	48,194
	IQR	27,887	39,040	38,396	43,912	44,812	42,506	42,989
MAY	*Median*	55,331	57,179	58,395	55,504	58,299	59,012	59,269
	IQR	37,375	67,927	60,123	58,837	60,402	59,515	61,767
JUN	*Median*	40,268	33,556	33,708	33,208	33,580	33,006	33,084
	IQR	38,207	30,748	28,226	29,327	32,205	22,794	28,648
JUL	*Median*	22,040	22,353	22,738	20,662	22,236	19,656	20,217
	IQR	19,451	34,810	37,264	24,646	37,613	25,401	25,429
AUG	*Median*	16,224	14,881	16,006	15,813	15,087	13,412	15,535
	IQR	9,865	13,716	11,416	10,932	11,117	11,772	10,317
SEP	*Median*	16,818	14,995	15,415	14,602	14,946	13,677	14,195
	IQR	7,457	6,076	5,576	6,050	5,927	4,516	4,788
OCT	*Median*	20,363	20,339	20,437	18,998	20,152	17,305	18,540
	IQR	4,800	5,995	6,132	6,669	6,562	7,449	7,140
NOV	*Median*	23,092	27,944	27,901	27,061	27,850	26,400	26,089
	IQR	5,835	31,917	31,710	31,317	32,543	32,081	31,717
DEC	*Median*	24,963	31,766	31,718	33,344	31,512	30,453	31,984
	IQR	11,654	31,434	29,723	29,502	29,529	27,734	24,952
ANNUAL	*Median*	386,490	475,208	474,142	443,832	456,418	425,458	433,845
	IQR	165,948	606,579	618,560	559,736	603,152	548,008	541,676

Parameter: **Net Inflow (ML)**
Climate Model: **CGCM3 B1**

	Scenario Group:	BASELINE	A	B	C	D	E	F
	Scenario Number:	66	29	31	35	37	39	41
JAN	*Median*	25,790	65,445	64,928	56,197	65,235	47,408	50,515
	IQR	22,700	87,256	78,870	85,543	85,744	76,809	80,446
FEB	*Median*	23,128	41,381	41,677	41,395	41,564	41,622	41,564
	IQR	8,440	48,190	49,077	48,774	48,236	48,547	48,775
MAR	*Median*	34,626	47,437	47,442	47,431	47,386	47,301	47,199
	IQR	21,935	25,594	20,829	25,701	25,203	18,001	17,894
APR	*Median*	39,196	57,951	58,006	57,002	58,017	57,328	57,232
	IQR	37,258	58,003	57,803	54,984	57,606	56,870	57,569
MAY	*Median*	54,084	86,441	86,952	85,594	86,704	75,548	85,206
	IQR	22,098	91,633	91,652	86,427	84,967	71,082	79,128
JUN	*Median*	50,931	63,286	63,377	57,209	62,929	49,413	52,428
	IQR	42,762	77,629	79,533	77,634	78,753	79,907	66,354
JUL	*Median*	26,549	73,018	73,692	60,946	72,518	57,442	57,064
	IQR	48,253	82,453	86,335	74,377	84,181	76,292	73,540
AUG	*Median*	20,784	24,149	24,418	23,838	23,368	21,907	23,195
	IQR	13,016	10,602	12,340	9,339	9,364	9,823	9,718
SEP	*Median*	16,896	19,784	19,879	19,458	19,629	18,944	18,906
	IQR	6,200	5,669	5,810	5,340	6,991	6,046	5,567
OCT	*Median*	20,537	23,137	23,254	22,608	22,786	22,612	22,475
	IQR	5,841	14,292	15,078	13,729	13,712	14,251	13,797
NOV	*Median*	22,733	29,118	29,235	27,303	29,203	26,928	27,107
	IQR	6,365	28,102	26,516	29,800	24,723	28,414	29,468
DEC	*Median*	24,229	35,890	37,097	36,821	35,542	34,720	36,829
	IQR	7,489	52,552	55,928	66,099	53,321	51,691	54,870
ANNUAL	*Median*	378,131	759,242	760,981	724,904	751,273	710,523	720,351
	IQR	295,466	447,430	444,449	461,785	468,087	456,493	459,928

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **HadCM3 A2**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	2.00	0.85	0.99	1.00	0.83	1.01
	IQR	3.34	0.99	1.02	0.99	0.98	1.00
FEB	*Median*	1.50	1.00	1.07	0.96	1.07	0.96
	IQR	0.91	0.99	0.94	1.06	0.92	0.95
MAR	*Median*	1.39	0.99	1.00	1.00	0.99	1.02
	IQR	3.62	1.00	1.01	0.97	0.95	1.00
APR	*Median*	1.14	1.01	0.98	1.00	1.02	1.00
	IQR	1.40	0.98	1.14	1.17	1.09	1.01
MAY	*Median*	1.03	1.02	0.95	1.00	1.03	1.00
	IQR	1.82	0.89	0.98	1.00	0.88	1.04
JUN	*Median*	0.83	1.00	0.99	1.00	0.98	1.00
	IQR	0.80	0.92	1.04	1.14	0.74	1.26
JUL	*Median*	1.01	1.02	0.91	0.98	0.88	1.03
	IQR	1.79	1.07	0.66	1.01	0.73	1.00
AUG	*Median*	0.92	1.08	0.99	0.94	0.90	1.16
	IQR	1.39	0.83	0.96	0.97	0.86	0.88
SEP	*Median*	0.89	1.03	0.95	0.97	0.91	1.04
	IQR	0.81	0.92	1.09	1.06	0.74	1.06
OCT	*Median*	1.00	1.00	0.93	0.99	0.85	1.07
	IQR	1.25	1.02	1.09	1.07	1.24	0.96
NOV	*Median*	1.21	1.00	0.97	1.00	0.94	0.99
	IQR	5.47	0.99	0.99	1.03	1.01	0.99
DEC	*Median*	1.27	1.00	1.05	0.99	0.96	1.05
	IQR	2.70	0.95	0.99	0.99	0.88	0.90
ANNUAL	*Median*	1.23	1.00	0.94	0.96	0.90	1.02
	IQR	3.66	1.02	0.90	0.98	0.90	0.99

Parameter: **Ratio of net inflow between indicated scenarios**
Climate Model: **CGCM3 B1**

	Ratio:	A:BASLINE	B:A	C:B	D:B	E:A	F:E
JAN	*Median*	2.54	0.99	0.87	1.00	0.72	1.07
	IQR	3.84	0.90	1.08	1.09	0.88	1.05
FEB	*Median*	1.79	1.01	0.99	1.00	1.01	1.00
	IQR	5.71	1.02	0.99	0.98	1.01	1.00
MAR	*Median*	1.37	1.00	1.00	1.00	1.00	1.00
	IQR	1.17	0.81	1.23	1.21	0.70	0.99
APR	*Median*	1.48	1.00	0.98	1.00	0.99	1.00
	IQR	1.56	1.00	0.95	1.00	0.98	1.01
MAY	*Median*	1.60	1.01	0.98	1.00	0.87	1.13
	IQR	4.15	1.00	0.94	0.93	0.78	1.11
JUN	*Median*	1.24	1.00	0.90	0.99	0.78	1.06
	IQR	1.82	1.02	0.98	0.99	1.03	0.83
JUL	*Median*	2.75	1.01	0.83	0.98	0.79	0.99
	IQR	1.71	1.05	0.86	0.98	0.93	0.96
AUG	*Median*	1.16	1.01	0.98	0.96	0.91	1.06
	IQR	0.81	1.16	0.76	0.76	0.93	0.99
SEP	*Median*	1.17	1.00	0.98	0.99	0.96	1.00
	IQR	0.91	1.02	0.92	1.20	1.07	0.92
OCT	*Median*	1.13	1.01	0.97	0.98	0.98	0.99
	IQR	2.45	1.06	0.91	0.91	1.00	0.97
NOV	*Median*	1.28	1.00	0.93	1.00	0.92	1.01
	IQR	4.41	0.94	1.12	0.93	1.01	1.04
DEC	*Median*	1.48	1.03	0.99	0.96	0.97	1.06
	IQR	7.02	1.06	1.18	0.95	0.98	1.06
ANNUAL	*Median*	2.01	1.00	0.95	0.99	0.94	1.01
	IQR	1.51	0.99	1.04	1.05	1.02	1.01

APPENDIX G: PHASE 3 DEMAND MODELING ASSUMPTIONS AND METHODOLOGIES

Phase 3 Demand Modeling Assumptions and Methodologies

Memo, RHF Systems

March 31, 2012

Aside from climate change, the scenarios modeled for Phase 3 of the Okanagan Supply and Demand Project looked at different population change trends, an expansion of lands used for agriculture, and change in efficiencies for both indoor water use and crop irrigation. Several of the methodologies used for exploring these changes were the same as those implemented in Phase 2; they are briefly outlined here, but described in more detail in documentation produced during the Phase 2 process.

Other processes are new for Phase 3, and they are outlined in more detail in this discussion.

Population Growth

In the Phase 2 scenarios (and as part of the Phase 3 modeling as well), there were different techniques used to account for population growth. As part of her thesis work, Nathalie Maurer looked at different urban growth patterns in the 4 major population centres in the Valley (Vernon, Kelowna, Penticton and Osoyoos). She created a series of templates representing a medium density population pattern (including combinations of single and multi-family dwellings), and placed the templates on a digital map in areas where the Official Community Plans indicated likelihood of future development. Nathalie's projection was limited to the 4 main centres and it extended only to the year 2025; enough templates were positioned (at times representing developments in new areas and in other cases standing as redevelopment of existing neighborhoods under higher densities) to meet the population projections to 2025. Later, Liyang Zhang of the Ministry of Agriculture and Lands extended Nathalie's work to match the population estimates to 2035, and to include the smaller population centres as well (e.g. Summerland, Oliver, Okanagan Falls, Naramata).

Indoor water use within the water demand model isn't actually represented by population, but instead through a daily use associated with each parcel according to the actual use codes provided by the BC Assessment Authority. A single family dwelling, for example, has an associated daily indoor use of 0.45716 cubic metres. To model the increased use due to population growth between 2006 (the base year for the cadastral fabric within the water demand model) and 2035 (the highest year of the spatially located growth templates), a lookup table was developed containing a key to each new development shape and a randomly selected year of development between 2006 and 2035. As each year was modeled, properties with development years up to the processing year were added into the residential set along with their associated daily water use amounts. The template properties included both an indoor use value and a percentage representing the amount of the shape's area that would likely be irrigated for landscaping; the irrigated area was added to the ***domestic*** crop type and assumed to use a ***Landscapesprinkler*** irrigation system.

Between 2036 and 2040 (and to 2070 in some of the Phase 2 scenarios), the population, as represented by the amount of water used for indoor residential use, was scaled up statistically since there were no spatially located growth templates beyond 2035. Each of the following municipalities and regional districts were assigned different growth extrapolation equations based on the figures used as part of Nathalie's and Liyang's work:

Kelowna
Lake Country
NORD
Peachland
Penticton
Regional District of Okanagan Similkameen (RDOS)
Summerland
Vernon

The equations were the trend lines describing the graphs of each area's growth as a function of the year being model between 2011 and 2035 (the 2011 to 2035 uses plotted and used to derive the equations); for example, Kelowna's extrapolation equation was

(1.600865703 + -0.000287428 * modelingYear) ^ modelingYear – 2035

For years beyond 2035, the 2035 daily indoor uses were scaled up by multiplying them by each area's extrapolation coefficients. Note that this represents adding density to the same locations rather than performing any additional spatial developments beyond 2035.

A different technique was used for the Industrial, Commercial and Institutional indoor water uses since none of the growth templates included ICI development, The ICI daily use was multiplied by the ratio of the new residential daily use for each year compared to the residential daily use of 2006, the base year for the population calculations. The total daily volume for residential indoor use as of 2006 is designated in the water demand model databases as 41841 cubic metres. If in 2020, the population growth and/or indoor use efficiency changes resulted in a new residential indoor use total of 50000, then the daily industrial, commercial and institutional indoor uses were multiplied by 1.195 (50000 / 41841). Note that while this is representative of the overall change in water use at the full valley level, it doesn't provide a good representation of changing ICI use when viewed at local levels. It doesn't, for example, reflect the fact that a new hospital might be built to service an expanded population in a specific area; it simply increases the water use at the existing hospitals to match the overall population increase, regardless of where that growth has occurred.

High Sprawl Growth

Some of the Phase 3 scenarios attempted to model a high sprawl growth scenario – continuing to develop new lands using similar lot sizes and proportions of outdoor irrigated areas as we currently have in the valley. Since there hadn't been any work done to investigate how and where that type of development could take place, it was modeled by implementing rules-based approach to identifying possible areas of development and potential lot sizes and landscaping ratios.

Data from several sources, from a detailed regional growth strategy in the North Okanagan to data from a MetroQuest presentation application that categorized development in various areas as "strongly encourage","encourage", and "neutral", was combined and intersected with the land use layer to produce candidate polygons for the sprawl scenario. These candidate polygons were then classified by elevation strata and assigned a lot size according to:

Elevation (m)	Lots per Ha	Percentage Landscaping
< 550	3.3	0.37
550 – 650	1.1	0.37
750 – 750	1	0.37
750 – 850	1	0.37
> 850	1	0.3

These categories, sizes and landscaping proportions were derived by analyzing the current breakdown of residential parcels. Note that in the first few attempts, the results appeared to be unrealistic in terms of the vast amounts of areas going into outdoor landscaping, likely because of the small numbers of sample properties in some the categories in the current cadastral set; the maximum property sizes and proportions of landscaped area were adjusted to try to bring a more reasonable perspective to the high sprawl scenario.

A similar technique to the other urban growth methodologies was used, whereby a lookup table with randomly selected development years between 2007 and 2040 controlled the timing of the new properties coming on stream.

Population Rewind
To simulate the valley's population growth over the 1971 to 2006 period, the water use in the population-dependent categories (residential, commercial, industrial and institutional indoor use and residential outdoor landscaping) was estimated for 2006 and then scaled backwards according to the municipal and regional district population statistics available through:

http://www.bcstats.gov.bc.ca/data/pop/pop/mun/Mun1921_2006.asp
and http://www.bcstats.gov.bc.ca/data/dd/handout/hist_cen.pdf

All of the local government designations within the water demand model source database had corresponding records in one of the sources above except for the District of Lake Country, which wasn't incorporated until 1995. The district's communities (Winfield, Okanagan Centre, Oyama, and Carr's Landing) weren't listed on the municipal population reports available at that site either. Lake Country had a similar population in 2006 to Summerland (approx. 10,700); the Summerland population estimates were therefore used as representative of Lake Country for modeling these scenarios.

For the municipalities, the populations were listed for each of the 5-year census events from 1921 through to and including 2006; for the regional districts, however, the covered period is only 1941 to 1986. The 2006 populations for the districts were available from the earlier work done for the Phase 2 scenarios, and these were added into the tables for this modeling.

To scale the water demand to reflect population change between 1970 and 2006, each year's population was estimated by interpolating linearly between the specified values for the corresponding municipality or regional district. Outside of the listed year ranges, the algorithms extrapolate linearly using the outermost specified data points (this didn't come into play for these 1971 – 2006 modeling runs since this period is covered for all of the local government designations). The estimated population for the modeling year was then divided by the 2006 population for that area and the resulting ratio used to scale back the 2006 water use. For example, Kelowna's 1981 population of 59196 over the 2006 value of 106707 resulted in a multiplier of 0.555. The 1981 indoor water use was then calculated as 0.555 times the 2006 use. To account for fewer houses, the outdoor landscaping area for each property was also scaled back by the same multiplier.

Water Use Efficiencies
Two options were modeled for water use efficiency:
- present conditions (no improvement in water use efficiency)
- standard improvement – a 33% reduction in water use over the 2010 – 2040 period

To model the efficiency improvements for indoor water use, the daily use volumes for each residential property were multiplied by a factor that decreased from 1.0 in 2010 to 0.67 in 2040:

indoorReductionPct = 1 - (33 / 30 * (modelingYear - 2010) / 100)

The technique used to scale up the Industrial, Commercial and Institutional indoor water use (multiplying it by the ratio of the modeling year's residential use to that of 2006) meant that efficiencies in indoor residential use were automatically reflected as the same kind of improvement in ICI indoor use.

For residential outdoor landscaping, the irrigation management classification, which affects the amount of water lost to deep percolation due to overwatering, was assumed to improve from a "poor" rating now to an average rating by 2040. To model the improvement, a lookup table was created that associated each residential landscaping area (areas with a crop type designation of "domestic") with a randomly assigned year of improvement between 2010 and 2040. As each year in the period was modeled, any properties with improvement years less than or equal to the current year were switched from poor management to average.

For agricultural crops, efficiency improvements were modeled as replacement of current irrigation system types to more efficient types (from gun to sprinkler for alfalfa and grass and to drip or microsprinkler for most other crop types). Once again, a lookup table was used to associate each property and crop type to a new irrigation system type and a randomly selected year of conversion between 2010 and 2040. As each year was modeled, the properties with equal or earlier conversion years were switched to the more efficient systems.

Agricultural Landbase

Areas suitable for agricultural expansion were mapped out by MAL and subsequently overlaid with the source database to produce a list of intersected polygon identifiers. Using a similar process to the urban growth phase-in, the agricultural polygons were assigned random years between 2010 and 2040 and brought on stream accordingly over the modeling period. New agricultural properties in zone 4 (Winfield and north) were designated as growing *alfalfa* under *sprinkler* irrigation; properties south of Wood Lake were treated as *medium density apples* under *microsprinkler*.