# Memo

**Date:** July 7, 2010

**File:** 1390-10

**To:** City Manager

**From:** R. Cleveland, Director, Infrastructure Planning with M. Watt, Manager, Strategic Projects

**Subject:** City-Wide Water Supply and Treatment Options

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**Recommendation:**
THAT Council receive, for information, the Report prepared by Associated Engineering ("AE") dated June 2010 as attached to the Report of the Director, Infrastructure Planning dated July 7, 2010;

AND THAT Council directs staff to forward copies of the Associated Engineering Report dated June 2010, the July 7, 2010 Council Report from the Director, Infrastructure Planning and all associated Council Resolutions to the Minister of Community and Rural Development to show progress.

AND THAT Council directs staff to formalize a Memorandum of Understanding ("MOU") with all water purveyors operating in the City limits to collaborate fully in the development of a long-term technical water treatment and supply solutions that achieves:

- safe and reliable domestic water to all Kelowna residents in a way that meets or exceeds Canadian health and water quality standards,
- reliable and affordable agricultural water, and
- the least total life-cycle cost;

AND FURTHER THAT Council direct staff to report back to Council with the finalized MOU.

**Purpose:**
At a regular Council meeting on April 20, 2009, Council directed that staff engage Associated Engineering to undertake a technical study to determine the best long-term strategy to adequately supply clean and safe water to the entire community. The study was needed to provide a context for evaluating City and Provincial financial participation in the short and long-term expansion and water quality capital projects planned by the water purveyors operating in Kelowna.

**Background:**
Kelowna's water customers are supplied by 5 principle water purveyors (and several smaller private water systems) that for historical reasons have used different water sources and relatively independent treatment and distribution systems. The five principle purveyors and the main water sources are: City of Kelowna Water Utility (source: Okanagan Lake), Rutland Waterworks District (source: 12 confined aquifer wells), Black Mountain Irrigation District (source: Mission Creek, Scott Creek & 3 wells), Glenmore-Ellison Improvement District (source: Kelowna Creek & 5 confined aquifer wells), and South East Kelowna Irrigation District (source: Hydraulic Creek & 3 confined aquifer wells).

Each purveyor provides treated water to their customers through a combined domestic/agricultural water distribution system. From a city-wide perspective, domestic and agricultural users demand equal amounts of water annually, but only the domestic customers require treated water. As a result, water for irrigation purposes is being treated unnecessarily at a cost to all users.

Key observations of the Associated Engineering study include:

- Four of the five systems do not currently comply with the Canadian Drinking Water Quality Guidelines (CDWQG)
- Combined domestic and agricultural water systems are not cost effective, especially from a treatment perspective
- Weak interconnections between the 5 systems leaves all systems vulnerable to supply interruption events (drought and flood events)
- Two of the systems have recently experienced declines in raw water supply storage and quality which although now resolved, signal potential service capacity issues in the future
- Some systems have limited treated water storage capacity which increases vulnerability to supply interruptions/reductions, equipment failure and major fire events.

Interior Health (IH) has revised their standards to require conformance to the increasingly stringent requirements of the CDWQG. Corrective solutions will require substantial capital upgrades to water systems to achieve compliance and adaptability to future regulatory requirements; costs which will likely be shared between senior government (grants) and ratepayers. Given the magnitude of potential costs, it is important that the water supply infrastructures selected provides the best water quality for all Kelowna's residents at the least possible life-cycle cost.

This study was an extension of Associated Engineering's "Kelowna Joint Water Committee 2005 Strategic Water Servicing Plan". The current study evaluated 4 new technical options (refer Summary Report pg.21-25) for an integrated water supply and distribution system against a fifth "business as usual approach" (BAU). The BAU was based on the consultant's knowledge of the existing plans of each water purveyor to meet future demand and regulatory requirements. The four new options were all based on separation of domestic and agricultural distribution systems. In addition, the consultants assessed two strategies regarding the domestic water treatment for all five options:

1. UV treat all water sourced from Okanagan Lake as well as filter and UV treat all upland water sources; and,
2. Filter and UV treat all water sources.

The first treatment strategy is acceptable so long as all Kelowna water utilities qualify for filtration deferral; the second strategy is the more future-proof but the most costly. The options were cost estimated and then evaluated using a multiple bottom line approach. The evaluation included a broad range of technical, financial, environmental and social criteria including; life-cycle cost, resilience of the water quantity and quality at each source, the robustness of the treatment and distribution systems against various events (flood, drought, climate change, fire events), health risks, and system expandability (refer Summary Report pg 29-31). These criteria were weighted by a broad cross-section of planning, construction and operational City staff and IH, and tested for sensitivity to changing priorities and an appropriately conservative appetite for risk. It was also important that the partial filtration option (#1 above) selected for the near-term could easily be migrated to a full filtration strategy (#2 above) if Okanagan Lake water quality deteriorated enough to warrant the additional treatment measure.

The preferred option was the maximum separation of domestic and irrigation systems following the interconnection of domestic supplies with Okanagan Lake water as the primary raw water source. From a discounted 20-year life-cycle cost perspective, the least expensive option also rated the best against all other criteria. It was also $75 million less expensive than the BAU approach. This demonstrated that viable collaborative alternatives are available to Kelowna residents.

All water purveyors participated in the final review of this study. Their primary concerns were that the next iteration needed to incorporate recent changes in the individual systems and be considered within a longer time frame, and that all water purveyors needed to participate fully in a collaborative approach.

**Internal Circulation:**
General Manager, Community Services
General Manager, Community Sustainability
Manager, Strategic Projects

Director, Community & Media Relations
Manager, Utility Services

**Legal/Statutory Authority:**
Water Quality Performance is monitored and enforced by Interior Health (IH) who participated in all aspects of the preparation of this report. The City is preparing an application to IH for Water Filtration Deferral, a mandatory component of compliance with the City's Operating Permit. The other water purveyors will also need to apply. Kelowna (because of the reliable quality of Okanagan Lake water supply), and Rutland Waterworks (because of the high quality ground water source) have the highest probability of long-term success in achieving filtration deferral based on the systems currently installed.

**Financial/Budgetary Considerations:**
The water purveyors have agreed to develop an MOU to collaborate on further technical study. It is recommended that this be done immediately, using external facilitation if required. A budget already exists for the City to fully underwrite this process.

There are significant financial implications for the community to build and operate water supply system(s) that fully comply with the CDWQG. None of the water purveyors will qualify for senior government financial assistance without a general consensus that the best City-wide solution in terms of water quality and cost effectiveness is being achieved through the investments. In addition, both domestic and agricultural water customers expect a reasonable equity in water rates across the City.

It should also be noted that IH expects any utility that achieves filtration deferral to be in a position to implement filtration within a two year period if water quality circumstances dictate. This requires that a conceptual design and the site selection for treatment facilities be completed. Commitment to a clear and proactive financial strategy will be required as part of the filtration deferral application.

**External Agency/Public Comments:**
The Mayor of the City of Kelowna and the Chair of BMID on behalf of the other water purveyors wrote to the Minister of Community and Rural Development (MCRD) in September 2009 requesting technical support and funding for this technical study. The Minister responded on January 12, 2010 recognizing that there was a potential for provincial funding in the foreseeable infrastructure projects and indicated that the principles of an acceptable solution must include:

1. Best-lowest cost solution from a city-wide perspective
2. Flexibility to consider governance options that achieved a coordinated approach similar to one local government, through a facilitated, open and transparent process that built trust among purveyors, stakeholders and residents
3. Achievement of public health outcomes
4. Maintenance of agricultural Interests

The Mayor wrote a letter to all water purveyors on March 11, 2010 that listed similar principles for developing a long-term water treatment and supply system, and provided a schedule of follow-up events including:

- A meeting to introduce the draft report to the water purveyors (held on May 13, 2010);
- A meeting of the water purveyor Boards and their staffs to review their input to the technical study (held on June 24, 2010);
- A formal report to a public meeting of Council (scheduled for July 12, 2010);
- The development of a formal MOU to guide future collaboration.

Interior Health (IH) provided a response to the draft report and spoke to the meeting of June 24 reinforcing that "there are potential collaborative solutions that will benefit drinking water consumers in the area", and further that the study had respected three of the four MCRD criteria noted above, but that the issue of governance remained unaddressed. IH identified the poor compliance status of the purveyors relative to operating permits, treatment objectives, and drinking water quality improvement programs. IH insisted that a goal of only meeting current minimum expectations would be discouraged in favour of capital, operational and governance strategies designed to achieve continuous improvement for the benefit of the public. Finally IH emphasized that full commitment to collaborate was an essential public duty of all water purveyors to assure clean safe reliable drinking water.

**Community & Media Relations Comments:**

A media release will be prepared regarding the technical study with the following key messages:

- the City has undertaken a technical review and demonstrated that collaboration of the five principle water purveyors operating in Kelowna could lead to an overall improvement in water quality for the citizens of Kelowna;
- the principle 5 water purveyors have agreed to draft a Memorandum of Understanding to collaborate in a city-wide approach to the further design and improvement of water systems.

The Associated Engineering technical study "City Wide Water Supply and Treatment Options Evaluation, June 2010" will be posted on the City web-site with an introduction explaining that the purpose of the study was to determine, considering multiple criteria, whether there were water treatment and supply options available to the 5 principle water purveyors that could provide better water at a lower cost. This possibility has been demonstrated. A collaborative effort based on current technical information for each system and a longer-term planning horizon will now be required to prove out a final recommended option.

The technical study, this Council report and Council's resolution will be forwarded to the Minister of Community and Rural Development to show progress towards eligibility for Ministry funding.

**Considerations not applicable to this report:**

Legal/Statutory Procedural Requirements:
Existing Policy:
Personnel Implications:
Alternate Recommendation:

Submitted by:

R. Cleveland, Director, Infrastructure Planning

**Approved for inclusion:** J. Paterson, General Manager, Community Sustainability

cc:
J. Bulach, Chair, Glenmore-Ellison Improvement District
G. Zarr, Chair, Rutland Waterworks
B. Caswell, Chair, South East Kelowna Irrigation District
G. Ivans, Chair, Black Mountain Irrigation District
Dr. P. Hasselback, Medical Health Officer, Interior Health
J. Vos, General Manager, Community Services
J. Creron, Director, Civic Operations
K. Grayston, Director, Financial Services
B. Berry, Director, Design and Construction
C. Stephens, Director, Community & Media Relations

Attachment 1: Associated Engineering Summary Document
Attachment 2: Associated Engineering PowerPoint presentation

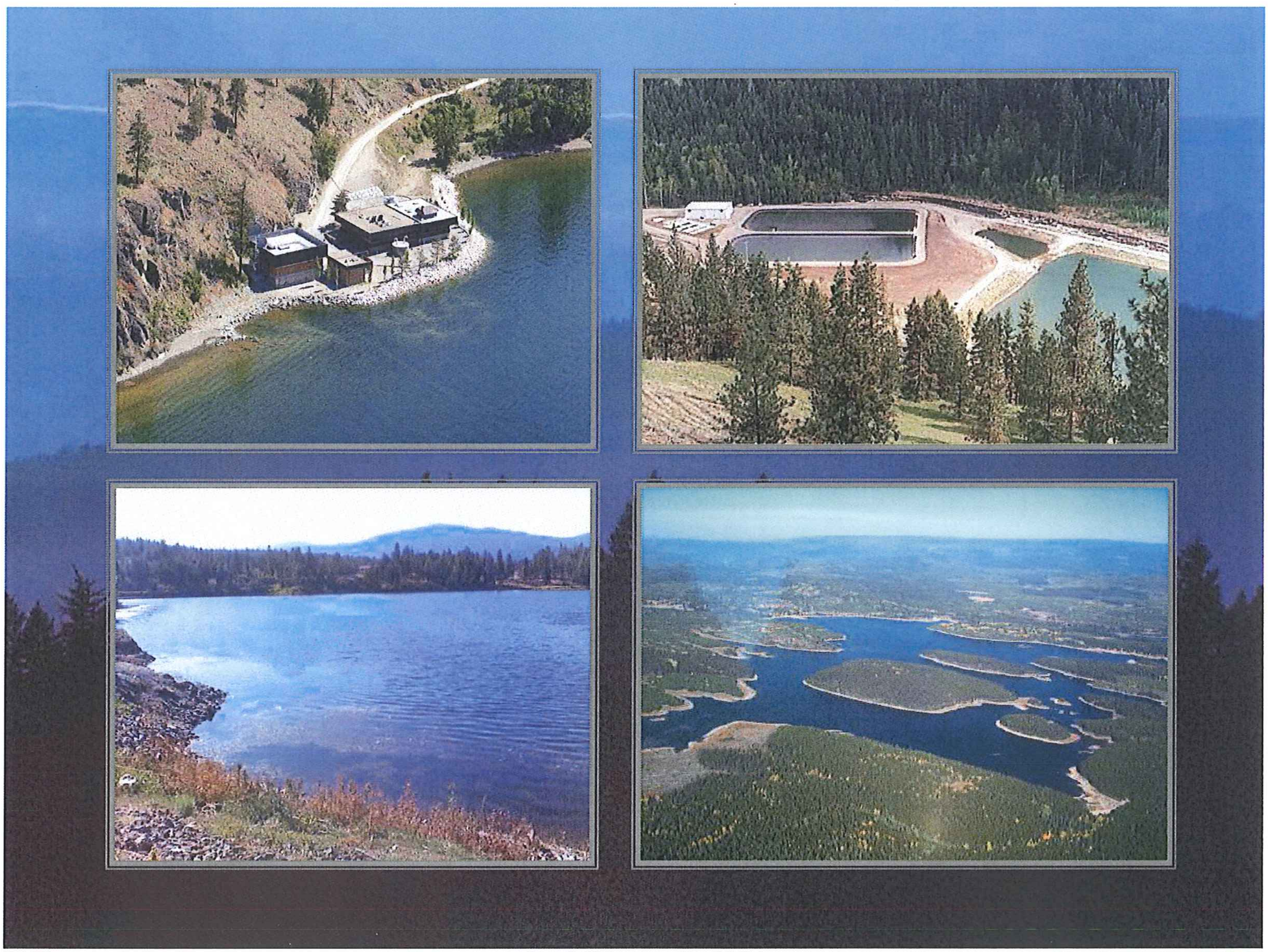
# Summary Report

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

City of Kelowna

## City-Wide Water Supply and Treatment Options Evaluation

June 2010



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# List of Abbreviations

| | |
|---|---|
| % | percent |
| ALR | agricultural land reserve |
| AOC | assimilable organic carbon |
| AO | aesthetic objective |
| ASR | aquifer storage and recovery |
| B.C. | British Columbia |
| BDCM | bromodichloromethane |
| BMID | Black Mountain Irrigation District |
| CHE | Federal-Provincial-Territorial Committee on Health and the Environment |
| CT | concentration x time |
| DWPA | Drinking Water Protection Act |
| DWO | Drinking Water Officer |
| EPA | Environmental Protection Agency (U.S.) |
| GCDWQ | Guidelines for Canadian Drinking Water Quality |
| GEID | Glenmore-Ellison Improvement District |
| GTD | Guidance Technical Document |
| HAA5 | haloacetic acids –Total of 5 that are regulated |
| $H_2O_2$ | hydrogen peroxide |
| KJWC | Kelowna Joint Water Committee |
| OH• | hydroxyl radicals |
| IHA | Interior Health Authority |
| MAC | maximum allowable concentration |
| MCPA | methyl-4-chlorophenoxyacetic acid |
| mL | millilitre |
| ML/d | mega litres per day |
| m | metres |
| $m^2$ | square metres |
| $m^3$ | cubic metres |
| mg/L | milligrams per litre |
| MOE | Ministry of Environment |
| MOH | Ministry of Health |
| MTBE | methyl tertiary-butyl ether |
| OCP | official community plan |
| OGV | Operational Guidance Value (Health Canada) |
| NDMA | N-nitrosodimethylamine |
| NTU | nephelometric turbidity unit |
| P3 | public-private partnership |
| pH | hydrogen ion concentration |

| | |
|---|---|
| POE | point of entry |
| RWD | Rutland Waterworks District |
| SEKID | South East Kelowna Irrigation District |
| TCE | trichloroethylene |
| TCU | True Colour Unit |
| TDS | Total Dissolved Solids |
| THM | Trihalomethane |
| TOC | total organic carbon |
| µg/L | micrograms per litre |
| USEPA | United States Environmental Protection Agency |
| UV | ultraviolet |
| WTP | Water Treatment Plant |

# SUMMARY REPORT

## 1 Overview

### 1.1 Introduction

In July 2009, the City of Kelowna commissioned Associated Engineering to undertake a strategic review of technical options for area wide water supply and distribution planning throughout the entire area within the City corporate boundaries. This work is a natural extension from the preliminary options developed for the Kelowna Joint Water Committee in our report entitled Water Quality Improvement Plan Overview, February 2009. The intent of the review was to cover both water quality improvements as well as water supply and distribution on a City-wide basis within the areas presently served by the Rutland Waterworks District, Black Mountain Irrigation District, Glenmore-Ellison Improvement District, South East Kelowna Irrigation District, and City of Kelowna Water Utility.

### 1.2 Report Objectives

The study objectives were agreed to as follows:

1. To develop, evaluate, and compare the technical options for treating and delivering domestic and irrigation demands on a city-wide basis. To do this several new options would be developed and compared to the existing plans set out in the KJWC 2005 Strategic Water Servicing Plan.

2. To identify the technical option(s) which best meet(s) the City-wide objectives. In order to evaluate and compare all options, a structured evaluation process utilizing Triple Bottom Line approach was to be developed by the consulting team in order to allow the City to select the preferred option(s).

The study was undertaken under the direction of the City of Kelowna without the participation of the other four water suppliers.

### 1.3 Background Information

The City of Kelowna includes several major and a number of smaller water supply systems supplying water to various areas within the City. The major water suppliers and their primary sources of supply are as follows:

- *City of Kelowna Water Utility* – supplied from Okanagan Lake via four intakes
- *Rutland Waterworks District (RWD)* – supplied from 19 wells, of which 12 are currently active, drawing water from confined aquifers
- *Black Mountain Irrigation District (BMID)* – supplied from intakes on Mission Creek, Scotty Creek, and three wells

- *Glenmore-Ellison Improvement District (GEID)* – supplied from an intake on Kelowna Creek and five wells drawing water from confined aquifers
- *South East Kelowna Irrigation District (SEKID)* – supplied from an intake on Hydraulic Creek and three wells drawing water from confined aquifers

All five of the major utilities have sufficient source water supply and sufficient licenses to meet the water demands projected to 2030. BMID, GEID, and SEKID have areas of Agricultural Land Reserve (ALR) within their service areas. Water for irrigation is allocated to "graded" lands within the Districts that have rights to water. The full allocation is not used in most years as some properties are in fallow or are not in production. This allocation must be held in reserve so that water can be supplied to these properties paying the water tax. This irrigation water does not require treatment other than possibly to minimize biological growth in the distribution system.

There are no specific allocations required for domestic customers other than the demand must be met and fire protection must be provided. There is significant population growth in the metropolitan City area served by the five utilities. All the utilities have capital plans in place to provide the capacity infrastructure necessary to service the growing population. The scope of these plans was reviewed in the February 2009 Kelowna Joint Water Committee study entitled Water Quality Improvement Plan Overview authored by Associated Engineering.

There are several other known small water supply systems within the City boundaries including the following:

- *South Okanagan Mission Improvement District (SOMID)* – irrigation water supplied from two wells via Fraser Lake
- *DeMontrieul Water Utility (DWU)* – domestic and irrigation water supplied from one well drawing water from Mission Creek aquifer
- *Braeloch Water Utility (BWU)* – domestic water supplied from an intake on Okanagan Lake
- *Mission Creek Water Users Community* – irrigation water supplied from an intake on Mission Creek

While not the focus of this document, the existence of these utilities and how they will be serviced in the long term needs to be considered in the overall technical strategy.

## 1.4 Report Organization

The Summary Report provides an overview of the study process, options development and options evaluation. More detailed information is available from the following technical memoranda which are included in a separate volume:

- Technical Memorandum No. 1-1 - Water Sources, Treatability, and Costing Criteria
- Technical Memorandum No. 1-2 - Water Demand Design Criteria
- Technical Memorandum No. 1-3 - Options Conceptualization
- Technical Memorandum No. 2-1 - Options Cost Estimates
- Technical Memorandum No. 2-2 - Evaluation and Comparison of System Options

## 1.5 Acknowledgements

We would like to acknowledge the input of the following City of Kelowna personnel who have been actively involved in its development:

Mark Watt, Manager Strategic Projects
Randy Cleveland, Director Infrastructure Planning
Don Degen, Manager Utility Services
Keith Grayson, Director Financial Services
Adrian Weaden, Pump Operations Supervisor
Jason Ough, Infrastructure Planning

# 2 Existing Water Sources and Treatment

## 2.1 Sources of Supply

As noted above, the various suppliers within the City depend primarily on Okanagan Lake, groundwater, Mission Creek, Scotty Creek, Kelowna Creek, and Hydraulic Creek for virtually all of their water supply. Water quality data for each of these sources was presented in the "Water Quality Improvement Plan Overview" and is therefore not repeated herein. The following provides a brief description of each of these sources:

### Okanagan Lake

The City holds licenses totalling 51,996 ML of annual waterworks requirements of which it is presently using approximately 30%. It also holds a small irrigation allocation. The GEID also holds licenses totalling 2,219 ML for irrigation purposes and 199 ML for waterworks from Okanagan Lake and has submitted an application to increase this allocation. The raw water quality in Okanagan Lake is relatively good and is considered to be the most stable of all of the surface water sources with minimal quality excursions.

### Groundwater

Groundwater is used by four of the major suppliers and makes up a significant component of the City's overall water supply. Groundwater quality in the area is good. There are presently 23 active wells and 10 inactive wells supplying City residents. Of the active wells, 15 draw from confined aquifers, 6 draw from semi-confined aquifers, and 2 draw from unconfined aquifers. Golder Associates has recently completed the first two phases of a Groundwater Protection Plan for the Greater Kelowna Aquifer. The work done so far has involved assessing time of travel zones for each well and conducting a preliminary contaminant inventory within each of the time-of-travel capture zones. The third phase of work which remains to be completed will consist of the development of a joint management strategy, monitoring and contingency plans, as well as on-going evaluation protocols.

Currently groundwater is used as a supplemental source by the SEKID, BMID, and GEID and as the primary source by RWD. While there is documentation of significant surplus capacity, there is not an adequate quantity to serve the City's overall water supply requirements. From an area-wide perspective groundwater should continue to be used as a supplemental source to the surface water supplies.

### Mission Creek and Scotty Creek

BMID holds annual licenses totalling 22,674 ML for irrigation purposes and 5,003 ML for waterworks; the majority of which is sourced from Mission Creek. The BMID operates four storage reservoirs including Fish Hawk Reservoir, Graystoke Lake Reservoir, Ideal Lake and Loch Long to capture snowmelt runoff which is released into Mission Creek after spring runoff subsides. Mission Creek reportedly supplies approximately 30% of the total inflow to Okanagan Lake. Water quality in Mission Creek is better than most creeks in the region with the primary parameters of concern beyond the current treatment being colour, organics, protozoa, and turbidity. The Scotty Creek water supply is considered to be lower quality than Mission Creek and therefore a project is underway to separate this supply from the domestic water system within BMID.

### Kelowna Creek

GEID holds annual licenses totalling 10,940 ML for irrigation and 518 ML for waterworks from Kelowna Creek. The watershed includes Bulman, Postill, and South Lakes. Water from Kelowna Creek is supplied via pipeline to McKinley Reservoir which is an open earth reservoir used to balance system demands. Kelowna Creek water quality parameters of concern beyond the current treatment include aluminum, colour, organics, disinfection by-products (due to the organics), protozoa, and turbidity.

### Hydraulic Creek

SEKID holds annual licenses totalling 36,073 ML for irrigation and 1,824 ML for waterworks from Hydraulic Creek. The watershed includes McCulloch Reservoir, Fish, Brown, and Long Meadows Lakes and Stirling and KLO Creeks. Hydraulic Creek water quality parameters of concern beyond the current treatment include colour, organics, disinfection by-products (due to the organics), protozoa and turbidity.

## 2.2 Water Distribution Breakdown

Table 1-1 shows the 2007 breakdown in maximum day demand for each of the existing water suppliers:

**Table 1-1**
**Existing Water Demand Breakdown 2007**

| DEMAND/SUPPLIER | BMID | GEID | SEKID | RWD | CITY | TOTAL |
|---|---|---|---|---|---|---|
| Domestic MDD (ML/d) | 37<br>(7.8%) | 19<br>(4.0%) | 9<br>(1.9%) | 22<br>(4.6%) | 102<br>(21.5%) | 189<br>(39.8%) |
| Irrigation MDD (ML/d) | 111<br>(23.4%) | 49<br>(10.3%) | 126<br>(26.5%) | 0<br>(0.0%) | 0<br>(0.0%) | 286<br>(60.2%) |
| **Total MDD (ML/d)** | **148<br>(31.2%)** | **68<br>(14.3%)** | **135<br>(28.4%)** | **22<br>(4.6%)** | **102<br>(21.5%)** | **475<br>(100.0%)** |

A plan showing the overall system is shown on Figure 3-1.

## 2.3 Raw Water Quality Summary

From the available data, the following observations can be made regarding the quality of Kelowna's raw water supply sources:

- The quality of Okanagan Lake water is generally very good and satisfies most of the parameters set in the Guidelines for Canadian Drinking Water Quality (GCDWQ).
- The quality of groundwater is generally very good and satisfies all of the parameters set out in the GCDWQ.
- Turbidity spikes ranging as high as 10 NTU occur annually in Mission Creek, Kelowna Creek, and Hydraulic Creek.
- Colour levels ranging as high as 50 TCU occur annually in Mission Creek, Kelowna Creek, and Hydraulic Creek.

## 2.4 Water Treatment

The following treatment is currently used for each of the sources:

### Okanagan Lake

The City of Kelowna utilizes UV disinfection followed by chlorination at each of its Okanagan Lake intakes, although it should be noted that the treatment project underway at the Cedar Creek intake is not yet complete.

### Groundwater

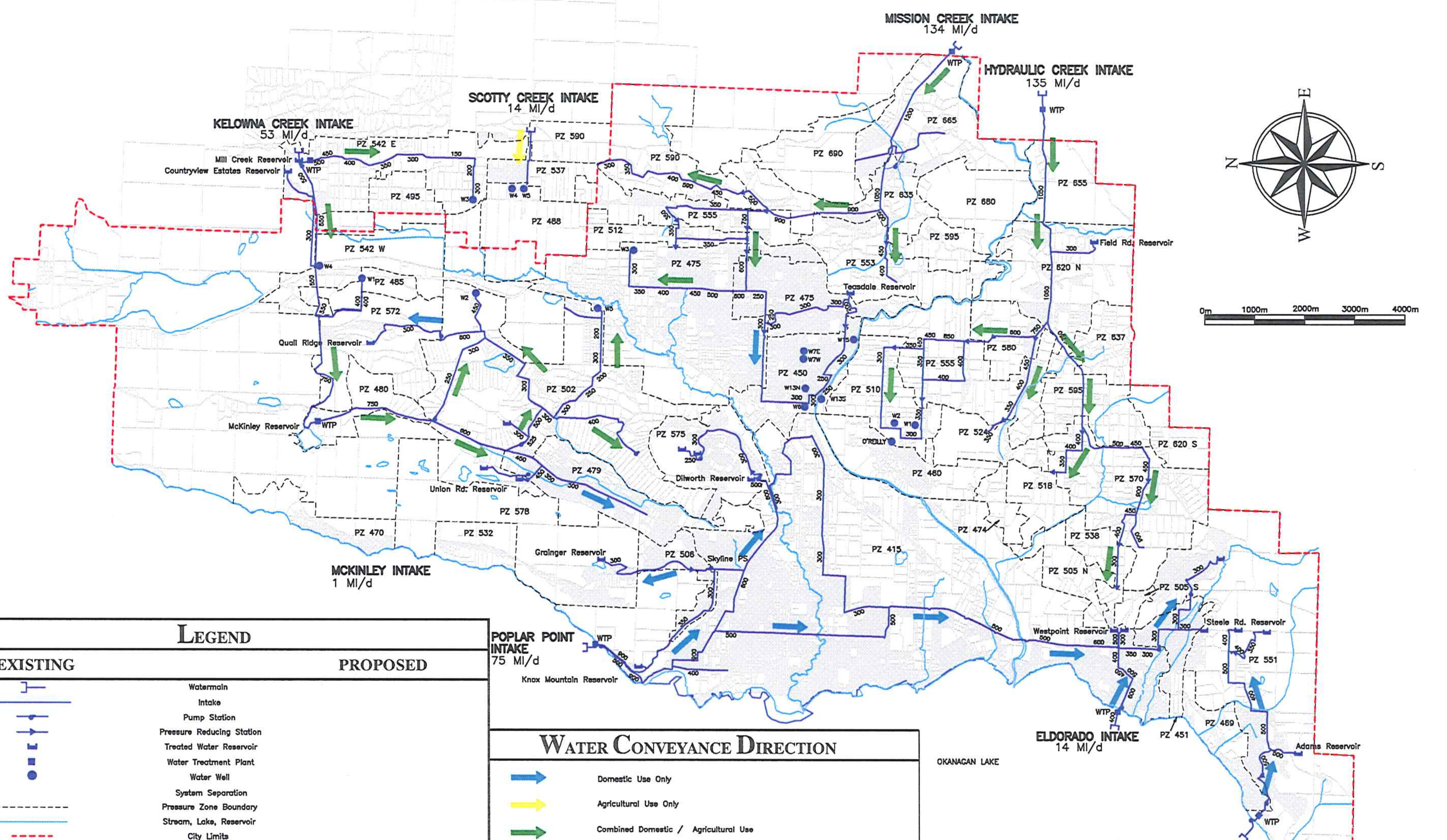
Some of the groundwater wells are chlorinated, otherwise there is no treatment for the groundwater wells.

### Kelowna Creek

GEID chlorinates water sourced from Kelowna Creek. It has plans to discontinue the use of this water to serve the Glenmore area through implementation of a new intake on Okanagan Lake. Kelowna Creek water will then be limited to serving the Ellison area..

### Mission Creek

BMID provides seasonal flocculation and clarification treatment which is used when poor water quality conditions are present in Mission Creek. It has plans to build a downstream reservoir and add UV disinfection. This approach has some inherent compromises including the fact that clarification is only part-time, that there is nothing in place to remove floc carryover or deal with process upsets, and that the system is reliant on a single process for TOC reduction.




## LEGEND

| EXISTING | | PROPOSED |
|---|---|---|
| | Watermain | |
| | Intake | |
| | Pump Station | |
| | Pressure Reducing Station | |
| | Treated Water Reservoir | |
| | Water Treatment Plant | |
| | Water Well | |
| | System Separation | |
| | Pressure Zone Boundary | |
| | Stream, Lake, Reservoir | |
| | City Limits | |

## WATER CONVEYANCE DIRECTION

- Domestic Use Only
- Agricultural Use Only
- Combined Domestic / Agricultural Use

Associated Engineering

City of Kelowna

# CITY-WIDE WATER OPTIONS

FIGURE 3-1: EXISTING SYSTEM

### Hydraulic Creek

SEKID chlorinates water sourced from Hydraulic Creek. It has plans to separate its domestic system from its irrigation system therefore dedicating the Hydraulic Creek supply for irrigation purposes only and meet the domestic demand using chlorinated groundwater except for a few services that will use Hydraulic Creek water with Point-Of-Entry (POE) treatment systems.

Of significant concern regarding existing water treatment is that Trihalomethane (THM) production exceeding 100 ug/L occurs in treated water sourced from Mission Creek, Kelowna Creek, and Hydraulic Creek. This is caused by reactions between certain organic carbon compounds in the raw water and the chlorine that is used for disinfection. Haloacetic acids (HAA), which are another group of disinfection by-products (DBPs) of concern, are also expected to be present at unacceptable levels.

# 3 Treated Water Quality Goals

## 3.1 Provincial Regulations

The province provides regulations to govern the operation of drinking water systems in British Columbia via the Drinking Water Protection Act. The province has not gone as far as other provinces in setting prescriptive standards. For water systems in the Southern Interior approval is required from Interior Health Authority (IHA). IHA's Guidelines for The Approval of Water Supply Systems states that "the overall objective is water quality that consistently meets the Drinking Water Protection Act, the Drinking Water Regulation, and the Guidelines for Canadian Drinking Water Quality".

A meeting was held with representatives of IHA at the outset of this study in July 2009 to confirm their requirements. During that meeting the IHA representatives reconfirmed the requirement to meet the GCDWQ. The IHA's own "4-3-2-1-0" guidelines are an interim device to help utilities quickly focus on the most important health-related parameters. IHA indicated at that meeting that UV treatment is considered a proven interim strategy assuming other parameters are compliant with the GCDWQ. Ultimately treatment solutions should be driven by risk assessment and public safety.

During a subsequent meeting with the City in January 2010, IHA provided guidance that if filtration deferral requirements are in place it is unlikely that filtration would be mandated for supply sourced from Okanagan Lake, however, the deferral plan and criteria would need to be reviewed annually to monitor compliance. To meet the deferral criteria, the water supplier needs to have certainty of siting (including adequate footprint) for filtration, a draft plan for the facilities, and certainty of capital to undertake the works. In the event of a subsequent non-compliance that filtration could have prevented, IHA would then request filtration to be built within a reasonable timeframe. IHA was not prepared to provide the same guidance for the uplands sources (Mission Creek, Kelowna Creek, and Hydraulic Creek) due to significant concerns regarding the water quality risks for these sources.

It is therefore recommended that the City utilize the Guidelines for Canadian Drinking Water Quality as the basis for its drinking water quality. For supply originating from Okanagan Lake initial planning can be based on utilizing UV treatment with the provision to allow future upgrading to filtration. For other surface water sources, planning should be based on implementing filtration prior to 2015. Long term planning for all surface sources, including Okanagan Lake, should be based on a filtration strategy. Planning on this basis will allow for the City and its water suppliers to be proactive in dealing with the issue of drinking water quality.

### 3.2 Water Quality Parameters

The key water quality parameters of concern for the City water treatment facilities based on the IHA "4-3-2-1-0" guidelines are as follows:

- 4-log (99.99%) inactivation of viruses
- 3-log (99.9%) removal or inactivation of *Giardia Lamblia* and *Cryptosporidium*
- 2 treatment processes for all surface drinking water systems
- Less than 1 NTU of turbidity with a target of 0.1 NTU
- 0 total and fecal coliforms and E. Coli

The turbidity requirements in the IHA objectives are not consistent with Health Canada guideline for unfiltered water as the IHA guidelines do not appear to differentiate turbidity requirements for filtered versus unfiltered supplies. The IHA guidelines, however, appear more flexible regarding protected watershed requirements when considering deferral of filtration.

Measured source water levels for *Giardia* and *Cryptosporidium* at intake depth in Okanagan Lake are low. Therefore the minimum 3-log reduction levels have been assumed for water sourced from Okanagan Lake. Source water levels of *Giardia* and *Cryptosporidium* in Mission Creek, Kelowna Creek, and Hydraulic Creek are unknown. Building an accurate and dependable profile of *Giardia* cyst and *Cryptosporidium* oocyst concentrations takes time. A testing regime is recommended to confirm the assumed levels of these protozoa in these sources if they are to continue to be used for drinking water purposes.

The IHA Drinking Water Officer commented during the initial meeting that the objective is to achieve compliance with the GCDWQ. The 4-3-2-1-0 Objectives are a step in that direction. Therefore, in moving forward, it would be wise to review where the GCDWQ guidelines are going as that will be a good indication of future requirements. Of particular note is the setting in 2008 of 0.080 mg/L as the limit for Haloacetic Acids (HAA's). HAA's are by-products of chlorination and are commonly formed in waters with high levels of organic carbon. The IHA Drinking Water Officer indicated that this should be included as part of long term planning. There is presently no data available regarding the formation of HAA's in the Kelowna water supplies but as noted in Section 2.3, based on THM data HAA's are expected to be present at unacceptable levels in the chlorinated uplands water supplies.

### 3.3 Filtration Deferral

In February 2008 the IHA published an Issue Paper defining the criteria for the "Deferral of Filtration". As described in more detail in the Water Quality Improvement Plan Overview report, the following are the basic requirements that must be met in order for a water source to be considered for deferral of filtration:

a) 4-log removal or inactivation of viruses and 3-log inactivation of protozoa is achieved using a minimum of 2 disinfection processes.

b) A watershed control program designed with the express purpose of minimizing fecal contamination in the source water is being implemented. Watershed control programs expressly intended to minimize fecal contamination can be accomplished by completing appropriate modules of the Comprehensive Source to Tap Assessment Guide developed by MOE and MOH. Modules appropriate to the water supply system will be identified by the DWO (basically Modules 1, 2, 7 and 8) and may be included in conditions of the operating permit.

c) Background baseline levels of Cryptosporidium and Giardia, adequate to establish trends, have been established.

d) No more than 10% of source/raw water E.coli samples exceed 20/100 mL in any 6-month period.

e) No more than 10% of source/raw water total coliform samples exceed 100/100 mL in any 6-month period.

f) Turbidity in source immediately before disinfection does not exceed 1NTU 95% of the time in any 30-day period.

g) Peak turbidity readings do not exceed 5NTU for more than 2 days in a 1-year period.

h) Expected average annual total Trihalomethanes at locations farthest from treatment will not exceed 0.100 mg/L or 100 µg/L.

UV disinfection with chlorine achieves requirement a) providing that the source water is of sufficiently good quality for the processes to be technically feasible. Okanagan Lake water would be sufficiently good. There is a significant concern as to whether or not uplands source water would be good enough depending on the transmittance and turbidity. Monitoring must be done to achieve requirements c) to h).

### 3.4 Future Regulatory Changes

The science behind drinking water safety is constantly developing. Thus, water suppliers are faced with a moving target. There is an inherent risk that if water supplies are developed to barely meet the current standards, they will find themselves out of compliance sometime in the future due to regulatory changes. Sometimes facilities are "grandfathered" in when standards change if the regulator considers the change non-critical. However, recent experience suggests that regulators are less likely to take this approach than they may have previously been.

Health Canada provides a list of what is currently being investigated for consideration for the GCDWQ. This list was included in the 2009 Water Quality Improvement Plan Overview report. Other good sources of information regarding upcoming water treatment trends include the U.S. EPA, the World Health Organization, other regulatory bodies such as those in Europe and Australia and industry research groups such as the Water Research Foundation.

# 4 Water Treatment

## 4.1 Water Treatment Strategy Considerations

Selecting the treatment strategies for Kelowna water systems encompasses some unique challenges. The systems supply two diverse customer groups. The domestic water customer group includes residential, commercial, and industrial users who utilize the supply for drinking water and other uses. These customers require water treated in accordance with the GCDWQ. The agricultural irrigation water customer group includes farms, vineyards, and orchards which utilize the supply for agricultural irrigation purposes. These customers require large quantities of water that essentially does not require any treatment other than possibly provision of a disinfectant to prevent significant biological growth within the distribution system.

System planning and water treatment process selection therefore needs to take into account the following considerations:

- Recognition that peak summer demands are several times average winter demands with the majority of the peak being created by the agricultural irrigation component.
- Recognition that 80% of the domestic demand originates at elevations less than 430 m ASL (PZ 480) while 80% of the irrigation demand originates at elevations greater than 430 m ASL.
- Separation of the agricultural irrigation component from the domestic supply as much as possible in order to reduce the size and associated costs for the treatment facilities.
- Optimizing utilization of the best quality sources for the domestic supply thereby reducing the treatment requirements and costs. While groundwater is generally of good quality there are insufficient amounts to meet the domestic demands, therefore it should continue to be used as a supplemental supply.
- Diversification and interconnection of the supply and treatment facilities thereby allowing supply to continue during a major contamination event or failure at one of the supplies.
- Designing the process for worst-case water conditions, while protecting against making the process unnecessarily complex and inefficient for water conditions encountered most of the time.

The intent is to design water treatment facilities that treat the combined range of water quality and quantity demands encountered throughout the year. The water treatment facilities would operate at lower capacity during periods of poor raw water quality to handle the increased loading on the processes.

For the Kelowna area the water quality parameters having the highest impact on treatability are organic carbon and turbidity both of which typically peak during spring runoff when water demands are about average. For Okanagan Lake water the peaks of these parameters generally fall within the CGDWQ and therefore are not a concern. For the other surface supplies however the peaks are significant and will require more robust treatment process selection than Okanagan Lake.

Therefore for the purposes of design, the treatment processes can be sized to handle the worse of two conditions:

- The worst organic carbon and turbidity spikes for the projected peak Spring daily demand, which approximately corresponds to average water demands; or
- Average organic carbon and turbidity levels for the projected maximum day demand, which correspond to peak summer demands.

Residuals management processes will also need to operate for longer periods of time during the poor raw water conditions. For example: Depending on the selected process, filter cleaning or backwashing operations will need to be performed more frequently during instances of exceptionally high turbidity.

Selection of the treatment processes should also take into account other risk factors associated with the City's water supply.

## 4.2 Residuals Management Considerations

Each of the filtration processes that would be suitable for the surface water supply sources will generate significant volumes of liquid and solid wastes. In the past, water treatment facilities frequently used the source water body or the municipal sewage system for disposal of residuals. That practice is no longer preferred. Beyond the fact that there may not be a sewer system in close proximity to the plant, the most environmentally responsible approach is to minimize the requirements for offsite disposal of process residuals. The concepts presented herein are therefore based on providing onsite treatment and handling of most of the liquid waste stream with consideration of options for onsite handling of all liquid wastes.

Human activity at the plant will result in the generation of small quantities of human and other related wastes. Handling and treatment of these may be more challenging if a sanitary sewer system is not available although onsite options are available. The final decision on these should ultimately be based on cost/benefit considerations, although that level of detail is beyond the scope of this study.

The non-sanitary solid wastes will have to be disposed at a landfill unless an opportunity for reuse is identified, therefore process selection should be based on reducing the volume of solid wastes.

## 4.3 Treatment Options and Approach

Based on the available water quality data, it was determined that the main water quality parameters that would need to be addressed by the water treatment plant are pathogens, turbidity and organic carbon.

The water treatment facilities will be developed with the following design objectives:

- Consistently treat sufficient water to satisfy the projected treated water MDD.
- Incorporate particulate removal processes to consistently produce treated water conforming with the requirements set out in Section 4.
- Select treatment processes capable of reducing organics in the water.
- Provide suitable disinfection.
- Include provision for alkalinity and pH adjustment, if required, for corrosion control and/or aluminum residual control.

Treatment processes considered in this study generally comprise of the following unit processes in various combinations:

a) *Chemical Coagulation and Mixing:* Application of a primary metal coagulant to improve colloid and organics removal and increase downstream process efficiency.

b) *Flocculation:* Application of gentle mixing for an appropriate length of time to produce a Floc optimized for the subsequent treatment process.

c) *Clarification*: Utilization of gravity forces or flotation to remove flocculated solids and organic matter from the water to improve filter performance.

d) *Filtration:* Utilization of either granular media or membrane technology to remove particles remaining in the water after clarification.

e) *Primary Disinfection:* Utilization of a disinfection process to inactivate micro-organisms including viruses, bacteria, and some or all protozoa.

f) *Secondary Disinfection:* Utilization of a chlorine based chemical to ensure an adequate residual in the supply and distribution system.

g) *Corrosion Control:* Chemical conditioning to adjust alkalinity and adjust the pH to reduce corrosion in the supply and distribution system.

h) *Treated Water Storage:* Provision of storage to allow disinfectant contact time to meet treatment process disinfection contact time requirements in addition to treatment process water supply storage for inventory management, in-plant water use and operational process control.

i) *Residuals Management:* Utilization of a treatment process to assist in managing and disposing of residual products from the main treatment process and optional re-use of recovered waste water.

As noted in Section 3.1, for Okanagan Lake one solution considered acceptable to IHA (subject to Filtration Deferral approval) would include two stage disinfection utilizing UV disinfection followed by chlorination assuming the source water meets all other criteria set out in the GCDWQ and by IHA and that provisions are included to allow subsequent upgrading to filtration. It is important, for the purpose of this study, to seriously consider the fact that Filtration Deferral could be retracted in the future should source water quality change or the regulatory environment change.

For sources requiring filtration, three basic treatment schemes have been identified that could be capable of satisfying the above criteria for the sources under consideration:

- **Direct Filtration:** Incorporating chemical coagulation and mixing, flocculation, granular media filtration, UV primary disinfection, chlorine disinfection, and treated water storage. Based on current available water quality data this technology would only be considered suitable for the Okanagan Lake supply.

- **Conventional Treatment:** Incorporating chemical coagulation and mixing, flocculation, clarification, granular media filtration, chlorine disinfection, and treated water storage. This technology is considered suitable for water withdrawn from creeks originating from uplands surface sources.

- **Membrane Filtration:** Incorporating chemical coagulation and mixing, flocculation, membrane filtration, chlorine disinfection, and treated water storage. For water withdrawn from creeks originating from the uplands sources, pre-treatment involving chemical coagulation, mixing, and flocculation will be required upstream of the membrane filtration process. It is not expected that this pre-treatment would be required for water withdrawn from Okanagan Lake.

Membrane filtration was selected as the basis for developing cost estimates and comparing options. It should be noted that there is no water treatment process piloting data for any of the sources under consideration except for Okanagan Lake. Therefore process selection has been based on utilizing engineering judgement and experience from other projects utilizing similar quality sources. This included making broad assumptions regarding process loading rates. All of these factors should eventually be proven through piloting in order to confirm treatment technology suitability and costs.

### 4.4 Plant Hydraulics Impact on Overall System Hydraulics

The water treatment processes involving disinfection only (groundwater) would have minimal headloss through the treatment process. For the purposes of comparing options at this level of detail it can be assumed that the headloss for disinfection processes is zero. The membrane process would be primarily gravity driven, with the exception of permeate pumps downstream of the submerged membranes or membrane feedwater pumps upstream of the pressurized membranes.

It was assumed that the pumps would be sized to produce just enough head to compensate for losses through the membranes and fine strainers, in order to minimize pump power requirements.

The treatment plant would include a clearwell from which the treated water would be delivered into the distribution system to meet demands. In a worst-case scenario where the treatment plant is operating but the clearwell is nearly empty, the headloss would total approximately 5 m TDH (assuming a 5 m clearwell depth). The overall system hydraulics needs to take into consideration the scenario where the clearwells are near empty which could occasionally occur during rapidly changing demand conditions.

# 5 Water Demands

## 5.1 Approach

Existing development levels and design criteria were analyzed in order to determine the appropriateness of existing design criteria. Current demands reference 2007 demands based on available information. The City of Kelowna provided a list of future developments within the city to project demands to 2030. These current and future demands were used to compare water supply and treatment options for comparison purposes rather than developing a detailed plan. Therefore this study did not include an exhaustive analysis of demand criteria, but focused on historical demand trends and patterns as well as the potential impact of future development and conservation initiatives to develop a probable demand scenario to year 2030. This scenario will be used as the basis for comparing water supply and treatment options.

## 5.2 Historical Demands

The KJWC 2005 Strategic Water Servicing Plan provided information on historical water consumption for each of the water systems to the year 2004. Basically the trend from 1991 to 2004 indicated an extremely flat water demand increase due primarily to demand flattening/reductions in the RWD, SEKID, and the City utility. These demand characteristics are considered to have been due to a combination of education, metering, movement toward more effective pricing, and operational efficiency improvements despite significant development growth which occurred during this period.

## 5.3 Development Projections

The City of Kelowna 2030 draft OCP was used as the basis for projecting the planned and potential development through 2030. The information provided by the City Planning Department projects a total of 12100 multi-family units and 8900 single family units. Technical Memorandum No. 1-2 includes a table showing a detailed breakdown of projected new development location and number of units (connections).

### 5.4 Projected Water Demands

Table 5-1 shows the combined demands projected for the year 2030 within the areas serviced by each of the water suppliers.

**Table 5-1**
**Year 2030 Water Demand and Population Projections**

| | BMID | GEID | SEKID | RWD | CITY | TOTAL |
|---|---|---|---|---|---|---|
| Single Family Connections | 7,510 | 5,340 | 2,050 | 4,100 | 18,450 | 37,450 |
| Multi Family Connection | 3,700 | 2,200 | 0 | 1,150 | 25,250 | 32,300 |
| ICI Connections | 970 | 30 | 0 | 170 | 2,550 | 3,720 |
| Total Domestic Connections | 12,180 | 7,570 | 2,050 | 5,420 | 46,250 | 73,470 |
| Density (Persons/Connection) | 2.4 | 2.5 | 3 | 2.8 | 2.0 | 2.2 |
| Serviced Population | 28,950 | 19,020 | 6,150 | 15,160 | 95,550 | 164,830 |
| Irrigated Area (ha) | 2,070 | 1,780 | 2,349 | 0 | 0 | 6,090 |
| Domestic MDD (ML/d) | 57 | 28 | 9 | 24 | 153 | 272 |
| Irrigation MDD (ML/d) | 111 | 49 | 126 | 0 | 0 | 286 |
| **Total MDD (Ml/d)** | **168** | **77** | **135** | **24** | **153** | **558** |

The projected 2030 City-wide demand represents an increase from the current estimated maximum day demand of 475 ML/d to 558 ML/d for an increase of 83 ML/d (17.5%). This represents a 0.7% annual increase in water demand compared to the projected population growth rate of 1.6% over the same period. The reduced water demand growth rate is largely due to the fact that irrigation demands are projected to remain unchanged and both domestic and agricultural irrigation water demands will benefit from improved water use efficiency.

# 6 Water Supply and Treatment Options

## 6.1 Kelowna Joint Water Committee

As outlined in Section 2, the City of Kelowna includes five major suppliers and a number of smaller water supply systems supplying water to various well defined service areas within the City. This section focuses on options available to jointly supply water to the five major systems including City of Kelowna Water Utility, Rutland Waterworks District (RWD), Black Mountain Irrigation District (BMID), Glenmore-Ellison Irrigation District (GEID), and South East Kelowna Irrigation District (SEKID).

Each of the suppliers has developed a capital plan to undertake and finance improvements to their water supply and treatment facilities. In 2005 the KJWC commissioned Agua Consulting Inc. and Mould Engineering to prepare the 2005 Strategic Water Servicing Plan which combined the capital upgrade plans into a single area wide servicing plan. In 2008 the KJWC commissioned Associated Engineering to carry out a strategic review of water supply and treatment direction for the five drinking water utilities making up the KJWC. That study outlined several technical options that could be considered in the KJWC's future planning.

## 6.2 Area Wide System Issues

The following briefly summarizes some of the key issues relative to the existing area wide supply and treatment systems:

- The current water treatment practices employed by four of the five suppliers do not comply with IHA requirements. It should be noted however that each of these suppliers are planning water treatment upgrades based on a long term staged approach.
- Using common water supply and treatment infrastructure to meet both domestic and agricultural demands results in increased water treatment chemical use, increased operation & maintenance costs, and water treatment infrastructure upgrade costs.
- While some of the five systems include links to other systems, these links are relatively weak in comparison to the overall demand and leaves these systems vulnerable in the event of a major supply interruption event.
- The SEKID system does not include any links to other systems and, over the past two years, has experienced a significant decline in raw water supply storage which could have impacted its ability to meet demand in 2010 or 2011. Wet weather in spring of 2010 has alleviated this situation.
- Some of the systems have very limited treated water storage capacity which increases their vulnerability in the event of a short term supply interruption/reduction, equipment failure, or major fire.

## 6.3 Options Development Approach

Some basic tenets have been used as a basis for conceptualizing the options to be analyzed for the City-wide water supply. These tenets are outlined below.

### 6.3.1 Robustness of Supply

Three of the existing systems (BMID, GEID, and SEKID) are largely dependent on a single intake and source of surface supply although they do have limited groundwater supply capability and small capacity interconnections to other systems for two of these suppliers. This leaves them vulnerable in the event of the loss of their primary supply either through drought condition, contamination, or loss of the supply pipeline. Large City drinking water distribution systems commonly include more than one supply intake (which Kelowna has) and system reinforcement to allow water to be delivered throughout the system from at least two points of supply (which Kelowna does not have). The majority of water for the City system is supplied from Poplar Point. While the City has other intakes, the supply from these other intakes is not available to large parts of the City making the dependence on this single source an inherent weakness of the system.

### 6.3.2 Affordability and Cost Effectiveness

The system has to be affordable and cost effective. Affordability is difficult to define especially for different user groups. Based on a survey of 11 Canadian municipalities conducted as part of the KJWC Water Quality Improvement Plan Overview, the Kelowna water suppliers' average monthly billing for domestic water consumption is generally lower than 9 of those municipalities even though per capita consumption in Kelowna is generally higher.

Agricultural users however depend on the water supply for their livelihood and use much more water than domestic users. Therefore a cost adjustment which may be perceived as small to the domestic users could have a much more significant impact on agricultural users. Anything that can be done to reduce costs to these agricultural users has a significant impact on their bottom line. Water treatment facility operation and maintenance costs have a larger impact on user fees than capital costs. Therefore cost effectiveness will be measured based on life cycle costs in lieu of initial capital costs alone.

### 6.3.3 Centralization of Domestic Supply, Treatment and Distribution

The current water supply planning for the various water suppliers has been based on a decentralized approach, i.e. each supplier has developed what it believes to be the most effective supply and distribution system for its local customers. The focus of this study has been to develop more centralized concepts for the domestic supply and distribution to evaluate the benefits and issues associated with more centralized approaches in comparison to the current approach. The concepts have been developed with an eye to servicing zones having reasonably similar HGL elevations from a common supply where the topography and proximity allow this to be feasibly achieved. They are also based on maximizing the use of the existing supply infrastructure wherever possible.

### 6.3.4 Separation of Domestic and Agricultural Irrigation Systems

The three primary uses of water within the City of Kelowna involve the use of water for domestic/commercial purposes, fire protection, and for irrigation. Domestic/commercial use typically includes indoor water use (for residential, commercial, and institutional users) including drinking and food preparation, bathing, washing, sanitary waste, etc. and is drawn year-round. Irrigation typically includes outdoor water use including landscape irrigation and agricultural irrigation and is drawn seasonally.

Of the City's total water supply, approximately 60% of the maximum day demand (the demand for which the supply and treatment facilities are sized) is attributable to agricultural irrigation. Water used for this agricultural irrigation or fire protection requires minimal treatment, if any, however water used for domestic/commercial purposes requires treatment to meet potable standards which involves significant power and chemical use. Therefore, anything that can be done to separate the agricultural supply from the domestic supply will allow significant reductions in power and chemical consumption, reduce residuals production, and provide a more sustainable long term solution for the City's supply.

### 6.3.5 Agricultural Irrigation Supply and Distribution Strategy

As previously noted agricultural irrigation demand represents the highest single customer demand group within the City and the majority of this demand occurs within higher elevation areas around the periphery of the City. This demand will therefore be most efficiently met through utilization of the highest elevation sources of supply having the available capacity. It is clear, from our review, that the supply sources and infrastructure currently serving the agricultural irrigation demand group better meets these requirements than any other option.

The concepts developed herein have therefore been based on continuing to supply the agricultural irrigation demands utilizing the existing supply sources and infrastructure with minimal change. To provide more robustness to the agricultural irrigation systems, interconnections should be provided to the domestic system at strategically selected locations to allow emergency supply in the event of a system component breakdown or failure. These connections should include backflow prevention devices and air-breaks to prevent backflow into the domestic system during normal operating conditions.

### 6.3.6 Water Treatment Strategy

Water used for domestic purposes requires treatment in accordance with IHA's requirements, should conform to the GCDWQ, should be aesthetically pleasing to the end users, and should provide an equivalent level of water quality to all customers. Water from different sources must be able to intermix within the distribution system. Groundwater should continue to be used as a supplemental supply, however, the majority of the domestic demands will have to be supplied from surface water sources. Based on consultation with IHA as outlined in previous sections herein, two treatment strategies have been developed for the domestic demand component as follows:

*Filtration:* Provision of filtration for all domestic water withdrawn from surface water sources.

*Okanagan UV – Uplands Filtration:* Provision of UV treatment for all domestic water withdrawn from Okanagan Lake and filtration for all water withdrawn from uplands water sources.

Water used strictly for agricultural irrigation purposes requires no treatment. All existing irrigation supply systems are equipped with chlorination facilities. The continued application of a small dose of chlorine (but lower than presently applied) would control biological growth in the irrigation supply system thereby maintaining hydraulic efficiency. We therefore believe that it would be prudent to keep the existing chlorination facilities in place for the agricultural irrigation supply.

## 6.4 System Options

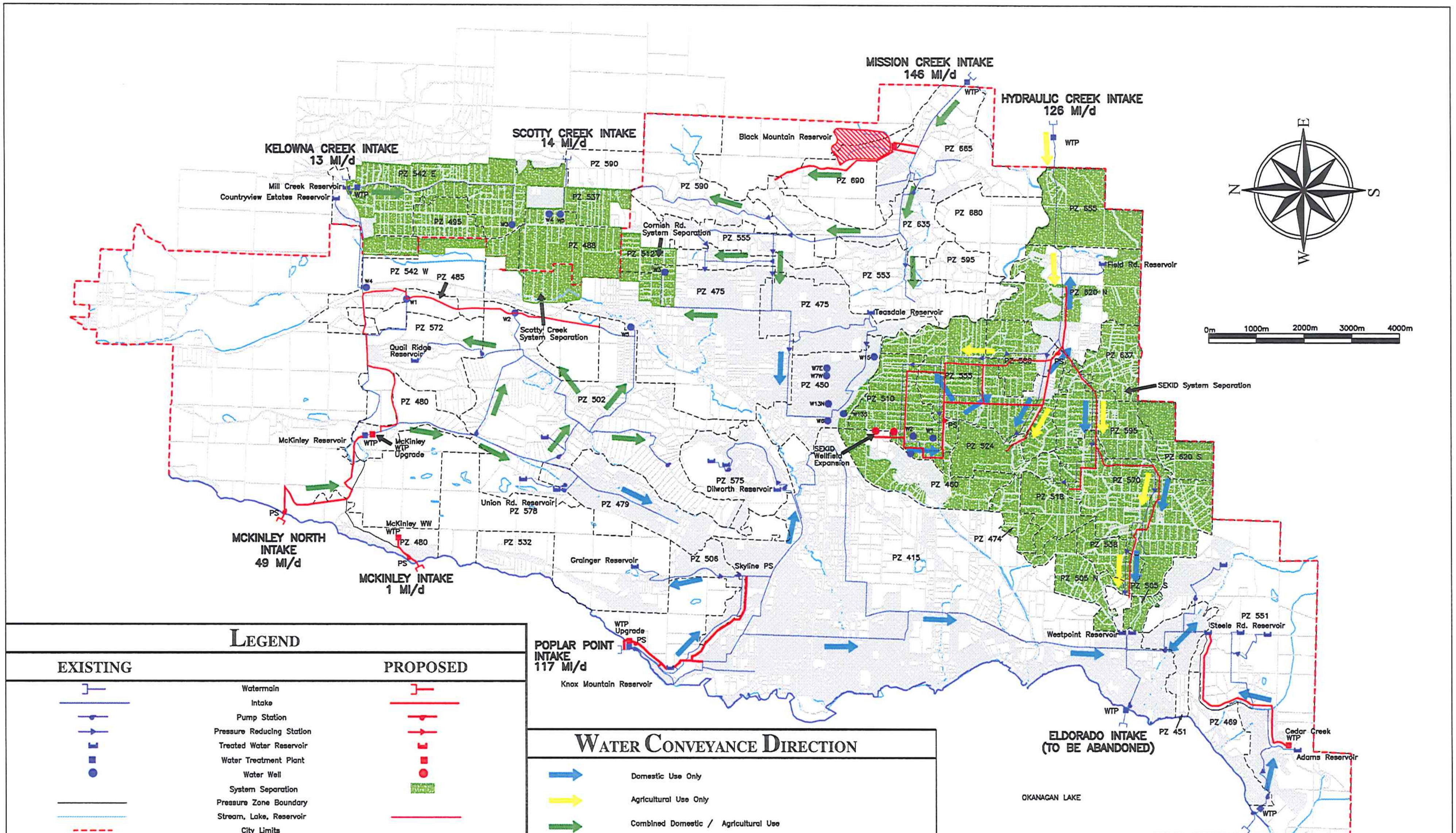
Five system options were prepared to a conceptual level of detail. Of these options, Option 1 was based on the consultant team's understanding of the five water suppliers' long-term plans. The other four options were developed to address the area wide system issues noted in Section 6.2 and applying the tenets noted in Section 6.3. Plans showing the components included in each of the options are included herein as well as in Technical Memorandum No. 1-3. The technical memorandum also includes more detailed descriptions of each of the options. The options developed herein are based on providing the infrastructure required to address the long-term water supply and treatment requirements, but not internal distribution upgrades, which would be common to all of the options.

### 6.4.1 Option 1 – Current Plan

Option 1 is shown on Figure 3-2. Water supply would be largely based on the plans set out in the 2005 KJWC Strategic Water Servicing Plan. The supply and distribution system planning would be left as proposed in the 2005 Plan (except for SEKID which has since developed a new strategy), however the treatment strategy would be revised to comply with IHA's updated requirements. Refer to Table 6-1 for a breakdown in projected 2030 demands and treatment plant capacity based on our understanding of the current strategy:

**Table 6-1**
**Option 1 – Supply Summary**

| Source/Intake | Domestic Demand ML/d | Irrigation Demand ML/d | WTP Capacity ML/d |
|---|---|---|---|
| Cedar Creek Intake | 36 | - | 36 |
| Eldorado Intake | - | - | - |
| Poplar Point Intake | 117 | - | 117 |
| McKinley Intake | 1 | - | 1 |
| McKinley North Intake | 13 | 36 | 49 |
| Kelowna Creek Intake | - | 13 | 13 |
| Scotty Creek Intake | - | 14 | - |
| Mission Creek Intake | 57 | 89 | 146 |
| Hydraulic Creek Intake | - | 126 | - |
| Groundwater | 48 | 8 | - |

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City of Kelowna

# CITY-WIDE WATER OPTIONS

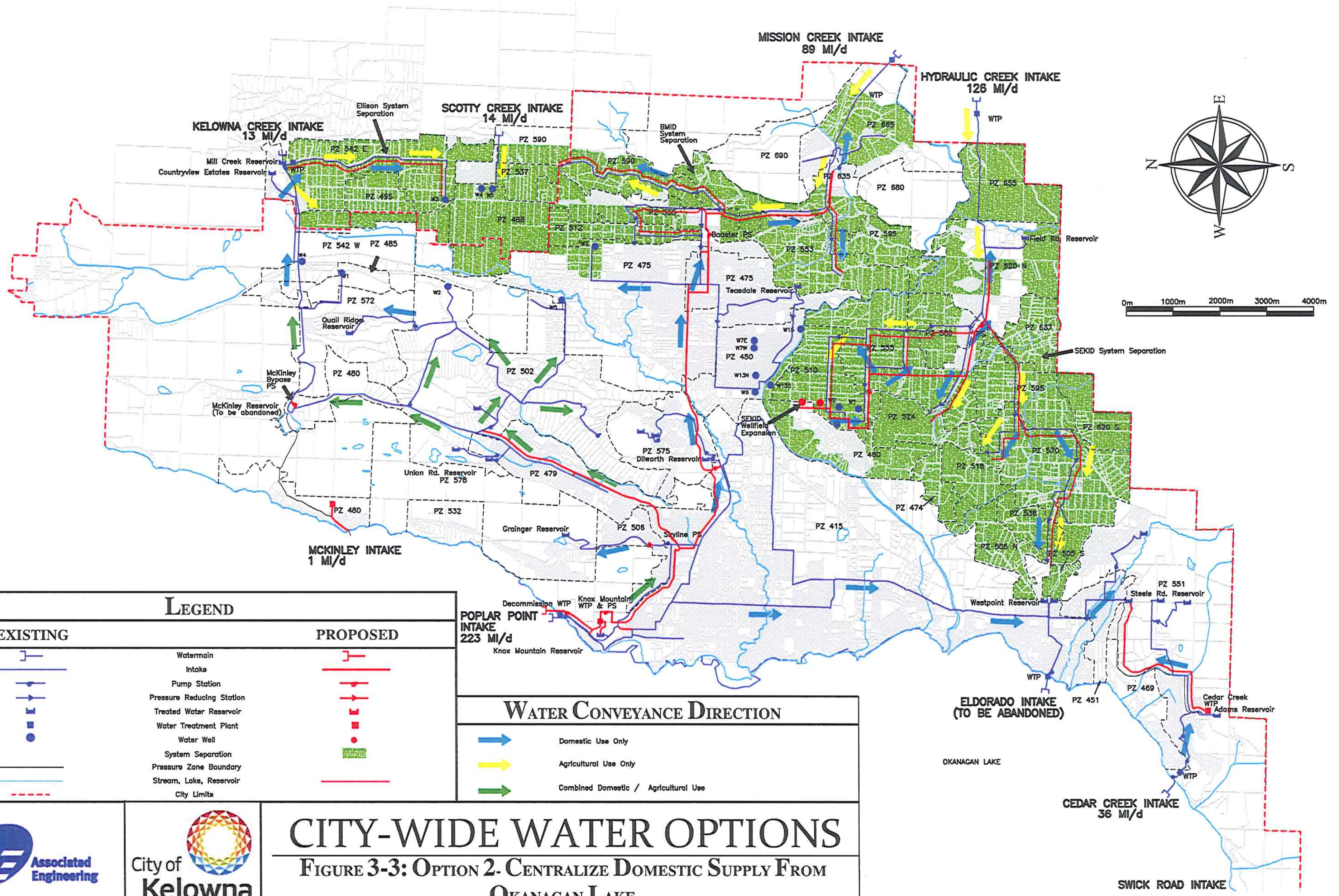
**FIGURE 3-2:**
**OPTION 1: CURRENT PLAN**

### 6.4.2 Option 2 – Centralize Domestic Supply from Okanagan Lake

Option 2 is shown on Figure 3-3. The majority of the domestic supply including the City utility, GEID service area, and BMID service area would be sourced from Okanagan Lake at the Poplar Point and Cedar Creek intakes. The majority of the BMID agricultural irrigation service area would be separated utilizing a small diameter domestic distribution system. The SEKID irrigation service area would be separated similar to Option 1. The RWD service area would continue to be supplied via the existing groundwater supply but the system would be bolstered utilizing water sourced from Okanagan Lake. Refer to Table 6-2 for a breakdown in projected year 2030 demands and treatment plant capacity:

**Table 6-2**
**Option 2 – Supply Summary**

| Source/Intake | Domestic Demand ML/d | Irrigation Demand ML/d | WTP Capacity ML/d |
|---|---|---|---|
| Cedar Creek Intake | 36 | - | 36 |
| Eldorado Intake | - | - | - |
| Poplar Point Intake | 187 | 36 | 223 |
| McKinley Intake | 1 | - | 1 |
| Kelowna Creek Intake | - | 13 | - |
| Scotty Creek Intake | - | 14 | - |
| Mission Creek Intake | - | 89 | - |
| Hydraulic Creek Intake | - | 126 | - |
| Groundwater | 48 | 8 | - |




## Legend

| EXISTING | | PROPOSED |
| --- | --- | --- |
| | Watermain | |
| | Intake | |
| | Pump Station | |
| | Pressure Reducing Station | |
| | Treated Water Reservoir | |
| | Water Treatment Plant | |
| | Water Well | |
| | System Separation | |
| | Pressure Zone Boundary | |
| | Stream, Lake, Reservoir | |
| | City Limits | |

## Water Conveyance Direction

- Domestic Use Only
- Agricultural Use Only
- Combined Domestic / Agricultural Use

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City of Kelowna

# CITY-WIDE WATER OPTIONS

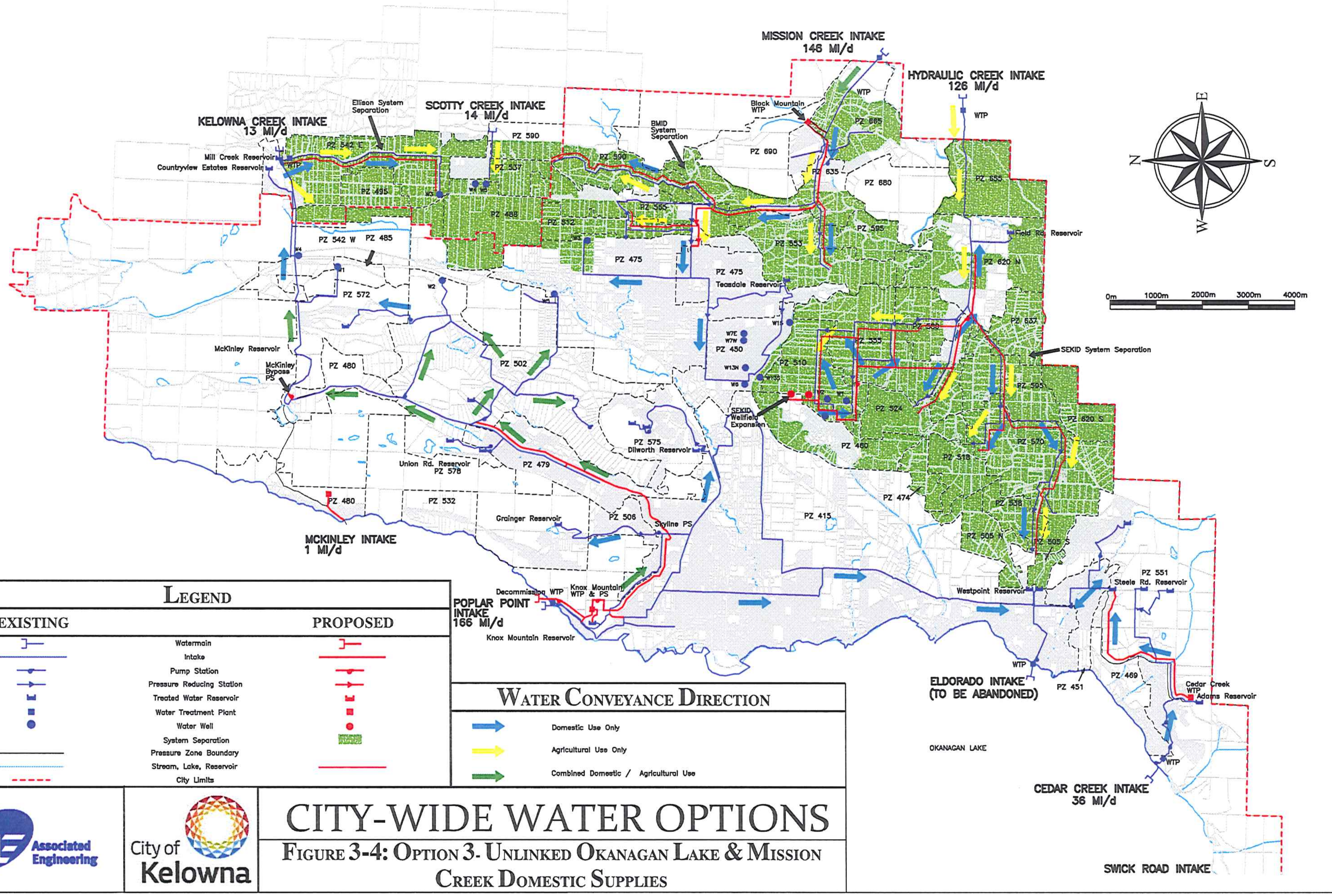
**Figure 3-3: Option 2- Centralize Domestic Supply From Okanagan Lake**

### 6.4.3 Option 3 – Unlinked Okanagan Lake and Mission Creek Domestic Supplies

Option 3 is shown on Figure 3-4. The City utility and GEID service area domestic supply would be sourced from Okanagan Lake and the BMID service area would be sourced from Mission Creek where water treatment facilities would be provided. The majority of the BMID agricultural irrigation service area would be separated utilizing a small diameter domestic distribution system. The SEKID irrigation service area would be separated similar to Option 1. The RWD service area would continue to be supplied via the existing groundwater supply. Refer to Table 6-3 for a breakdown in projected year 2030 demands and treatment plant capacity:

**Table 6-3**
**Option 3 – Supply Summary**

| Source/Intake | Domestic Demand ML/d | Irrigation Demand ML/d | WTP Capacity ML/d |
|---|---|---|---|
| Cedar Creek Intake | 36 | - | 36 |
| Eldorado Intake | - | - | - |
| Poplar Point Intake | 130 | 36 | 166 |
| McKinley Intake | 1 | - | 1 |
| Kelowna Creek Intake | - | 13 | - |
| Scotty Creek Intake | - | 14 | - |
| Mission Creek Intake | 57 | 89 | 57 |
| Hydraulic Creek Intake | - | 126 | - |
| Groundwater | 48 | 8 | - |




# LEGEND

| EXISTING | | PROPOSED |
|---|---|---|
| | Watermain | |
| | Intake | |
| | Pump Station | |
| | Pressure Reducing Station | |
| | Treated Water Reservoir | |
| | Water Treatment Plant | |
| | Water Well | |
| | System Separation | |
| | Pressure Zone Boundary | |
| | Stream, Lake, Reservoir | |
| | City Limits | |

## WATER CONVEYANCE DIRECTION

- Domestic Use Only
- Agricultural Use Only
- Combined Domestic / Agricultural Use

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City of Kelowna

# CITY-WIDE WATER OPTIONS

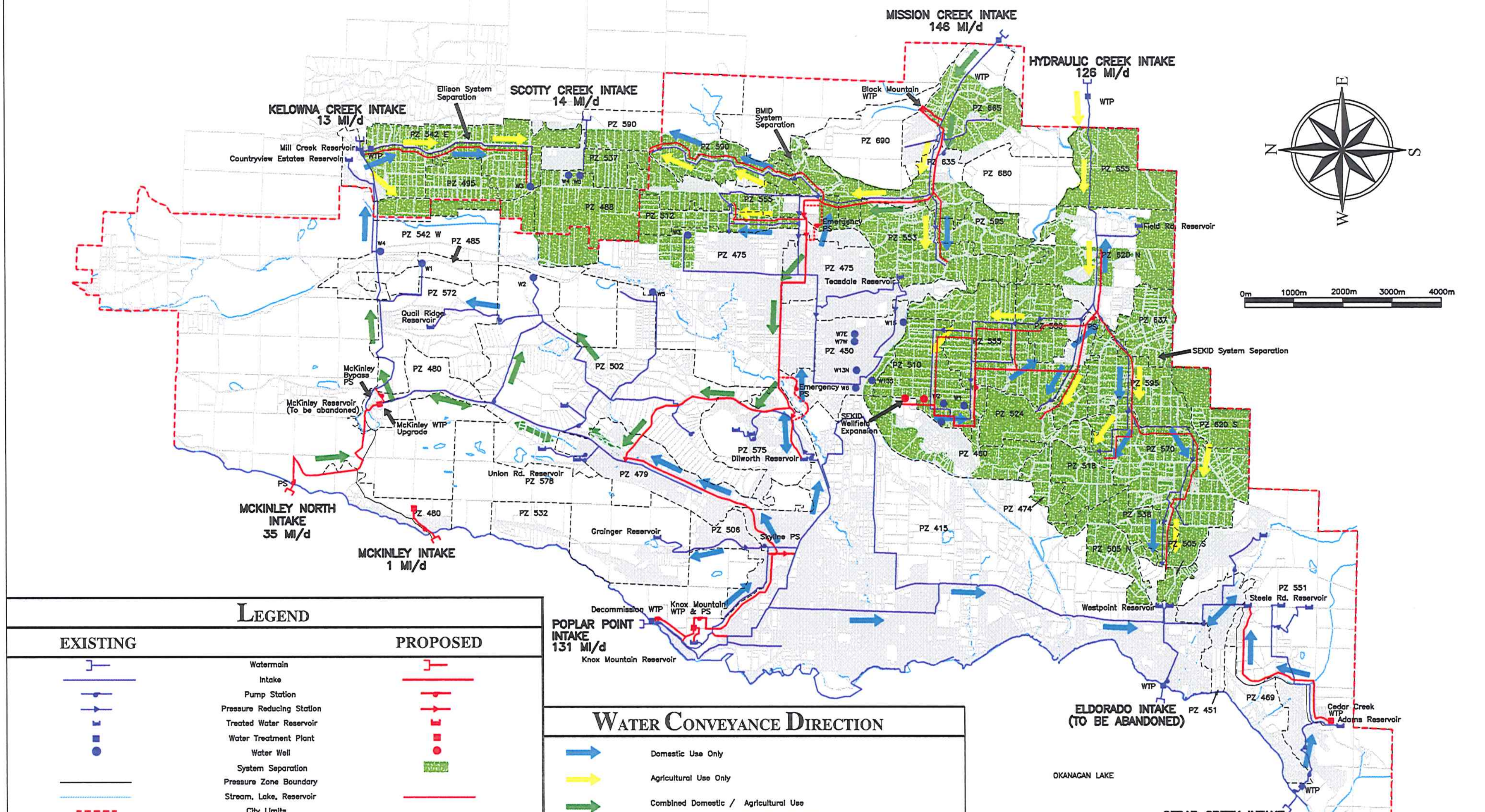
## FIGURE 3-4: OPTION 3- UNLINKED OKANAGAN LAKE & MISSION CREEK DOMESTIC SUPPLIES

### 6.4.4 Option 4 – Joint Okanagan Lake and Mission Creek Domestic Supply – Supply North Areas from McKinley Landing

Option 4 is shown on **Figure 3-5**. This option is similar to Option 3 except that the two sources of supply would be interlinked via an east-west transmission pipeline. Normally the BMID service area would be sourced from the Mission Creek intake for the majority of the year and the GEID service area sourced from an additional intake at McKinley Landing supplying water to a treatment plant adjacent to McKinley Lake. This intake system could be operated full time or used primarily as a peaking facility to operate only on a seasonal basis during summer months. The majority of the BMID and GEID (Ellison) agricultural irrigation service area would be separated utilizing a small diameter domestic distribution system. The SEKID irrigation service area would be separated similar to Option 1. The RWD service area would continue to be supplied via the existing groundwater supply. Refer to **Table 6-4** for a breakdown in projected year 2030 demands and treatment plant capacity:

**Table 6-4**
**Option 4 – Supply Summary**

| Source/Intake | Domestic Demand ML/d | Irrigation Demand ML/d | WTP Capacity ML/d |
|---|---|---|---|
| Cedar Creek Intake | 36 | - | 36 |
| Eldorado Intake | - | - | - |
| Poplar Point Intake | 128 | 3 | 131 |
| McKinley Intake | 1 | - | 1 |
| McKinley North Intake | 2 | 33 | 35 |
| Kelowna Creek Intake | - | 13 | - |
| Scotty Creek Intake | - | 14 | - |
| Mission Creek Intake | 57 | 89 | 57 |
| Hydraulic Creek Intake | - | 126 | - |
| Groundwater | 48 | 8 | - |

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# CITY-WIDE WATER OPTIONS

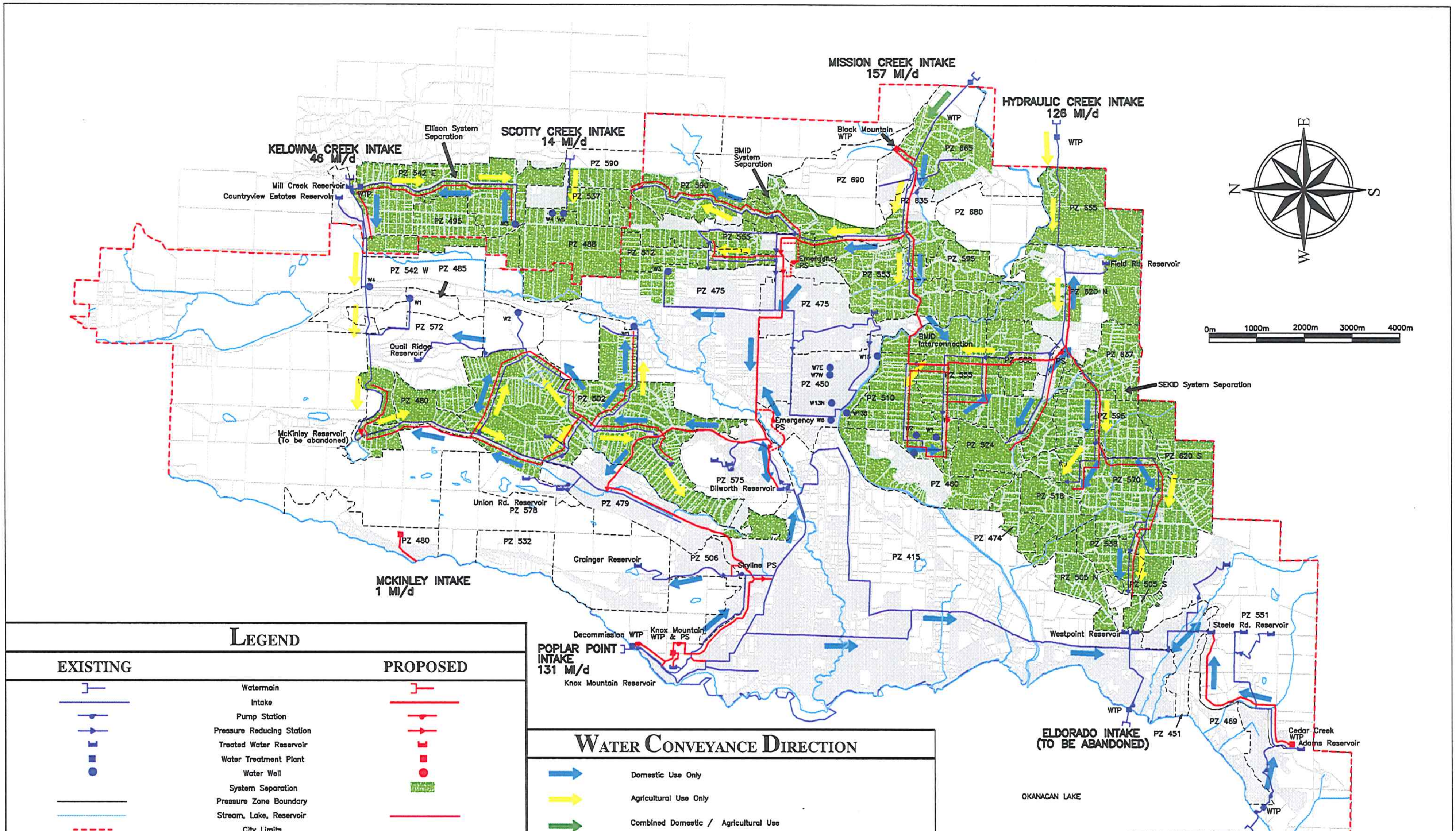
FIGURE 3-5: OPTION 4- JOINT OKANAGAN LAKE & MISSION CREEK DOMESTIC SUPPLY- SUPPLY NORTH AREAS FROM MCKINLEY INTAKE

### 6.4.5 Option 5 – Joint Okanagan Lake and Mission Creek Supply – Maximize System Separation

Option 5 is shown on Figure 3-6. Similar to Option 4, a large portion of the domestic supply including the GEID service area and BMID service area would be interlinked to allow sourcing from Mission Creek or Okanagan Lake. This option would also include a domestic supply link to the SEKID system. The majority of the BMID, GEID, and SEKID agricultural irrigation service areas would be separated utilizing a small diameter domestic distribution system. The separation would be expanded from that included in Option 4 in that the Glenmore valley irrigation area would be separated as part of Option 5. This would eliminate the need for the new McKinley intake as the irrigation demand could be supplied from the Kelowna Creek intake. The RWD service area would continue to be supplied via the existing groundwater supply. Refer to Table 6-5 for a breakdown in projected year 2030 demands and treatment plant capacity:

**Table 6-5**
**Option 5 – Supply Summary**

| Source/Intake | Domestic Demand ML/d | Irrigation Demand ML/d | WTP Capacity ML/d |
|---|---|---|---|
| Cedar Creek Intake | 36 | - | 36 |
| Eldorado Intake | - | - | - |
| Poplar Point Intake | 128 | 3 | 131 |
| McKinley Intake | 1 | - | 1 |
| Kelowna Creek Intake | - | 46 | - |
| Scotty Creek Intake | - | 14 | - |
| Mission Creek Intake | 68 | 89 | 68 |
| Hydraulic Creek Intake | - | 126 | - |
| Groundwater | 39 | 8 | - |




Associated Engineering

City of Kelowna

# CITY-WIDE WATER OPTIONS

## FIGURE 3-6: OPTION 5- JOINT OKANAGAN LAKE & MISSON CREEK SUPPLY -MAXIMIZE SYSTEM SEPARATION

# 7 Costs

## 7.1 Effective Date

The estimated costs are considered to represent costs as of January 2010.

## 7.2 Capital Cost Allowances

- ***Costing Basis:*** The capital costs are based on the curves included in Technical Memorandum No. 1-1 which includes allowances for direct construction costs plus 30% to cover engineering and contingencies.
- ***Accuracy:*** The estimates have been prepared at a conceptual level of detail suitable for comparing options but not suitable for preparing project budgets. They are considered to be accurate to +/- 30%.
- ***Water Treatment Facilities:*** The water treatment facility costs have been based on the capital cost curves included in section 8.3 of Technical Memorandum No. 1-1.
- ***Pumping Stations:*** Pumping station capital costs have been based on the cost curves included in Section 9.2 of Technical Memorandum No. 1-1.
- ***Pipelines:*** Transmission main capital costs have been based on the cost curves included in Section 9.3 of Technical Memorandum No. 1-1.
- ***System Separation:*** The costs associated with separating the domestic and irrigation systems in rural areas have been based on a unit cost allowances ranging from $5,000 to $8,600 (depending on servicing complexity) per hectare of irrigated land. This allowance has been based on the experience of the consulting team in developing a cost estimate for SEKID which has considerably larger lots than BMID and GEID.

## 7.3 Operating Cost Allowances

- ***Water Treatment Operating Costs:*** The annual operation and maintenance costs for the water treatment infrastructure are based on percentages of capital costs for each unit process based on recent historical records. This allowance is deemed to represent all staffing, chemicals, residuals management costs, utility costs, equipment replacement allowances, and normal maintenance and repair costs for similar facilities.
- ***Pumping Facility Operating Costs:*** The annual operation and maintenance costs for the pumping infrastructure include an allowance for energy consumption based on flow-rate and hydraulic lift plus an additional allowance for general operation and maintenance based on a percentage of capital cost. Cost of power was assumed to be $0.10/kWh.
- ***Transmission Pipeline Operating Costs:*** The annual operation and maintenance costs for the pipeline components are based on a percentage of capital cost.

## 7.4 Life Cycle Cost Basis

- ***Operating Life:*** All components have been sized to meet projected growth to 2030 as envisioned in the OCP. As such, a 20 year operating life was utilized for calculating life cycle operating costs. In reality, the assets would have a much longer operating life.
- ***Discount Factor:*** Amounts included for future expenditures were discounted at a rate of 2% to bring them to the 2010 present value thereby representing the difference between assumed investment return rate and inflation rate for present value life cycle costing.
- ***Inflation Allowance:*** No inflation allowance was included for future expenditures due to the method used in determining present value as noted above.

## 7.5 Cost Estimates: Filtration of All Domestic Water Supply

Table 7-1 below provides a comparative summary of the costs of the five options based on filtration of all domestic water supply from surface water sources.

**Table 7-1**
**Filtration Options Cost Summary**

| Option No. | Option Name | Capital Cost | Avg. Annual Operating Cost | Discounted 20 Year Operating Cost | Discounted 20 Year Life Cycle Cost |
|---|---|---|---|---|---|
| 1F | Current Plan | $261,944,000 | $8,422,000 | $139,972,000 | $401,916,000 |
| 2F | Centralize Domestic Supply From Okanagan Lake | $218,245,000 | $7,128,000 | $118,464,000 | $336,709,000 |
| 3F | Unlinked Okanagan Lake and Mission Creek Supplies | $221,496,000 | $6,470,000 | $107,527,000 | $329,022000 |
| 4F | Joint Okanagan Lake and Mission Creek Supply - Supply North Areas From McKinley | $240,242,000 | $6,700,000 | $111,350,000 | $351,592,000 |
| 5F | Joint Okanagan Lake and Mission Creek Supply - Maximize System Separation | $227,626,000 | $6,010,000 | $99,878,000 | $327,503,000 |

## 7.6 Cost Estimates: Okanagan UV - Uplands Filtration

Table 7-2 below provides a comparative summary of the costs of the five options based on UV treatment of water extracted from Okanagan Lake and filtration of water extracted from the uplands water sources.

**Table 7-2**
**Okanagan UV – Uplands Filtration Options Cost Summary**

| Option No. | Option Name | Capital Cost | Avg. Annual Operating Cost | Discounted 20 Year Operating Cost | Discounted 20 Year Life Cycle Cost |
|---|---|---|---|---|---|
| 1UVF | Current Plan | $158,708,000 | $5,373,000 | $89,302,000 | $248,010,000 |
| 2UVF | Centralize Domestic Supply From Okanagan Lake | $108,365,000 | $3,372,000 | $56,042,000 | $164,408,000 |
| 3UVF | Unlinked Okanagan Lake and Mission Creek Supplies | $125,597,000 | $3,537,000 | $58,789,000 | $184,386,000 |
| 4UVF | Joint Okanagan Lake and Mission Creek Supply - Supply North Areas From McKinley | $142,913,000 | $3,767,000 | $62,613,000 | $205,526,000 |
| 5UVF | Joint Okanagan Lake and Mission Creek Supply - Maximize System Separation | $148,334,000 | $3,583,000 | $59,544,000 | $207,878,000 |

# 8 Evaluation and Comparison of Options

## 8.1 Evaluation Process

### 8.1.1 Multiple Bottom Line Assessment

The assessment process involved a structured evaluation process using multiple bottom line (MBL) assessment techniques. The primary criteria include Financial, Social/Community, and Natural Environmental and sub-criteria within each of the primary criteria. When undertaking the evaluation some consideration needs to be made regarding how the financial impact criteria are incorporated into the evaluation process. There is no single "right" way to do this. Some like to keep the financial evaluation completely separate from all of the non-financial criteria while others prefer to keep integral to the evaluation matrix. The method used for this study integrates the financial and non-financial criteria into the evaluation matrix, which is the most common approach when doing multiple bottom line assessments.

The following sections provide additional information regarding the evaluation process.

### 8.1.2 Numerical Scoring of Options Under Each Criterion

In order to assist in the evaluation process, a qualitative evaluation of each option under each criterion is undertaken. A numerical score was then assigned based on the qualitative evaluation. This provides a measured quantitative evaluation for each option under each criterion.

### 8.1.3 Consideration of Risk in Evaluation Process

The options were subjected to a risk assessment. The question of risk is an important consideration in the MBL analysis and how the MBL findings will be used to make a decision to allow the City to move forward. Consider the situation where a scenario scores very high relative to the other scenarios on the basis of the MBL criteria. But if this scenario has a very high risk signature relative to the other scenarios, it is reasonable to suggest that it may not be held in the same overall high regard.

As a result the question is really – how will risk be incorporated within an MBL-type framework to allow an overall comparison of each scenario's attributes relative to each other? For this analysis, we undertook a "MBL + Risk" framework that adds risk to the three broad MBL categories of financial, social/community, environmental/natural criteria. In this case the results of the separate risk analysis were converted into a single overall risk "score" (i.e. one risk score per option), with these values brought into the MBL + risk analysis. The City provided a weighting for this overall risk category, similar to and relative to the weightings needed for the MBL criteria.

### 8.1.4 Numerical Importance Weighting of Each Criterion

A numerical weighting was identified for each of the evaluation criteria and sub-criteria. Understanding and weighting the importance of each criterion is a critical component in the evaluation process. Criteria which were considered to have high importance to the City were given a higher weighting compared to those of less importance.

During the Options Evaluation Workshop, the City staff participants provided relative weighting of each sub-criterion within each of the MBL and Risk criteria using a ballot process. Refer to Technical Memorandum No. 2-2 for further details on how weightings assigned to each of the sub-criteria. The following summarizes the relative weighting of the primary criteria:

- Financial – 28.6%
- Social/Community – 21.4%
- Environmental – 14.3%
- Risk – 35.7%

### 8.1.5 Overall Numerical Scoring Methodology

The overall scoring was undertaken utilizing "Criterium Decision Plus" software. Prior to the Options Evaluation Workshop each option had already been scored under each criterion and the rationale for this scoring is covered in Technical Memorandum No. 2-2. The "Criterium Decision Plus" software was used to apply the weighting factors and run sensitivity analyses.

### 8.1.6 Caution in Using Numerical Evaluation Techniques

Undertaking numerical evaluations of options can be a highly subjective exercise and therefore caution needs to be exercised when using this approach. It should not be used as the sole criteria for selecting a preferred option. We therefore recommend balancing the numerical evaluation with a pragmatic subjective review to ensure that the scoring system is providing a realistic assessment of the options that best meets the City's needs.

## 8.2 Evaluation Summary and Findings

The following summarizes the findings and conclusions arising from the evaluation process:

- All ten options were evaluated based on a structured evaluation approach using a combination of engineering judgement and software developed for the purpose of options evaluation and decision making as outlined in the previous section.

- Options based on the UV-Filtration treatment strategy scored considerably higher than options based on the Filtration treatment strategy primarily due to their significantly lower life-cycle costs and reduced environmental impacts.

- Option 2UVF – "Centralize Domestic Supply From Okanagan Lake" scored better than all other options under the MBL excluding Risk analysis. It also scored better than all other options when Risk was added to the MBL criteria. Option 5UVF – "Joint Okanagan Lake and Mission Creek Supply – Maximize System Separation" had the second highest scoring.

- Amongst the Filtration strategies, Option 5F scored better than all other options under the MBL plus Risk analysis, although Options 2F and 3F also scored well.

# 9 Conclusions

## 9.1 Water Treatment Strategy

1. Based on discussions with IHA, the Filtration strategy will provide the most reliable basis for long term domestic water system planning.

2. The City of Kelowna has submitted an application to IHA for Filtration Deferral for water extracted from deep intakes on Okanagan Lake. IHA has stated that there is a strong likelihood of approval of the City's Filtration Deferral application thereby allowing the City to initially proceed on the basis of UV treatment for the Okanagan Lake source. Filtration Deferral will be reviewed by IHA on an annual basis and should source water quality deteriorate or the associated risks increase the Filtration Deferral approval could be withdrawn.

3. For domestic water extracted from the existing uplands sources, it may be difficult to achieve and maintain Filtration Deferral. These suppliers have not yet submitted applications for Filtration Deferral and IHA is not prepared to predict how these applications would be judged.

4. Two treatment strategies were therefore developed for the domestic demand component as follows:

   a. **Filtration**: Filtration of water extracted from all surface water supplies serving the City.
   b. **Okanagan UV – Uplands Filtration**: UV treatment for all water extracted from Okanagan Lake and filtration for all water extracted from uplands surface sources.

5. Water supplied and distributed solely for agricultural irrigation purposes does not require any treatment, although there is merit in continuing to chlorinate the water at significantly reduced dosages in order to minimize bacterial regrowth in the distribution system.

## 9.2 Future Growth and Water Demands

1. For the purposes of comparing options, future water demand growth was based on projected development envisioned to 2030. The projected increase in demand is 17.5% higher than current demand which is significantly lower than projected population growth.

2. It was assumed that agricultural irrigation demand would remain unchanged from the current demand. Regardless, it is unlikely that increases in agricultural irrigation demand would have any impact on the findings of this study.

### 9.3 Area Wide System Issues

1. The current treatment practices employed by four of the five systems do not comply with IHA requirements, although these suppliers are planning upgrades to their treatment facilities.

2. The use of common supply and treatment infrastructure to handle combined domestic and irrigation demands results in increased water treatment chemical use, increased operation & maintenance costs, and treatment infrastructure costs compared to having separated domestic and irrigation systems.

3. While some of the five supply systems include links to other systems, these links are relatively weak. The systems are extremely vulnerable in the event of a major supply interruption.

4. The SEKID system does not include any links to other systems and recently experienced a significant decline in source water storage which could have impacted its ability to meet demand in the near future. Wet weather in spring 2010 has alleviated this situation and the storage has returned to normal.

### 9.4 Options Development Considerations

1. One of the most important aspects in water supply planning is system robustness. Large City systems commonly include more than one supply intake and system reinforcement to allow water to be delivered throughout the system from at least two points of supply. While the City has multiple area-wide intakes, the supply from any one of these intakes is not available to large parts of the City due to inadequate area-wide system reinforcement thereby creating an inherent weakness in the system.

2. Affordability is a key factor for water supply within the City limits. A cost increase which may be perceived as small to the domestic users could have a much more significant impact on agricultural irrigation users due to the amount of water that they use and their dependence on it being available and at a low cost for their livelihoods.

3. This study has been focused on centralizing the domestic supply and treatment infrastructure due to the associated cost benefits and supply benefits. Centralizing the domestic supply will also enable consistent water quality to be achieved and support rate equity across the City.

4. Separating the domestic and irrigation supply and treatment systems will allow significant reductions in treatment infrastructure capital and operating costs.

5. Agricultural irrigation demands are being efficiently supplied via the existing supply and distribution infrastructure and there do not appear to be any benefits in significantly changing this approach.

6. Each of the options developed herein was developed based on good engineering principles, however, there are a number of subsystems within each option which could be revised or optimized.

### 9.5 Options Evaluation

1. Options 2 and 5 scored highest under both of the treatment strategies.

2. Between these two options, Option 2 has the lowest life-cycle costs while Option 5 had a better Risk profile.

3. There are similarities between Options 2 and 5 which would allow the City to develop a plan which gives it the flexibility to migrate from one to the other in the future if conditions or assumptions change.

# 10 Recommendations

## 10.1 Treatment Strategy

Because of uncertainties associated with the maintenance of Filtration Deferral, selection of the preferred option(s) should take into account how well the option(s) rank under both of the strategies considered herein. In order to ensure conformance with the federal Guidelines for Canadian Drinking Water Quality and IHA's requirements, long term planning should be based on providing filtration for all surface water supplies utilized for domestic purposes.

## 10.2 Communication of Findings to Water Suppliers

As recommended in the April 2010 version of this report, City staff met with the other four water suppliers in order to communicate the report findings to them and obtain their feedback. The technical component of their responses has been considered in the revisions incorporated herein.

## 10.3 Optimization of Preferred Options

The work done to date has been done at a relatively low level of detail for the purposes of comparing options. The options which were rated highest by the City were Options 2 and 5. As a next step, we recommend that the selected option(s) be refined to a higher level of detail including the following prioritized aspects:

a. Developing a single option which combines the best attributes of Options 2 and 5.
b. Reviewing the number, location, and capacity of intakes on Okanagan Lake with specific emphasis on how the McKinley Landing intake fits into the strategy and recognizing that Poplar Point alone presently provides most of the City system water.
c. Reviewing opportunities for increasing the groundwater supply component to augment the surface water supply.
d. Reviewing the optimum strategy for supplying domestic demands in SEKID i.e. groundwater only or a combination of groundwater and supply from the BMID Mission Creek supply system.
e. Developing system separation concepts for each of the irrigation areas and improving links between the systems.
f. Developing a staging plan for migrating from the Okanagan UV-Uplands Filtration treatment strategy to the area wide Filtration treatment strategy.
g. Developing an area-wide water treatment residuals management strategy focused on sustainable residuals management and minimization of waste disposal.

### 10.4 Assignment of Cost Burden

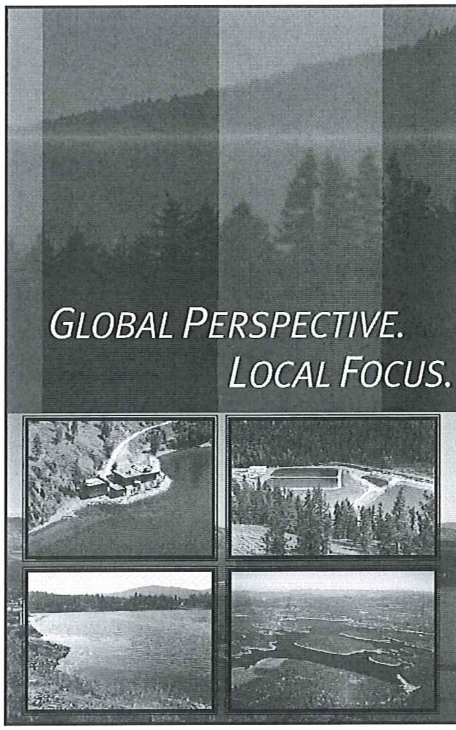
The improvements incorporated into the each of the options outlined herein are based on making significant capital investments which will directly improve water supply and quality to the domestic water users while improving supply to the agricultural irrigation users at minimal expense. Therefore we would recommend that the capital and O&M costs related to the proposed improvements be borne entirely by the domestic users whether it be through development cost charges or through water rates.

Respectfully Submitted,

W.J. (Bill) Harvey, P.Eng.
Project Manager

Reviewed by,

Ian P.D. Wright, P.Eng.
Vice President, Water



GLOBAL PERSPECTIVE.
LOCAL FOCUS.

Associated Engineering

City of Kelowna

**City-wide Water Supply and Treatment Options Evaluation – June 2010**

**Presentation to City Council**
**July 12, 2010**

Bill Harvey, P.Eng.
Ian Wright, P.Eng.

## Study Objectives

- To develop, evaluate, and compare technical options for treating and delivering domestic and irrigation demands on a city-wide basis.
- To identify the technical options which best meet City-wide objectives utilizing a multiple bottom line approach.

City of Kelowna

Associated Engineering

## Treated Water Quality Goals

- To produce water quality that consistently meets:
  - Health Canada Guidelines for Canadian Drinking Water Quality
  - BC Drinking Water Protection Act
- IHA 4-3-2-1-0 Guidelines
- IHA Filtration Policy - Filtration Deferral
  - Certainty of siting for filtration
  - Draft implementation plan
  - Certainty of capital to undertake filtration
- Future Regulatory Changes

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## Water Treatment Strategy

- Water Demands – 2030
  - Domestic – 272 Ml/d
  - Agricultural Irrigation – 286 Ml/d
- Agricultural Irrigation - No additional treatment required
- Domestic - Different water treatment solutions for different water sources
  - Groundwater
  - Uplands water sources
  - Okanagan Lake
- Two treatment strategies evaluated for the drinking water system
  - Filtration
  - Okanagan UV – Uplands Filtration

City of Kelowna

Associated Engineering

## Area Wide System Issues

- Kelowna's water demands are very high in comparison to other Canadian municipalities
- Current treatment practices by four suppliers don't meet IHA requirements – these suppliers are planning upgrades
- Using a common system for distributing domestic and agricultural demands is not sustainable
- Linkage and reinforcement between systems is weak
- Some suppliers were facing water supply challenges during the study – since alleviated
- Water quality delivered to all ratepayers is inconsistent

City of Kelowna

Associated Engineering

## Options Development Approach

- Robust system with more than one intake with strong interlinkage and reinforcement
- Must be affordable and cost-effective (life cycle)
- Maximize use of existing infrastructure
- Integrated approach
- Separation of domestic and agricultural systems
- Continued agricultural supply from existing high elevation sources

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## System Options

- Option 1 – Current Plan per 2005 KJWC Strategic Water Servicing Plan
- Option 2 – Consolidated Domestic Supply from Okanagan Lake
- Option 3 – Unlinked Okanagan Lake and Mission Creek Supplies
- Option 4 – Joint Okanagan Lake & Mission Creek Supply – Supply North Areas From McKinley
- Option 5 – Joint Okanagan Lake & Mission Creek Supply – Maximize System Separation

City of Kelowna

Associated Engineering

## Filtration Strategy Options Cost Summary

| Option No. | Option Name | Capital Cost | Discounted 20 Year Life Cycle Cost |
|---|---|---|---|
| 1F | Current Plan | $261,944,000 | $401,916,000 |
| 2F | Consolidated Domestic Supply From Okanagan Lake | $218,245,000 | $336,709,000 |
| 3F | Unlinked Okanagan Lake and Mission Creek Supplies | $221,496,000 | $329,022,000 |
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| 5F | Joint Okanagan Lake and Mission Creek Supply - Maximize System Separation | $227,626,000 | $327,503,000 |

City of Kelowna

Associated Engineering

# Okanagan UV – Uplands Filtration Strategy Options Cost Summary

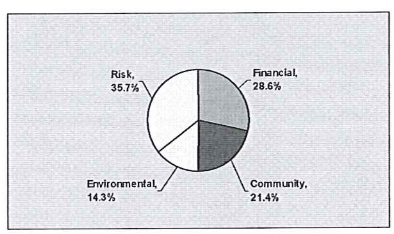
| Option No. | Option Name | Capital Cost | Discounted 20 Year Life Cycle Cost |
|---|---|---|---|
| 1UVF | Current Plan | $158,708,000 | $248,010,000 |
| 2UVF | Consolidated Domestic Supply From Okanagan Lake | $108,365,000 | $164,408,000 |
| 3UVF | Unlinked Okanagan Lake and Mission Creek Supplies | $125,597,000 | $184,386,000 |
| 4UVF | Joint Okanagan Lake and Mission Creek Supply - Supply North Areas From McKinley | $142,913,000 | $205,526,000 |
| 5UVF | Joint Okanagan Lake and Mission Creek Supply - Maximize System Separation | $148,334,000 | $207,878,000 |

City of Kelowna

Associated Engineering

# Options Evaluation

- Multiple Bottom Line Assessment
  - Financial
  - Social/Community
  - Environmental
- Risk Assessment
- Findings
  - Okanagan UV- Uplands Filtration Strategy – Option 2 ranked highest
  - Filtration Strategy – Option 5 ranked highest




City of Kelowna

Associated Engineering

## Recommendations

1. Treatment Strategy – base long term planning on filtration
2. Communicate findings to the other four water suppliers – completed in June 2010
3. Collaborate with the other water suppliers to develop a longer-term city-wide approach
   - Incorporate area water suppliers' technical input
   - Combine the best attributes of all options
   - Review groundwater strategy
   - Develop separation concepts
   - Develop migration plan from UV-Filtration to Filtration
4. Assign entire cost burden for improvements to domestic users

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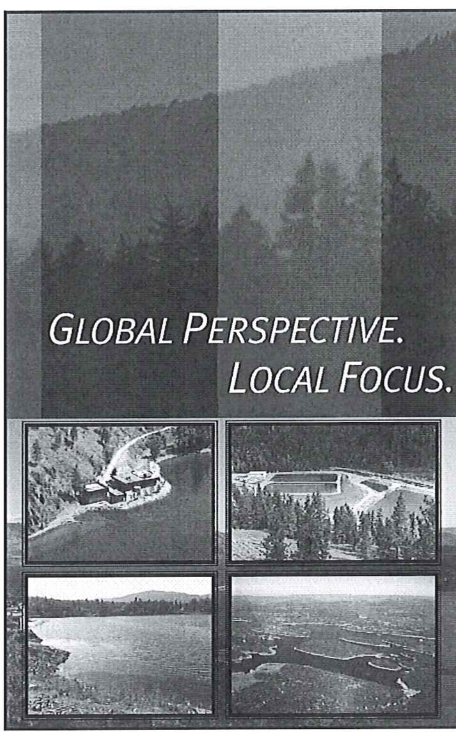



Associated Engineering

City of Kelowna

**City-wide Water Supply and Treatment Options Evaluation - June 2010**

**Presentation to City Council**

**July 12, 2010**

Bill Harvey, P.Eng.

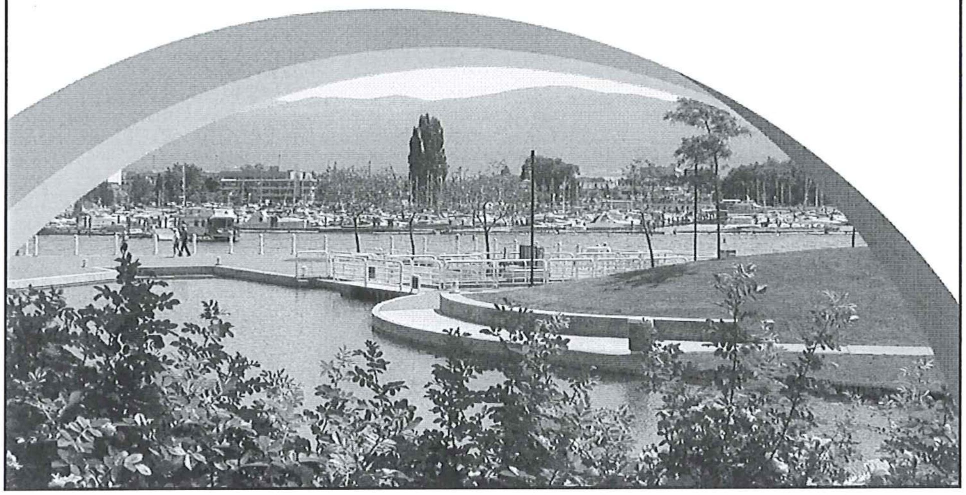
Ian Wright, P.Eng.

# CITY-WIDE WATER SYSTEM

## WATER SUPPLY & TREATMENT OPTIONS

Report to Council- 2010 July 12

City of Kelowna



## PRESENTATION AGENDA

- Overview
- Technical Summary
  (Bill Harvey, Associated Engineering)
- Next Steps & Recommendations

## PURPOSE: APRIL 20, 2009 COUNCIL DIRECTION

- Best long term system for safe, reliable water supply for all residents
- Technical confidence to support capital grant applications of local water purveyors
- Associated Engineering
  - Terms of Reference: Are there better long-term options available than Business as Usual
  - Team Lead: Bill Harvey, Peer Review: Ian Wright

## PROCESS

- Technical Reports:
  - Water Sources, Treatability &Costing Criteria
  - Water Demand Design Criteria
  - Options Conceptualization
  - Options Cost Estimates
  - Evaluation and Comparison of System Options
  - Summary Report

## MINISTRY'S PRINCIPLES - 2010JAN 12

- Best-Lowest Cost Solutions
- Flexibility
- Achievement of Public Health Outcomes
- Agricultural Interests Maintained

A City-wide solution supported by stakeholders and residents achieved through an open transparent process that builds trust

## MAYOR'S PRINCIPLES - 2010 MARCH 11

- Achieve Canadian Health Standards
- Ensure Affordable water for agriculture
- Charge citizens equitably for service
- Plan for long-term financial sustainability

## IH PLANNING PRINCIPLES PUBLIC HEALTH - 2010 JUNE 10

- **Coordinate:** Boundary-less planning
- **Equitable quality, consistent service:** centralization of domestic supply & treatment
- **Reduced cost:** separation of domestic & agricultural systems
- **Robustness, Redundancy:** system interconnection
- **Filtration readiness:** deferral plans annual review
- **Proactive:** plan for migration toward filtration:
- **Commit:** design option optimization, phased implementation, timelines, financial resources

## PROCESS

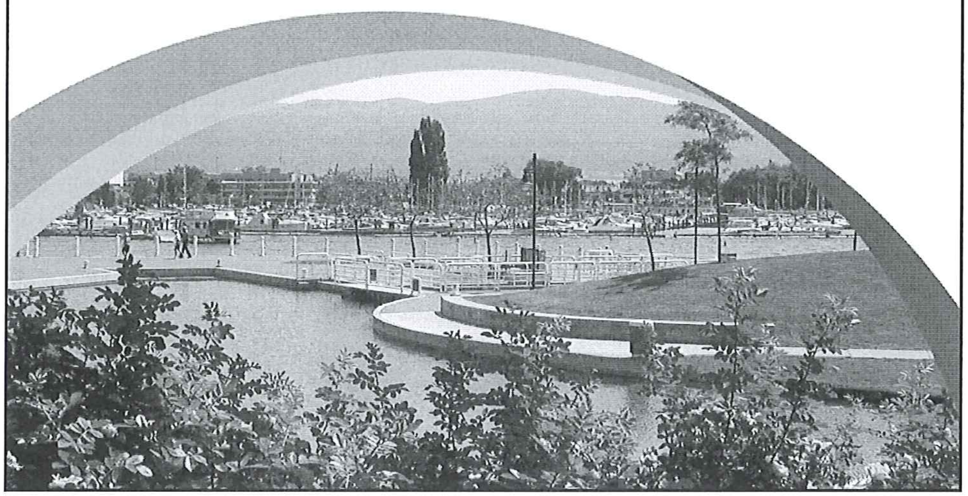
- May 13, 2010: Draft report to Irrigation Districts & Interior Health
- June 24, 2010: Workshop to incorporate stakeholder input

## SUMMARY REPORT: CITY-WIDE

### WATER SUPPLY & TREATMENT OPTIONS

City of Kelowna

Associated Engineering



## NEXT STEPS -

- Media Release
  - Value of collaborative approach demonstrated
  - Stakeholders agree to draft MOU
- Post AE technical study
- Progress Report to Minister, Community & Rural Development
- Draft MOU with all Irrigation Districts
- Budget & Commission feasibility/concept design
  - current system info and longer planning horizon

## ADDITIONAL TASKS

- Kelowna Water Utility Filtration Deferral Application (IH) finalized December 2010
  - Adjust Utility Rates:
    - water source protection plan
    - future filtration implementation