Smart Growth on the Ground

FOUNDATION RESEARCH BULLETIN: Greater Oliver

Research compiled by:

Design Centre for Sustainability at UBC and Oliver Brandes

No. 3
April, 2006

WATER CONSERVATION

1.0 Introduction

The town and region of Oliver was founded with the establishment of its water supply. The "Ditch", which continues to supply irrigation and domestic water to Oliver's rural residents, was a progressive and successful piece of water-supply infrastructure that has been the backbone of the region's success. Today, Greater Oliver also has a relatively clean and reliable municipal water-supply, which uses a system of six wells and a reservoir. In this arid-climate, and in the context of climate change and increasing pressure on available water, Oliver may once again need to look for a new and progressive solution to its water supply needs.

Several factors are looming on Oliver's horizon that will stress its water resources. Population growth, a dynamic agricultural economy, and the uncertain effects of climate change are likely to cause an increase in water demand and a decrease in available water supply. Climate change impact studies, for example, suggest that earlier snow-melt runoffs, lower precipitation with warmer, wetter winters and longer, hotter and drier summers will become the norm for the Okanagan Basin[1]. Other projections suggest that population growth alone could cause water demand to meet all potential supply by the year 2031, with no safety factor for drought years[2].

Even without this possible water supply shortage, a higher population that uses water at the current per capita rate would require an expanded supply infrastructure. Oliver's municipal water system tends to operate at or near capacity[3] (Water Capital Plan,), and its rural supply upgrade plans will cost over $10,000 per home[4]. Extending supply mains and developing new wells and reservoirs can be expensive when compared to other water management strategies.

Reducing water demand is often a cheaper alternative to almost any supply option; it can also be implemented more quickly and with less environmental damage. Options that improve water efficiency abound—drip irrigation and rainwater harvesting; water reuse and recycling; low-flow faucets, toilets and appliances. A comprehensive water management strategy would encourage such measures and a water conservation ethic by providing consumers with the necessary education, resources, and incentives.

This demand-based water management approach allows the Town of Oliver to:

- Plan for the uncertainty of climate change;
- Defer infrastructure capital costs for both supply and wastewater systems;
- Make more water available for other beneficial uses such as agriculture;

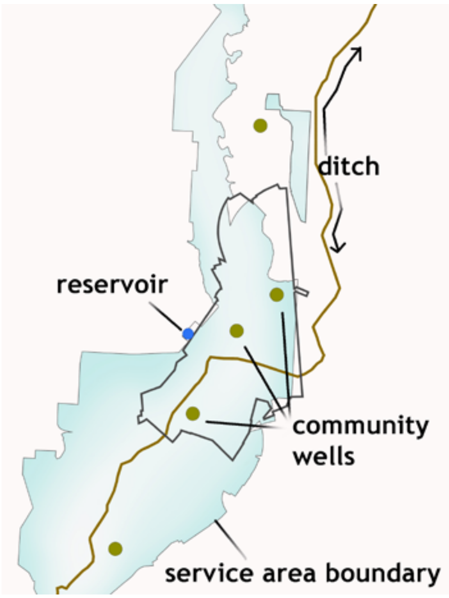

Figure 1: Community wells and a balancing reservoir provide water to most of the town.

<u>estimated population</u>
2005: 4,380
2041: 8,000-12,000

<u>consumption from current trend</u>
water capital plan maximum daily supply: 22,630 m^3
2041 maximum daily supply: 28,200 to 47,600 m^3

<u>conversions</u>
1 m^3 = 1,000 Litres = 3,785 gallons

- Reduce emissions, chemical use, and energy costs needed for pumping and treatment;
- Enable households to lower their utility bills;
- Promote and demonstrate a water ethic and a community commitment to sustainability;
- Protect the natural functioning of local aquatic and riparian habitats.

2.0 Supply and Demand in Oliver

Oliver residents currently use water at a higher rate per capita than the average Canadian and the average British Columbian, including their arid-climate neighbours in Penticton and Kelowna.

Table 1: Annual water use averages per capita

	total (m^3/c/y)	indoor (m^3/c/y)	outdoor (m^3/c/y)
Oliver[5] (2003-2005)	**470**	[9]	[9]
similar Canadian towns[6]	400 to 466	-	-
Penticton[7] (2001)	244	146	98
B.C.[8] (2001)	155	-	-
Kelowna[7] (2001)	149	85	62
Canada[8] (2001)	122	-	-

The current water system plan for the Town of Oliver is designed for a population equivalent of 5700 using a per capita maximum-day water demand of 3.97 m^3,[10] or a daily water supply capacity of 22,630 m^3. At the current water use rates, and with a conservative population growth rate for the Town of Oliver only, this system will reach capacity by the year 2019. At higher growth rates this year could be much sooner. With either situation, the balance of water supply and demand will require significant adjustments by the year 2041, which could see a town population that has doubled or even tripled. The maximum-day water demand that year, without considering the impacts of climate change, could be from 28,200 to 47,600 cubic metres[11], or 25-100% greater than the current system design.

There is also a carrying capacity inherent in any natural system. While the potential supply of water is difficult to estimate, it is certainly finite, and this limit needs to be balanced between human interests and ecological necessity. As more water is withdrawn from the ground, for example, less water becomes available to recharge the wells, irrigation ditches, and the sensitive ecosystems of creeks, rivers, and wetlands.

3.0 Demand-Side Solutions

There are several structural approaches to water use reduction, including efficient or waterless plumbing fixtures, greywater recycling, efficient landscaping, and rainwater harvesting.

3.1 Efficient Plumbing Fixtures

Demand reduction can be built into any house or building by installing efficient fixtures and appliances, waterless fixtures, and water recycling systems. A study in Seattle found that indoor water usage could be reduced to 151 litres per capita per day, or 55 m^3 per year, by replacing

Figure 2: Composting toilets fit in to a typical bathroom, though they do require special installation.

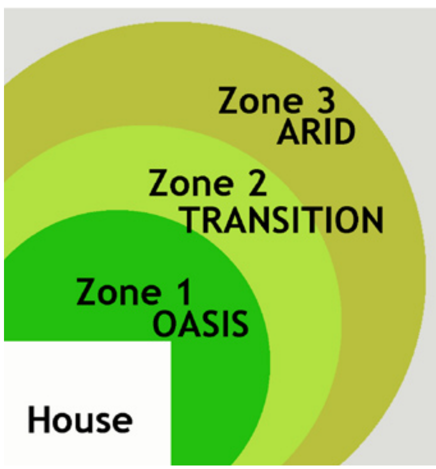

Figure 3: Xeriscaping recommends that plantings follow water-use zones, so that water-intensive areas are closer to the house.

all water-using fixtures with highly efficient ones. Assuming that half of Oliver's domestic water demand is for indoor use (235 $m^3/c/y$), this represents a potential 75% reduction in demand.

Table 2: Measured Indoor Use from Fixture Replacements in Seattle (adapted from Keen[12])

	Mean Water Usage (L/c/d)	
Category	**Pre-Retrofit**	**Post-Retrofit**
Toilets	71	30
Leaks*	25	8.3
Clothes Washers	56	35
Faucets	35	30
Showerheads	34	33
Other/unknown	20	15
Total Indoor	**241**	**151**

* Mostly attributable to toilets.

3.2 Waterless Plumbing Fixtures

Toilets can consume over 25% of daily household water use. Today there are several brands of waterless toilets which either incinerate or compost waste, creating ash or humus that is pathogen and odor free. This waste can be used to amend landscaping soils. While no municipality has adopted the widespread use of such devices, there are hundreds of successful examples in houses and commercial buildings across North America. While the technology is proven even in urban places, this approach is usually more feasible and acceptable in rural or remote areas.

3.3 Efficient Landscaping and Irrigation

Lawn and landscape irrigation can represent 50 to 70% of all domestic water use. Xeriscaping is a landscaping strategy which selects plant species and design strategies which minimize outdoor watering and maintenance in arid climates. This strategy generally would minimize lawn areas, select native and drought tolerant plant species, and specify deep, organic soils which absorb water and keep it from draining or evaporating too quickly.

Where irrigation is required, proper scheduling can minimize water use by applying only as much water as is necessary. Arid climate lawns require 2.5 to 4cm of water per week in the summer, and the same amount per two weeks in the spring and fall. Warm season grasses should require no watering in the winter.

Assuming that one-half of Oliver's domestic water use (235m^3 annual per capita, or 2m^3 per capita maximum day demand) is for landscape and lawn irrigation, Oliver could reduce average per capita water use by 25% through watering restrictions and xeriscaping[13]. Oliver could also reduce maximum day demand by regulating watering schedules; for example, using odd and even house addresses for odd and even watering days.

3.4 Rainwater Harvesting

Rainwater can be used for many household activities, though it is often limited to outdoor watering. Many Canadian municipalities distribute rain barrels for this purpose, which collect and store water from roof downspouts. In Oliver, where monthly rainfall averages 20-30mm per month, this strategy

Figure 4: This cistern collects rainwater from the roof for non-potable domestic uses.

Figure 5: The White Rock Green Operations building saves 2 million litres of water per year by harvesting rainwater into a 500,000 litre storage pond. The water is used for irrigation, toilet flushing, vehicle washing, and street washing.

could collect enough water from a typical house roof to irrigate about 25 to 40 m^2 of lawn or garden area[14]. This same volume of 3.8 m^3 would be more than enough to flush an efficient toilet for a month for an average-size household[15], which could reduce per-capita indoor demand to 121 litres per day.

4.0 Demand Management Strategies

A demand management strategy would engage the options listed above through regulation, education and promotion, and best practice subsidies.

Education and metering alone can have the net effect of reducing indoor and outdoor water use by 30% each (see table 3). Other strategies combined could reduce indoor demand by 59% and outdoor demand by 66%, bringing Oliver's per capita maximum-day water demand volume from 3.97 m^3 down to 2.56 m^3. This would suggest that the current capital plan for Oliver's water system would serve an equivalent population of 8,840, which is within the lower end of the projected population range for 2041.

Table 3: Water use reductions (adapted from Neale p46)

Method	Indoor savings	Outdoor savings
Education	10%	10%
Metering	20%	20%
Xeriscaping	-	50%
Efficient fixtures	40%	-
Total	59%	66%

4.1 Water Demand Scenario

How could Oliver accommodate a growing population without increasing its total water consumption or water supply infrastructure? Could Oliver actually reduce its annual or maximum-day water demand? In 2041, Oliver could potentially host a population of 12,000 people. In the ideal scenario, the water supply infrastructure would require no expansion because of an innovative demand management strategy.

In 2005, total residential water use for the year was approximately 2.2 million cubic metres[16]. Given complete application of available technologies, it is possible that 12,000 people could consume only 660 thousand cubic metres of water for indoor use per year.[17] If each person had access to an outdoor yard area of 100m^2 each (or 200-400m^2 per household), all the lawns in town could be irrigated with 1.08 million cubic metres of water[18]. At 1.74 million cubic metres total, Oliver would be well below the current domestic use even with almost triple the population.

This scenario suggests that Oliver would require efficient plumbing for all new housing, subsidize retrofits for existing houses, regulate and monitor landscaping and irrigation standards, and provide ongoing education and support for its residents. Further steps, such as rainwater harvesting or waterless toilets, could reduce demand to 1.61 million cubic metres.

Metering in Oliver

Oliver recently introduced a sliding scale water rate based on housing types - the lowest cost rate is for apartments and condos. Large lot owners with big lawns also pay a rate per irrigated acre that is double the agricultural rate. Water users can choose to install their own meter and pay a per volume rate, and new houses are required to install meters.

Oliver Scenario Summary

population
2005: 4,700
2041: 12,000

total annual water consumption
2005: 2,200,000 m^3
2041: 1,740,000 m^3

per capita annual water consumption
2005: 428 m^3/c/y
2041: 145 m^3/c/y

per capita assumptions
potential indoor demand: 55 m^3/c/y
potential outdoor demand: 90 m^3/c/y
100 m^2 of irrigated outdoor space
(900mm irrigation depth annual per m^2)

5.0 Water conservation in action

Many water utilities in the Okanagan Basin employ demand management techniques in the residential sector. In a 2002 survey, Shepherd found that while most municipal utilities are using some demand management measures, only a few have established programs employing a suite of initiatives.[19] Larger municipalities such as Kelowna and Vernon employ a variety of demand management techniques, most commonly education programs, metering, watering restrictions and rebates for fixtures and toilets. The Southeast Kelowna Irrigation District (SEKID) universal agricultural metering pilot project, which reduced annual allocated water allotments by 27%, is another major local success story.[20]

Success stories from within the Okanagan Basin abound. These innovative local solutions are proof that change is possible—and already occurring. The following table provides a list of many of the more successful initiatives in the region.[21]

Table 4. Okanagan Basin demand management initiatives (adapted from deVries[22])

Black Mountain Irrigation District:
Watershed protection, collaboration with other utilities, public education

City of Kelowna:
Residential and ICI metering, watering restrictions, demand management planning, water audits, benchmarking, voluntary in-home, low-flow fixture programs, leak detection, sector demand study, Green design/SmartGrowth, water supply upgrades, computer upgrades, watershed protection, residential technologies, programs, pilot programs, pricing review, water conservation applied to operations and maintenance, collaboration with other utilities, public education, education for elected officials.

Greater Vernon Water:
Residential and ICI metering, demand management planning, water reuse, water supply upgrades, computer upgrades, voluntary in-home low-flow fixture program, public education

Lakeview Irrigation District:
Watering restrictions, sector demand study, computer upgrades, watershed protection, water conservation applied to operations and maintenance, public education

Rutland Waterworks District:
Metering, pricing review, watering restrictions, water supply upgrades, computer upgrades, collaboration with other utilities, drought management planning, demand management planning, water conservation applied to operations and maintenance, public education, education for elected officials

South East Kelowna Irrigation District:
Agricultural metering, collaboration with other utilities, sector demand study, water supply upgrades, computer upgrades, watershed protection, pilot programs, pricing review, drought management planning, demand management planning, water conservation applied to operations and maintenance, public education

Westbank Irrigation District:
Watering restrictions, water supply upgrades, computer upgrades, pilot programs, xeriscaping, public education, drought management planning.

6.0 The Last Oasis

The water conservation measures presented above stand out as promising opportunities to reduce water use and promote sustainability in the Okanagan Basin. As prices reflect a "truer" cost of water, and public education programs increase acceptability, recycling and reuse options become more economically feasible and socially acceptable. This encourages innovation and technological advances, which in turn reduce costs, potentially leading to further opportunities for cost-effective alternatives. Furthermore, these options are equally relevant across sectors—agricultural, industrial and municipal water.

Collectively, water conservation, efficiency, education, pricing, recycling and reuse represent significant opportunities to manage water demand and reduce water use. Sandra Postel believes this "last oasis" is "large enough to get us through many of the shortages on the horizon, buying time to develop a new relationship with water systems and to bring consumption and population growth down to sustainable levels."[23]

Agricultural Water Use

Agricultural generally demands as much as 70% of total water use in the Okanagan Valley. The BC Ministry of Agriculture recommends that agricultural water users can conserve by:

- using equipment that is more efficient
- ensuring that equipment is operating properly
- managing the application of water on the farm more effectively

The South East Kelowna Irrigation District was able to promote a 10% reduction in water use through metering, education, and providing soil water meters to all farms.

additional information at:
www.agf.gov.bc.ca/resmgmt/publist/Water.htm

Additional resources

Household water conservation
www.h2ouse.org/resources/links/index.cfm

Okanagan xeriscaping resource
www.summerlandornamentalgardens.org/xeriscape/

BC water management best practices, examples, and networking
www.waterbucket.ca

POLIS water-related materials and information
www.waterdsm.org

References

[1]Cohen, S., D. Neilsen, and R. Welbourn (eds.). Expanding the Dialogue on Climate Change & Water Management in the Okanagan Basin, British Columbia. 2004. From website: http://www.ires.ubc.ca
[2] Hartley,L.G. "Impact of Population Growth on Okanagan Water Resources." In Proceedings of Water - Our Limiting Resource – Towards Sustainable Water Management in the Okanaga (Feb 23-25, 2005 CWRA - BC Branch). Kelowna, BC .
[3] Water Capital Plan Update, p2.5. Town of Oliver. Prepared by TR Underwood Engineering, July 1999.
[4] the Town of Oliver's website indicates that the $7million dollar upgrade will serve 600 houses. Town of Oliver website. Public Works, Water and Water Quality: www.oliver.ca
[5] 3-year average from 2003-2005, derived from estimates by TRUE Engineering
[6] based on population, from Environment Canada - 2004 Municipal Water Use Report
[7] Neale, p58. Impacts of Climate Change and Population Growth on Residential Water Demand in the Okanagan Basin, British Columbia. UBC Masters Thesis, 2005. available at website: www.sgog.bc.ca/uplo/TNeale_Thesis_finalsubmission.pdf
[8] Environment Canada - 2004 Municipal Water Use Report.
[9] outdoor use in Oliver is estimated to be slightly higher than indoor use (Neale, p58)
[10] Water Capital Plan Update, p11.4
[11] (projected population between 8,000-12,000) x (per capita maximum-day water demand 3.97 m^3)
[12] Keen Engineering, pB.12. Water and Waste Management Plan. Report for the City of Vancouver, 2002. available at website: vancouver.ca/commsvcs/southeast/background.htm
[13] Xeriscaping can reduce outdoor water demand by 50%, from Neale, p46
[14] (190 m^2 roof area) x (20mm rainfall per month) compared to 5mm per day irrigation demand Environment Canada, 2004 Municipal Water Use Report. website: http://www.ec.gc.ca/WATER/en/info/pubs/sss/e_mun2001.htm#1
[15] same volume (3.8 m^3) compared to a 3-person household using 30 L/c/d for toilet flushing
[16] estimated from actual water use by TRUE Engineering
[17] 12,000 people x 151 l/c/d x 365 days = 660,000 m^3 per year
[18] 12,000 x 100m^2 x 900mm (typical irrigation depth for arid-climate turf per year) = 1.08 million
[19] Shepherd, P. The Nature of Human Adaptation: Exploring Local Water Resource Management in the Okanagan Region. Unpublished Masters thesis. University of British Columbia, Vancouver. 2005.
[20] Pike, T. "Agricultural Water Conservation Program Review" In Proceedings of Water - Our Limiting Resource – Towards Sustainable Water Management in the Okanaga (Feb 23-25, 2005 CWRA - BC Branch). Kelowna, BC. 2005.
[21] For a detailed discussion of these success stories see the 2004 BC Water Conservation Survey at www.waterbucket.ca
[22] de Vries. BC Water Conservation Survey. Ministry of Water Land and Air Protection. Victoria, BC. 2004.(With the individual examples available at www.waterbucket.ca)
[23] Postel, S. p.191. Last Oasis: Facing water scarcity. WW Norton and Company. New York. 1997.

Credits

Figure 2: www.longbrancheec.org

Contact Us

Design Centre for Sustainability
University of British Columbia, 394-2357 Main Mall, V6T 1Z4
t. 604-822-5148, f. 604-822-2184
For more information visit the following websites:
www.designcentreforsustainability.org, ww.sgog.bc.ca