Value Planning Study

Final Report

2017 Kelowna Integrated Water Supply Plan

Kelowna, BC

February 2017

Strategic Value Solutions, Inc.

Value Improvement Specialists

February 24, 2017

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Subject: Using this Report

Dear Ron & Toby,

Attached is the final report for the Value Planning Study conducted on the 2012 Kelowna Integrated Water Supply Plan. This report presents 10 elements for consideration in a new or updated 2017 Kelowna Integrated Water Supply Plan. These elements were developed based on prescribed guidelines to identify an alternative plan that meets the best-lowest cost technical solution for achieving the public health objectives, simplifies system administration, and maintains agricultural interests without regard to how the system would ultimately be governed.

By design, these value planning studies are intense but short duration efforts. The Value Alternatives provided in this report are intended to be conceptual and advisory in nature. It is important to understand that the Value Team is only offering an alternative to the 2012 plan for further development into a detailed feasibility plan, if it is acceptable to the City and others. We make no project decisions and have not performed any detailed engineering analysis beyond that shown within this report. Detailed feasibility assessment and final design development of any of the alternatives, should they be accepted, remain the responsibility of the system stakeholders. The accepted concepts are only to provide a framework or starting point for a detailed engineering feasibility study.

The plan stakeholders are encouraged to use the results of this study to pursue those concepts that result in the maximum benefit for the end users.

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These alternatives were developed under some prescribed guidelines to identify an alternative plan that meets the best-lowest cost solution that achieves the public health objectives, simplifies system administration, and maintains agricultural interests without regard to how the system would ultimately be governed.

Sincerely,

John Robinson, PE, CVS-Life, FSAVE
Owner/Principal

Final

Value Planning Study Report

for

2017 Kelowna Integrated Water Supply Plan

Kelowna, BC

February 2017

Prepared by:

Strategic Value Solutions, Inc.

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Acknowledgements

Strategic Value Solutions, Inc. would like to express our appreciation to the City of Kelowna and the South East Kelowna Irrigation District staff members who assisted us in the review of this project. Particular thanks go to Ron Westlake and Toby Pike for providing valuable insights into project issues and for assisting in the coordination and management of this study. Additionally, we would like to thank Tara Faganello, Liam Edwards, and Regan Purdy for all their efforts to coordinate this Value Planning Study with all of the local and provincial stakeholders.

In addition, we would like to thank the staff and consultants from the City and SEKID for sharing their knowledge about the Kelowna water systems as well as the previous planning and engineering studies.

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EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

This report presents the results of a Value Planning (VP) Study conducted by Strategic Value Solutions, Inc. (SVS) to identify the best value solutions for a city-wide integrated water supply plan for Kelowna, BC. The study was commissioned by the City of Kelowna and the South East Kelowna Irrigation District.

The Value Planning workshop was conducted over a 5-day (40-hour) period in Kelowna on January 9-13, 2017. The VP Team was led by a Certified value Specialist® (CVS®) and was comprised of consultant subject matter experts in water system planning, financial and rate analysis, and construction cost of water systems. The consultant VP Team was augmented with local and provincial expertise from the City of Kelowna, the South East Kelowna Irrigation District, the Ministry of Community, Sport and Cultural Development (MCSCD), Interior Health Authority (IHA), the Ministry of Forests, Lands and Natural Resource Operations, as well as Agua Consulting and Associated Engineers.

Background

The City of Kelowna's water service is currently provided by the City Municipal Utility (City), the South East Kelowna Irrigation District (SEKID), the Black Mountain Irrigation District (BMID), the Rutland Water Works District (RWWD), and the Glenmore-Ellison Improvement District (GEID) as well as 26 other small water utilities. These various organizations deliver water to serve domestic, commercial, industrial, and agricultural needs with limited interconnectivity between providers. The water supplying these needs comes from a variety of water sources including Lake Okanagan, Mission Creek, Kelowna (Mill) Creek, Scotty Creek, Hydraulic Creek, and numerous wells. These varied sources have differing water qualities that have resulted in boil notices and long-standing advisories being issued for parts of Kelowna by the Interior of Health Administration (IHA) due to public health concerns. Additionally, there are also significant aesthetic issues related to taste, odor, and color.

A recent survey conducted by the City of Kelowna identified water quality improvements as the citizens' number one priority across the city. While technically, these water quality issues can be solved independently by each provider, these independent technical solutions will be very costly, creating substantial rate inequity for customers. The most sustainable and cost effective solution is to create an integrated water system that meets the customers' water service expectations relative to serving the demand, protecting public health, improving the aesthetic qualities of the water, and ensuring that there is equity in both services and costs.

In 2009, the Ministry of Community, Sport and Cultural Development (MCSCD) began working with Kelowna on a path forward to resolving the water issues in the region. The City, the South East Kelowna Irrigation District, the Black Mountain Irrigation District, the Rutland Water Works District, and the Glenmore-Ellison Improvement District (IDs) with support from the Province developed the 2012 Kelowna Integrated Water Supply Plan.

The 2012 Plan addresses important areas such as operation and maintenance, flexibility, best-lowest cost solutions, an achievement of public health outcomes, and agricultural interests. The Plan was cooperatively developed with the full participation from the City and the IDs; however, there has been very limited implementation of the plan toward the goal of integration. In general, the 2012 Plan involved improving water quality within the IDs, separation of the domestic and agricultural water service needs within each distribution system, and interconnections between systems to allow water to be moved from one distribution system to another through a controlled and metered connection.

MCSCD currently has a grant program that is available through March 2018 to help fund an integrated water supply plan for Kelowna. This grant can provide up to 83% of the funding for approved projects. There are also other funding sources that either are or will be available that could also provide a partial funding source for approved projects.

Scope of the Value Planning Study

The Ministry requires that Value Planning (or Value Engineering) studies be completed before providing funding for major infrastructure projects. For Kelowna, this means that a Value Planning (VP) process should be included in a plan that meets the needs of the residents of the City.

The purpose of this VP study is to review the 2012 Kelowna Integrated Water Supply Plan, along with other materials provided by the City and SEKID to ensure that all proposed works and their identified priorities are the best, lowest cost solutions, the solutions that meet current health standards and to ensure solutions are flexible in their nature and maintain agricultural interests.

The intent was that the workshop associated with this study would be conducted cooperatively between the City and the four major IDs: SEKID, BMID, RWWD, and GEID. However, prior to the workshop, BMID, RWWD, and GEID opted to not participate feeling that the needs of their districts had been addressed through their self-funded capital improvement projects.

Study Objectives

The VP Study was to assess the 2012 Plan and follow the original guiding principles for an integrated water supply plan that will serve all residents of Kelowna:

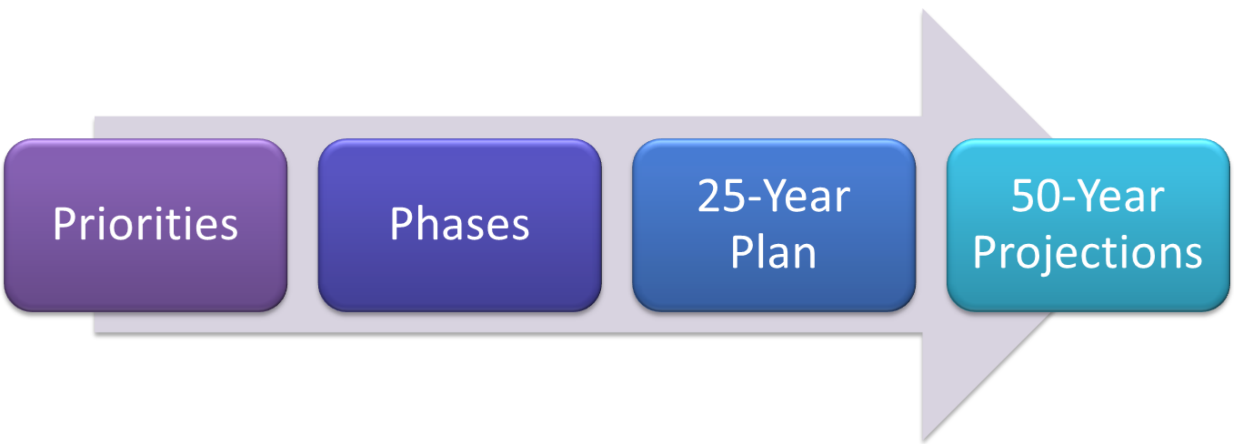
1. Identify the best, lowest cost solutions
2. Achieve public health standards
3. Allow flexibility from administrative and operational perspectives
4. Maintain agricultural interests

Specifically, the plan should address the best technical solution for an integrated water supply plan not just an interconnected plan. This means:

- Customer equity relative to costs
- Consistent level of service
- Consistently high water quality
- Efficiency in operations and administration
- Uniformity in practices and procedures
- A seamless experience for all water users of Kelowna
- Meeting the delivery demand for both domestic and agricultural needs

The VP Study was to specifically focus on the technical solution without regard to system Governance. Further, the technical solutions were not limited based on any ownership or rights to existing systems.

The plan needs to have a long-term perspective of 50 years; however, it is only practical to consider a 25-year planning horizon relative to supplies, demands, and capital projects. The plan will have to accommodate phased implementation due to funding availability, coordination between water providers, and other considerations. The graphic below illustrates that plan aims for where the region will be in 50 years; plans for where it needs to be in 25 years along that path; identifies the phases to accomplish that plan; and use priorities to determine the phases.



As a VP Study, the solutions developed are planning level concepts and will require additional engineering analysis to verify their feasibility and to substantiate the estimated costs.

Value Methodology

This VP Study used the international standard Value Methodology established by SAVE International®. The Value Methodology (VM) uses a six-phase process executed in a workshop format with a multidisciplinary team. Value is expressed as the relationship between functions and resources where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

With this process, the value team identifies the essential project functions and alternative ways to achieve those functions, and then selects the best solutions for achieving the required functions. These function-based solutions are then combined into value alternative concepts.

Workshop Results

The workshop began with presentations on the existing conditions and the prior analyses that have been performed by the City and SEKID. The presentations were followed by a tour around the Kelowna area to allow the VP Team to see the location of key features of the Kelowna water systems and to give the VP team a better understanding of the physical challenges of delivering water in Kelowna.

Following the presentations and site visit, the VP team analyzed the functional requirements associated with an integrated plan. From this, the VP Team concluded that the mission or higher order function of an integrated water supply plan is to meet the community's water service expectations. To meet these expectations, the plan must accomplish the following basic functions:

- ensure customer equity,
- deliver the volume of water demand,
- protect public health, and
- satisfy the aesthetic expectations for taste, odor, and color.

With an understanding of the basic functions that must be accomplished for a successful integrated plan, the VP team brainstormed to identify possible ways to accomplish those functions. This effort resulted in 124 ideas. The VP Team then selected the best options for accomplishing the required functions. These options were then combined into 10 different Value Alternative concepts that provide the key elements of a function-based solution to achieve a new integrated water supply plan.

Project Cost Basis

Project cost was developed for each of the Value Alternatives. Unit costs were taken from the updated cost estimates provided for the November and December 2016 reports regarding the surface water supply options and the groundwater supply option developed to serve the domestic water quality needs for SEKID. Other costs were taken from the 2012 Kelowna Integrated Water Supply Plan as well as cost developed by the VP Team's cost estimator. All costs were brought to equivalent 2017 values. For consistency, a 15% engineering cost allowance and a 30% design contingency allowance was added to the overall construction cost.

Significant Findings/Project Constraints

During the analysis of the project and development of the Value Alternatives, the VP Team made some significant discoveries and came to some important understandings relative to constraints on possible solutions.

- There are sufficient water supplies to meet Kelowna's city-wide demands for both domestic and agricultural needs into the foreseeable future.
- Currently, the City and various IDs have their own sources of water, with varying water qualities that supply distribution systems with combined flows for domestic and irrigation uses. The lowest cost solution for Kelowna should use source water with a quality most appropriate for the end use.
    - domestic drinking water that requires a minimum amount of treatment to meet regulations
    - water for agricultural purposes that has sufficient supply but would generally require significant treatment for domestic use
- The Kelowna area has numerous pressure zones requiring a significant portion of the water to be pumped to customers. The lowest cost solution should seek to minimize pumping costs.
- Agriculture is vital to the Kelowna economy and it requires as much water on an annual basis as the domestic water usage.

Value Improvement Alternatives

While the alternative concepts developed in this Value Planning study largely parallel the principal concepts in the 2012 Kelowna Integrated Water Supply Plan, there are also some significant changes from the 2012 Plan.

Source Water Quality

The 2012 Plan did not remove the operational boundaries constraint between the various water utilities; therefore, the plan addressed source water quality by adding supplemental water sources to serve specific poor water quality areas.

The concept from the Value Planning study focuses on the city-wide use of the two highest quality water sources, Lake Okanagan and Mission Creek for domestic water and lower quality water from Hydraulic Creek, Scotty Creek, and Kelowna Creek to serve the agricultural needs. This concept minimizes the need for advanced water treatment and ensures that all Kelowna water consumers receive the same quality water.

Source Water Redundancy and Resiliency

The 2012 Plan provides redundant water sources for each water utility by either adding a new source and/or providing a system interconnect with an adjacent water utility service area.

The Value Planning concept is to use the Mission Creek water source to the maximum extent possible to serve all of Kelowna domestic water needs when the water quality meets regulatory standards. This source can serve all of Kelowna's needs for nominally nine months of the year allowing gravity feed instead of pumping from the lake. When Mission Creek does not meet water quality standards, Lake Okanagan water will serve all of Kelowna. This provides the same two water sources for the entire city. Further resiliency is provided with four existing lake intakes and by maintaining the existing wells with interconnection to the city-wide distribution system as a backup source.

Separate Domestic and Agricultural Systems

The 2012 Plan recommended developing separate distribution systems to serve the domestic and agricultural needs. The existing piping system would remain to serve the agricultural needs. The domestic demand is smaller which allows smaller diameter pipes for the new parallel system.

The Value Planning concept is to implement this separation as recommended in the 2012 Pan.

Domestic Transmission System

The 2012 Plan recommended developing a transmission system to deliver the higher quality source water to all parts of the City; however, this was a last phase in the plan.

The Value Planning concept is to develop a transmission system for Mission Creek and Lake Okanagan water as an instrumental part of achieving an integrated water supply plan for the entire city. A significant portion of this new transmission system would be constructed as an initial phase of the plan to allow broader use of Mission Creek and Okanagan Lake water. By doing so, filtration can continue to be deferred until stipulated by a regulatory change.

Agricultural Transmission System

The Value Planning concept is to develop a transmission system for agricultural uses that would maximize use of lower water quality supplies from Kelowna Creek, Scotty Creek, and Hydraulic Creek, with backup supplies from Lake Okanagan, Mission Creek, some higher capacity wells, and interconnects with the domestic system.

Filtration

The 2012 Plan recommended filtration before developing an integrated transmission system. This seems to be a result of not truly integrating the water systems but rather trying to maintain operational boundaries between water utilities.

The Value Planning concept is to use Mission Creek and Lake Okanagan water with UV disinfection and chlorine until water quality regulations dictate the need for filtration. With these high quality sources, the expectation is that filtration may be deferred for most, if not all, of the 25 year planning period. When filtration is required, there would be a filtration plant built on Mission Creek first with the potential to construct a second plant on one of the lake intakes. To ensure high quality water from the lake, the intakes would be extended to a depth of 35 meters; this should further delay the need to filter the lake sources. With the transmission system in place, the overall system would have filtration redundancy in the future with only two plants; one on Mission Creek and one on the lake.

Table 1-1 includes a complete list of all the Value Alternatives developed. This table shows the number and title of the alternative as well as the estimated construction cost to implement that portion of the plan.

Conclusions

The following are the key changes to the 2012 plan resulting from the Value Planning study.

- The domestic water quality needs in the SEKID area would be resolved by constructing Phase 1 of the new domestic transmission system which would supply Lake Okanagan water to the SEKID service area rather than developing a new groundwater source to service this area. While this has a higher initial capital cost than adding a well, it completes the first phase of the an integrated, city-wide domestic water transmission system, which will not require the use of wells, and it will further delay the need for filtration of the Mission Creek supply. This will substantially reduce the capital cost of filtration and the operational costs for treatment and pumping.
- The 2012 Plan recognized the value of using the highest quality water from Mission Creek and Lake Okanagan to service the domestic water demand. However, the plan allowed the operational boundaries to delay the implementation of this critical component. The Value Planning concept recognizes that the development of a domestic transmission system is pivotal to developing a truly integrated water supply plan that offers the best, lowest cost solution and ensures customer equity relative to water quality and costs. This approach also eliminates the need to construct a storage reservoir and treatment facility for high turbidity flows on Mission Creek. This results in a significant cost savings.
- The Value Planning concept focuses on using Mission Creek to service the entire demand whenever the water quality will allow without going to filtration. When Mission Creek water quality is lower, lake water will serve the city-wide system. The groundwater resources will be held in reserve as a backup in the future.
- The need for filtration is significantly reduced and deferred for many years by having redundant high quality water sources that can serve the entire city.
- The Value Planning concept puts greater focus on creating resiliency and redundancy for the agricultural water demand.

In response to the objective to identify the best, lowest cost solution, these Value Planning concepts offer a plan that can be implemented for approximately $100 million less than continuing to implement the 2012 Plan. In addition, the VP concepts substantially reduce operational costs by using the Mission Creek supply for nominally 75% of the year, essentially eliminating all source water pumping cost during this period. This concept, provided there are no significant pathogen-related changes in water quality, or lack of water supplier maintenance of activities necessary for filtration exclusion, should allow continued deferral of filtration until required by a change in the regulations which is another significant operational cost savings.

Most importantly, the concepts from this Value Planning study offer a solution that will ensure every citizen of Kelowna receives domestic water equal to their neighbors and of a quality that meets public health standards.

2017 Kelowna Integrated Water Supply Plan
Summary of Alternatives

Ideas		Cost
Technical Plan		
1	Construct system modifications to ensure the needed domestic water quality improvements for SEKID and irrigation quality improvements for SOMID are addressed as an initial implementation phase of the integrated system	$ 61,300,000
2	Interconnect distribution systems city-wide to provide a consistent level of service and reliability to all water users	$ 5,583,000
3	Separate domestic and agricultural water within all distribution systems	$ 41,902,000
4	Construct a domestic water transmission system that provides redundancy and resiliency for distributing source water to supply the distribution system	$ 96,126,000
5	Construct an agricultural water transmission system that provides redundancy and resiliency for distributing source water to supply the distribution system	$ 21,585,000
6	Develop long term strategies and contingency plans for anticipated changes in water supplies and demands	$ 46,618,000
7	Develop an implementation strategy for future filtration or advanced water treatment requirements	$ 108,291,000
Implementation		
8	Perform advance work to support further planning and design of an integrated water system	
9	Develop a strategy for funding and allocation of costs that assures customer equity	
10	Develop a change management plan to facilitate the successful implementation of the integrated water supply plan	$ 6,656,000
Total (does not include No. 6 which is beyond the planning horizon)		**$ 347,946,000**

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SECTION 2

2012 KIWSP

SECTION 2
2012 KELOWNA INTEGRATED WATER SUPPLY PLAN

The following text was extracted from the 2012 Plan document. Some minor modifications and additions have been made to the original text.

The 2012 Kelowna Integrated Water Supply Plan recommended an eight-stage approach that maximizes the use of existing infrastructure and alleviates constraints created by existing service boundaries.

Regulatory Requirements

The water quality supplied must meet the requirements of Interior Health Authority. All larger water utilities in the Southern Interior must provide water that meets the 4, 3,2,1,0 water quality objective. The objective is defined as:

4 log (99.99%) removal and/or inactivation of Bacteria and Viruses;

3 log (99.9%) removal and/or inactivation of protozoa including Giardia Lamblia and Cryptosporidium;

2 treatment barriers refer to two form of treatment for surface water sources or unprotected Groundwater;

< 1.0 NTU turbidity refers to maintaining turbidity of less than 1.0 NTU;

0 Total Coliforms or E.coli in the system at all times

Project Priorities

All domestic water must meet the required water quality standard. The prioritization of work is based on reducing the highest risk areas first and then funding works that benefit the greatest number of persons. The project priority goals are listed in order:

1. Eliminate all Boil Water Notices (BWNs): The reduction of Boil Water Notices can be realized through system separation and the use of higher quality raw water sources;
2. Eliminate all Water Quality Advisories (WQAs): Water Quality Advisories would be reduced through accessing the best quality raw water sources and upgrading water treatment barriers;
3. Meet the IHA 4,3,2,1,0 Requirement: This would be accomplished through use of high quality water and cost effective water treatment technologies such as UV disinfection followed by chlorination;
4. Meet MACs and AO Criteria: The plan will then ensure that all water quality parameters are below the Maximum Acceptable Concentrations (MACs) set out within the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Improvements would then ensure water will meet the aesthetic objectives (AOs) within the GCDWQ;

5. Filter all Drinking Water: This objective is more costly and will result in substantial rate increases for most of the water service areas. Protecting the raw water sources and meeting the IHA deferral requirements are steps to be taken to reduce risks and costs so that filtration is not required in the near future.

The utilities must achieve Goal No. 3, to meet the IHA requirement as soon as possible. The risk to the public for known waterborne pathogens and completing the necessary improvements is part of the operating permits for some of the utilities.

Water Quality Improvement Plan - Approach

The 2012 KIWSP is to be carried out in eight (8) stages:

1. Improve Source Water Quality: Access water from the highest quality available water sources;
2. UV disinfection and Filtration Deferral: Maximize the use of ultraviolet disinfection throughout the region as it is proven to be the best available technology and a cost effective barrier that is required for use on the high quality surface water sources;
3. Primary Separation: These are the agricultural areas that require separation immediately. They include the Ellison area (GEID) and almost all of the SEKID service area;
4. Phase 1 Interconnections: Interconnect the existing water distribution system grids in order to improve the interconnection capacity and emergency supply capacity;
5. Ancillary Works/Reassessment of Status: These projects improve water quality, redundancy, protect source water quality and/or assist in overall water management;
6. Secondary Separation: These secondary areas including the Scenic area in GEID and the Morrison, McKenzie, Gallagher's Road and Belgo areas within BMID;
7. Filtration of Primary Sources: If any of the four primary water sources experiences significant deviations in raw water quality, filtration and/or additional treatment barriers would be added;
8. Phase 2 Interconnections: The second stage of interconnections is to provide substantial capacity between utilities through the construction of high capacity transmission mains.

Centralization of Water Treatment vs. Multiple Sites

The issue of many vs. few vs. a single centralized water treatment site was considered by the 2012 KIWSP technical Committee. Factors considered in the evaluation included water treatment plant siting, available land area, transmission main routing, alternate treatment technologies, staging of treatment, system redundancy, source capacity and economics.

The cost to use UV disinfection forms a critical part of the plan. Ultraviolet (UV) light disinfection is considered to be the best-available-technology (BAT) and is approximately 1/10th the capital and operational cost of filtration. UV disinfection followed by chlorination kills or inactivates all known microbiological risks in the source waters. The one-year financing cost for a filtration facility would be equivalent to the capital cost for a complete UV disinfection facility. This plan maximizes the use of UV disinfection followed by chlorination.

It is recognized that with more than 40 available water sources, it is beneficial to reduce the number of primary sources. The number of UV disinfection facilities was limited to the four primary domestic sources, three on Okanagan Lake at Cedar Creek, Poplar Point and McKinley Landing, and one for Mission Creek. In the longer term, filtration may still be required. Although the location for where filtration will first be required should not be determined at this time, all four large UV sites have room for filtration. The future decisions on filtration will be a function of raw and treated water quality and risks present in the future and should be deferred until the end of Stage 5. During the Stage 5 reassessment, the priority for building transmission capacity vs. constructing filtration would be assessed. The ability to convey substantial water from a cleaner source may be a feasible strategy to defer the need to immediately install filtration.

Project Costs

The capital cost per stage for water quality improvements is set out in the table below. There are 48 projects proposed in the 8 project stages. Detailed project data sheets for the proposed projects are available in Appendix E of the 2012 KIWSP. Most of Phase 1 and 2 have been completed as well as several projects in Phase 3. The table below shows the projects identified in the 2012 Plan that have not been completed. The cost estimates from the 2012 Plan used a variety of Markups on the direct construction cost (contract cost). These cost estimates were normalized by extracting the direct cost from the individual project construction cost estimates and then applying a 5.7% escalation factor to adjust the cost from 2012 to 2017, a 15% engineering allowance, and a 30% contingency allowance.

No.	2012 KIWSP - Projects Not Completed	Direct Cost
1.4	SEKID - SOURCE - GW Supply Development	$6,330,200
Add	GEID Reservoir below McKinnley Dam (original $4 M; assumed 10% engineering and 15% contingency)	$2,991,538
3.3	GEID - SEPARATION - Ellison West - Low PZ Area (Phase 2)	$932,325
3.4	GEID - SEPARATION - Ellison East Area - Upper PZ (Phase 3)	$2,029,250
3.5	SEKID - SEPARATION - Phase 1	$3,456,764
3.6	SEKID - SEPARATION - Phase 2	$3,456,764
3.7	SEKID - SEPARATION - Phase 3	$3,456,764
3.8	SEKID - SEPARATION - Phase 4	$3,456,764

No.	2012 KIWSP - Projects Not Completed		Direct Cost
4.1	GEID - TRANSMISSION MAIN - Tutt Watermain Upgrade		$567,400
4.2	BMID - TRANSMISSION MAIN - East Bench Trunk Main		$2,058,700
4.3	KWU - TRANSMISSION MAIN - Cedar 750mm to Westpoint		$3,954,000
4.4	ALL - INTERCONNECTIONS - 12 small Connections - shared costs		$3,700,000
4.5	KWU - CEDAR STAGE 2 WORKS		$8,526,000
5.1	ALL - CONSERVATION - Collective Metering program		$4,740,000
5.2	GEID - SOURCE PROTECTION - McKinley Reservoir Protection Works		$674,500
5.3	BMID - RESERVOIR STORAGE AND CONSERVATION - Black Mountain Res		$12,633,250
5.4	BMID - TRANSMISSION MAIN - Reservoir Drawdown Main		$2,871,000
5.5	KWU - TRANSMISSION MAIN - Cedar to Distribution		$3,057,000
5.6	RWD - RESERVOIR STORAGE - Lower Pressure Zone		$1,520,000
5.7	GEID - CONVEYANCE CAPACITY UPGRADE - High Cap. McKinley P.Stn		$522,000
6.1	GEID - SEPARATION - Scenic Transmission mains & Tutt lands		$2,425,000
6.2	GEID - SEPARATION - Scenic North Area (Phase 1)		$1,157,668
6.3	GEID - SEPARATION - Scenic South Area (Phase 2)		$1,157,668
6.4	BMID - SEPARATION - Cornish/Morrison		$715,275
6.5	BMID - SEPARATION - Moyer Rd		$185,775
6.6	BMID - SEPARATION - McKenzie Bench		$3,765,136
6.7	BMID - SEPARATION - Gallaghers Road		$1,072,406
6.8	BMID - SEPARATION - Belgo		$3,108,800
7.1	CITY - FILTRATION - 72 ML/day @ CEDAR CREEK		$34,830,000
7.2	BMID - FILTRATION - 75 ML/day @ BLACK MOUNTAIN RES.		$24,375,000
7.3	GEID - FILTRATION - 50 ML/day @ McKINLEY RESERVOIR		$17,500,000
7.4	CITY - FILTRATION - 123 ML/day @ KNOX MOUNTAIN		$53,200,000
7.5	CITY - TRANSMISSION MAIN - Knox Mtn Connection		$1,219,000
7.6	CITY - TRANSMISSION MAIN - BROADWAY		$704,000
7.7	CITY - TRANSMISSION MAIN - Swick Road		$1,380,000
7.8	GEID - UV DISINFECTION - McKinley Ldg - local service area		$378,000
8.1	ALL - TRANSMISSION MAIN - 1500mm City to Central Connection		$4,550,000
8.2	ALL - TRANSMISSION MAIN - 1500mm Central to BMID		$20,075,000
8.3	ALL - TRANMISSION MAIN - 1200mm Central to GEID		$15,450,000
8.4	ALL - TRANSMISSION MAIN - 1200 mm Central to South City		$20,100,000
8.5	ALL - TRANSMISSION MAIN - 1050mm BMID to SEKID		$5,000,000
	Subtotal		**$283,282,947**
	Escalation from 2012 to 2017	5.7%	$16,147,128
	Engineering	15%	$44,914,511
	Contingency	30%	$98,459,237
	Total Construction Cost		**$442,803,823**

SECTION 3

VALUE IMPROVEMENT ALTERNATIVES

SECTION 3
VALUE IMPROVEMENT ALTERNATIVES

The results of this VP Study represent the value opportunities that can be realized on this project. They are presented as individual alternatives for specific changes to the current concept.

Each alternative includes:

- A description of the concept
- Sketches, where appropriate, to further explain the alternative
- Calculations, where appropriate, to support the technical adequacy of the alternative
- A capital cost estimate

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Value Alternative

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	1
Construct system modifications to ensure the needed domestic water quality improvements for SEKID and irrigation quality improvements for SOMID are addressed as an initial implementation phase of the integrated system	
Ideas Included:	
DW-63 Service the SEKID service area domestic needs through KLO and Hall Road with water supplied from Cedar Creek	
Description of Concept:	
The concept involves supplying a cost-effective and resilient water supply for the South East Kelowna Irrigation District. The concept is to supply water through an interconnected City system that allows supply from either Mission Creek or Okanagan Lake Supplies. The work involved in Phase 1 includes three main components: a new separate domestic water distribution system from the existing irrigation supply from Hydraulic Lake, a transmission mainline connector from Gordon Road north along KLO Road to Hollywood Road, and pipeline capacity upgrades at Cedar Creek to improve the capacity along Gordon Road, which also includes upgrades necessary for the integration of the South Okanagan Mission Improvement District (SOMID).	

Cost Summary

First Cost:	$67,803,000
O&M:	$0
Life Cycle Cost:	$67,803,000

Advantages/Disadvantages

Alternative No.: 1

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Provides a secure and resilient domestic water supply to SEKID • Provides opportunity for all services to access both City and Mission Creek supplies • Fits into a long-term domestic looped transmission system • Incorporates strategic storage to provide the Rutland service area with supply resiliency • Operational issues are solved in the long term for supplies in the southern portion of the City • Eldorado intake/pump station can be removed from regular operations • The KLO connector has simpler construction conditions (i.e. more rural roads, less traffic, simpler creek crossing than the road bridge planned for replacement and tunnelling under Mission Creek) • Provides capacity to integrate smaller water systems in the future • Mission Creek water can be supplied by gravity, improving operational costs	• None apparent

Discussion

Alternative No.: 1

The goal of Phase 1 of the Integrated Water Supply Plan is to provide all SEKID and SOMID water users with a safe, reliable and resilient domestic water supply. There were two options presented for addressing the water quality needs for the SEKID area.

SEKID had originally proposed the installation of a new well to meet their service area's domestic water quality needs. Based on concerns raised in a graduate student's whitepaper about the long-term viability of the groundwater source, the City questions the feasibility of further relying on the groundwater to supply the SEKID service area. However, during the workshop, Remi Allard (Piteau Assoc. Engineer) provided what seemed to be an informed expert opinion that the groundwater source is viable. While the VP team did not include a hydrogeologist expert to provide an independent assessment of the data, the presentation of data and conclusions by Mr. Allard did seem reasonable.

The City option included a new transmission main system from Cedar Creek Intake on Lake Okanagan that would supply both the SOMID and the SEKID service areas.

The Value Planning concept is to create a domestic water transmission system to serve all of Kelowna with either Mission Creek water or Lake Okanagan water. Under this alternative, the existing SEKID well field can continue to supplement agricultural supply during periods of drought. This specific Value Planning alternative addresses Phase 1 of the ultimate plan for an integrated domestic water transmission system.

Consistent with the global outcome of being supplied from multiple sources within the City, the SEKID water supply can be accessed from a new 350 millimeter transmission mainline along KLO Road and McCullough Road in a west/east direction. Ultimate flows will be bi-directional, requiring a booster station and pressure reducing stations at different points to accommodate flows. The end of the mainline to the north will be in the vicinity of a proposed reservoir serving the Rutland area (not included in this phase).

The supply and distribution system to supply the Gordon Road transmission main is currently compromised with operational issues that already exist in the southwest corner of the City. The integration of SOMID already causes significant reservoir operational issues at Southcrest Reservoir. The SOMID work triggers pump and transmission upgrades at Cedar Creek. The additional transmission works and reservoir upgrades proposed provide the resiliency by efficiently allowing a secure supply from both Poplar Point and Cedar Creek intakes. The SOMID upgrades also require the decommissioning of the Frazer Lake dam, which was an old supply reservoir to the system which no longer meets Canadian Dam Safety Guidelines.

The Cedar Creek upgrades include new pumps and booster pumps at Cedar and Stellar pump stations, 2 ML of additional reservoir capacity at Adams Reservoir (where a new filtration plant could be built in the future, if necessary), and several kilometres of 750 millimeter diameter transmission main to the Westpoint Reservoir. This will allow bi-directional flow from north/south direction.

The SEKID system separation components consist of distribution and storage upgrades consistent with the project presented in the 2012 KIWSP. The project will allow domestic water delivery to all residential properties, including the McCulloch corridor, Hall Road, Gallagher's Canyon and all farm residential services.

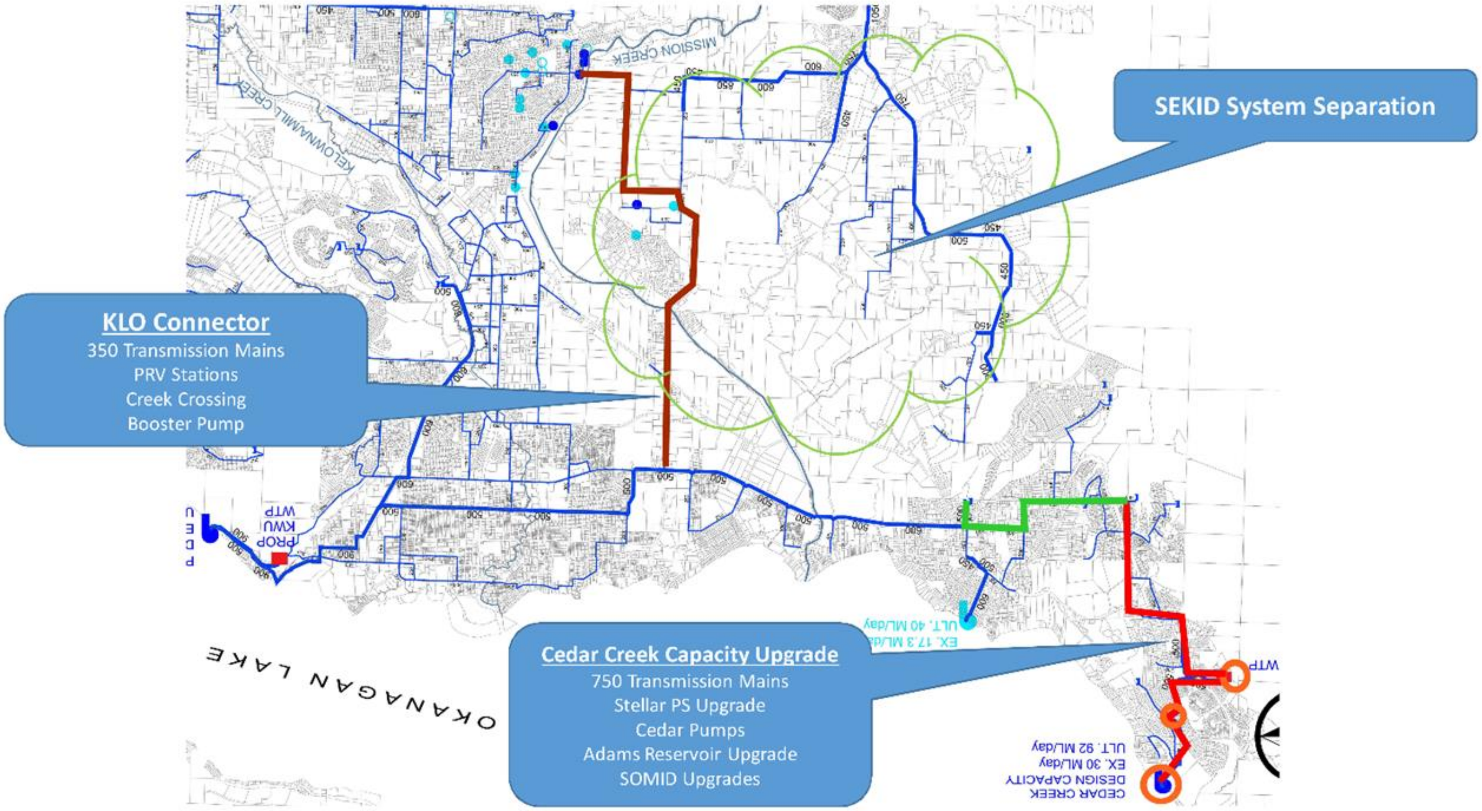
The work includes close to 90 kilometres of distribution mainline, 3 booster pump stations, and water meters to approximately 1,400 residences. Fire flows will be supplied through the existing irrigation system, and irrigation demands will be met through the existing supply from Hydraulic Lake and other upland reservoirs.

Interconnections for both the domestic and irrigation systems, as described in this plan, will improve the resiliency and supply options to every user.

While the VP team considers the SEKID option for expanding their well field to be a viable solution technically, in the opinion of the VP team, it is not the best solution for an ultimately integrated city-wide system, which was the goal of the integrated water supply plan. However, it is important to note that this Phase 1 of the Value Planning concept does require a greater initial expenditure than the well field expansion because it is the initial build out of the larger integrated plan. Depending on the availability and timing of grant funding, it may be necessary to expand the existing SEKID well field to be used as an interim supply for the SEKID service area, if required, until the new transmission mains are installed.

Sketch

Alternative No.: 1



Calculations

Alternative No.: 1

Remaining work to complete SEKID separation:

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Table 3.1 - Cost Estimate Summary

No.	Description	Extension	CTQ Rpt	Corrected	
1	Hall Road Area and Well Development	$ 4,208,244	$ 3,883,403	$ 3,883,403	
2	Gallahers Canyon - McCulloch Road Corridor	$ 4,902,406	$ 4,428,567	$ 4,428,567	
3	Lower Bench - East Kelowna - Dunster Roads	$ 2,307,265	$ 2,056,942	$ 2,056,942	
4	Lower McCulloch - Lower Spiers Road	$ 3,081,002	$ 2,722,707	$ 2,722,707	
5	Upper June Springs - Hayes Road	$ 2,703,115	$ 1,237,072	$ 2,486,439	**
6	Middle Bench - Bemrose - Reekie, Fitzgerald Roads	$ 2,108,534	$ 1,128,364	$ 1,992,533	**
7	Upper Spiers - SE Kelowna Elementary	$ 3,099,446	$ 2,721,026	$ 2,721,026	
8	Bedford Road - Wallace Hill Road areas	$ 2,825,087	$ 2,455,998	$ 2,455,998	
9	Lower Crawford - Dehart Roads	$ 1,890,467	$ 1,671,118	$ 1,671,118	
	TOTAL CAPITAL COST ESTIMATE	**$ 27,125,566**	**$ 22,305,197**	**$ 24,418,733**	**
			21.61% Increase	11.09% Increase	

** mathematical errors found

Hall Road Area and Well development is mostly complete except for the following elements:

No.	Description	Quantity	Unit	Unit Price	Extension
1.0	**Pipe Installation**				
	400 mm Well 2 to Rose Road	1547	m	$ 425	$ 657,475
	400 mm Well 3 to Well 2	645	m	$ 425	$ 274,125
	300 mm Well 4 to Well 3	550	m	$ 210	$ 115,500
	200 mm Rose Road to Hall Road	480	m	$ 145	$ 69,600
	150 mm East Kelowna Road to Bewlay	695	m	$ 125	$ 86,875
	200 mm PRV station	1	ea	$ 130,000	$ 130,000
	150 mm PRV station	1	ea	$ 100,000	$ 100,000

Hall Road Area completion = 69,600+86,875 + 130,000 + 100,000 = 386,475

Remaining separation cost = 27,125,566 – (4,208,244 – 386,475) = 23,303,797

This cost includes 10% engineering and 15% contingency; remove this cost to optain direct construction cost.

= 23,303,797 x 0.75 = 17,477,848

Use this cost in VP cost estimate and apply 15% engineering and 30% contingency factors

Construction Cost Estimate

Alternative No.: 1

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
(Cost From November 2016 SEKID Water Supply Options Report)				
Phase 1				
Cedar Creek Stage 2				
25 Ml/d (275 l/s) Pump - Cedar Cr. (each)	EA	2	330,000	660,000
25 Ml/d (275 l/s) Pumps - Stellar (each)	EA	3	1,000,000	3,000,000
Building Cost ($/Ml/d) - Stellar (per Ml/d)	ML/D	75	20,000	1,500,000
Reservoir Costs (per cu.m.)	CM	2,000	400	800,000
750 mm Transmission Mains (lin.m.)	LM	2300	1,052	2,419,600
750 mm Transmission Main Tie In-s (each)	EA	2	18,200	36,400
Asphalt R & R (lin.m.)	LM	2300	200	460,000
Adans to Southcrest Transmission				
750 mm Pipe (lin.m.)		3360	1,052	3,534,720
750 mm Tie-In (each)		1	18,200	18,200
Large Diameter Asphalt R&R (lin.m.)		2010	200	402,000
Southcrest West Point Transmission				
600 mm Pipe (lin.m.)		1090	872	950,480
600 mm Tie-In (each)		2	14,600	29,200
500 mm Pipe (lin.m.)		830	816	677,280
500 mm Tie-in (each)		1	10,900	10,900
450 mm Pipe (lin.m.)		800	697	557,600
450 mm Tie-in (each)		1	9,700	9,700
Large Diameter Asphalt R&R (lin.m.)		1090	200	218,000
Small Diameter Asphalt R&R (lin.m.)		1630		260,800

			Concept	
Item	Unit of Meas.	Unit Cost	Qty	Total
			160	
600 mm PRV (each)		1	400,000	400,000
450 mm PRV (each)		1	325,000	325,000
KLO				
350 mm PVC pipeline (in secondary roads)	KM	415,000	8	3,320,000
Pavement	KM	165,700	8	1,325,600
Connect to existing water mains	EA	8,850	2	17,700
PRV stations	EA	235,000	2	470,000
Booster pump station (assume 50 ML/d)	EA	3,450,000	2	6,900,000
Creek crossing	EA	40,000	1	40,000
350 mm pipe bridge	M	9,000	100	900,000
Valves & fittings	LS	40,000	1	40,000
SEKID - SEPARATION	EA	17,477,848	1	17,477,848
Subtotal				46,761,028
MarkUp - Engineering 15% + Contingency 30% = 45%		45%		21,042,463
TOTALS				67,803,000

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Value Alternative

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	2
Interconnect distribution systems city-wide to provide a consistent level of service and reliability to all water users	
Ideas Included:	
DW-25 Plan distribution for future service to small service areas DW-38 Develop a system wide model to understand system operations DW-53 Construct looped interconnections between service areas DW-55 Combine systems to improve fire protection DW-56 Consolidate and simplify the number of distribution reservoirs and booster stations DW-57 Consolidate pressure zones	
Description of Concept:	
The concept is to revisit proposed interconnections between systems to suggest improvements in consideration of the concept proposed for a large domestic transmission system. Specifically, the objective of this alternative is to provide a resilient domestic water supply between current systems. The 2012 KIWSP envisioned three interconnections between SEKID and the City Water Utility, one on KLO Road and two in the Crawford area. It's understood that fire protection for SEKID would be provided by the agricultural irrigation system.	

Cost Summary

First Cost:	$5,583,000
O&M:	$0
Life Cycle Cost:	$5,583,000

Advantages/Disadvantages

Alternative No.: 2

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Interconnection at some locations with transmission mains rather than distribution mains would provide more resilient domestic water to all customers • Interconnections could be built into long-term domestic looped transmission system Options can incorporate strategic storage for multiple current systems (i.e. Rutland Waterworks system gaining fire storage and balancing from SEKID) • Strong interconnection through rural areas takes advantage of simpler construction conditions (i.e. more rural roads, less traffic, simpler creek crossing than the road bridge planned for replacement including creek crossings)	• None apparent

Discussion

Alternative No.: 2

Reconsider the recommendations of the 2012 KIWSP for interconnections between the systems in light of implementing a city-wide integrated system. The table below reviews each of the proposed interconnections from the 2012 KIWSP with recommendations for each.

The interconnection proposed between the City and SEKID water systems is insufficient to meet the full domestic demand for the SEKID service area. With the current Canada/Provincial funding program, there is a good opportunity to provide a resilient water supply from Okanagan Lake that is incremental to the longer term strategy of a looped transmission main interconnecting SEKID with other water districts. An alternative to a minor interconnection would be to provide a strong transmission main that fits in with the ultimate strategy.

Two alternatives to the minor connection are: (1) to extend a new transmission main along KLO Road between Gordon Drive and a strategic point within SEKID and (2) would be to implement a portion of a future transmission main through Rutland.

Both transmission mains need to end near the existing SEKID well field (KLO Rd/E. Kelowna/McCulloch Rd), so the estimated length is close to the same. Alternatives will likely be less expensive when they follow rural roads with less traffic and simpler construction conditions.

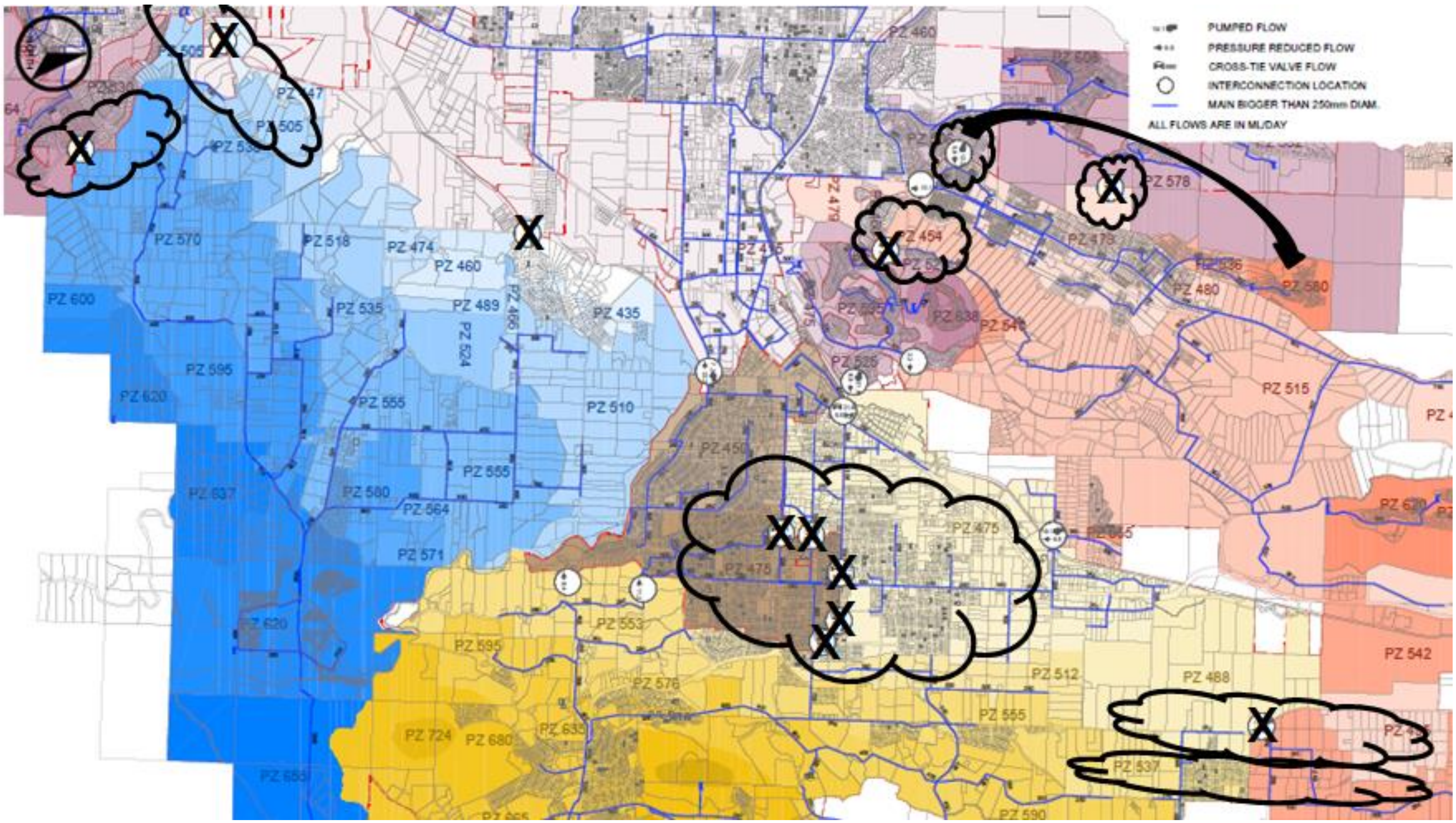
ID	2012 KIWSP Interconnection	Proposed Plan	Scope (PRV/Pump?)	Notes
4.1	Crawford 564 CoK – 570 SEKID DeHart 415 CoK – 447	Eliminate through consolidation of pressure zones. Allows for local (non PRV) interconnection. Consolidate CoK 564 with SEKID 570 as well as reconfigure CoK 530 & 451 with SEKID 538, 505 and 447.		Far end of SEKID system. Eliminating zone boundaries will improve water quality and fire supply.
4.1	KLO / Hall Road 415 CoK – 460 SEKID	Eliminate. This pump is replaced in the VP Concept.		

ID	2012 KIWSP Interconnection	Proposed Plan	Scope (PRV/Pump?)	Notes
4.1	Springfield Gerstmar 415 CoK - 450 RWW	Eliminate. This pump is replaced in the VP Concept. Depends on transmission timing and scope.		The PRV may still be required.
4.1	Glenmore / Summit 454 GEID – 460 City	Eliminate interconnection and consolidate zones.		Saves money by eliminating a costly PRV. Reduces dead ends and improves water quality and capacity.
4.1	High /Clifton 479 GEID – 506 CoK.	Relocate pump and PRV to Union, north end of CoK (allow backup to Skyline pump supply to 578 Zone CoK.	Add 1 PRV and 1 pump (12 ML/d)	
4.1	Dilworth Mtn / Summit 525 CoK – 454 GEID.	Eliminate and reconfigure existing CoK PRV to service larger consolidated zone.		Improve fire flow and water quality by eliminating artificial boundaries.
4.1	Dilworth / Rifle 525 CoK – 515 GEID	Eliminate. Consolidate CoK 525 with GEID 515. Raise domestic GEID to 525.		Improve fire flow and water quality by eliminating artificial boundaries.
4.1	Dilworth / Marshall. 525 CoK - 475 BMID	Keep PRV, keep pump as it is more efficient to pump from 475 than 415 when ____ Mission Creek.	Add 1 PRV Add 1 pump	Consolidation of utilities will address known fire flow capacity and storage in this area.
4.1	Enterprise / Hwy 97 475	Keep PRV Eliminate		Already

ID	2012 KIWSP Interconnection	Proposed Plan	Scope (PRV/Pump?)	Notes
	BMID – 450 RWW	pump		installed.
4.1	Sexsmith / Hollywood 475 BMID – 555 GEID	Keep. If domestic supply looped along bench then could be PRV only (no pump).	Add 2 pump	Conservative assumption is to keep small pump
4.1	Hwy 33 / Dougall. 475 BMID – 475 RWW Houghton / Dougall 475-475 Mugford End. 475 – 475 Leathead / RSS 475 – 475 Leathead / Rutland Road 475-475.	Eliminate all 5 "interconnections" and simply eliminate boundary between systems.		Improve fire flow and water quality by eliminating artificial boundaries.
4.1	Belgo (2) 553 BMID – 475 RWW	Keep.	Add 2 PRVs	
4.1	McKenzie 488 BMID – 542 GEID	Zone review and consolidate zones for both domestic and separated system. Eliminate one zone. Assume 1 PRV still needed, pump should not be.	Add 1 PRV	Improve fire flow and water quality by eliminating artificial boundaries.

Sketch

Alternative No.: 2



Construction Cost Estimate

Alternative No.: 2

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
High/Clifton				
PRV	EA	250,000	1	250,000
Pump 12 ML/d	EA	2,000,000	1	2,000,000
Dilworh/Marshall				
PRV	EA	250,000	1	250,000
Pump	EA	200,000	1	200,000
Sexsmith/Hollywood				
Pump	EA	400,000	1	400,000
Belgo				
PRV	EA	250,000	2	500,000
McKenzie				
PRV	EA	250,000	1	250,000
Subtotal				3,850,000
Markup - Engineering 15% + Contingency 30% = 45%		45%		1,732,500
TOTALS				5,583,000

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Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	3
Separate domestic and agricultural water within all distribution systems	
Ideas Included:	
DW-02 Put all domestic lawn watering on an agricultural water source DW-21 Maximize use of agricultural water for fire protection DW-53 Construct looped interconnections between service areas	
Description of Concept:	
Retain the existing pipelines that are currently delivering combined domestic and irrigation water for use in distribution of irrigation water, lawn watering, and fire flows, and construct a new looped domestic water distribution system in all of the improvement and irrigation districts.	

Cost Summary

First Cost:	$41,902,000
O&M:	$0
Life Cycle Cost:	$41,902,000

Advantages/Disadvantages

Alternative No.: 3

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Allows use of high quality water for domestic use and lower quality water for irrigation, fire flows and lawn watering • Provides greater interconnection of sources for high quality domestic water and delivers higher quality domestic water than current conditions • Avoids wasting higher quality water than is necessary for fire flow, lawn watering and irrigation	• Temporary disruption associated with new pipeline construction • Additional pipelines to maintain • Added construction cost

Discussion

Alternative No.: 3

The existing water distribution pipeline networks in the agricultural service areas generally have sufficient capacity to deliver the high demands required for irrigation in the summer, along with the required domestic flows occurring at that time (which includes water for lawn watering). However, during low flow times, because of the large pipe sizes required to convey the irrigation flows, the domestic-only flows in these same pipes are low enough to create potential pathogen regrowth exposure and high chlorinated organic compound levels at the ends of the distribution system because of the long residence time in the pipes. Creation of a domestic water distribution system that does not have to convey irrigation water, water for lawn watering, or water for fire flows, allows use of much smaller pipes, which substantially reduces the water residence time and thus can virtually eliminate the pathogen regrowth potential and substantially reduce the production of chlorinated organic compounds.

Additionally, water source quality that is adequate quality for irrigation is not sufficient at all times of the year for domestic use to meet provincial and federal standards. Separation of the domestic and irrigation water pipeline systems allows conveyance of two different qualities of water to meet the specific needs of the two different types of demands. Construction of a new domestic system, rather than a new irrigation system allows the use of much smaller piping at a lower cost because of the lower and more uniform year-round demand for domestic water.

For the purposes of this planning analysis, the evaluation of domestic separation contained in the 2012 Kelowna Integrated Water Supply plan has been used as a basis for the cost estimate for separation.

Construction of a separate domestic distribution system in those areas where it is appropriate would occur in phases, based on water quality and available funding. However, for this analysis, to simplify the cost analysis, all construction has been assumed to occur in a single phase.

It has also been assumed that small portions of the existing piping will have to be replaced due to damage or deterioration.

Construction Cost Estimate

Alternative No.: 3

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
2012 Plan Projects (costs adjusted to direct cost)				
GEID - SEPARATION - Ellison West - Low PZ Area (Phase 2)	EA	932,325	1	932,325
GEID - SEPARATION - Ellison East Area - Upper PZ (Phase 2)	EA	2,029,250	1	2,029,250
GEID - SEPARATION - Scenic Transmission mains & Tutt lan	EA	2,425,000	1	2,425,000
GEID - SEPARATION - Scenic North Area (Phase 1)	EA	1,157,668	1	1,157,668
GEID - SEPARATION - Scenic South Area (Phase 2)	EA	1,157,668	1	1,157,668
BMID - SEPARATION - Cornish/Morrison	EA	715,275	1	715,275
BMID - SEPARATION - Moyer Rd	EA	185,775	1	185,775
BMID - SEPARATION - McKenzie Bench	EA	3,765,136	1	3,765,136
BMID - SEPARATION - Gallaghers Road	EA	1,072,406	1	1,072,406
BMID - SEPARATION - Belgo	EA	3,108,800	1	3,108,800
Subtotal (detailed estimates in Cost App.)				16,549,303
2012 Cost Adjusted to November 2016 (% From SEKID Water Supply Options)		5.7%		943,310
Total Adjusted Cost to November 2016				17,492,613
Agricultural Water System Renewal				
200 mm Pipe	M	167	5,000	835,000
250 mm Pipe	M	236	5,000	1,180,000
300 mm Pipe	M	323	5,000	1,615,000
350 mm Pipe	M	415	5,000	2,075,000
400 mm Pipe	M	518	5,000	2,590,000
450 mm Pipe	M	622	5,000	3,110,000
Subtotal				28,897,613
Markup - Engineering 15% + Contingency 30% = 45%		45%		13,003,926
TOTALS				41,902,000

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	4
Construct a domestic water transmission system that provides redundancy and resiliency for distributing source water to supply the distribution system	
Ideas Included:	
DW-04 Use all water sources based on seasonal water quality DW-05 Use Mission Creek for all domestic water in the winter DW-65 Interconnect the Poplar Point supply to the BMID service area DW-66 Interconnect the Poplar Point supply to the BMID and Rutland service areas and discontinue use of the Rutland wells	
Description of Concept:	
This concept constructs new transmission mains to interconnect the various systems to allow distribution of Mission Creek water throughout the entire combined domestic water system when Mission Creek water quality is adequate, and permits distribution of Okanogan Lake water throughout the system when Mission Creek water quality is not adequate. It also provides adequate domestic water to the entire system within the City in the event of loss of the Mission Creek supply or any two of the four major Lake Okanogan intakes.	

Cost Summary

First Cost:	$96,126,000
O&M:	$0
Life Cycle Cost:	$96,126,000

Advantages/Disadvantages

Alternative No.: 4

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Maximizes use of naturally high quality water for domestic use while minimizing the need for advanced treatment measures • Allows distribution throughout the City of gravity fed Mission Creek water most of the year • Allows distribution of high quality Lake Okanagan water throughout the City at any time • Eliminates the dependence on well water, but allows continued well water use as needed or desired for redundancy and other operational reasons • Provides dependable sources of high quality domestic water throughout the City at all times of the year • Minimizes overall system-wide pumping	• May not represent the optimal configuration without modeling to confirm • Does not have a dedicated main to the SEKID service area from the Mission Creek supply. Depends on a connection from the Rutland service area, high pressure water conveyance in this configuration through the SEKID pipe is not possible

Discussion

Alternative No.: 4

The City of Kelowna is served by five large and several small independent water systems; one operated by the City and four by individual improvement/irrigation districts (IDs). The City system is primarily domestic water service, with a small amount of agricultural service. The four IDs range from primarily domestic water supply (Rutland) to primarily irrigation water supply (Black Mountain, Glenmore-Ellison, and South East Kelowna). Water is supplied by a combination of multiple wells (some in confined and some in unconfined aquifers), several area creeks, and Lake Okanagan. Each of the five systems is, for the most part, independent, with few interconnections. The majority of the IDs provide both domestic and irrigation water to their customers from a single distribution system. The water quality does not meet current provincial domestic water quality guidelines on a consistent basis in the IDs. Accordingly, City of Kelowna residents have substantially different domestic water quality depending on which water system supplies their water.

This alternative interconnects all of the water systems in the City to permit delivery of consistently high quality domestic water to all City residents. The project consists of the following four elements:

- KLO Road Connector
- Central Connector
- Mission/Cedar Creek Connector
- Glenmore Connector

The alternative configuration permits the use of water from Mission Creek when that water is of adequate quality for domestic use, which is typically at least 75% of the year, for distribution to the entire city-wide service areas. It presumes that initially, water from Mission Creek will be usable for domestic use with only UV treatment and chlorination most of the year (filtration deferral is assumed for this source). At such time as additional treatment is required, and once that treatment has been installed, Mission Creek water can be used up to full time if system economics dictate.

It is also configured to permit distribution of Okanagan Lake water from the various existing City lake intakes throughout the City for domestic use, as well.

Operationally, the proposed approach would utilize Mission Creek water for domestic supply, without supplemental clarification, but with UV and chlorine disinfection, whenever the turbidity is sufficiently low to be acceptable. The creek turbidity would be monitored upstream, and when an approaching turbidity excursion is identified, the domestic water intake gates from Mission Creek would be closed and the appropriate pumps started on one or more of the Lake Okanogan intakes to supply lake water.

When the Mission Creek water quality returns, the intake would again be opened and the lake pumps turned off. This approach may require modification of the existing intake to incorporate fast-closing gates, or diverting questionable flow into the existing BMID clarification tanks to avoid lower quality water entering the domestic system during the transition. This operational requirement will necessitate close coordination between engineering, operations, and IHA as the plan is developed to ensure water quality objectives are met.

Existing wells can be used or not used depending on localized demand issues and when needed to support water delivery when system repairs take parts of the system out of service. Wells are not required for water supply adequacy purposes in the near future, but may be a useful supply augmentation down the road.

Each of the proposed transmission system improvements is described below.

KLO Road Connector – This pipeline will be designed to accommodate flow in both directions. It will be an approximately 8 kilometers long, 350 millimeter diameter, new domestic pipeline connecting to the existing 500 millimeter domestic waterline in Gordon Road at KLO Road. The line will run east on KLO Road to McCulloch Road to East Kelowna Road and then east on East Kelowna Road and north on a new road right of way across Mission Creek, connecting to an existing 300 x 300 x 300 millimeter domestic main junction in Hollywood Road at Springfield. It will require two pressure reducing valves (PRV)/ booster pump stations, two creek crossings, and an approximately 100 meter pipe bridge. It may be possible to locate one pipeline on an existing bridge.

Central Connector – This pipeline will be designed to accommodate flow in both directions. It will be an approximately 4.8 kilometers long, 900 millimeter diameter, new domestic pipeline connecting to the existing City domestic mains at Enterprise Way and Dilworth Drive. It would proceed northeast along Enterprise Way and along Leathead Road to Rutland Road and connect with the existing 600 millimeter domestic main at the intersection of Rutland Road and Mugford Road. It will require a PRV and booster station to address pressure zone differences of 60 meters, as well as larger pumps at BMID PRV-1 and PRV-2.

Upper Mission Creek Connector – This pipeline will be designed to accommodate flow in both directions. It will be an approximately 9.2 kilometers long, 900 millimeter diameter, new domestic pipeline connecting the existing BMID Mission Creek withdrawal location to a junction with the domestic system and the new Central Connector at Rutland Road and Mugford Road. It would proceed generally along the Kelowna Rock Creek Highway alignment, requiring a PRV and booster pump station, with the location to be determined after system modeling.

Mission/Cedar Creek Connector –The Cedar Creek upgrades include adding two new pumps (275 liters per second each) at Cedar Creek, a pump station addition at the Stellar Pump Station with the addition of two 275 liters per second booster pumps, and 2,000 m^3 of new reservoir storage at Adams Reservoir.

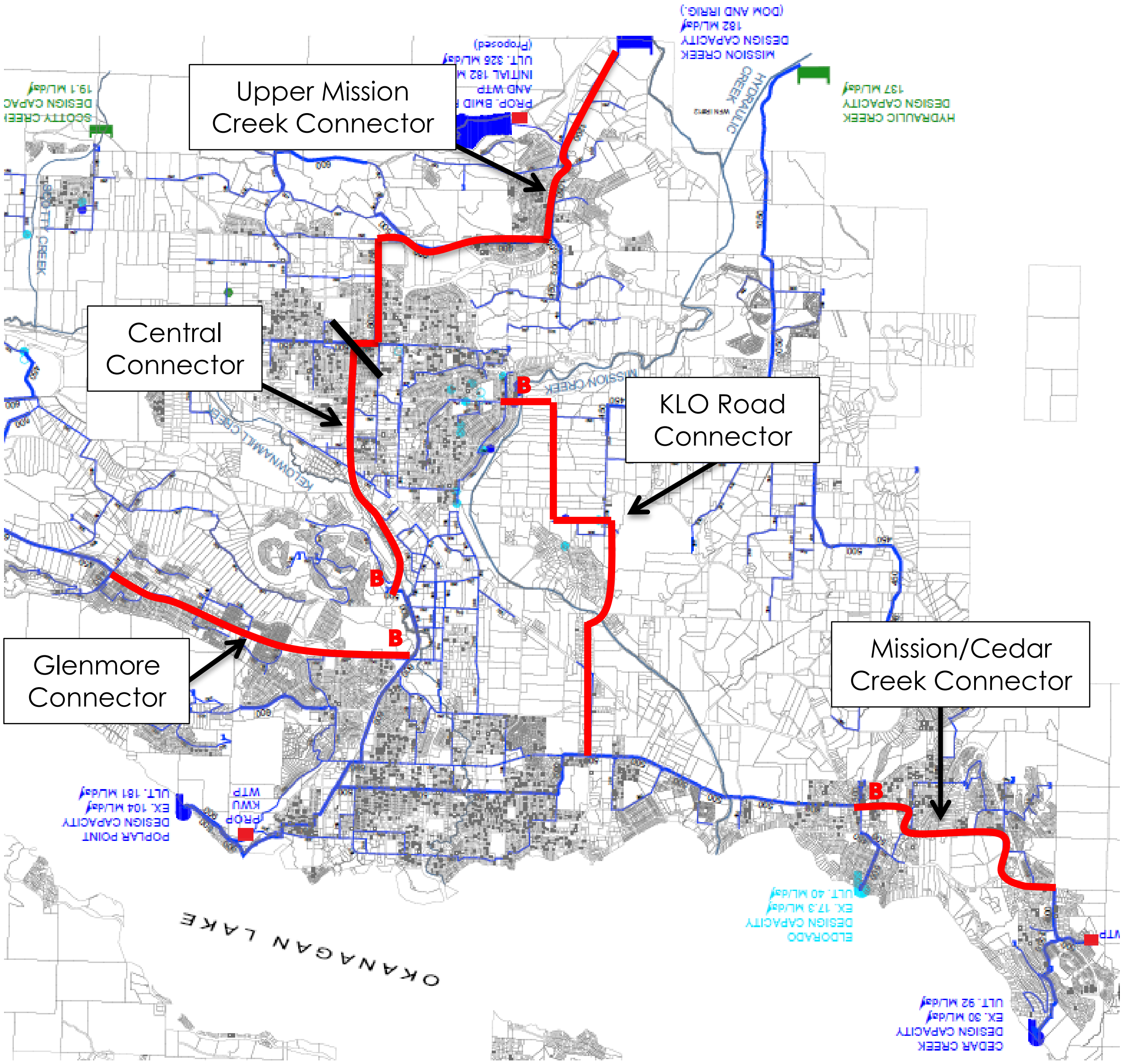
- The transmission line from Adams Reservoir to Southcrest Reservoir will consist of 3.4 kilometers of 750 millimeter diameter pipeline to twin and add capacity to this growing pressure zone and to support operations.
- The new transmission pipeline from Southcrest Reservoir to Westpoint Reservoir provides the capacity to supply water in either north or south directions. This provides improved capacity in the City system to supply the SEKID service area and the other areas in the system. This option includes over 2.7 kilometers of pipeline capacity ranging from 350 to 600 millimeter diameter, as well as two pressure reducing stations.
- To complete the SOMID supply, upgrades are required within the system to adapt to City standards. This includes 150 millimeter pipeline, decommissioning of the Frazer Lake Dam and additional fire hydrants and miscellaneous connections.

Glenmore Connector - This pipeline will be designed to accommodate flow in both directions. It will be an approximately 5.5 kilometer long, 600 millimeter diameter, new domestic water transmission pipeline. It would tee off of the 600 millimeter "North-End" connector at Glenmore Road connecting to the existing 450 millimeter domestic pipeline in Glenmore Road at or near the intersection with Union Road. It will require a PRV and booster station to address pressure zone differences of 64 meters.

According to the Integrated Water Supply plan (Appendix E), the BMID UV facility currently being constructed for Mission Creek will have a capacity of 125 ML/d. Typical projected interior domestic water demand for the entire Kelowna area is on the order of 40-43 ML/d. Once complete separation is achieved, the new Mission Creek UV facility will be able to treat the entire interior domestic demand, so expansion to meet the projections for this proposed plan should not be required. In the interim, once the new major pipelines are constructed and the systems interconnected, the combination of Lake Okanagan water and Mission Creek water should be able to meet the combined demand, as well. The maximum monthly demand for all domestic use (including lawn watering, but excluding commercial irrigation) for the peak demand month of July is about 4,800 ML/month, which is about 154 ML/d, so a combination of Mission Creek and Lake Okanagan water should easily meet the demand, once the new pipelines are in place.

Sketch

Alternative No.: 4



Construction Cost Estimate

Alternative No.: 4

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
Central Connector				
900 mm ductile iron pipe (in city streets)	KM	1,395,000	5	6,696,000
Pavement	KM	265,118	5	1,325,590
PRV station	EA	340,000	1	340,000
Booster pump station (assume 250 ML/d)	EA	14,950,000	1	14,950,000
Replace pumps at BMID PRV 1 & BMID PRV 2 (assume 150 ML/d ea)	EA	1,600,000	2	3,200,000
Valves & fittings	LS	350,000	1	350,000
Connect to existing water mains	EA	32,000	2	64,000
Glenmore Connector				
600 mm ductile iron pipe (in city streets)	KM	900,000	6	4,950,000
Pavement	KM	220,931	6	1,325,586
PRV station	EA	266,000	1	266,000
Booster pump station (assume 150 ML/d)	EA	9,200,000	1	9,200,000
Valves & fittings	LS	110,000	1	110,000
Connect to existing water mains	EA	14,000	2	28,000
Upper Mission Creek Connector				
900 mm ductile iron pipe (in highway shoulder)	KM	1,395,000	8	11,160,000
900 mm ductile iron pipe (in highway shoulder)	KM	1,395,000	1	1,674,000
Pavement	KM	265,118	1	318,142
PRV station	EA	340,000	1	340,000
Booster pump station (assume 150 ML/d)	EA	9,200,000	1	9,200,000
Valves & fittings	LS	350,000	1	350,000
Connect to existing water mains	EA	32,000	4	128,000
*Costs for the KLO Road and Mission/Cedar Creek Connectors are included in Alternative 1 (Phase 1 of the Integrated Water Supply Plan)				
Subtotal				66,293,460
Markup - Engineering 15% + Contingency 30% = 45%		45%		29,832,057
TOTALS				96,126,000

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Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	5
Construct an agricultural water transmission system that provides redundancy and resiliency for distributing source water to supply the distribution system	
Ideas Included:	
DW-70 Complete a large agricultural water transmission system with interconnected sources	
DW-09 Use low cost gravity systems for irrigation needs	
DW-08 Use multipurpose reservoirs for water and flood control	
Description of Concept:	
The agricultural transmission system is optimized to create resiliency and back up supply for all agricultural regions. This concept takes advantage of different water sources, including upland reservoirs, creeks, Okanagan Lake, wells, or supplement from the domestic water supply system.	

Cost Summary

First Cost:	$21,585,000
O&M:	$0
Life Cycle Cost:	$21,585,000

Advantages/Disadvantages

Alternative No.: 5

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Provides access to multiple water sources for redundancy and increased reliability • Ensures equitable consideration for agricultural and domestic servicing • Increases resiliency to drought and climate change • Provides some flexibility for operational control of reservoirs to increase potential flood protection without risk to the irrigation system • Maintains domestic water connectivity to the system as an alternative source	• May require low use pump stations to service higher pressure zones normally covered by gravity • May result in higher cost to supply certain areas

Discussion

Alternative No.: 5

As part of the project objective to ensure the protection of agricultural interests and water equity, consideration must be given for alternative supplies in the event of an outage or shortage in any one of the main raw water supplies. The projects listed allow access to one or more sources of water and provide greater flexibility for system supply and operations. Mill Creek and Hydraulic Creek water sources were considered to be at higher risk of supply shortage or failure compared to Mission Creek and Okanagan Lake.

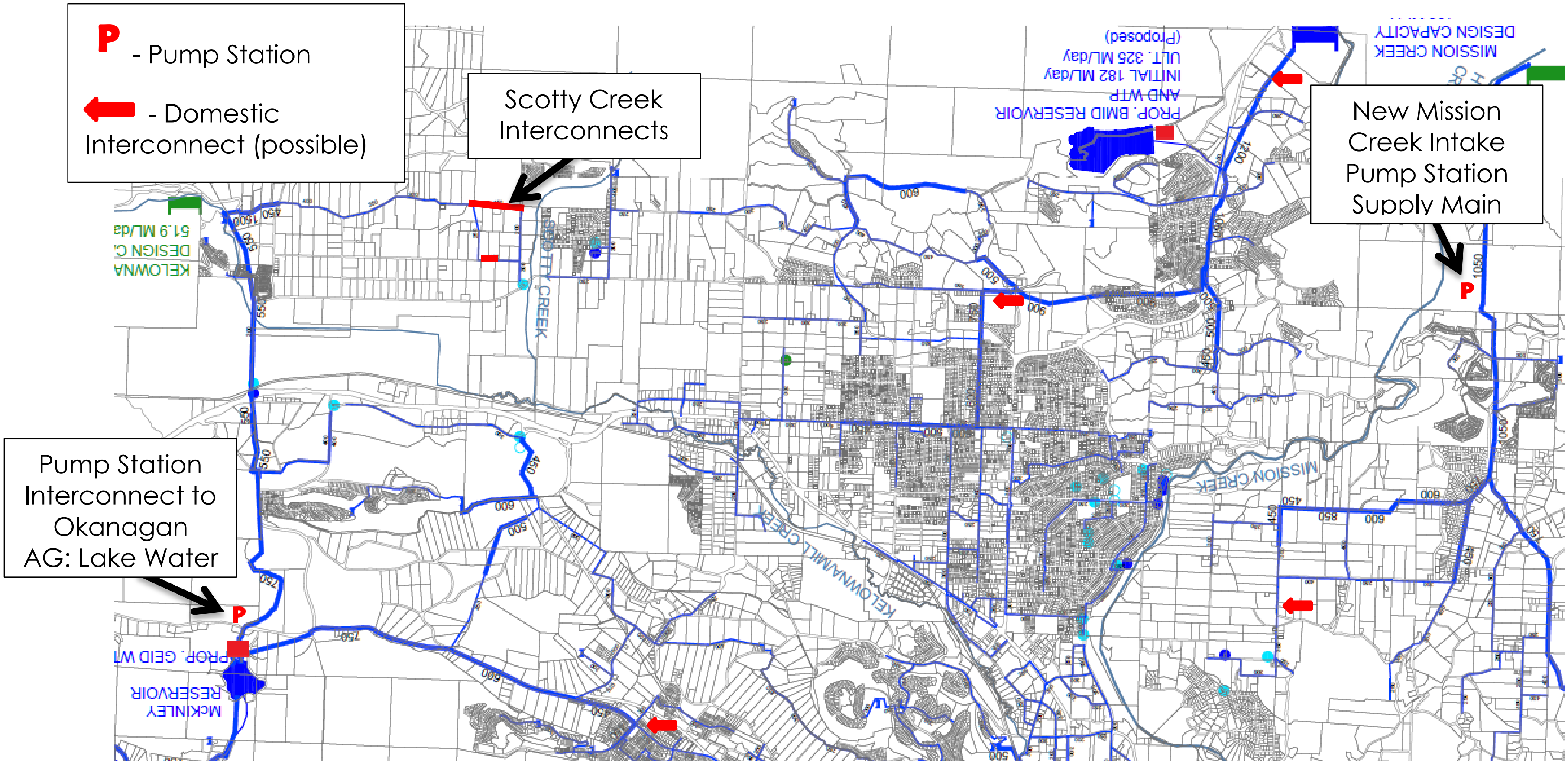
A backup agricultural supply to the Glenmore, Scotty Creek, and Ellison areas can be supplemented from either Mill Creek or Okanagan Lake through the McKinley intake. A new raw water booster station would be required to pump lake water from the McKinley intake through the existing Mill Creek pipeline to service these areas. A slip liner will likely be required for the pipe between McKinley Reservoir and Mill Creek. Backup supply to the Scotty Creek and Ellison areas can also be supplemented by the Mission Creek source. Small interconnections between Ellison and Scotty Creek communities are possible.

A new pump station, supply main, and intake along Mission Creek appears to be the most feasible solution for backup supply water to South East Kelowna Irrigation District (SEKID), should supply from Hydraulic Creek be compromised. An alternative water supply to the upper Mission Creek area of the BMID service area was deemed not necessary as the water supply shortage on this source was considered to be low risk. Interconnection is also possible from the domestic transmission system. This provides even more flexibility to supplement agricultural supply at critical times.

In addition, there would be interconnects with the domestic water system as yet another level of redundancy on water supply for agricultural needs.

Sketch

Alternative No.: 5



Construction Cost Estimate

Alternative No.: 5

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
Mission Creek Emergency Connection to SEKID				
Pump Station 102 ML	EA	6,000,000	1	6,000,000
Supply Main 1050 MM (Across Country)	M	1,680	800	1,344,000
McKinley Reservoir Emergency Pumping Station				
Interconnect for Lake Agricultural Supply to Pump Station 130 ML	EA	7,000,000	1	7,000,000
750 mm slip liner	M	194	390	75,660
550 mm slip liner	M	129	360	46,440
Scott Creek #1 (1000M) & #2 (300M) Interconnects				
300 mm	M	323	1,300	419,900
Subtotal				14,886,000
Markup - Engineering 15% + Contingency 30% = 45%		45%		6,698,700
TOTALS				21,585,000

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Value Alternative

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	6
Develop long term strategies and contingency plans for anticipated changes in water supplies and demands	
Ideas Included:	
DW-08 Operate reservoirs for multipurpose water storage and flood control DW-17 Improve source water protection for Mission Creek DW-19 Install Ranney wells on upland creeks DW-28 Added upland reservoir storage DW-60 Improve demand and supply estimates	
Description of Concept:	
Long term strategies include both projects and data compilation that will be required to continually stay abreast of changing conditions and prepare for future needs. Certain projects are not currently needed, but it is recognized that changing climate, future growth, and other factors will change both future supply and demand.	

Cost Summary

First Cost:	$46,618,000
O&M:	$0
Life Cycle Cost:	$46,618,000

Advantages/Disadvantages

Alternative No.: 6

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Identifying potentially complex projects, program, and policies early in the planning process is required due to the long lead time before implementation • Long term data sets are valuable for identifying or confirming trends and can be used for triggering certain actions	• None apparent

Discussion

Alternative No.: 6

System wide, current supplies are adequate to meet both irrigation and domestic demands. However, over the 25–50 year planning horizon there is potential growth for both domestic and agricultural demands. Changing housing density, lawn sizes, technology, etc. will all impact domestic demands. Similar changes in agriculture demands can occur due to crop changes, expansion of irrigated areas, and irrigation technology improvements. As a result, two general classes of recommendation are made in this section. First are projects that will help improve the water quantity and quality from Mission Creek beyond current needs and the second provides for continually updating demand and supply estimates to help inform the timing of those and other projects.

Climate change is widely recognized as the single greatest unknown for future water supply planning. Potential impacts include, increased growing seasons in the shoulder months, precipitation falling more as rain rather than snow in the uplands, increased irrigation requirements (both domestic and agriculture), increase in extreme events (both drought and flooding), and possible reductions in mean streamflow. Therefore, it is recommended that a methodology be developed to continually update demand forecasts and consider supply impacts due to climate change. Climate science research related to watershed impacts is continually evolving; however, care should be taken to use that information carefully and appropriately. The most recent climate data set (CMIP 5) is a recent update (to CMIP 3) and should be considered to determine if and how updates to temperature and precipitation projections have occurred. Comparisons can then be made to watershed observations and help inform timing for any new supply projects or other infrastructure. The North American Regional Climate Change Assessment Program products continue to provide some of the latest and most up to date information for North America and should therefore be considered.

Additional Storage

Adding upland storage would allow additional water to be stored for use during drought cycles. Capturing and storing water high in the watershed allows for delivering more water by gravity and saving pumping costs compared to lowland sources. Expanding existing reservoirs would generally be easier to permit and construct as opposed to developing new reservoir sites and would therefore be considered preferable unless there were distinct operational considerations for alternative locations. Additional benefits may include some modest benefit of increased flood control.

The following table summarizes the major hydrologic characteristics of the upland systems:

	Mission Creek	Hydraulic Creek	Kelowna Creek (Mill)	Scotty Creek
Watershed Capacity Above Intake *	61,250 ML	10,400 ML	5,100 ML	2,500 ML
Intake elevation (meters)	638.7 m	656 m	540 m	537 m
Use	Domestic and Agriculture	Agriculture	Agriculture	Agriculture
Average annual naturalized flows	125,000 ML	21,200 ML	10,310 ML	5,040 ML
Source Storage reservoirs	Belgo Reservoir 6,785 ML Graystoke 5,015 ML Fish Hawk 2,107 ML Loch Long 600 ML Total 15,507 ML	McCulloch 16,615 ML Fish, Long Meadow & Brown 930 ML Turtle Lake 2,020 ML Total 19,565 ML	Postill 5,607 ML South Lake 777 ML Bulman 1,181 ML Total 7,565 ML	James Lake 1,400 ML Total 1,400 ML
	Total storage 44,307 ML			
Current Demand	12,300 ML	10,311 ML	4,400 ML	500 ML
Net available to store	48,950 ML	5,629 ML	652 ML	1,968 ML

*Capacity above Intake is based on 1:25 year drought (49% of average annual flow)

From the integrated system perspective and in round numbers, there is a total 43,500 ML of constructed storage in the upper watersheds. Existing storage licenses total 50,000 ML leaving 6,000 ML of licensed but unconstructed storage. Of the four watersheds, Mission Creek has the greatest potential for future storage based on available precipitation and runoff.

The Mission Creek watershed also contains the two most likely reservoir sites. Fishhawk reservoir has the potential for 6,900 ML of expansion (storage study). Mission Lake reservoir site was previously decommissioned but has the potential to be used as a low head dam with an estimated capacity of 1,800 ML. These two potential sites total approximately 8,700 ML which would require additional storage licensing beyond what currently exists. Additionally, the integrated system wide storage licensing will need to be reviewed to assure the proper geographic distribution of any new storage with respect to existing storage licenses.

Any new Mission Creek storage will need to consider and maintain the instream flow requirement. Additionally, a single operator in the watershed would have the benefit of reducing potential conflicts and confusion over release scheduling and other operational activities.

It is important to continue to evaluate the potential for construction of additional storage in the upland watersheds. This will put the system in a better position to pursue these alternatives if long-term changes occur in the outlook for the existing supplies and system demand.

Water Quality

Mission Creek is currently a source of domestic supply and is considered a critical component of the future integrated water system; therefore, a long term strategy to protect the upland source water areas is needed. The current Mission Creek upland areas are classified as multiuse which makes it difficult to exclude any uses that could be considered inconsistent with drinking water source watersheds. Using best management practices (BMPs) for current activities will help reduce the chances that any class of activity will negatively impact the water quality originating in the upland areas. All uses have the potential to collectively and negatively impact the watershed by contributing sediment and/or pathogens to the water supply as follows.

Logging – impacts include soil compaction, erosion due to loss of vegetation, and erosion from roads and soil disturbance. Increased runoff and sediment loads could persist for years after activities cease.

Grazing - impacts include streambank erosion due to stream bank grazing intensity (different than density based on animal per unit area). Cattle are sources of fecal coliforms, nutrients, E.coli, and can also be sources of Cryptosporidium and Giardia.

Keeping cattle away from streambanks serves a dual purpose of reducing the streambank damage contributing to erosion and sedimentation while keeping the majority of cattle defecation away from the stream, thereby decreasing the amount of fecal pollution entering the stream. Examples of riparian grazing BMPs would be total stream exclusion fencing or off-stream watering areas that will reduce the time cattle spend streamside in riparian areas.

Genetic source tracking identifies sources of fecal contamination which is useful information for watershed management. In the Mission Creek watershed a 2000 report by BWP Consulting reported that E.coli sources were approximately 1/3 cattle, 1/3 humans and domestic animals, and 1/3 wildlife. BMPs related to grazing and recreation could reduce E.coli by a maximum of 2/3. A comprehensive source water protection plan would help watershed managers protect the high quality source of Mission Creek and reduce the amount of future water treatment over the long term.

A source water protection program has the advantage of water quality improvements without physical or chemical treatment thereby lowering long term capital cost and O&M costs. An integrated upland water supply system should be a strong advocate for watershed protection and should proactively partner with the watershed stakeholders.

Multiuse Operations

The integrated utilities should explore opportunities to operate reservoirs with a multipurpose function for water supply and flood control. The concept is to use existing reservoirs to not only store water for domestic and or agriculture use but to also help with flood control, primarily to help control freshets.

Water normally stored for domestic or agriculture use would be released in advance of high flow events in order to create flood storage space. The storage void created by releases would be subsequently refilled with freshet water creating a zero sum change in storage yet reducing high and potentially damaging flows creating a community benefit of increased flood protection. There may be some increase of O&M cost due to more coordinated operations and adding the need for forecasting and timing. There is also a recognition that a risk exists where the storage may not refill completely due to some operational or water rights specific to any particular reservoir which may require modification. However, with multiple water supply sources, this risk can be minimized.

Ranney Wells for Turbidity Control

The Mission Creek water supply is normally very low in turbidity. However, it is subject to periodic extreme flow events that produce high sediment load and turbidity. This can overwhelm the capability of any water treatment facility. The approach to date to manage this condition has been to provide off-stream storage to retain high quality water and to allow shutting the intake during high-turbidity events. The proposal for the new Black Mountain Reservoir is a continuation of this strategy. However, the ability to gain approvals for this proposed reservoir in a timely fashion is under question.

The VP Team suggests that consideration be given to investigating and developing a Ranney Well-type creek withdrawal system. Under this concept large capacity radial wells would be constructed adjacent to Mission Creek, but out of or above the flood plain. Water would be induced to flow from the creek through the water table aquifer to the wells. Depending on their characteristics, the natural formations would serve to filter large turbidity particles and greatly improve treatment influent quality.

Each well might have a capacity in the range of 5-50 ML/d. A series of 5-10 wells might be required to develop the desired capacity for the domestic system. These could be constructed on a staged basis.

The well system could provide excellent pretreatment for a filtration plant. It would allow the plant to operate throughout extreme flow events and reduce chemical and waste residuals disposal costs.

The most appropriate location for a Ranney Well system might be the Gallaghers Canyon area of Mission Creek south of the UV and proposed Black Mountain Reservoir site. This site is on Westbank First Nation lands. Thus, permission to locate facilities there may prove difficult.

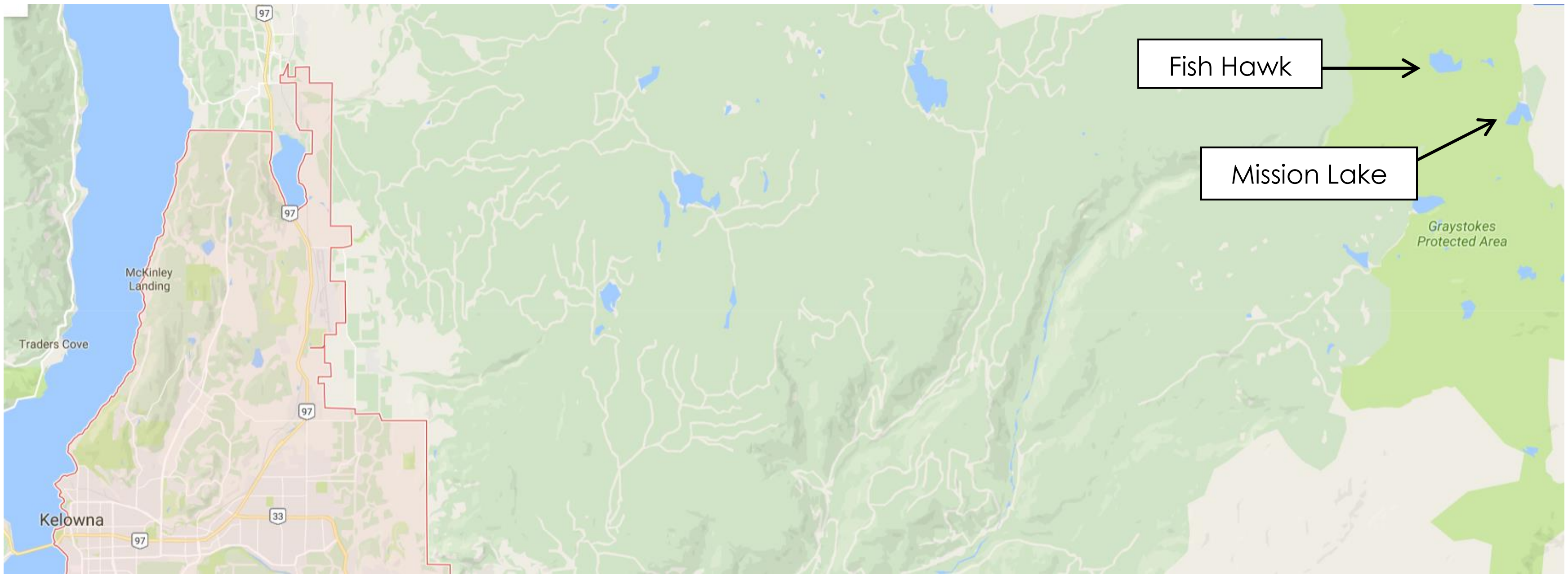
The first step in assessing this concept would be to perform a desk-top hydrogeological investigation. A small test boring and drilling program might follow. The third step would be constructing a full-scale demonstration well. If this work proves successful and cost effective, the full system would be constructed, with a pipeline to the proposed future Mission Creek Water Treatment Plant.

Implementation of the long term integrated plan will require adaptive management in order to provide flexibility in the face of future uncertainty. Adaptive management will require careful tracking of key indicators of change or "signposts" such as annual water demand, per capita water demand, population, climate trends (i.e., magnitude and rate of change for mean annual temperature, precipitation, and stream flows), regulatory changes, and changes in water rights administration. These indicators will inform the water supplier as to what projects, policies, and water supply strategies should be implemented at various points in time.

Adaptive management concepts should also be used to determine a schedule for implementing or modifying the projects in a manner that appropriately considers all relevant factors and conditions, including supply need, opportunities, and financial considerations.

Sketch

Alternative No.: 6



Construction Cost Estimate

Alternative No.: 6

			Concept	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**
Fishhawk expansion $1500/ML based on Bighorn dam expansion	ML	1500	6900	10,350,000
Mission Creek $418/ML in the report but should be increased to around $1000/ML	ML	1,000	1800	1,800,000
Ranney Wells	EA	2,000,000	10	20,000,000
Subtotal				32,150,000
Markup - Engineering 15% + Contingency 30% = 45%		45%		14,467,500
TOTALS				46,618,000

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Value Alternative

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	7
Develop an implementation strategy for future filtration or advanced water treatment requirements	

Ideas Included:

DW-05 Use Mission Creek for all domestic supply in winter

DW-16 Build an upland filtration plant on Mission Creek

DW-44 Extend El Dorado Intake to improve water quality

DW-77 Reserve space for future WTPs

Description of Concept:

The integrated domestic water system will take advantage of the flexibility, reliability, and efficiency offered by multiple sources: Okanagan Lake, Mission Creek, and existing wells.

Major elements of the proposed strategy are:

1. Proactively address current and potential future water quality risks eliminating long-term water quality advisories.
2. Provide sufficient capacity as the system evolves to be able to meet maximum daily demand (MDD) with any one source out of service.
3. Use the high-elevation Mission Creek supply as a base supply to minimize system pumping costs.
4. Be prepared to implement additional treatment at sources, if required by changed future conditions.

Cost Summary

First Cost:	$108,291,000
O&M:	$0
Life Cycle Cost:	$108,291,000

Advantages/Disadvantages

Alternative No.: 7

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Greatly reduces public water quality advisories • Saves pumping costs • Improves water quality to areas now served by inferior sources • Improves water supply reliability and resiliency	• May negatively impact water quality as a result of mixing sources

Discussion

Alternative No.: 7

The integrated water system will be able to draw water from Okanagan Lake, Mission Creek, and existing high-quality wells. (The Hydraulic Creek, Scotty Creek, and Mill Creek supplies will be dedicated to the irrigation water system.)

Demands

The following maximum daily demands (MDD) in megaliters per day (ML/d) for the domestic system were derived from the 2012 Kelowna Integrated Water Supply Plan (KIWSP):

Demands	Current	2030	2050	2070
Winter (November - March)	85	103	116	137
Summer	266	319	362	425

Capacity of Sources

The following source capacities (ML/d) are also based on the 2012 KIWSP:

Sources	Existing	Potential Future
McKinley	65	130
Poplar Point	150	182
El Dorado	26	41
Cedar Creek	30	92
Wells (high-quality only)	30	31
Subtotal (exclusively domestic)	301	476
Mission Creek (domestic & irrigation)	189	320
Total	**490**	**796**

Water Quality Conditions

The McKinley Intake is newly constructed at an optimum depth in the lake for water quality. The water is pumped inland to an existing small open reservoir. From there, it receives ultraviolet (UV) and chlorine treatment before entering the distribution system. There is a water quality advisory in place because of deteriorating water quality in the open reservoir being slightly above 1.0 NTU turbidity units. This situation has been remedied by construction of a covered tank that draws directly from Okanagan Lake. It is anticipated that the advisory will soon be removed, and the supply will receive filtration deferral. A site has been designated for a future water filtration plant at this location.

The Poplar Point Intake and Cedar Creek Intake both have UV and chlorine treatment. Both also have filtration deferrals and designated sites for future treatment plants.

The El Dorado Intake has UV and chlorine treatment. Its intake is shallower than the other lake intakes. A proposal for filtration deferral is under Interior Health Authority (IHA) review. There is no room at the El Dorado site for a future treatment plant. If filtration is required, the City plans to abandon this intake and increase the capacity at Cedar Creek.

The high-quality wells receive chlorination only and provide groundwater, which is not subject to filtration requirements. The poorer quality wells would be decommissioned.

The Mission Creek Supply receives pretreatment (coagulant addition and sedimentation) when creek turbidities are elevated. It is then chlorinated and discharged to the combined irrigation and domestic system. When high turbidity events occur, a water quality advisory is put in place for these supplies; a UV system is under construction and a new Black Mountain open surface holding reservoir is proposed upstream of the UV. It is not certain that this plan can obtain the required IHA and local approvals.

Proposed Strategy

The following strategy is proposed for use of and further development of these sources in the integrated domestic water system:

1. Eliminate the current water quality advisories by interconnecting the overall supply system. During an occasional water quality excursion period for any one supply, it will shut off temporarily and be replaced with another supply.
2. Maintain sufficient total capacity such that any one source can be "lost" and demands still be met. This will help to ensure that new water quality advisories will not be imposed in the future.
3. Continue to operate the high-quality wells, in certain specific areas where quality is high, additional groundwater development could be considered in the future, if needed.
4. Minimize pumping costs by operating the high-elevation Mission Creek supply as a base-load source. A capacity of about 85 ML/d would allow it to supply the whole system between the months of November and March. When the overall system begins to depend more and more on the Mission Creek supply and maintenance of overall supply becomes problematic during high turbidity events, the first stage of a filtration plant for this supply should be implemented.
5. Proactively prepare for the possible future need to implement additional treatment at the surface water sources.
6. Ensure that the different supplies are chemically compatible for mixing in the distribution system. (This may require adding corrosion control chemicals at certain locations.)

Mission Creek Supply

The most pressing supply need is to achieve water treatment compliance from Interior Health Authority for the Mission Creek supply. In order to achieve compliance, two types of treatment are required.

The plan described in the 2012 KISWP might be implemented. However, the VP Team has several concerns about the approvability of this plan. These include:

1. Local and City objections to the proposed Black Mountain Reservoir.
2. Health concerns that the existing pretreatment process may produce small floc particles that carry over from the sedimentation process and interfere with the effectiveness of UV and chlorine.

The following steps seem to be most appropriate to provide a reliable high-quality domestic supply from Mission Creek:

1. Implement the plan to construct a domestic transmission system to allow the delivery of lake water into the areas now served by Mission Creek during the periodic high turbidity events.
2. Accelerate the separation of domestic and irrigation service in the upper reaches of the current Black Mountain Irrigation District (BMID) service area.
3. The overall system dependence on this supply will increase in the future; therefore, plan now for the first stage of a water filtration plant for Mission Creek. The most appropriate location would be near the site of the UV facility that is now under construction. A capacity of about 85 ML/d would provide for all current winter system demands. A smaller initial capacity also could be considered. The ultimate capacity may need to be as much as 140 ML/d.

Lake Supplies

For the four lake supplies, the only immediate recommended capital improvement is to increase the capacity of the Cedar Creek Intake to 92 ML/d. This will allow more lake water to be pumped into an enhanced transmission system to allow additional amounts of lake water to be conveyed to the north on the east side of the system.

It is recognized that the El Dorado Intake is the most vulnerable of the four intakes in terms of water quality risks. The extension of this outfall to a depth (about 35 meters) similar to the other three should be considered. This would require a horizontal extension of about one kilometer and involve a cost on the order of $ 1-2 million. However, construction of this extension now is not recommended because:

1. The expanded Cedar Creek intake would be able to compensate for the loss of El Dorado.

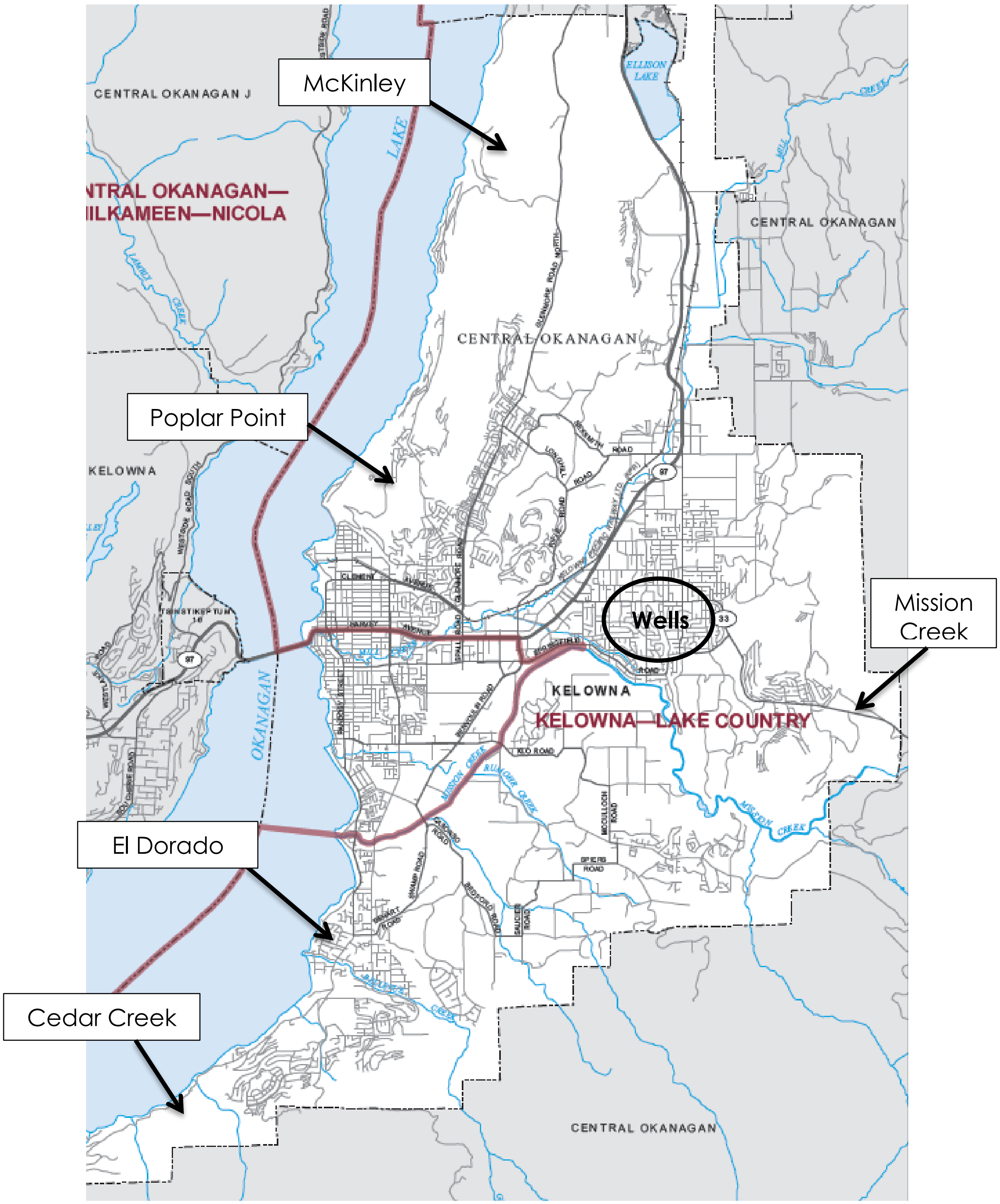
2. There is no space at the El Dorado site for the future construction of a treatment plant. So, it could be possible that the cost of the expanded outfall would be lost if a treatment plant were to be required in the near future.

The Cedar Creek Intake is at a depth of about 20 meters. Consideration should be given to extending this intake to a depth of 35 meters. This would cost on the order of $1-2 million.

The designated sites for future filtration plants for the McKinley, Poplar Point, and Cedar Creek Intakes should be formally reserved. In addition, conceptual planning for the plant configurations should be performed to ensure that one or more of these could be implemented expeditiously if required in the future.

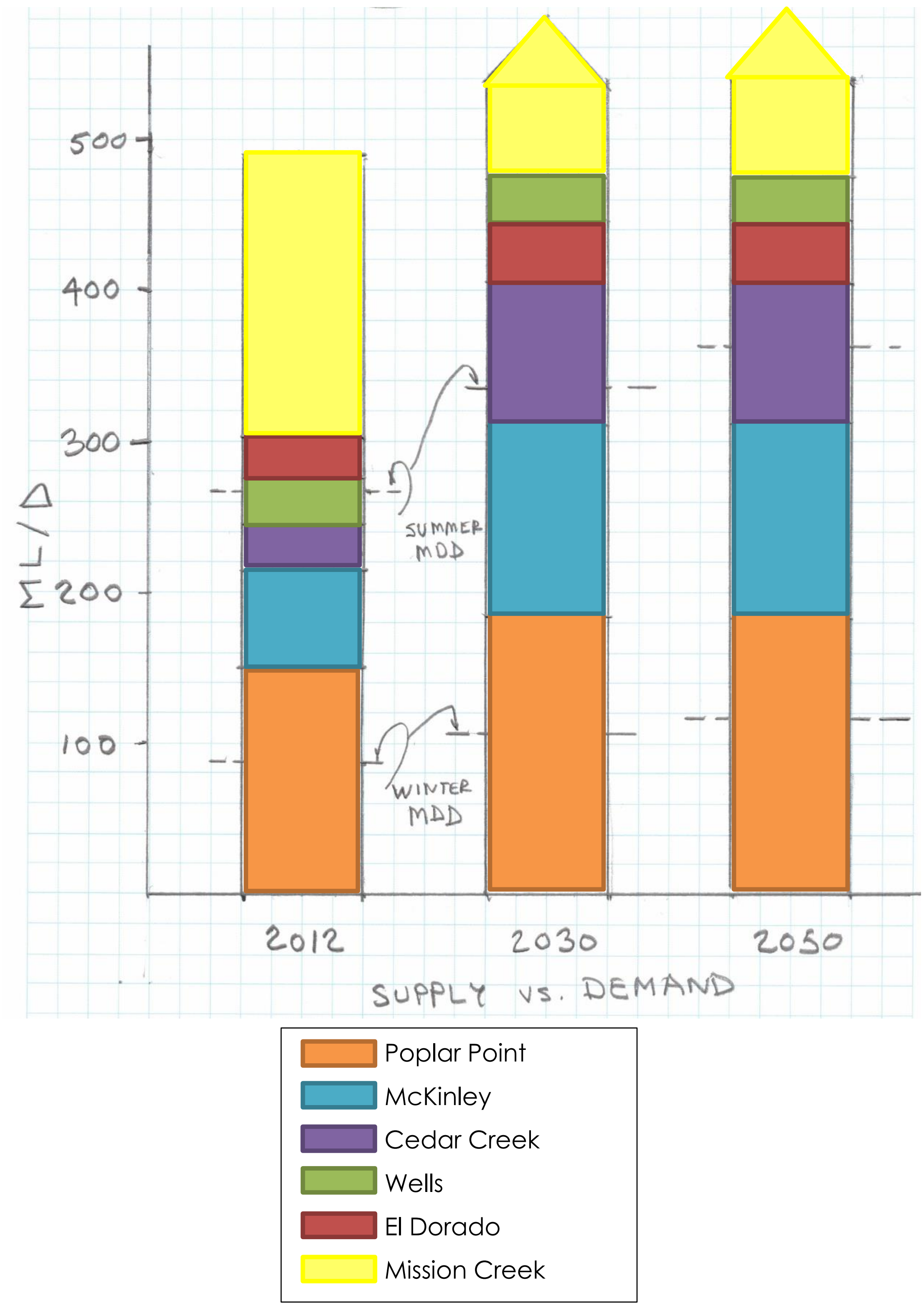
Sketch

Alternative No.: 7



Sketch

Alternative No.: 7



Construction Cost Estimate

Alternative No.: 7

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
Separation of domestic connections (Project 6.7 - Gallagher				
Separation) (From 2012 KWSIP)	LS			1,356,594
2012 Cost Adjusted to November 2016 (% From SEKID Water Supply Options)		5.7%		77,326
Mission Creek WTP (85 ML/d)	LS			60,000,000
Cedar Creek Intake expansion				
(Project 4.5) (from 2012 KWSIP)	LS			12,535,000
2012 Cost Adjusted to November 2016 (% From SEKID Water Supply Options)		5.7%		714,495
Subtotal				74,683,415
Markup - Engineering 15% + Contingency 30% = 45%		45%		33,607,537
TOTALS				108,291,000

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Value Alternative

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	8
Perform advance work to support further planning and design of an integrated water system	
Ideas Included:	
DW-34 Implement a city-wide water asset management system DW-37 Perform water mixing tests to evaluate water quality DW-38 Develop a system-wide model to understand system operations	
Description of Concept:	
Certain activities toward implementation of the proposed plan should be completed as soon as possible. The results of this work will serve as the foundation for the overall water plan strategy.	

Cost Summary

Cost: No Cost Developed

Advantages/Disadvantages

Alternative No.: 8

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Ensures that sound decisions are made on design and operating arrangements for an integrated system • Allows for changes to the plan at a less costly stage of development, if needed • May produce cost savings in construction and operations • Allows for planning of common pressure zones consistent with a city-wide integration plan • Allows for coordination of capital improvements with capital replacement projects	• None Apparent

Discussion

Alternative No.: 8

The Value Planning Team has identified three areas of investigation where "advance" work should begin immediately.

Jump Start Consolidated Asset Management

Each of the existing utilities has its own asset inventory and management system. These systems should be consolidated into one integrated system. This work may take years to complete and then will require continuous upkeep. However, higher priority and basic elements should be performed as soon as possible.

A consolidated inventory of all infrastructure assets should be made. This will be valuable for many purposes, including the development of domestic and irrigation water system distribution models as described below.

Condition assessments of assets should be consolidated. For key locations, where new construction is anticipated, specific new condition assessments should be performed. An example of the value of this work would be the decision on whether to parallel an existing main where additional capacity is needed. If the existing main has a long remaining life, the decision would point to a parallel main. If the remaining life is questionable, replacement with a larger pipe might be best.

Evaluate the Blending of Source Water Supplies

Each of the five utilities has its own supplies that have rarely been intermingled. When water of different chemistries is mixed, detrimental impacts to water quality can occur. Of chief concern is the impact of water of different corrosivity on the interior deposits that have built up in distribution mains. Negative impacts could include increased turbidity, iron, and manganese. Leaching of additional lead and copper from customer service lines and fixtures could also be a concern.

The surface water sources have generally less dissolved solids than the groundwater sources. There are also some quality differences between lake water and Mission Creek source water. Compounding the concern is that there are no existing facilities for adjusting finished water quality (pH control or corrosion inhibitor addition).

Many water systems across North America use blended supplies from different sources. So, it is likely that the concerns expressed above will prove manageable. Nevertheless, it is important to do investigations to predict possible water quality issues before they need to be managed in real time.

The investigations would first include a desktop review of the differing water chemistry and the probable deposition layers on water main walls. Bench-scale testing might be warranted depending on the results of this review.

Build an Integrated Water System Model

The distribution models of the five major utilities should be merged into one model as soon as possible. The model will assist in not only identifying physical capabilities and states of the system, but can be used to support project alternative economic analysis. Combining with current and accurate GIS data gives planners and operators more reliable information when evaluating existing deficiencies, service to potential customer bases, water quality, and operations. A GIS-centric hydraulic modeling software system provides great flexibility for performing various analyses and simplifying hydraulic model updates. The model should be used to confirm and refine the general recommendations of this VP Study.

In addition, it is recommended that the model be used to simulate water quality throughout the integrated domestic system. Of special concern is (1) maintenance of chlorine residual through all parts of the system and (2) disinfection by-product formation in the parts of the system that will have the longest travel time. These issues will be especially important in the rural areas where a new domestic system will replace the current combined irrigation/domestic system. In these areas, there will be long travel times to individual users. The new configuration should be optimized to reduce dead ends and maximize looping.

Value Alternative

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	9
Develop a strategy for funding and allocation of costs that assures customer equity	
Ideas Included:	

EE-07	Stage water quality improvements to the areas with the worst water quality first
EE-08	Stage water quality improvements to the areas with the highest risk first
EE-11	Develop an asset valuation of the existing water utilities to better understand the contributions of each
EE-25	Consider a two-part rate system for agricultural users that provides a base rate and a use rate
EE-27	Develop a capacity fee for new development to buy into the system

Description of Concept:

The concept is to determine the costs and timing of recommended improvements and identify available funding sources to estimate annual capital, financing, and operating costs of the integrated system. An asset valuation of the five existing water utilities establishes a baseline for what the existing customers have contributed to the integrated system. Utility rates for various customer types or classes (e.g., residential, commercial, agricultural) will be developed after completion of a cost of service study to allocate the costs to the users who are benefiting from the services or facilities. Once customer class cost of service is calculated, a rate structure can be developed to recover these costs in an equitable manner at the end of the integration implementation period. The recommended rate structure should include a fixed charge to recover costs that are not based on water consumption and a volumetric rate. Other fees, such as a capacity fee or development cost charge, should be considered to offset the costs that need to be recovered through utility rates. A plan to transition from existing utility rates for the five water utilities to the integrated utility rates over a multi-year period will be developed.

Cost Summary

Cost: No Cost Developed

Advantages/Disadvantages

Alternative No.: 9

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Strategic prioritization of recommended improvements reduces risk and minimizes costs • Valuation of existing water utilities' systems can be used to develop a rate transition plan that improves customer equity and ensures fairness of rates and project implementation • Developing a cost charge or capacity fee maximizes financial resources and improves intergenerational customer equity • A transition rate plan phases in an integrated rate structure to minimize customer rate shock	• An integrated rate structure may result in significant impacts to customer bills • There may be a political reluctance to implement an integrated rate structure • Implementation of an integrated rate structure will require significant change management and public outreach

Discussion

Alternative No.: 9

Prioritization of Recommended Capital Improvements

There are several factors that should be considered when prioritizing the recommendations for integrating the water system, including:

- Existing water quality - focus initial improvements on lowest quality water
- Risk - focus initial improvements on areas at highest risk of failure
- Funding - maximize grant funding by focusing on high-cost improvements that can be completed within the Ministry's timeline for grant funding

For both the domestic and irrigation systems, a System Risk Management Plan should be completed. As part of this exercise, we recommend development of rating criteria to assist with prioritization of projects. Examples of criteria are:

- Risk of infrastructure failure
- Risk of water quality violation or boil water notice
- Probability of grant funding
- Net present value
- Implementability

In a group exercise, weighting factors can be determined and applied to the criteria so that a final rating can be calculated for each of the recommended projects.

Although System Risk Management Plans may be available for the five water utilities' systems, it will be necessary to develop a System Risk Management Plan for the integrated system, depending on the magnitude of changes that are recommended that would change the risks identified in the individual plans. This would be facilitated by an integrated asset management program discussed under Alternative 10.

Asset Valuation

The purpose of completing a valuation of the five existing water utilities' assets is to determine a starting point for financial integration. What is each entity bringing to the table? There are many elements of this valuation that must be considered:

- Tangible capital assets (original cost and replacement cost new)
- Accumulated depreciation
- Cash reserves

- Outstanding debt
- Contributed assets
- Assets funded with grants
- Other potential liabilities (i.e., pending litigation)

To compare the contributions of the existing water utilities' customers, the net asset value (accumulated surplus) must be divided by a service unit to normalize the data. Potential service units to use for normalization are:

- Volume capacity - this can be measured in ML/d or equivalent dwelling units and factors in available capacity of each system
- Population - this would result in a per capita value but may overstate the unit value of those systems that are more rural
- Consumption - this normalizes domestic vs. agriculture usage but does not factor in any recent expansions that provide available capacity

Once system valuations are compiled for each of the five water utilities, it may be good to consider the unit valuation of the combined system. The same methodology should be used as what was used to calculate the unit valuation of each individual system, but the combined valuation would provide a weighted average for comparison purposes. Comparing each system unit valuation to the combined system unit valuation helps establish the existing equity among the five water utilities.

Consideration of how to best utilize the valuations is important. The valuations can be used to improve equity among the customers of the five water utilities:

- Establish local service areas to allow for different service rates, ensuring equity through transition to a fully integrated system.
- Develop rate credits or surcharges to be applied to the integrated rate structure based on each water utilities unit valuation as compared to the combined system unit valuation. Those water utilities with a unit valuation that is higher than the combined system unit valuation would receive a credit on their rate, and those water utilities with a unit valuation that is lower would pay a surcharge or higher rate.
- Develop a transition plan for each water utilities that transitions water rates from the existing rate structure to an integrated rate structure. The comparison of the water provider's unit valuation to the combined system unit valuation will determine the pace of the transition. Those water utilities with a higher unit valuation may transition in a way that minimizes their rates early in the transition period. Those water providers with a lower unit valuation may transition toward higher rates at a faster pace.

- Assess a buy-in charge or tax to customers of water utilities with a lower unit valuation and a tax credit to customers of water utilities with a higher unit valuation.

The decision of how to bring all water utilities into the integrated system in a fair and equitable manner is highly political. As such, elected officials may prefer to simply consider the valuation exercise as informational and depend on a smooth transition of rates toward an integrated rate structure to settle the equity issue so that all customers are paying the same rates for the same level of service.

Revenue Sources

There are many potential sources of revenue that an integrated utility can use to fund capital and operating expenses, including the following:

- User tax
- Utility rates
- Development cost charge
- Latecomer agreements

We recommend a review of existing revenue sources and consideration of revised or alternative revenue sources to equitably recover the cost to provide water service to various customer groups.

User Tax

A user tax can be used to recover capital-related costs to the integrated utility. The tax would be payable annually and can be based on property value, meter size, lot size, or other factors. Alternatively, a flat user tax could be implemented. It may be appropriate to vary the user tax by service area based on historical contributions to the system infrastructure, as discussed in the Valuation section.

Utility Rates

To improve equity among customers, we recommend a rate structure that is at least partially based on consumption - the more you use, the more you pay. This type of rate structure would also encourage conservation, which could defer future capital improvements to add capacity. However, volumetric rates reduce revenue stability and can put the utility at risk of recovering revenues insufficient to fund capital and operating expenses. Therefore, a balanced rate structure with fixed and volumetric components is recommended.

The fixed component of the rate structure should recover the costs associated with providing services to customers that are independent of the volume of water used. An example of this is the cost to read the water meter. The cost to the utility to read a water meter is the same for a customer who does not use any water as for a customer who uses 60 cubic meters bimonthly. Other costs that could be included in a fixed component are:

- Replacement of meters and service lines
- Customer service
- Indirect fire protection
- Distribution system capital costs

The volumetric component of the rate structure would recover all costs not captured in the fixed component. Within the volumetric component, a utility can establish consumption blocks or tiers to incentivize customers to use water efficiently. For example, the City of Kelowna's rate structure includes a four-tier volumetric rate component:

- First 60 cubic meters - $0.483 per cubic meter
- Next 100 cubic meters - $0.637 per cubic meter
- Next 90 cubic meters - $0.964 per cubic meter
- Balance of cubic meters - $1.930 per cubic meter

As mentioned previously, a transition plan is essential to phase in the integrated rate structure so customers do not experience rate shock as their rates change from their existing rate structure to an integrated rate structure.

<u>Development Cost Charge</u>

The existing water utilities have development cost charges (DCC) that are charged to new development to pay for growth-related capital improvements. We recommend calculation of an integrated DCC that incorporates the capital improvements necessary to integrate the five separate systems into one. Future development would pay this DCC to buy into the improved integrated system and will benefit from the higher water quality and system reliability.

<u>Latecomer Agreements</u>

There may be future developments that cannot be connected to the integrated system immediately. In these instances, it may be appropriate to negotiate a latecomer agreement that outlines the cost to extend service to the development and defines responsibility for these costs. In some cases, payment of the DCC may satisfy this requirement.

Project: Kelowna Integrated Water Supply Plan
Location: Kelowna, BC

	Alternative No:
Title:	10
Develop a change management plan to facilitate the successful implementation of the integrated water supply plan	
Ideas Included:	

EE-02	Install meters on all domestic customers
EE-03	Develop a uniform metering and billing procedure across the city
EE-04	Establish uniform service procedures across all areas
EE-05	Establish an agricultural advisory board to transition to uniform service across the city
EE-12	Provide one face to the community for water
EE-14	Develop uniform water restriction policies
EE-17	Pass new by-laws for an integrated water system to eliminate conflicts/ duplications/inequities caused by existing by-laws from five different water suppliers
EE-18	Create a common or uniform by-law to serve all customers

Description of Concept:

The concept is to facilitate the significant changes that will result from integrating the water system with a Change Management Plan to address concerns and to generate enthusiasm for the benefits of the systems integration. The Change Management Plan will address the following:

- Uniform by-laws and procedures for metering, billing, and customer service
- Communication to the public
- Governance of the integrated utility

Cost Summary

First Cost:	$6,656,000
O&M:	$0
Life Cycle Cost:	$6,656,000

Advantages/Disadvantages

Alternative No.: 10

Advantages of Alternative Concept	Disadvantages of Alternative Concept
• Anticipate potential problems and develop a plan for mitigation • Establish a vision for the integrated utility to minimize concerns that result from uncertainty • Communicate the plan to the public to solicit buy-in	• Change management may be perceived as low value and not worth the investment because it does not produce a tangible asset • Governance issues seem to be the primary barrier to integration

Discussion

Alternative No.: 10

The successful implementation of the integrated water supply plan depends on the willingness of all parties to make changes in how the water system is governed, how it operates, and how it provides service to and charges its customers. Some changes will result in a perceived loss of power or control and may be opposed by the water utilities. We recommend development of a Change Management Plan (CMP) to facilitate the implementation process. The CMP should include a process for addressing any issues that arise during implementation:

1. Identify the issue.
2. Prepare for change (plan and communicate).
3. Manage the change.
4. Measure the change.
5. Improve the change.

The CMP should address the following issues, as well as any others that are identified as critical to implementation:

- Governance of the integrated system - this includes leadership, by-laws, and policies
- Operations - this includes optimization of combined assets and development of standard operating procedures
- Communication of implementation plan - plan for public outreach to communicate details of implementation plan and benefits of integrated water system

Governance

The Governance section of the CMP should include the following:

- Establishment of an agricultural advisory committee to council
- Plan for developing a new set of by-laws for the integrated system
- Uniform metering and billing procedures
- Uniform water restriction policy

At least for the duration of the implementation period, we recommend an agricultural committee made up of representatives from the five water providers to provide guidance and support to the implementation process. This group may also make decisions regarding the governance and operation of the integrated system. In addition to this committee, we recommend a second committee made up of agricultural customers from each of the irrigation service providers. This second committee would provide guidance regarding transitioning from existing levels of service to a uniform level of service throughout the city.

Each of the five water providers has its own by-laws. Many of them are likely similar and can be easily accommodated in an integrated set of by-laws. However, some may conflict with one another and in those cases, the most appropriate by-law for the integrated system must be determined. It should also be noted that there may be existing by-laws that are determined to be irrelevant to the integrated system, or a new by-law may need to be established to address an element of the integrated system. We recommend a committee be established, with representation from each of the five water suppliers, to review existing by-laws and propose by-laws for the integrated water system.

As a first step to move toward uniform metering and billing procedures, water meters must be installed for all domestic customers. It may also be necessary to install water meters for agricultural customers, if the recommended irrigation rate structure includes a volumetric component. In addition, billing procedures need to be reviewed and a standard policy proposed to ensure that all customers are billed in a similar manner. Billing considerations include frequency of bills (e.g., monthly, bimonthly, quarterly) and a billing system to use for integrated rate structure.

While the five water providers have already worked together to prepare a uniform water restriction policy, that policy should be reviewed to consider if it is still valid for the integrated system. The integrated water supply plan may recommend changes that influence the impact of drought and water restrictions. Improved system redundancy could delay the need for water restrictions in certain situations. Finally, an integrated water supply system could mitigate drought impacts through improved operational efficiency.

Operations

An integrated system will provide flexibility for operations and improved response to certain less-than-ideal conditions. Similar to the by-laws, billing, and water restrictions, new standard operating procedures must be developed to optimize the operation of the integrated water supply system and improve system efficiency.

Existing assets should be inventoried, and redundant assets should be liquidated. This includes property, vehicles, and equipment. Where redundant facilities exist, the facility that best optimizes operations should be retained and others should be sold to generate cash for capital improvements.

Communication of Implementation Plan

Public outreach is critical to gaining buy-in and support from customers. The details of the integrated water supply plan and the implementation plan should be communicated to the customers in a consolidated effort with one "face" to the community. This ensures that a consistent message is communicated to all customers. There are many methods of communicating with the public, including:

- Public meetings
- Customer newsletter
- Media reporting / news features

Public messaging should highlight the benefits of the integrated water supply plan, including reduced unit cost to provide water. As much as possible, the benefits should be quantified. An example of this is to calculate the unit cost of water of the integrated system and compare it to a weighted average unit cost of the five separate systems.

$$\text{Integrated System Unit Cost} = \frac{\text{Total Capital Cost of Integrated System}}{\text{Total Capacity of Integrated System}}$$

VS.

$$\text{Weighted Average Unit Cost} = \frac{\sum \text{Total Capital Cost of Individual Systems}}{\sum \text{Total Capacity of Individual Systems}}$$

The total capital cost for both calculations should include future improvements that are recommended for water supply integration or the future improvements planned by each of the five water providers as recommended in the 2012 Kelowna Water Supply Integration Plan (KWSIP).

In addition, any planned capital improvements of the individual systems that can be deferred or eliminated as a result of system integration should be outlined so customers can understand the financial and environmental benefits. For example, if the capital improvements recommended for system integration result in higher water quality for one service area that would otherwise require a new reservoir, the cost of that eliminated reservoir is a financial benefit of the integration plan.

Any improvements to water quality and system resiliency should be highlighted, as well. Finally, the proposed integrated rate structure should be explained so customers understand the impact on their utility bill and how their rates are directly related to the cost to provide them with water service.

While it is important to focus the public message on successes during implementation, any challenges should also be communicated, with an explanation of how they are being addressed. Lessons learned at all stages of implementation should be documented and used to develop a model for the long-term approach to integration of the entire water system.

Construction Cost Estimate

Alternative No.: 10

Item	Unit of Meas.	Unit Cost	Concept Qty	Concept Total
Meter connections	EA	450	10,200	4,590,000
Subtotal				4,590,000
Markup - Engineering 15% + Contingency 30% = 45%		45%		2,065,500
TOTALS				6,656,000

APPENDICES

A – AGENDA

VALUE PLANNING WORKSHOP AGENDA

Kelowna Integrated Water Plan

Kelowna, BC

January 9-13, 2017

Monday		Who Should Attend
8:00 – 8:30	VP Team Orientation	VP Team
8:30 – 9:00	VP Study Introduction	Stakeholder Reps
9:00 – 9:30	Kelowna Regional Overview & the 2012 Plan	Stakeholder Reps
9:30 – 11:00	City System Overview	Stakeholder Reps
11:00 – 12:30	SEKID System Overview	Stakeholder Reps
12:30 – 1:00	Lunch Break (box lunch provided)	
1:00 – 1:30	Provincial Overview	Stakeholder Reps
1:30 – 5:00	Site Visits	Stakeholder Reps
Tuesday		
8:00 – 10:00	Team Review & Discussion	
10:00 – 12:00	Project Analysis/Function Analysis (Cont.)	VP Team
12:00 – 1:00	Lunch Break	
1:00 – 3:00	Project Analysis/Function Analysis (Cont.)	VP Team
3:00 – 5:00	Creative Idea Generation	VP Team
Wednesday		
8:00 – 10:00	Creative Idea Generation (Cont.)	VP Team
10:00 – 12:00	Evaluation of Ideas	VP Team
12:00 – 1:00	Lunch Break	
1:00 – 3:00	Value Alternative Development	VP Team
3:00 – 4:00	Review of Ideas Selected for Development	Stakeholder Reps
4:00 – 5:00	Value Alternative Development (Cont.)	VP Team
Thursday		
8:00 – 12:00	Value Alternative Development (Cont.)	VP Team
12:00 – 1:00	Lunch Break	
1:00 – 6:00	Value Alternative Development (Cont.)	VP Team
Friday		
8:00 – 11:00	Value Alternative Development (Cont.)	VP Team
11:00 – 12:00	Prepare for Value Team Presentation	VP Team
12:00 – 1:00	Lunch Break	
1:00 – 3:00	Value Team Presentation of Value Alternatives	Stakeholder Reps
3:00 – 4:00	Clean Up & Wrap Up	VP Team

B – PARTICIPANT

Kelowna Integrated Water Supply Plan

Kelowna, BC

January 9-13, 2017

Name:	Organization:	Role:	Phone:	Email:	Introduction	Site Visit	VE Presentation
John Robinson	Strategic Value Solutions	Team Leader	816-795-0700	John@svs-inc.com	X	X	X
Amanda Rentschler	Strategic Value Solutions	Admin	816-795-0700	Amanda@svs-inc.com	X	X	X
Don Stafford	Strategic Value Solutions	System Planner	816-795-0700	Don@svs-inc.com	X	X	X
Cecil Stegman	Strategic Value Solutions	Cost Estimator	816-795-0700	Cecil@svs-inc.com	X	X	X
Tom Lane	Arcadis	System Planner	347-531-7939	Thomas.Lane@arcadis.com	X	X	X
Jennifer Ivey	Carollo Engineers	Rate Consultant	972-339-0783	Jivey@carollo.com	X	X	X
Leon Basdekas	Black & Veatch	System Planner	303-264-0560	BasdekasLD@bv.com	X	X	X
Tara Faganello	CSCD (Prov. Govt.)	ADM	250-217-7711	Tara.Faganello@gov.bc.ca	X	X	X
Liam Edwards	CSCD (Prov. Govt.)	Observer	250-208-4835	Liam.Edwards@gov.bc.ca	X	X	X
Rod MacLean	Associated Engineering	Consultant	250-470-8133	MacLeanR@ae.ca	X		X
Brian Wright	SEKID	Chairman	250-681-0198	Briwri@shaw.ca	X		X
Remi Allard	Piteau Assoc. Engineer	Hydrogeology	250-212-7511	Rallard@piteau.com	X		X
Wayne Radomske	Interior Health Authority	WS Regulator	250-770-5540	Wayne.Radomske@interiorhealth.ca	X	X	X
Mike Noseworthy	Forests, Lands, & NRO	Regulator	250-490-2291	Mike.Noseworthy@gov.bc.ca	X		
Gordon Moseley	Interior Health Authority	WS Regulator	250-549-5725	Gordon.Moseley@interiorhealth.ca	X	X	X
Skye Thomson	Forests, Lands, & NRO	Regulator	250-490-8276	Skye.Thomson@gov.bc.ca	X		
Ray Reilly	Forests, Lands, & NRO	Regulator	250-490-2218	Ray.Reilly@gov.bc.ca	X		
Andrew Reeder	City of Kelowna	City of Kelowna	250-469-8876	Areeder@kelowna.ca	X	X	X
Kevin Van Vliet	City of Kelowna	City of Kelowna	250-864-7240	KVanVliet@kelowna.ca	X	X	X
Alan Newcombe	City of Kelowna	City of Kelowna	250-317-5982	Anewcombe@kelowna.ca	X		X

Kelowna Integrated Water Supply Plan

Kelowna, BC

January 9-13, 2017

Name:	Organization:	Role:	Phone:	Email:	Introduction	Site Visit	VE Presentation
Ron Westlake	City of Kelowna	Project Manager	250-317-3626	Rwestlake@kelowna.ca	X	X	X
Ron Mattiussi	City of Kelowna	City Manager	250-317-1997	Rmattiussi@gmail.com		X	X
Toby Pike	SEKID	Manager	250-208-4010	Pike@sekid.ca	X	X	X
Darlene McKnight	SEKID	Sec./Treasurer	250-863-9633	Darlene@sekid.ca	X		X
Bob Hrasko	Agua Consulting, Inc.	Consultant	250-212-3266	Rhrasko@shaw.ca	X		X
Colin Basran	City of Kelowna	Mayor					X
Carla Weaden	City of Kelowna	Director Comm.	250-317-8993	Cweaden@kelowna.ca			X
Christine Dendy	SEKID	Trustee	250-860-3537	Christine@dendy.ca			X

C – COST INFORMATION

Cost Information

The Value Team was provided a construction cost estimates from several reports as part of the project documentation. The estimates that were used for this workshop were the City-Wide Master Water Plan, Technical Memorandum No. 1.1, January 2010, Kelowna Integrated Water Supply Plan, Appendix E, September 2012, SEKID Water Supply Options, Unit Cost Comparison summary worksheet, November 2016.

As a part of this workshop, the team reviewed these construction cost estimates to verify the estimated costs, ensuring that the Value Team had reliable data to use as the basis for cost comparisons of alternative concepts

The VE team's review of the estimate verified the reasonableness of the:

- Estimated unit costs
- Estimated contingencies
- Overall project cost

In general, the estimated costs presented in the project cost documents, as provided to the Value Team, seemed reasonable and were used as the basis for cost comparisons of alternative concepts.

Adjustments were made where appropriate to bring unit prices and quantities into conformance with the current design documents and presentation information provided to the Value Team.

A complete review of all estimate's supporting backup data was not attempted due to time limitations and availability of information; however, limited reviews were made of some quantities for the larger cost items within the estimate.

Costs from the 2012 documents have been escalated by 5.7% based on the Canadian Consumer Price Index. All costs are represented in present day values.

The following mark-ups were applied as a line item on each of the Value Alternative cost estimates. Subcontractor costs were assumed to already be built into the unit prices.

- Engineering 15%
- Contingency 30%
- Listed below is a summary of unit costs used to develop the cost for each piping alternative.

Pipe and Service Installation	Unit	AE Unit Costs
50 mm	M	$75
100 mm	M	$104

Pipe and Service Installation	Unit	AE Unit Costs
150 mm	M	$127
200 mm	M	$167
250 mm	M	$236
300 mm	M	$323
350 mm	M	$415
400 mm	M	$518
450 mm	M	$622
500 mm	M	$726
550 mm	M	$735
600 mm	M	$900
900 mm	M	$1,395
1050 mm	M	$1,680
Domestic Service	EA	$2,110
Domestic Meter	EA	$370
Road Restoration		
Road Restoration (Urban)	m^2	$63
Road Restoration (Full Asphalt)	m^2	$58
Road Restoration (Half Asphalt)	m^2	$42
Road Restoration (No Asphalt)	m^2	$26
PRV		
50 mm PRV	EA	$50,000
100 mm PRV	EA	$150,000
150 mm PRV	EA	$175,000
200 mm PRV	EA	$200,000
250 mm PRV	EA	$225,000
300 mm PRV	EA	$230,000
350 mm PRV	EA	$235,000
500 mm PRV	EA	$245,000
600 mm PRV	EA	$266,000
900 mm PRV	EA	$340,000
1050 mm PRV	EA	$368,000
Connect to existing mains		
50mm to 150mm	LS	$2,880
200mm to 300mm	LS	$4,608
350mm to 500mm	LS	$8,850
600mm to 700mm	LS	$14,000
800mm to 900mm	LS	$32,000
1000mm to 1100mm	LS	$45,000
Slip Liner 550mm (from means)	M	$390
Slip Liner 750mm (from means)	M	$360

D – VALUE STUDY PROCESS

Value Study Process

This Value Study used the international Value Methodology (VM) Standard established by SAVE International®. The VM Standard establishes the specific six-phase sequential job plan and outlines the objectives of each of those phases, but does not standardize the specific activities in each phase.

Value Methodology is the general term that describes the structure and process for executing the Value Workshop. This systematic process was used with a multidisciplinary team to improve the value of the project through the analysis of functions and the identification of targets of opportunity for value improvement.

The **VM Job Plan** provides the structure for the activities associated with the Value Study. These activities are further organized into three major stages:

1. Pre-Workshop preparation
2. Workshop
3. Post-Workshop documentation and implementation

Figure C-1 at the end of this section shows a diagram of the VM Job Plan used for this Value Study.

Defining Value

Within the context of VM, Value is commonly represented by the following relationship:

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

In this expression, functions are measured by the performance requirements of the customer, such as mission objectives, risk reduction and quality improvements. Resources are measured in materials, labor, price, time, etc. required to accomplish the specific function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer. Ideally, the Value Team looks for opportunities to increase function and concurrently decrease resource requirements. This will achieve the best value solution.

Understanding how Value is affected by changes in function and resources provides the foundation for all Strategic Value Solutions, Inc. (SVS) Value Studies. The following paragraphs describe the general process we used. This is followed by the specific workshop agenda used for this Value Study.

Pre-Workshop

Before the start of the workshop, the Value Team is tasked with reviewing the most current documentation on the project development. The team does this to become familiar with the project design and to identify questions for the project team to address during the project presentations at the beginning of the workshop. Much of the background information for this study was generated by the project design team.

VM Workshop

The VM workshop is an intensive session during which the project design is analyzed to optimize the balance between functional requirements and resource commitments (primarily capital and O&M costs).

The VM Job Plan used by SVS includes the execution of the following six phases during the workshop:

Information Phase

From the beginning of the workshop, it is important to understand the background of the project and the rationale underlying the design decisions. An overview of the project history, objectives, issues, as well as an overview of the project design to date, is critical to the success of the Value Study. The workshop agenda will indicate whether this project overview was provided at the beginning of the workshop.

When the project development team does not provide an overview, the Value Team allocates a greater portion of the workshop time for Team Review.

When appropriate, the workshop includes a team visit to the project site. The workshop agenda will indicate whether a site visit was performed during this workshop.

Function Analysis Phase

During the Function Analysis Phase, the team identifies functions that describe the expected outcomes of the project under study. These functions are described using a two-word, active verb and measurable noun pairing. Function Analysis also defines the intended methods for accomplishing the desired outcomes.

Some of the specific function tools the Value Team uses in studies include Tabular Function, FAST Diagraming, and the Function Wheel. The Function Analysis appendix of this report includes documentation of the Function Analysis phase and the tools used.

Creative Phase

This step in the VM process involves generating ideas using creativity techniques. The team records all ideas regardless of their feasibility. In order to maximize the Value Team's creativity, evaluation of the ideas is not allowed during the Creative Phase. The Value Team's efforts are directed toward generating a large quantity of ideas. These ideas are later screened in the Evaluation Phase of the workshop.

The creative ideas generated by the team are included in the Creative Idea Listing appendix of this report. The list also includes ratings for each idea based on the Evaluation Phase of the workshop.

Evaluation Phase

In this phase of the workshop, the team selects the ideas with the most merit for further development.

The evaluation process is designed to identify those ideas with the greatest potential for value improvement that can be developed into Value Alternatives. The evaluation process is also influenced by the duration of the workshop and the production capacity of the team. As a result, the remaining ideas that are not selected for development are not given any further consideration by the team during the workshop. It is recommended that the other ideas also be reviewed by the project team, as there may be circumstances which may make these ideas viable. These ideas may be further evaluated or modified to gain the maximum benefit for the project.

Development Phase

During the Development Phase, each idea is expanded into a workable alternative to the original project concept. Development consists of preparing a description of the value alternative, evaluating advantages and disadvantages, and making cost comparisons.

Each alternative is developed with a brief narrative to compare the original concept and the alternative concept. Sketches and brief calculations are also developed, if needed, to clarify and support the alternative. The value alternatives developed during this Value Study are presented in the Study Results section of this report.

Presentation Phase

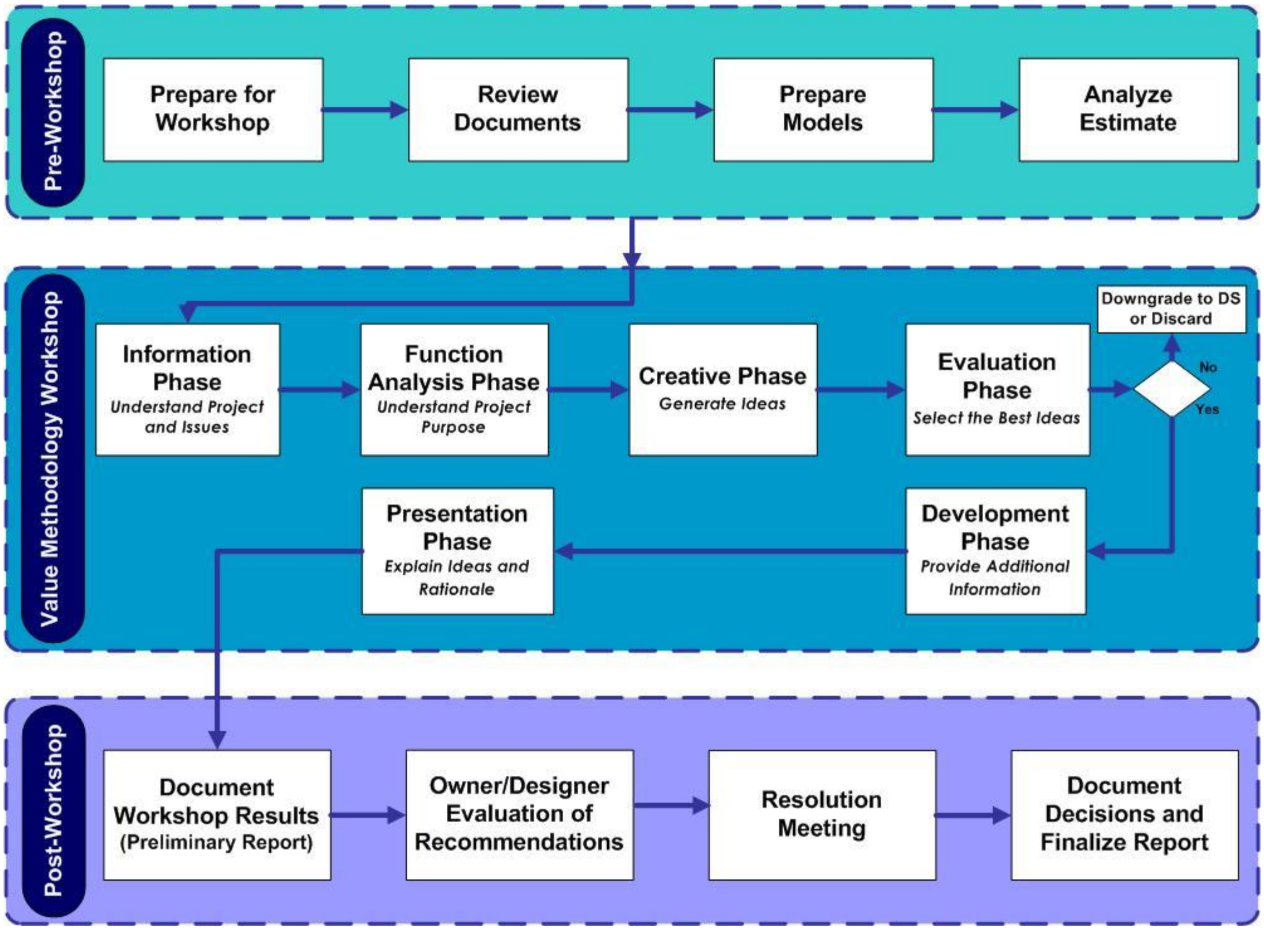
In this final phase of the workshop the Value Team presents the work that was produced during the workshop. The Value Team presents alternatives and fields any final questions from the project stakeholders who were present. This presentation phase also closes out the responsibilities of the Value Team's subject matter experts.

The workshop agenda will indicate whether a presentation was performed by the Value Team during this workshop.

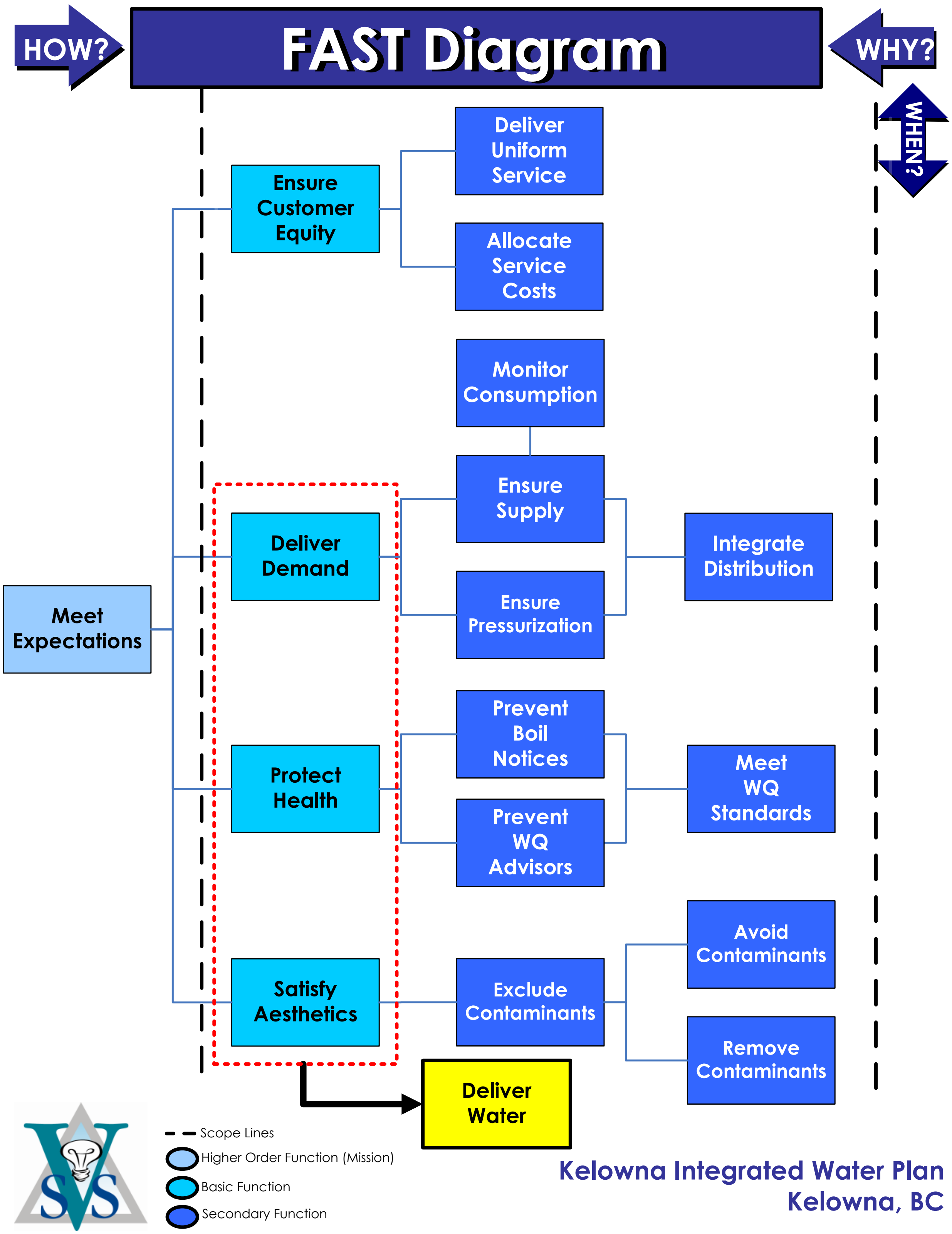
Post-Workshop

The Post-Workshop activities of a Value Study consist of preparing the value study report. This Final Value Study Report includes the Value Alternatives developed during the workshop, as well as documentation of the Value Process.

Figure C-1
Value Engineering Process Diagram



E – FUNCTION ANALYSIS



Kelowna Integrated Water Plan
Kelowna, BC

F – CREATIVE IDEA LISTING

Creative Idea Listing

Idea No.	Description
DW - Deliver Water	
DW-01	Separate domestic from agricultural water delivery where water systems are separated
DW-02	Put all domestic lawn watering on an agricultural water source
DW-03	Put all higher density areas on the lake water
DW-04	Use all water sources based on seasonal water quality
DW-05	Use Mission Creek for all domestic water in the winter
DW-06	Recharge groundwater with surface water and use groundwater where appropriate
DW-07	Convert most wells to irrigation use only
DW-08	Use multipurpose reservoirs for water and flood control
DW-09	Use low cost gravity systems for irrigation needs
DW-10	Connect Mission Creek source water to Hydraulic Creek source
DW-11	Drill high elevation rock tunnels for seasonal storage
DW-12	Combine storm water management with groundwater recharge
DW-13	Use grant funding to build filtration plants
DW-14	Use membrane bags to filter stormwater
DW-15	Build one upland filtration plant
DW-16	Build an upland filtration plant on Mission Creek
DW-17	Improve source water protection specifically for Mission Creek
DW-18	Install Ranney wells on Mission Creek for water extraction during freshet
DW-19	Install Ranney wells on upland creeks
DW-20	Cover upland reservoirs with floating balls to reduce evaporation
DW-21	Maximize use of agricultural water for fire protection
DW-22	Minimize pumping
DW-23	Maximize use of sources to reduce pumping
DW-24	Add agricultural water distribution to serve irrigation needs in the City
DW-25	Plan distribution for future service to small service areas
DW-26	Do not distribute domestic water to Agricultural Land Reserve areas
DW-27	Proved all domestic water from the lake
DW-28	Increase upland reservoirs to capture maximum safe yield

Idea No.	Description
DW-29	Coordinate long term agricultural and domestic separation with long term capital improvements
DW-30	Install small diameter domestic pipes inside existing pipes serving agricultural needs
DW-31	Create excess capacity in upland reservoir for contingency
DW-32	Match water source to pressure zones and treat water where necessary
DW-33	Use trenchless technology to install lines where not in a roadway right of way
DW-34	Implement a city-wide asset management system for water
DW-35	Connect Scotty Creek supply to Mission Creek irrigation lines
DW-36	Field test water lines where water sources will be mixed
DW-37	Do water mixing tests to evaluate water quality
DW-38	Develop a system wide model to understand system operations
DW-39	Ensure that water supply is not inducing corrosively in the system
DW-40	Develop contingencies for invasive species
DW-41	Anticipate increasingly stringent regulations
DW-42	Anticipate additional restrictions on agricultural water quality
DW-43	Use system model to predict DBP formation throughout the system
DW-44	Extend the Eldorado intake to improve water quality
DW-45	Use WWTP effluent for parks, golf course, and turf farm irrigation
DW-46	Use effluent water to enhance wetlands
DW-47	Use water sources conjunctively to maximize use
DW-48	Base system planning on an assumption that the aquifers are sustainable
DW-49	Install and infiltration intake for Eldorado
DW-50	Implement a re-chlorination strategy in the parts of the system with water age concerns
DW-51	Use chloramines to serve system with potential for aged water
DW-52	Plan intakes for zebra mussels
DW-53	Construct looped interconnections between service areas
DW-54	Use higher elevation sources to generate hydropower
DW-55	Combine systems to improve fire protection
DW-56	Consolidate and simplify the number of distribution reservoirs and booster station
DW-57	Consolidate pressure zones
DW-58	Treat effluent to drinking water standards and incorporate into the domestic water system

Idea No.	Description
DW-59	Implement smart growth strategies to coordinate with water system
DW-60	Perform an analysis to better predict the ultimate water demand
DW-61	Serve the SEKID service area with additional groundwater
DW-62	Feed SEKID area domestic needs from Cedar Creek intake and also service the SOMID area
DW-63	Feed SEKID area domestic needs from Cedar Creek intake through KLO to the Haul Road area
DW-64	Eliminate BMID reservoir and supply water from interconnect with Rutland area
DW-65	Interconnect the Poplar Point supply to the BMID system
DW-66	Interconnect the Poplar Point supply to the BMID and Rutland systems and eliminate Rutland wells
DW-67	Service Rutland's proposed reservoir with domestic water SEKID water wells
DW-68	Build a WTP on Mission Creek and serve all of the domestic needs thru a looped system
DW-69	Complete a large domestic looped transmission system
DW-70	Complete a large agricultural water transmission system with interconnected sources
DW-71	Connect at Clifton Road north to McKinnley
DW-72	Install new balancing reservoirs where needed
DW-73	Extend a smaller domestic pipe from a treatment plant at Mission Creek and separate domestic and irrigation water at the source
DW-74	Lower all lake intakes to 35m
DW-75	Interconnect Scotty Creek area to Ellison area
DW-76	Use McKinnley reservoir as a detention basin for flood flaws from Mill Creek
DW-77	Reserve space for future WTPs
DW-78	Extend SEKID irrigation water to serve SOMID and Benvoulin Flats
DW-79	Serve SOMID and Benvoulin Flats from Eldorado
DW-80	Serve SOMID and Benvoulin Flats from BMID
DW-81	Build a WWTP reuse line along the Benvoulin Corridor
DW-82	Do separation over time as part of system replacement
DW-83	Develop an application so irrigators can schedule their water flow needs
DW-84	Serve a connection between Scotty Creek area and Ellison area from Mission Creek
DW-85	Serve Scotty Creek area irrigation from Ellison

Idea No.	Description
EE - Ensure Equity	
EE-01	Use the concept of separated agricultural and domestic water as a basis for different costs structure
EE-02	Install meters on all domestic customers
EE-03	Develop a uniform metering and billing procedure across the city
EE-04	Establish uniform service procedures across all areas
EE-05	Establish an agricultural advisory board to transition uniform service across the city
EE-06	Create a mechanism to maintain political accountability to the agricultural community
EE-07	Stage water quality improvements to the areas with worst water quality first
EE-08	Stage water quality improvements to the areas with the highest risk (consequence)
EE-09	Consider income disparity when developing the plan
EE-10	Maximize funding opportunities to reduce community cost
EE-11	Develop an asset evaluation of the existing water providers to better understand the contribution of each
EE-12	Provide one face to the community for water
EE-13	Do whatever the Okanagan Water Board advises
EE-14	Develop uniform water restriction policies
EE-15	Hire an outside public relations or outreach group to communicate the operation and cost changes
EE-16	Provide a rate credit for delivery of lower quality of water
EE-17	Pass new by-laws for an integrated water system to eliminate conflicts/duplications/inequities caused by existing by-laws from (5) different water suppliers
EE-18	Create a common or uniform by law to serve all customers
EE-19	Allocate agricultural water by volume according to the crop grown
EE-20	Eliminate allocation for agricultural users and use a volumetric rate structure
EE-21	Charge different rates based on actual delivery cost inputs
EE-22	Provide low income assistance program
EE-23	Implement a domestic water budget billing system
EE-24	Create incentives for water conservation, especially for the agricultural users
EE-25	Use a two part rate system for agricultural users that provides a base rate and a use rate

Idea No.	Description
EE-26	Let agricultural users bottle and sell water
EE-27	Develop a capacity fee for new development to buy in to the system
EE-28	Modify policies to allow agricultural water providers to be eligible for grant funding
EE-29	Operate the system as long as possible using UV and chlorine with a single pipe system
EE-30	Create a mechanism where agricultural water can be allocated for domestic use in time of need
EE-31	Remove land use restrictions om the Agricultural Land Reserve
EE-32	Provide incentives for using recycled water
EE-33	Privatize the entire system through a P3
EE-34	Remove agricultural zoning and call it commercial
EE-35	Provide lower rates for preserving open space and agricultural
EE-36	Create development cost fees based water use efficiency
EE-37	Develop rate structure that fairly distributes costs based reduced use
EE-38	Develop rate structure to consider efficiency of irrigation systems
EE-39	Develop sophisticated system that measures soil moisture and irrigates from a central control

G –MATERIALS PROVIDED

Materials Provided

City of Kelowna Documents for Review with Value Planning:

The following is a list of the documents that the City wants to be considered by the Value Planning Team on the Kelowna Integrated Water Plan. The numbered items refer to a specific document while the sub-numbers provide additional information about why it is deemed relevant or of benefit to the Team.

1. Kelowna Joint Water Committee, 2005 Strategic Water Servicing Plan, Aqua Consulting & Mould Engineering

2. Kelowna Joint Water Committee, Water Quality Improvement Plan Overview, Associated Engineering, 2009

    a. Provided an in-depth look at water quality concerns and upgrades to meet standards.
    b. First plan that removed political boundaries.
    c. Was not supported by IDs.

3. City of Kelowna, City Master Water Plan, AECOM, 2009

    a. A master plan for the City's Water Utility.
    b. Provided critical capital works triggers for the City's Water Utility.

4. City of Kelowna, City-Wide Master Plan Water Supply and Treatment Option Evaluation, Associated Engineering, 2010

    - Technical Memorandum No. 1-1. Water Sources, Treatability and Costing Criteria, January, 2010.
    - Technical Memorandum No. 1-2. Water Demand Design Criteria, January, 2010.
    - Technical Memorandum No. 1-3. Options Conceptualization, January, 2010.
    - Technical Memorandum No. 2-1. Options Cost Estimates, January, 2010.
    - Technical Memorandum No. 2-2. Evaluation and Comparison of System Options, November, 2009.

    a. Additional detail is provided for City Water Utility projects identified in the AECOM 2009 report.
    b. Conceptual review of water supply and treatment options identified a potential future city-wide system. Several alternatives were identified looking at interconnection and minimizing water sources.

c. The analysis included an in-depth look at water quality concerns and upgrades required to meet standards. Note the McKinley Landing Pump Station was not constructed at this time.
d. Report rejected by Improvement Districts.

5. City of Kelowna, Drinking Water Source Protection, EBA, 2011
   a. Okanagan Lake water sources are excellent and closely monitored.
   b. City has an extensive storm water control system with regular maintenance and monitoring.
   c. City's water supply system of four lake intakes provides the City with flexibility as well as redundancy in its overall water supply.
6. City of Kelowna, Filtration Deferral Planning Report, Associated Engineering, 2011
   a. Was a critical element in deferring high costs of filtration from the City's four Okanagan Lake water sources.
   b. Conceptual planning for filtration facilities using City Water Utility's two main lake intakes while decommissioning of others over time along with redundancy or back-up planning.
   c. Recommended risk management actions.
7. Kelowna Integrated Water Supply Plan, 2012
   a. Overseen by the Kelowna Joint Water Committee
   b. An update of the capital plans of each water utility from the 2005 Strategic Water Servicing Plan.
8. City of Kelowna, 2030 Official Community Plan – Greening Our Future. Bylaw # 10500, 2013
   a. Policies to ensure an adequate supply of high quality water.
   b. Policy promoting best practices to minimize water consumption toward increased resilience to drought.
9. City of Kelowna, Context Review of the 2012 Kelowna Integrated Water Supply Plan, Associated Engineering, 2014.
   a. Commissioned by Kelowna City Council, the 2012 KIWSP was reviewed to assure the goals coincided with the City's long term expectations and the OCP.
   b. It noted that, by making the changes noted in this review, a single area-wide utility:

i. Could lower water quality risk and long term costs;
ii. Improve distribution and utilization of highest quality water; &
iii. Improve the chance of maintaining filtration exclusion into the future.

10. Province of BC, Dam Safety Regulation, BC Water Sustainability Act, 2016

    a. Cost to repair and rehabilitate dams and structures in the uplands will continue to rise.
    b. There is an effort underway to decommission as many dams as possible in the Okanagan.

11. City of Kelowna, SEKID Water Supply Options, Associated Engineering, 2016

    a. Review and update of costs (to 2016) for the 2012 Aqua Consulting work related to the proposed SEKID well domestic supply option along with separation of the domestic water system from their irrigation water system.
    b. Conceptual design of two options that would supply domestic water to SEKID from the City's lake supply system. 2016 cost estimates of both options.

South East Kelowna Irrigation District Documents for Review with Value Planning:

1. Associated Engineering. November, 2007. Summary Report South East Kelowna Irrigation District Water Supply and Treatment Cost/Benefit Review
2. Golder Associates. November 2007. Hydrogeological Evaluation Well Field Capacity South East Kelowna Irrigation District
3. CTQ Consultants, May, 2012. Pre-Design Report Domestic Supply System - South East Kelowna Irrigation District
4. CTQ Consultants, May, 2012. Pre-Design Report - Drawings
5. Western Water Associates, May, 2011. SEKID Pre-Design – Preliminary Hydrogeological Findings
6. CARO Analytical. August, 2016. Comprehensive Analysis
7. Sustainable Subsurface Solutions, February, 2011. Preliminary Characterization of Nitrates in Groundwater in Wells Completed in the Mission Creek Fan Aquifer South East Kelowna, BC
8. Associated Environmental. April, 2016. Spring 2015 Pathogen Sampling Results Osoyoos and Penticton Indian Band and SEKID Drinking Water Supply Wells

9. Agua Consulting, September, 2016. Domestic Groundwater Supply Project – project review and cost update
10. Econics, October, 2016. Scenario_B5-5_Oct2016
11. Agua Consulting, December, 2016. SEKID – Water Supply Options Update
12. Econics, December, 2016. Scenario B5-5 (w grant + ACFAR)
13. Nicole Pyett, September, 2015. Physical measurements of groundwater contributions to a large lake
14. Piteau Associates. December 2016. Technical Memorandum - Update on Groundwater Recharge and Interaction with Surface Water in the Kelowna Area
15. Interior Health. September 2016. Letter: RE: Condition on Permit #7 Update – Review and Compliance Evaluation
16. Minister Chong, July, 2012
17. Minister Bennett, April, 2013
18. Kelowna Joint Water Committee, March 2013. 2013 Implementation Plan: Kelowna Integrated Water Supply Plan
19. Toby Pike. January, 2005. Agricultural Water Conservation Program Review