COMPREHENSIVE WATER CONSERVATION AND SUPPLY PLAN 2015 UPDATE REPORT

The Resort Municipality of Whistler | September 28, 2015

WHISTLER

THE RESORT MUNICIPALITY OF WHISTLER
4325 Blackcomb Way
Whistler, BC Canada V0N 1B4
www.whistler.ca
TEL 604 932 5535
TF 1 866 932 5535
FAX 604 935 8109

TABLE OF CONTENTS

PURPOSE

To operate as a successful resort community, it is essential Whistler has sufficient, high quality water at all times. This report will discuss the multiple paths available to achieving this objective in a sustainable manner, and will address complexities, principles and action plans related to:

- Current supply vs. supply requirements at build-out
- Supply under drought maximum-demand conditions
- The role of the 21-Mile Creek supply
- The differences between resort and residential usage
- Whistler 2020 sustainability objectives

The purpose of this report is to document progress on and update plans for water conservation and supply initiatives that have been pursued for the past several years, and identify a prioritized list of further water conservation programs and infrastructure projects that will assure Whistler of a reliable water supply sufficient to meet long-term needs.

DISCUSSION

1 WHISTLER'S DRINKING WATER SUPPLY

Whistler drinking water supply system consists of one surface water source (21 Mile Creek) and 15 water wells. The supply system has two major, physically separate water supply systems, Whistler Main and Emerald, as reflected in the operating permits Vancouver Coastal Health has issued to Whistler. The Whistler Main system has three sub-systems which are separated from each other by valves. These are the Core (which includes the Village, Creekside, Bayshores, Brio, Alta Vista, etc.), Alpine-Rainbow, and Cheakamus Crossing.

1.1 Key Concepts

"Annual Average Population" is permanent residents plus estimated overnight visitors as reported by Tourism Whistler. While Annual Average Population doesn't include day visitors, the effect of the day visitors on demand is already built into all consumption measures.

"Maximum Day Demand" is the amount of water actually provided to the Whistler community on the highest-use day of the year (for example, during Crankworx), divided by the number of occupied and built bed units in existence on that day.

"Design Maximum Day Demand" is the amount of water forecast to be required at build-out on the Maximum Day, assuming 100% occupancy.

The "Whistler2020 Water Use Target": Through the Whistler 2020 process, a community vision was established to reduce the amount of water removed from the natural environment for community use. As a result, a target of reducing water consumption to 425 litres per capita per day, based on the Annual Average Population for Whistler.

The "Whistler Community Performance Indicator", which is reported annually, is used to determine progress toward the Water Use Target. It is defined[1] as the actual amount of non-potable water removed from natural sources by the Whistler community in a given year, and then divided by the annual average population.

---

[1] From http://www.whistler2020.ca/whistler/site/indicator2.acds?instanceid=11159057&context=11158627
"Indicator Definition: Total water consumption (potable and non-potable RMOW water flows)
"Calculation: Sum the water flows entering all RMOW water treatment plants and the flows used for RMOW non-potable uses."

It is important to note that the Whistler2020 Water Use Target and Whistler Community Performance Indicator are not related to the Design Maximum Day Demand, because they're based on annual average use, not maximum day use. The water supply system must be designed for maximum day use, not average annual use.

1.2 Water System Principals

Six principals have been consistently applied to the development of Whistler's water system development:

1. Provide safe drinking water in accordance with the Canadian Drinking Water Standards and in compliance with Provincial Regulation
2. Provide sufficient water to meet all instantaneous domestic and fire flow demands at all times
3. Use 21 Mile Creek as much as possible to minimize costs and provide highest available drinking water aesthetic quality
4. Accommodate periods when 21 Mile Creek supply is off-line, using groundwater to satisfy all demands
5. Work towards integrating and simplifying the supply system in order to increase system resilience and minimize long-term costs
6. Both Conservation and Supply plans can be used to satisfy future demand growth. These will be implemented in the most cost effective manner.

1.3 Supply Volume Design Criteria

Developed bed units ("BU") are a theoretical measure used in Whistler for planning purposes. Whistler long-term supply requirements are established by determining the current Maximum Day Demand, then multiplying the result by the number of BU expected at build-out. This approach provides a consistent and uniform measure of demand for forecasting purposes. Examples of the theoretical BU values are:

- Single family home or Duplex unit = 6 BU
- Hotel Room = 2 BU
- Employee housing = 1 BU per person
- Multi-Family = 2 to 6 BU, based on size

The RMOW implements new supply and conservation measures in a gradual manner, and monitors progressive changes to Maximum Day Demand to adjust future demand forecasts.

Over time, as the community has developed, conservation measures implemented, and monitoring systems improved, Maximum Day Demands have declined.

The resulting decline in Design Demand has proceeded as follows:

pre-1990's:	1000 L/BU/day
post-1990's:	700 L/BU/day
2015:	530 L/BU/day[2]

All the changes that were implemented starting in the early 1990's (see section 3) have thereby enabled downward movement in Design Maximum Day Demand, with corresponding reductions in actual and planned spending.

2 NEED FOR WATER CONSERVATION

Whistler's 2014/2015 low-snowpack winter and subsequent 2015 regional drought conditions have made the importance of water conservation under such conditions very clear to Whistler residents. However, given that Whistler is surrounded by rivers, lakes, and glaciers, and has a high proportion of resort visitors, it is difficult for many to understand and support the water conservation and supply issues that are important here at all times.

The natural hydrologic cycle evaporates water from oceans, lakes, and rivers, and deposits the water in our local mountains in the form of both rain and snow. The water that runs off the mountains fills our rivers and creeks, and over time replenishes the

[2] (Draft) Potable Water Supply Plan 2014 Update D-17984.00, Opus Daytonknight, June 2015

below-ground aquifers. The RMOW's water supply and distribution system temporarily interrupts this cycle, but most of the water we "use" is treated and returns to the natural environment further downstream.

Whistler has established a Whistler 2020 Water Use Target, which is shown with yearly estimated per capita consumption in Figure 2-1 below.

Were one to set aside Provincial and Whistler 2020 environmentally-oriented water use objectives, water conservation would remain important for financial reasons: there are significant costs associated with expanding and operating our water and wastewater systems as required to meet increases in flow. Reducing the average amount of water used in Whistler is important as that would result in reduced maintenance and operating costs for our water and wastewater systems. Reducing the peak (maximum day) amount of water use can be even more financially significant as lowering this peak water usage can delay or even reduce the scope of needed supply and conservation programs.

British Columbia's Water Plan "Living Water Smart" was rolled out by the provincial government in 2009 and includes two key goals relevant to water conservation in Whistler:

1. Fifty percent of new municipal water needs will be acquired through conservation by 2020
2. By 2020, water use in British Columbia will be 33 percent more efficient

Meeting the first provincial goal would require that that for each additional unit of water demand, only half should be provided by expanded water infrastructure, with the other half to be provided by conservation. This is a challenging objective to meet.

Meeting the second provincial goal is also challenging: no definition of "efficiency" is provided, nor any allocation of required efficiency gains to each affected organization.

In acknowledging the challenges inherent in these high level provincial goals, it's also important to understand that the Province[3] requires a "water demand management plan" be established by local governments as a requirement for applying for water-related Provincial infrastructure funding. The attached Plan is intended to ensure the continuing fulfillment of this requirement.

Prior to the creation of Provincial goals, the Whistler community established, through the Whistler 2020 process, a Water Use Target of reducing annual average water consumption to 425 litres per capita per day (based on Whistler's annual average population).

[3] http://www.cscd.gov.bc.ca/lgd/infra/infrastructure_grants/

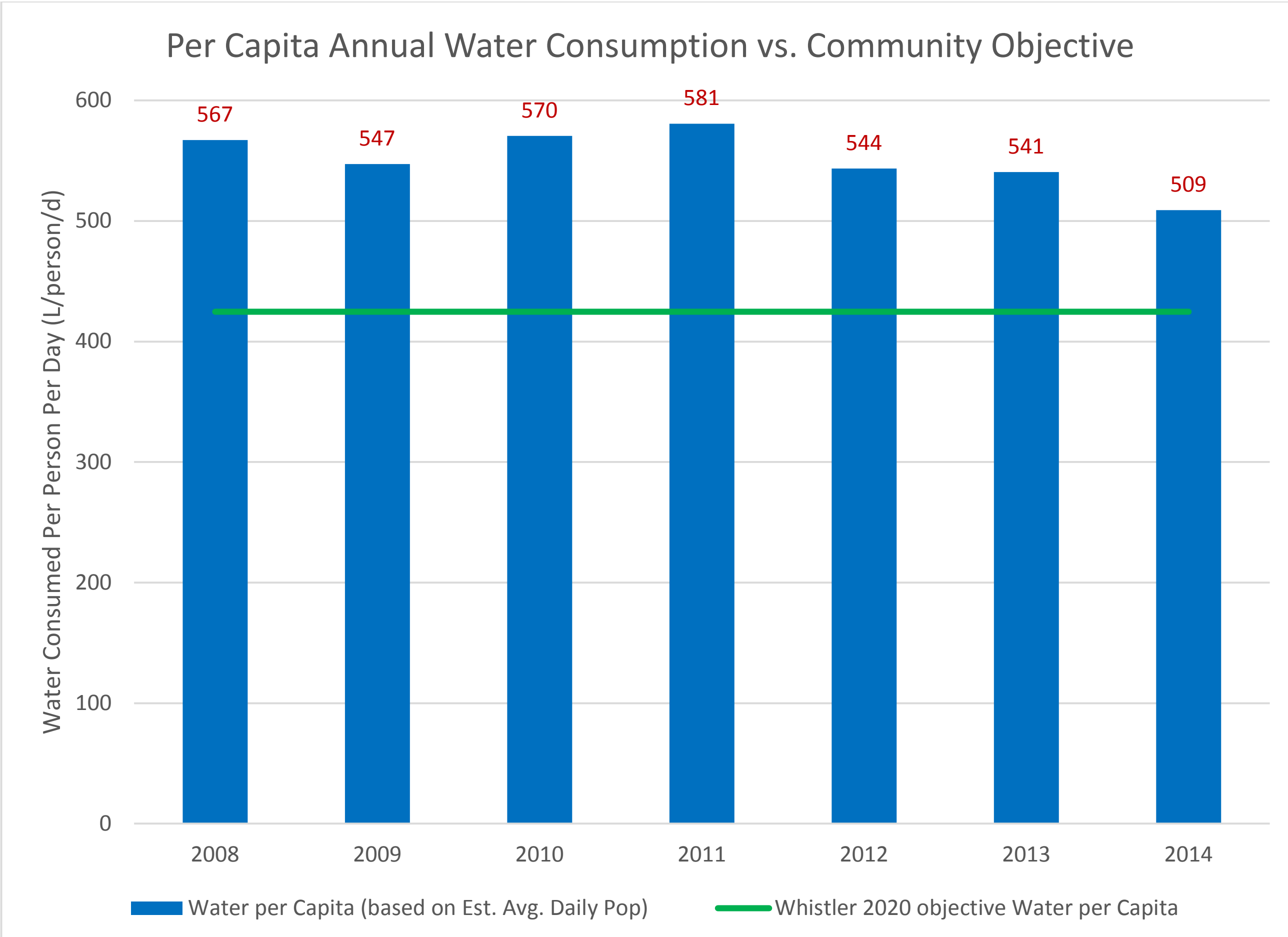

Figure 2-1 per Capita Water Consumed vs. W2020 Water Use Target

As can be seen in Figure 2-1, in 2014 the average daily drinking water supplied to the community was measured at 509 litres per capita, a significant improvement over prior years, but 17% higher than the 425 litre sustainability goal. Per capita water consumption will have to drop by 3% per year in the six years 2015 to 2020 to achieve the Whistler 2020 Water Use Target, requiring significant improvements to water conservation.

Per capita consumption will have to decline 3% per year to 2020 if Whistler is to achieve its' Whistler2020 Water Use Target.

---

3 BACKGROUND – HISTORIC WATER CONSERVATION IN WHISTLER

Between the 1990's and 2010, municipal staff implemented various water conservation projects and programs throughout the municipality. Initially, these projects and programs were the obvious first steps (the low-hanging-fruit) and provided high returns in regards to cost savings. The results of these conservation programs can be seen in Figure 3-1 (note the significant leveling of demand in the late 1990s and early 2000s).

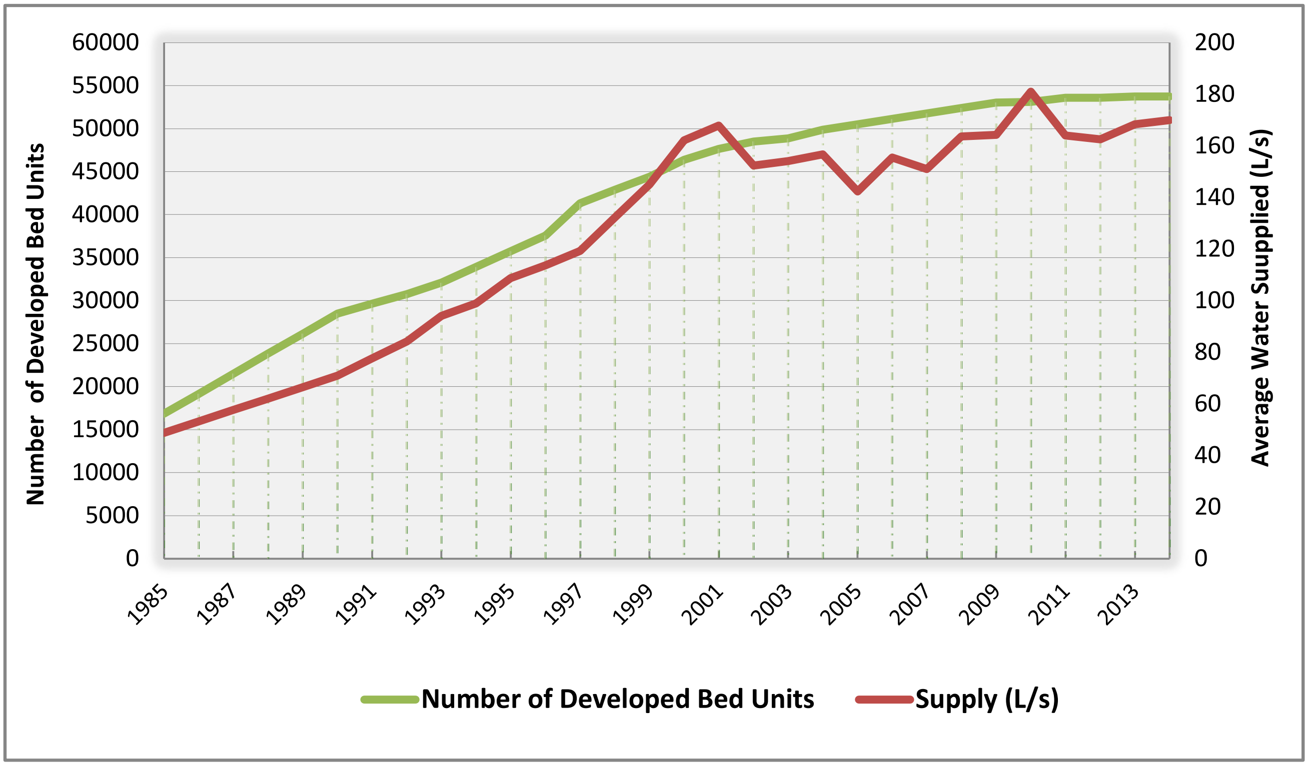

Figure 3-1 Number of Developed Bed Units vs Average Annual Supply Flow

The significant pre-2011 water conservation programs which were implemented by the RMOW are as follows:

3.1 Whistler Golf Course Irrigation Systems

In the late 1990's, the municipality partnered with the Whistler Golf Course on the development of an independent irrigation (non-potable) well. This resulted in a significant decrease in municipal water use for the operation of the golf course. All three golf courses in Whistler now use untreated water for irrigation.

3.2 Hydrant Use Permitting Process

In 1999, the Public Works (now Infrastructure Services) Department launched a program that regulated the use of fire hydrants by the private sector. A hydrant use permit and backflow preventer must be obtained from RMOW Utilities before a contractor can use a fire hydrant. This change significantly reduced the inappropriate use of fire hydrants for non-emergency services. In 2015, the Hydrant Use Permit process is being leveraged to afford additional water saving opportunities and will be used to improve construction-related water consumption data tracking on an ongoing basis.

3.3 Irrigation/Sprinkling Bylaw

In 2001, municipal council approved a bylaw to regulate and restrict lawn irrigation and other miscellaneous uses of water. These regulations are similar to those in the lower mainland and allow residents to water their lawns every other day during early morning and evening hours. Further restrictions on irrigation can be implemented under this bylaw if the municipality declares a “water emergency”.

3.4 Low Flow Plumbing Fixture Bylaw

In 2003, municipal council approved a bylaw that requires low flow toilets, showerheads and other fixtures for all new construction that involves a plumbing permit. Recent changes to the BC Building Code have incorporated fixture efficiency requirements within the BCBC (similar to, and in place of our local bylaw), and have incorporated incremental efficiency requirements for low flow fixtures (esp. toilets).

3.5 Independent Municipal Parks Irrigation

In 2003 and 2004, the municipality constructed independent irrigation (non-potable) wells at Rainbow Park, Spruce Grove Park and Myrtle Phillip Community School.

3.6 Water Leakage Reduction

Since 2009 the municipality has had an ongoing program to detect and fix water leaks.

4 CURRENT WATER SUPPLY AND CONSUMPTION CONDITIONS

4.1 Water Supply Infrastructure

Whistler's water supply system is relatively complicated due to the nature of how Whistler developed in isolated neighborhoods and our geography. The RMOW draws drinking water from 14 water wells and one surface water source to supply water our water distribution systems. On an annual basis, around half of the RMOW's water is supplied from the surface water source, Twenty-One Mile Creek, but during the months of March through June and October to November this water supply is periodically unavailable due to high turbidity or low UV transmittance. Turbidity usually occurs when sediment enters the creek from localized slope erosion or other activity in the watershed. Low UV transmittance usually occurs due to either turbidity or colour staining in the water resulting from organic matter. Even during hot July and August weather, when the maximum daily water demands normally occur, the turbidity occasionally exceeds the drinking water guidelines, thereby making the Twenty-One Mile Creek source temporarily unusable. This is usually caused by an intense, short duration summer rainfall event. This problem can be currently be temporarily managed for a few hours by our water storage reservoirs, with some fire storage risks. With the initiatives in this Plan, if we lose 21 Mile Creek Supply, sufficient water will be available even during peak season by using the groundwater supplies (Refer to S. 1.2 Water Supply Principals, Principal No. 4).

The 2015 Alpine Reservoir Level Control Project (E108) will increase the interconnectedness of Whistler's water system by automating the movement of water between the Village zone and the Alpine-Rainbow zones. This project will further improve Alpine-Rainbow water quality, reduce ongoing power costs and reduce demand on the Alpine water wells, thus preserving their peak capacity for times of greater need. The project will also facilitate automation of movement of water from Alpine to the Village Zone in the future, as may be required in an emergency.

4.2 Sufficiency of Supply

Figure 3-1 showed that although the demand for more water has leveled off significantly due to Whistler conservation efforts, overall demand continues to grow in alignment with our community growth. Total demand for water will likely continue to grow into the future as we reach build-out. Our continued success as a resort is reliant on reliable supply to meet this increased demand.

Whistler has established and continues to adhere to specific water supply system principals and water quality criteria, as follows:

1) Provide safe drinking water in accordance with the Canadian Drinking Water Standards and in compliance with Provincial Regulation. Our operating Permit also specifically requires the following:
    a. Do not use 21 Mile Creek when Turbidity NTU > 1
    b. Do not use 21 Mile Creek when UV Transmittance (UVT) insufficient to remove pathogens
2) Provide sufficient water to meet all domestic and fire flow demands at all times
3) Use 21 Mile Creek as much as possible to minimize costs and provide highest available drinking water aesthetic quality
4) Accommodate periods when 21 Mile Creek supply is off-line, using groundwater to satisfy all demands
5) Work towards integrating isolated sub-systems in the Core sub-system to increase system resilience and minimize long-term costs
6) Minimize costs by implementing conservation programs and supply projects in order of most to least cost-effective

Currently, the maximum available supply flow from all sources is 30 cubic-meters per minute (m3/min) including the new W219 well in Rainbow Park. If Twenty-One Mile Creek were unavailable for an extended period, the maximum available supply would be 21 m3/min (a reduction of 9 m3/min or 30%). 21 m3/min is substantially lower than Whistler core area's recent 2015 peak observed demand[4] of 28 m3/min. It is therefore clear that a supply gap currently exists during our busiest summer period if 21 Mile Creek were to go off line.

A supply gap currently exists during our busiest summer period when 21 Mile Creek is off line. At build-out, Whistler is forecast to face a 5 m3/min shortfall during maximum day demand.

As can be seen from Table 1, Whistler's is forecast to face a shortfall of 5 m3/min at build-out peak day demand with 21 Mile Creek off-line.

Where?	Current Max Day Demand (m3/min)	Build-Out Demand[5] (m3/min)	Current Supply (m3/min)	Supply Gap at Build-Out (m3/min)
Alpine	2.0	2.9	4.6	1.7
Cheakamus	0.47	1.3	4.5	3.2
Core Area	14	18	12	(5.4)
Emerald	0.63	0.76	1.5	0.72
All Whistler Sub-Total	18	23	23	0.17

Table 1 Summer Supply Shortfall

4.3 Other Factors

An initiative is underway to establish a climate change adaptation strategies for the RMOW. A subsequent update to this report will take the outcomes of that initiative into account.

Staff and Council may also subsequently consider changes to planting and irrigation policies as they apply to the RMOW itself.

4.4 Water Consumption Design Conditions

The design criteria used to design our waterworks infrastructure is based on bed units. While most municipalities use population as the unit for water use estimations, using bed units in Whistler makes sense as there is a significant water use associated with a developed bed unit. For example, once a hotel is built, water is consumed for irrigation, ice makers, and the swimming pool whether the hotel is occupied or not. In addition, the number of developed bed units can be relatively easily measured, while determining an accurate daily average population in Whistler is difficult, is only an annualized estimate, and is still not an exact comparison for water consumption purposes as the large visitor population does not use water in the same way as our resident population. Using bed units as the unit for water design criteria is common for resort communities.

The maximum demand design value is the measure of the maximum foreseeable demands that the water system will need to accommodate during the most challenging weather and demand conditions that will likely occur. In most of the world, including in Whistler, that situation will invariably arise during the hottest days of summer: in the discussion following only summer maximum demand will be considered.

Design for this relatively conservative criterion is the accepted standard, and a reasonable standard in light of the consequences of water supply system failure which can include pressure decreases, depletion of available firefighting supplies, or water supply interruptions. Whistler's previously established maximum demand design criterion of 700 litres per bed unit per day (L/BU/day) in the summer anticipated maximum foreseeable residential usage, maximum hotel occupancy, full irrigation demands and a margin of safety.

[4] Peak day demand for Whistler plus Whistler South excluding Cheakamus occurred July 3, 2015
[5] Assumes 90% occupancy on Maximum Day Demand day

Under current build-out conditions, summer maximum demand of 700 L/BU/day would translate to 26 m3/min, which is significantly higher than Whistler's currently available supply: this difference had raised the question of whether the design standard is too high, or whether maximum demand conditions simply haven't occurred. In order to answer this question staff commissioned a technical review of the 700 L/BU/day design standard.

A resulting recent (June 2015) update to the RMOW long-term water supply plan[6] and subsequent staff work have provided new insight into the observed maximum annual demands for the years 2013-2015. It has been found the actual amounts recently consumed to be different (significantly less than) the aforementioned design criteria. Additionally, Whistler is much closer to build-out than it has been historically, so there are fewer unknowns adding uncertainty to supply planning. Engineering practice under such conditions is to revise the design criteria downward to reflect current (as opposed to historical) usage patterns, but to retain a safety margin reflective of remaining unknown factors, for example, the actual number of bed units available in the current maximum demand period, and the likelihood of further tourism growth beyond 2014 and 2015's record levels.

A staff review of maximum day supply volumes established that the historical maximum demand of occurred for the Core Area[7] on July 3, 2015. Based on this finding, staff have accepted the consultant's recommendation the RMOW's maximum demand standard be reduced from 700 to 530 L/BU/day.

In 2015, the RMOW's design maximum demand standard was reduced from 700 L/BU/day to 530 L/BU/day

In 2014, approximately 5.4 million cubic meters were supplied to Whistler's potable water system from the surface and groundwater sources. The following two charts show historical water use in Whistler. Figure 4-1 shows peak daily water consumption per bed unit in Whistler's core area. Figure 4-2 shows average daily water consumption per bed unit. Comparing these two figures reveals that while 2014 had an annual average demand of 271 L/BU/day, peak day demand rate was 468 L/BU, significantly larger than the annual average. Understanding the peak demand is critical for designing infrastructure components to deal with these annual peak events.

The trend in Figure 4-1 reflects Whistler's transition from a mostly winter resort to a year-round destination resulting in a significantly increased maximum water demand in the 1990's. The decrease in maximum demand starting in 2000 shows the effectiveness of the water conservation measures that were implemented at that time. 2010 was an exceptional year, and has been removed for clarity. 2013 and 2014 show only a slight increase in average water use, possibly indicating the record-level

[6] (Draft) Potable Water Supply Plan 2014 Update D-17984.00, Opus Daytonknight, June 2015
[7] Whistler Village, White Gold, and South Whistler, excluding Cheakamus Crossing

tourism in those years was counter-balanced by effective conservation measures.

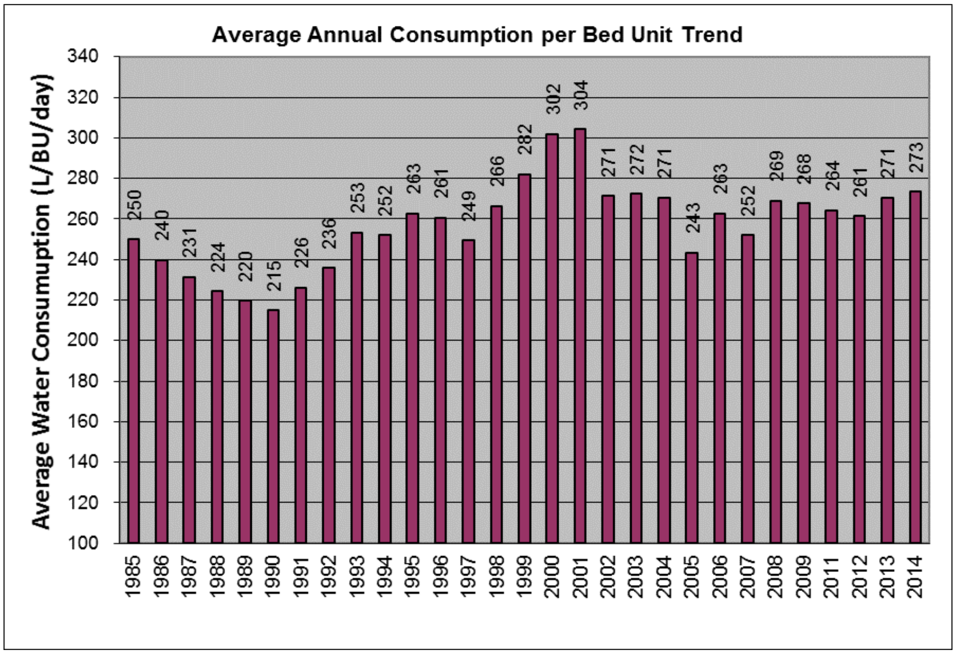

Figure 4-1 Average Consumption per Bed Unit Trend

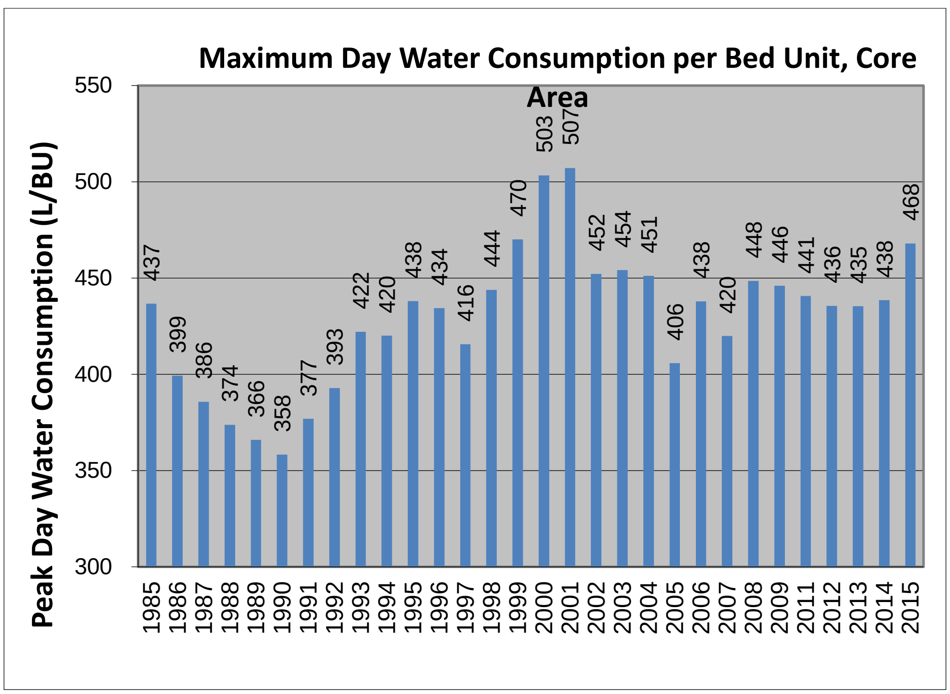

Figure 4-2 Water Consumption per Bed Unit Trend, Core Area

2015's peak day as seen in Figure 4-2 was significantly counter-trend, and 2015 has had higher consumption overall. 29 of the 38 weeks to-date in 2015 had higher consumption than 2014. As a result, 2015 is currently forecast to have 10% higher overall consumption than 2014: 2015's conditions show that per Bed Unit maximum demand trends and annual maximum consumption are subject to significant change: seemingly steady patterns may not hold true in the future without significant additional focus on conservation efforts, particularly in summer.

Figure 4-3 shows weekly consumption in the summer of 2015 compared with the 2011-2014 period. 2015 brought a combination of drought, high temperatures, and record tourism. In this example, until water use restrictions began to be enforced in 2015, consumption had exceeded 2014 consumption by 11%, with consumption in the non-irrigation period still up significantly due to increased 2015 tourism. With summer water use outreach and communication, consumption dropped significantly beginning the week of July 28th, and total 2015 consumption had trended back down to 8% higher than 2014 by the week of August 11th. By September, with cooler and wetter weather, and irrigation restrictions still in place, consumption was about equal to prior years'.

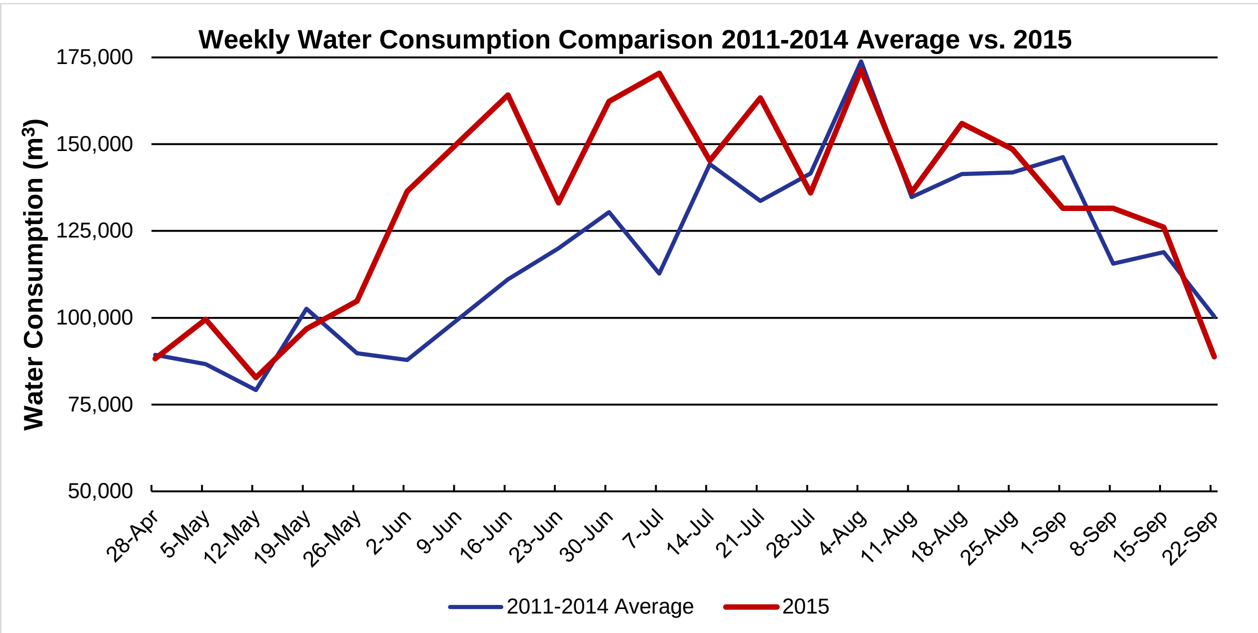

Figure 4-3 Weekly Summer Water Consumption 2015 vs. Recent Years

4.5 Residential vs. Other Consumption

There are significant differences in Whistler between residential and other uses. In general residential consumption per bed unit is much lower than for Whistler as whole. For example, in the week of August 31, 2015, Cheakamus Crossing consumption was 111 L/BU/day, *much* lower than the Whistler 2020 objective. Permanent resident areas are known to consume much less water per capita than the community as a whole, due to the effect of resort usage patterns.

4.6 Whistler Core Water Zone

Despite the RMOW water system as a whole having surplus supply in some zones, the locations of the supplies do not always match the areas of demand. For example, both Emerald Estates and Cheakamus Crossing have water supplies that exceed the local demand, but currently there are no connections that allow water from these areas to be pumped to the Village area – the area of highest demand.

The Whistler Core water zone (generally the area from Creekside through to Nesters), has sufficient water supply when Twenty-One Mile Creek water is available, but has a deficiency at maximum day demand if Twenty-One Mile Creek cannot be used. Since it is foreseeable that Twenty-One Mile Creek may not be available during maximum day demand periods, further water conservation programs or infrastructure development will be required to close the gap between available supply and maximum day demand when Twenty-One Mile Creek is offline.

4.7 Supply and Demand Summary

Normally water supply improvements are triggered when maximum day demand approaches the supply capacity. When that level is reached, the municipality has the choice to build additional water supply sources or to implement additional conservation programs if such programs can be relied upon to close the supply gap.

As explained above, the Village water zone does have supply deficiencies during maximum demand if Twenty-One Mile creek water is unavailable. The difference between supply and demand at build-out is approximately 5.4 m3/min[8], and the lowest cost method (either water conservation programs or infrastructure improvements, or a combination of both) must be pursued to correct this shortcoming otherwise there is a risk of water supply interruptions or firefighting storage shortfalls.

5 BUSINESS AS USUAL SCENARIO – NO FURTHER WATER CONSERVATION MEASURES

A *minimum* of 15% ($1.1 million[9]) of the total annual expenditures in the RMOW water and sewer utilities vary with the amount of water used in Whistler. These are costs such as electricity, chemicals, testing, equipment maintenance, and staff overtime for both water supply and wastewater treatment. As electricity makes up a significant portion of these costs, these costs have increased, and are expected to continue increasing, faster than overall inflation. The average annual variable cost of water supply based on the above value is approximately $402 per m3/min. A 16% reduction in water consumption from 2014 to Whistler 2020 target levels would result in operating savings of more than $182,000 per year.

The probability of the maximum demand event occurring concurrently with sustained high turbidity events at Twenty-One Mile Creek is not high but it is a prudent design approach. The potential of Twenty-One Mile Creek being off-line at maximum demand due to drought conditions alone, or due to drought combined with a sudden powerful rainstorm is somewhat higher. Responsible management of Whistler's water system require implementation of the measures described in this report to ensure that the catastrophic outcomes of water supply failure such as that experienced by Tofino in 2006[10] never happen in Whistler..

6 POTENTIAL WATER CONSERVATION PROGRAMS AND SUPPLY PROJECTS

Staff developed a prioritized list of possible water conservation measures in 2004, and updated that list in a report to Council in 2013 in Administrative Report 13-011[11], which included both water conservation and supply measures ranked by cost effectiveness. This list included estimated capital costs and peak flow reduction for each conservation and supply measure, and presented them in prioritized order. Many of these programs and projects have now been implemented or are in progress, and this report re-evaluates the remaining initiatives alongside a select few new/refined ideas for consideration.

The updated 2014 Whistler Potable Water Supply Plan identifies several possible infrastructure projects to increase Whistler's water supply and/or pump existing supplies from the area of the supply wells to the Whistler Village water zone, the area of highest demand. The higher benefit-cost ratio items in the Plan have already been included in past and present five year plans.

6.1 Potential Water Conservation Program Benefit Analysis

Based upon the Water Conservation Cost-Benefit Updates Technical Memorandum[12] both maximum and average water consumption reductions have been estimated for each of the possible conservation programs listed.

Table 2 below indicates conservation measures listed in order of greatest benefit to least benefit, as determined by comparing the cost of the measure with the reduction in flow that would likely result.

An explanation of each table column is:

"**Priority**":

> Priority identifier. Programs starting with "C" are conservation programs. The Programs have been ranked from C1 to C13, with C1 being the highest priority.

"**Program Name**":

> Descriptive name of the program. These names may not precisely match program names included in the 2015-2019 five year plan.

[8] Opus Dayton & Knight, Whistler Potable Water Supply Plan 2014 Update (draft)
[9] Unless otherwise noted, all valuations in this report are stated in 2014 Canadian dollars
[10] "Visitors scramble as water shortage shuts Tofino businesses", CBC News, August 30, 2006
[11] Comprehensive Water Conservation and Supply Plan, presented to Council February 5, 2013
[12] October 31, 2012, Kerr Wood Liedel

"**Capital Cost Estimate**":

An estimate of the total capital costs associated with a program over the program life.

"**Annual Conservation Savings**":

An estimate of the gross reduction in operating costs the program would provide, based on the *average* annual flow reduction it would provide.

"**Total Annual Cost/Savings Estimate**":

Average annual cost minus annual conservation savings for the first ten years of the program. The annual costs include first-year one-time costs, ongoing annual O&M costs, and amortized capital depreciation.

"**Estimated Max Flow Benefit** (m3/min)":

An estimate of the *peak day* flow reduction provided by the program. Peak day flow reductions result in reduced future infrastructure expences, and are therefore important in determining which programs to implement.

"**Max Flow Weighed Benefit** ($/m3/min)":

The Total Annual Cost/Savings Estimate divided by Estimated Max Flow Benefit. This provides a measure of cost or saving per unit of flow, and helps with comparing the cost-effectiveness of the various programs.

Table 2 Potential Water Conservation Program Cost-Benefit Analysis

#	Program Name	Capital Cost Estimate	Annual Conservation Savings	Total Annual Cost/Savings Estimate	Estimated Max Flow Benefit (m3/min)	Max Flow-Weighted Benefit ($/m3/min)
C1	Once through water use by-law	$0	($28,000)	($27,000)	0.28	($6,000)
C2	Update Comprehensive Water Usage bylaw	$0	($6,000)	($5,000)	0.06	($6,000)
C3	Water Use bylaw - Outreach	$0	($5,000)	$17,000	2.5	$1,000
C4	Water Leakage reduction program	$380,000	($140,000)	$12,000	1.4	$1,000
C5	Public education	$0	($9,000)	$11,000	0.09	$8,000
C6	Irrigation source program	$320,000	($8,000)	$9,000	0.23	$3,000
C7	Home water audits and retrofits	$0	($21,000)	$10,000	0.20	$3,000
C8	Universal Metering & Volume-Based Pricing	$10,710,000	($100,000)	$407,000	2.1	$12,000
C9	Non-residential audits	$0	($41,000)	($16,000)	0.61	($2,000)
C10	Low-volume toilet and waterless urinal rebate	$0	($4,000)	$14,000	0.04	$21,000
C11	Clothes washer rebate	$0	($5,000)	$33,000	0.05	$41,000
C12	Efficient landscaping program					TBD
C12	Rainwater Capture (Cistern) Rebate	$0	$0	$10,000	-	Low
C13	Efficient irrigation rebates	$0	$0	$12,000	-	Low

6.2 Detailed Description of Potential Water Conservation Programs

6.2.1 Once-Through Water Use By-Law

A bylaw was presented to Council in 2009 for the regulation of once-through cooling equipment, in which drinking water passes through cooling equipment, absorbs heat, and is discharged to the sewer system.

Once-through cooling equipment uses the low temperature of Whistler's drinking water in combination with a heat pump to cool walk-in refrigerators and freezers at a reduced cost versus other systems. Once-through cooling is also used for air conditioning, water coolers and ice makers without the need for a heat pump.

Such practices are banned or restricted to non-potable sources in many other jurisdictions for two reasons: once-through cooling creates higher greenhouse gas levels than alternative systems, and once-through cooling drives up both average and maximum day demand. Moreover, it wastes large amounts of water.

This bylaw received First Reading, but was never adopted mostly due to resistance from the Restaurant Association of Whistler (RAW) resulting from its members cost concerns. The thrust of the bylaw will be to permit ongoing use of these systems until they wear out.

Staff will bring a *Once-Through Water Use By-Law* to Council for consideration in 2015

6.2.2 Updated Water Use (Sprinkling) Bylaw

A number of potential changes to the Water Use (Sprinkling) Bylaw were identified in the 2002 Water Supply Master Plan which could have a positive effect on both annual and Maximum Day Demand summer water use if implemented, while simplifying the messaging to the community.

Staff will bring an updated *Water Use Bylaw to Council* for consideration in 2016, after significant dialogue with stakeholders in the community.

6.2.3 Completion of Water Leakage Reduction Program

The 2010 Water Leakage Management Strategy and its associated Implementation Plan identified a multi-phase approach to ongoing leak detection in Whistler.

After reviewing the high costs relative to savings anticipated from the proposed Implementation Plan, staff significantly revised the plan. The resulting approach is:

1. Where cost-effective staff have permanently installed water zone meters at various locations.
2. Staff monitor flows into all major water zones between the hours of 2 AM and 4 AM, using a combination of the permanently installed meters, reservoir level measurements, and temporary metered bypasses.
3. Once a major water zone is found to have high leakage, staff isolate individual streets, shut off water to buildings, and measure the water leakage directly. Once streets with major leaks are identified municipal crews do further work to locate, excavate and fix the leaks. This approach has been quite effective, for example, in early 2015 three major leaks were found in Emerald and fixed, resulting in a saving of more than 30 litres per second.

It is estimated that $30,000-$50,000 will typically be spent annually on an on-going basis to detect, locate, excavate and repair leaks. The 2015 leakage detection program budget was raised in order to effect detection in the Village zone, which is substantially more complex than the other zones.

6.2.4 Water Use Bylaw Outreach

It was previously reported to Council that adding two term bylaw officers dedicated to education and enforcement of Whistler's current water use bylaw would result in peak water use reductions. These term positions would be during the summer irrigation season.

As a result of the extraordinary situation in 2015, Utilities staff were reassigned from Unidirectional Flushing Program (UDF) to daily irrigation monitoring and outreach duties. Properties which are contravening Water Use Restrictions are being informed, then subsequently warned. The very small number of those failing to correct their irrigation practices have been referred to By-Law for enforcement.

The UDF program is essential to maintain water quality, so using technical Utilities staff to perform outreach is not a supportable long-term approach. There is however a lowest cost approach to enhanced outreach, specifically:

Employing one summer student each year to monitor irrigation, perform outreach, document and refer repeated infractions to By-Law would provide the same benefit as the 2015 outreach program, at a low cost and without impacting the UDF program. The staff would also be able to perform other related work, such as monitoring general water use by reading Whistler's installed base of water meters, and patrolling the Rainbow Lake access trail to identify and mitigate water quality hazards posed by trail users and provide information outreach and assistance to those users. This is a substantially lower cost approach (approximately $25,000 per year for this suite of activities) due to the low hourly rate and flexible hours associated with summer students, and can be supported by funds already included in the 2015-2019 five-year financial plan.

Funding for on-going *Water Use By-Law Outreach* is already included in the 2015-2019 financial plan.

6.2.5 Irrigation Source Program

In 2014 the Myrtle Philip School irrigation well collapsed, and the school's irrigation system was therefore reconnected to the municipal water system. This reversal was a significant step backward in for our demand reduction program, resulting in a likely increase in annual demand for drinking water in excess of 12,000 m3 of water in the summer of 2015.

A project to install a dedicated irrigation well for the Meadow Park sports fields would result in reduced demands on the potable water system. Capital and ongoing maintenance costs have been estimated by staff for potential inclusion in the capital plan. Meadow Park currently consumes about 15,000 m3 water for irrigation each year.

***Construction of an irrigation well at Meadow Park* has a low benefit relative to cost, and is not budgeted in the 2015-2019 financial plan.**

6.2.6 Home Water Audits and Retrofits

It was estimated that indoor water use savings of up to 45 litres per person per day (L/person/day) could be achieved by conducting water audits, replacing showerheads and faucet aerators, and repairing leaking toilets. The program cost estimate of $300,000 would be expended over a ten-year program lifespan.

***Home Water Audits and Retrofits* has a low benefit relative to cost, and is not budgeted in the 2015-2019 financial plan.**

6.2.7 Metering and Volume Based Pricing

The implementation of metered water billing is often high on the priority list of conservation advocates. According to Steven Renzetti, an economics professor specializing in water at Brock University, "Divide up Canadian cities from those that are metered and those that are not: the ones that are metered use about … 40 to 45 per cent less water per person", as quoted in the Globe and Mail[13]. The District of Squamish (Squamish) recently reported[14] that Squamish Council has decided to implement metered billing for all non-residential home uses in 2016-2017 in an effort to avoid the major infrastructure improvements that would otherwise be needed to address forecasted community growth and the associated water supply and storage infrastructure needed for that growth. The non-residential home uses identified include commercial, industrial, bulk, multi-family residential, and District-owned facilities. Squamish Council decided to take this particular partial-measure approach due to the much higher benefit-cost ratio compared to also metering its many single-family homes.

Various approaches to volumetric metered billing which have been pursued by other municipalities or could be pursued in Whistler include:

- Metering every water system connection in all building types ("Universal" metering)
- Industrial-Commercial-Institutional only ("ICI" metering)
- High volume user-only metering
- metered billing only for new connections and existing connections that already have a meter ("Opportunistic" metering)
- irrigation system-only metering
- whole-strata metering, rather than per-strata-unit metering ("Property" metering)

Examples of such billing approaches from the same Globe and Mail article include:

- Vancouver, with all multi-family and commercial properties metered since the 1970's, and single-family homes and duplexes built after 2012 billed based on meters has implemented a form of Opportunistic metering
- North Vancouver, which bills all commercial, industrial and municipal properties based on meters has ICI metering. 39% of its single family and duplex homes are 'meter ready' in case of future Universal metering, but have flat rate billing today.

Large decreases in peak water use have been achieved in other communities as a result of metering programs, but the question remains whether such reductions could be achieved in Whistler and whether the cost savings from the reductions

[13] "Experts call for increased use of residential meters in B. C."; Globe and Mail; August 2, 2015
[14] "Master Planning, Reinvestment Planning and Financial Planning: The combination that worked for the District of Squamish"; BCWWA Watermark Summer 2015 Vol. 24 No. 2; David Roulston, P. Eng.

would outweigh the large capital costs of metering. Business factors that could result in an outcome different from other communities include: the high proportion of commercial BU's, the desire of resort businesses to present a lush environment to visitors, and the large number of well-financed absentee property owners using third parties to maintain their grounds. Social factors likely to arise include publicly expressed concerns over potential of transfer of costs from absentee owners to resident owners.

Communities typically move forward with water metering programs when it makes financial sense in order to avoid major capital improvements or water supply failure. The plan provided in this report will not require any major supply improvement projects to meet Whistler's forecast demand. Without a large looming capital water supply improvement in our future forecast that could be avoided, it becomes more difficult to justify the large expense associated with water metering.

A small number of RMOW properties are currently billed for water use on a volume basis, including Whistler's largest commercial water user, the Chateau Fairmont. It is significant to note, in this context, that the Chateau Fairmont has been very successful in reducing its annual water consumption over the last decade, even though the volume rate it pays results in significantly lower costs than what it would pay under the RMOW flat-rate pricing structure to which other hotels as subject.

It had previously been estimated that implementing "Universal Metering" (metering all residential, industrial, commercial and institutional (ICI) customer connections and establishing usage-based billing) would result in a water-use reduction of 10-45%. It is assumed that universal metering and implementation of progressive block water rates for all customers will reduce overall demand by 15%. It has been measured in other jurisdictions that peak demand savings will be 1.5 times the annual average savings, in other words, summer sprinkling drops much more than other uses. This is very important as peak summer use drives Maximum Day Demand and system capacity capital infrastructure requirements.

The cost of universal metering was updated in the prior report. Using the same underlying values and assumptions, the capital cost of metering all unmetered connections, and inspecting and upgrading existing connections for proper function, is estimated at about $11,000,000 assuming a 35 year average system life, with an annual $100,000 cost for reading and maintaining the meters and equipment and processing water bills.

Significant changes have occurred since the previous cost estimates were made, however:

- Staff found in 2015 that historic commercial building plans indicate the presence of water meters not present in RMOW tracking systems such as Tempest and GIS. Fewer new installs of large ICI meters would therefore likely be required than had been previous estimated
- Meter inspection and replacement labour costs were found in a 2014 pilot study to be substantially lower than previously estimated: the average labour cost was less than $50 per meter
- Current generation radio-readable meters permit extremely fast and efficient reading using "drive-by" technology (or permanent network-connected gateway devices) without needing external building antennas as had been previously assumed
- A software interface now exists that will permit the RMOW's Tempest billing system to automatically receive water meter data. Funds are already included in the 2016 financial plan to implement this Tempest-meter interface.
- Current generation meters provide 'real time' metering, and long-term data logging. These capabilities facilitate more effective system leak detection, and enable the meters to perform automated leakage detection on the private side of the meter. While these features don't affect metering costs, they would have an impact of the amount of leakage found and fixed.

Given these changes since the prior valuations were made, and Whistler's specific social and behavioral factors, staff recommend a comprehensive water metering options and cost analysis be undertaken in 2016, including inventorying the RMOW's stock of existing ICI meters with a goal to refine the cost-benefit information

6.2.8 Non-Residential (Industrial-Commercial-Institutional) Water Use Audits

Industrial-Commercial-Institutional ("ICI") water audits can be very effective when aimed at sectors known to have opportunities for large water savings and individual customers with above-average consumption, but these audits are only effect once volume based pricing has been implemented. Hotels and restaurants, which likely represent a large proportion of Whistler's overall water usage, are typically excellent candidates for water savings. The Capital Regional District (Greater Victoria) has conducted several ICI audits annually since 2004, with typical water savings of 35% for hotels and 30-80% for restaurants. These savings are achieved largely through the replacement of once-through cooling systems often used in commercial refrigeration. These once-through devices are covered under a separate conservation program, and these water savings have been removed from the estimate for ICI audits.

It was assumed that 20 facilities would be audited annually at a cost of $2,500 per audit. It is assumed that the program would run for ten years at $50,000 annually, and it is estimated that 25% water savings would be achieved on average for 200 connections. This would include 75% of the hotels and restaurants in Whistler. Assuming these 200 customers represent 25% of Whistler's annual average water use, total water savings of 6% of 2011 demand, or 870 m3/day, is estimated to be achieved by the program.

***ICI Water Use Audits* has as a prerequisite ICI metering, and is not now budgeted in the 2015-2019 financial plan, but that may change given the outcome of the study recommended in the section above.**

6.2.9 Public Education

There is no well-defined convention for estimating water savings from public education or social marketing initiatives in general terms. Typical estimates range from 0-2% of average demand. A public education program with an annual budget of $75,000 has been previously estimated to achieve maximum day water demand savings of 0.10 m3/min (0.5% of maximum day demand) over a 10-year program implementation cycle.

Although public education is typically ineffective in isolation, it is a necessary component of a comprehensive water demand management program, supporting all other program measures.

As a result, an on-going public education program was started in 2013.

***Public Education* is budgeted as an on-going program in the 2015-2019 financial plan. These funds have a supported a substantially increased communication effort in 2015, including outreach, advertising, social media presence, and other measures.**

6.2.10 Low - Volume Toilet Rebate

Toilet replacement will be a primary factor in reducing future water demand as old toilets are replaced, and a well-designed rebate program might significantly accelerate the replacement of old, inefficient fixtures. However, the cost-effectiveness of a rebate program must consider the proportion of program participants who would make the same decision without the benefit of a rebate, and the fact that many old toilets are in Whistler's second homes which are only partially occupied. Standards have also changed and toilets that use more than 6 lpf are no longer available in BC. Many water utilities have recently examined the cost-effectiveness of toilet rebate programs and decided to discontinue the rebates based on market research that shows the incentives are not necessary to motivate most customers to replace toilets.

A total budget of $190,000 over four years would be sufficient to issue approximately 1,000 toilet rebates at $150 each, allowing for modest program administration costs. Assuming a toilet is flushed five times daily and the flush volume is decreased by 10 litres per flush, the total program water savings is estimated at an annual average of 0.7 litres per second.

A *Low Volume Toilet Rebate* program has very low benefit relative to cost, and is not budgeted in the 2015-2019 financial plan.

6.2.11 Efficient Clothes Washer Rebate

As with toilets, the pace of technology change in the mass market for washing machines has radically changed in the past decade. A washing machine program analysis must consider the proportion of program participants who would make the same decision without the benefit of a rebate. As horizontal-axis machines have gained market share and decreased in price, the need for a financial incentive to motivate the purchase of an efficient machine has decreased. When these factors are considered, single-family residential washing machine rebate programs are typically not found to be cost-effective, and several programs have been discontinued in recent years (e.g. Toronto and Greater Victoria).

A typical vertical-axis machine used by a family of four is estimated to use 45 m3/year of water, while high-efficiency washers typically use less than half as much water for the same quantity of laundry. It is assumed that replacing an old vertical axis residential washing machine with new horizontal axis machine will reduce water use by 20 m3/year on average, and that half of the machines for which a $250 rebate is claimed would not otherwise have been replaced within the program lifespan. Assuming 250 rebates per year over a ten-year program lifespan, the total water savings achieved would be 0.5 x 2,500 x 20 / 365 = 68 m3/day, and annual average of 0.04 m3/min

An *Efficient Clothes Water Rebate* program has very low benefit relative to cost, and is not budgeted in the 2015-2019 financial plan.

6.2.12 Efficient Irrigation or Landscaping Program

Our recent outreach to landscaping and irrigation companies in Whistler indicates that efficient irrigation or landscaping policies or incentives may have merit, particularly if combined with revised municipal development and sprinkling standards.

An investigation as to the costs and benefits of an *Efficient Irrigation / Landscaping Program* should be considered for inclusion in the 2016-2020 five year plan.

6.2.13 Rainwater Capture Rebate

Although the idea of using rain barrels to reduce water consumption has remained popular, harvesting rainwater for irrigation using small storage systems has been shown to be ineffective due to both the relative lack of rainfall to refill storage when the plants require irrigation, and due to neglect or disuse of such systems in the years after initial installation. For irrigation uses, rain barrels and similar-sized cisterns will, at best, only offset municipal water usage equivalent to a few times their volume annually, and will have no impact on peak demand as they will generally be empty when demand peaks in mid-summer.

A rainwater capture rebate program is no longer under consideration.

6.2.14 Efficient Irrigation Rebate

Past experience in the southern USA indicates that incentives for replacing or upgrading irrigation system components does not lead to durable water savings, as water efficiency is highly dependent on proper operation and ongoing maintenance. No water savings are expected from such a program.

In irrigation rebate program is no longer under consideration.

6.2.15 Data Quality Improvements

Understanding of water consumption and supply outcomes hinges on accuracy of water consumption and supply data. Benefit-cost analysis is highly dependent on water data, asset inventories and valuation, and accurate program plan and financial information. A number of the water quantity related-values used in developing this report can be substantially improved through various measures including expanded or improved instrumentation, improved SCADA reporting, inventorying installed meters, improved or increased field data gathering, and emphasis on converting paper forms to electronic data.

Many of these data quality improvements will flow directly out of projects and programs identified in this report, or other programs and projects in process or identified in the current five year plan, such as the Utilities SCADA upgrade project planned for completion December 1, 2015.

6.3 Potential Water Supply Projects Benefit Analysis

The costs and water produced by the identified potential projects have been estimated and shown in order of least costly to more costly on a per unit of water supplied basis in Table 2, the same units as used for the potential water conservation programs.

Table 3 below indicates supply projects listed in order of greatest benefit to least benefit, as determined by comparing the cost of the measure with the increase flow that would likely result.

An explanation of each table column is:

"**Priority**":

Priority identifier. Programs starting with "S" are supply projects. The Projects have been ranked from S1 to S6, with S1 being the highest priority.

"**Project Name**":

Descriptive name of the program. These names may not precisely match program names included in the 2015-2019 five year plan.

"**Capital Cost Estimate**":

An estimate of the total capital costs associated with a program over the program life.

"**Total Annual Cost/Savings Estimate**":

Average annual cost during the first ten years of the project. The annual costs include first-year one-time costs, ongoing annual O&M costs, and amortized capital depreciation.

"**Estimated Max Flow Benefit** (m3/min)":

An estimate of the *peak day* flow reduction provided by the project.

"**Max Flow Weighed Benefit** ($/m3/min)":

The Total Annual Cost/Savings Estimate divided by Estimated Max Flow Benefit. This provides a measure of cost or saving per unit of flow, and helps with comparing the cost-effectiveness of the various projects.

Table 3 Potential Water Supply Project Cost-Benefit Analysis

Priority	***Program Name***	***Capital Cost Estimate***	***Total Annual Cost/Savings Estimate***	***Estimated Max Flow Benefit (m3/min)***	***Max Flow-Weighted Benefit ($/m3/min)***
S1	*Spring Creek Booster Station*	*$480,000*	*$35,000*	*2.6*	*$1,000*
S2	*New Function Well*	*$320,000*	*$11,000*	*2.7*	*$1,000*
S3	*Third 21-Mile Aquifer Well (Rainbow Park)*	*$560,000*	*$14,000*	*1.2*	*$1,000*
S4	*Aquifer Storage and Retrieval (ASR) Pilot System*	*$700,000*	*$70,000*	*0.8*	*$5,000*
S5	*Whistler Cay Aquifer Well w/ Treatment*	*$10M - $20M*		*5.1 – 6.0+*	*Poor*
S6	*Surface Water Treatment*	*$15M - $30M*		*4.5 - 12*	*Poor*

6.4 Detailed Description of Potential Water Supply Projects

Where the potential supply projects have been previously determined to have highest flow-weighted benefit they have been included in the current or prior Water Utility five year plans. Descriptions of all potential future projects follow.

6.4.1 Spring Creek Booster Station

Installing a booster pump station at the location of the Spring Creek PRV station would allow excess water that can be supplied by the Athletes Village Well W217 to be pumped to the Baxter reservoir and supply water to the Village water zone. The well pump at Well 212-1 would also be replaced with a lower pressure pump as that pump would only need to supply water to the Spring Creek and Function Junction pressure zones.

The *Spring Creek Booster Station* project is included in the 2015-2019 Financial Plan.

6.4.2 New Function Junction Well

A second well near Well 217 would increase the amount of water that could be pumped from the Function Junction aquifer. This water is not required for Cheakamus Crossing, or Function Junction, but would be beneficial when pumped to the Village water zone via the Spring Creek Booster Station.

Constructing a *New Function Junction Well* is not currently required to close the supply gap, and is not currently under consideration.

6.4.3 Third Twenty-One Mile Creek Aquifer Well

The potential for a third well in the Twenty-One Mile Creek Aquifer has been identified, but this well would be lower in capacity and further from existing infrastructure than the other wells in this area, and would be subject to significant regulatory and project risks.

Constructing a *Third Twenty-One Mile Creek Well* is not currently required to close the supply gap, and is not currently under consideration.

6.4.4 Aquifer Storage and Retrieval System

The aquifer which supplies the Community Wells in Whistler Village has a very low recharge rate. As a result, the Community Wells can't sustain prolonged high rates of withdrawal.   It is feasible to pump water into the community aquifer during times of excess supply, which can occur even in dry, high demand periods. This would substantially enhance maximum day flow capacity.

An *Aquifer Storage and Retrieval System* has a relatively high cost for the flow benefit, and is currently not under consideration.

6.4.5 Whistler Cay Aquifer Well with Treatment

There is the potential for a well in Whistler Cay, which would require treatment (filtration) due to high iron and manganese in this aquifer. If the well were unable to provide a minimum sustainable flow of 5.1 m3/min it is likely surface water treatment would be a better option

***Whistler Cay Aquifer Well with Treatment* has significant project risk and high cost: it is not currently under consideration.**

6.4.6 Surface Water Intake with Treatment

There is the potential of treating (chemical dosing and filtering) water from Green Lake, the Cheakamus River, or 21 Mile Creek to provide additional supply. Such measures are of significant cost and would only be considered if other conservation and supply programs proved insufficient.

***Surface Water Treatment* has a very high cost and is not currently under consideration.**

6.4.7 Upgrade Community Wells

Historically, the Community Well aquifer had been estimated as supporting a maximum supply of 103 litres per second, while the current four wells in this aquifer are only configured to produce a maximum of 4.2 m3/min. The conclusion reached was that upgrades to the wells would provide additional supply at a low cost. Testing and hydrogeological review in 2014 demonstrated the aquifer can supply 4.2 m3/min for short periods, but can ordinarily provide no more than 3.0 m3/min.

***Upgrading the Community Wells* is no longer considered a viable option.**

6.5 Combined Benefit Analysis

Staff recommend that an integrated approach of both water conservation and infrastructure improvements be undertaken to reduce the risk of having a water supply interruption in the Whistler Village water supply zone.

Tables 2 and 3 have been combined into Table 4 (below), to allow the most cost-effective approaches to reducing the water supply risk to be easily identified.

An explanation of each table column is:

“**Priority**”:

Priority identifier. Programs starting with “C” are conservation programs, those starting with “S” are supply projects. The Programs have been listed in priority order from 1 to 18.

“**Program Name**”:

Descriptive name of the program or project. These names may not precisely match project and program names included in the 2015-2019 five year plan.

“**Capital Cost Estimate**”:

An estimate of the total capital costs associated with a program over the program life.

“**Total Annual Cost/Savings Estimate**”:

Average annual cost minus annual conservation savings (if any) for the first ten years of the program. The annual costs include first-year one-time costs, ongoing annual O&M costs, and amortized capital depreciation.

“**Estimated Max Flow Benefit** (m3/min)”:

An estimate of the *peak day* flow reduction provided by the program. Peak day flow reductions result in reduced future infrastructure expences, and are therefore important in determining which programs to implement.

“**Max Flow Weighed Benefit** ($/m3/min)”:

The Total Annual Cost/Savings Estimate divided by Estimated Max Flow Benefit. This provides a measure of cost or saving per unit of flow, and helps with comparing the cost-effectiveness of the various programs.

Table 4 Integrated Table of Conservation and Infrastructure Improvements

Priority	Program Name	Capital Cost Estimate	Total Annual Cost/Savings Estimate	Estimated Max Flow Benefit (m3/min)	Max Flow-Weighted Benefit ($/m3/min)
C1	Once-Through Water Use By-law		($27,000)	0.28	($6,000)
C2	Update Comprehensive Water Usage bylaw		($5,000)	0.06	($6,000)
C3	Water Use bylaw - Outreach		$17,000	2.5	$1,000
C4	Water Leakage Reduction Program	$380,000	$12,000	1.4	$1,000
C5	Public Education		$11,000	0.09	$8,000
S6	Spring Creek Booster Station	$480,000	$35,000	2.6	$1,000
S7	New Function Well	$320,000	$11,000	2.7	$1,000
S8	Third 21-Mile Aquifer Well (Rainbow Park)	$560,000	$14,000	1.2	$1,000
C9	Irrigation source program	$320,000	$9,000	0.23	$3,000
C10	Home water audits and retrofits		$10,000	0.20	$3,000
S11	Aquifer Storage and Retrieval (ASR) Pilot System	$700,000	$70,000	0.84	$5,000
C12	Universal Metering & Volume-Based Pricing	$10,710,000	$407,000	2.1	$12,000
C13	ICI audits		($16,000)	0.61	($2,000)
C14	Low-volume Toilet Rebate		$14,000	0.04	$21,000
C15	Clothes washer rebate		$33,000	0.05	$41,000
C16	Efficient Landscaping Program				TBD
S17	Whistler Cay Aquifer Well w/ Treatment	$10M - $20M		85 - 100+	Poor
S18	Surface Water Treatment	$15M - $30M		75 - 2200	Poor

Table 4 has been organized highest to lowest priority. For full descriptions of the Projects and Programs in Table 4 see Sections 5 and 6.

A review of Table 4 indicates that almost all projects and programs have a net cost, and supply projects' *Max Flow-Weighted Benefits* are generally competitive with conservation programs'.

C5 ("Public Education") has been prioritized higher than its *Max Flow-Weighted Benefit* would suggest, for two reasons: The absolute cost of this program is very low, and all Conservation programs require a public education component in order to be accepted by the community.

C13 ("ICI Audits") has been prioritized lower than its *Max Flow-Weighted Benefit* would suggest because this program is dependent on ICI metering being implemented first.

RECOMMENDATIONS

Delivering 5.4 m3/min equivalent of supply and conservation is the long term goal, as noted previously. Recommended timing and prioritization will be presented to Council for consideration in the next five year plan.

The identified long-term supply gap to be addressed by the supply and conservation programs is 5.4 m3/min. In order to address this gap, programs totaling 5.4 m3/min minimum must be implemented. Table 5 below shows the programs which will be required to fulfill this requirement. These programs comprise the programs recommended by staff to Council for ongoing inclusion in the RMOW's five-year financial plan.

Table 5 Recommended Supply and Conservation Programs

Priority	Program Name	Capital Cost Estimate	Total Annual Cost/Savings Estimate	Estimated Max Flow Benefit (m3/min)	Max Flow-Weighted Benefit ($/m3/min)
C1	Once-Through Water Use By-law		($27,000)	0.28	($6,000)
C2	Update Comprehensive Water Usage bylaw		($5,000)	0.06	($6,000)
C3	Water Use bylaw - Outreach		$17,000	2.5	$1,000
C4	Water Leakage Reduction Program	$380,000	$12,000	1.4	$1,000
C5	Public Education		$11,000	0.09	$8,000
S1	Spring Creek Booster Station	$480,000	$35,000	2.6	$1,000
RECOMMENDED PROGRAM TOTAL		**$860,000**	**$43,000**	**6.9**	**$374**

The recommended programs are each already identified in the 2015-2019 financial plan, with only minor adjustments required for the 2016-2020 plan.

The first five programs shown in Table 5 provide significant, economical supply reduction through conservation. Over the *long term* C1 – C5 are expected to reduce average water consumption by approximately 4.3 m3/min. These programs will make a significant contribution towards Whistler's goal of reducing water consumption to 425 litres per person per day.

In order to provide the necessary 5.4 m3/min required to meet maximum future demand, however, more than these conservation programs will be required. The next best choice is a booster station at Spring Creek, to bring surplus Cheakamus Crossing water north. This project is straightforward, has a flow-weighted cost equivalent to conservation programs, and provides many other operational benefits.

Staff recommend continuing with the six programs and projects identified in Table 5, which will close supply gap with a small margin of safety, by providing an overall flow benefit of 6.9 m3/min.

Staff recommend a Comprehensive Volumetric Metering Options Review be commissioned and presented to Council in 2016.

Staff recommend including in the 2016-2020 five year plan an investigation as to the costs and benefits of an *Efficient Irrigation / Landscaping Program*.