Chapter Three: **MAKING A BUSINESS CASE FOR INTEGRATED WATER CYCLE MANAGEMENT AND RAINWATER HARVESTING IN THE CITY OF CALGARY**

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Chapter Three: **MAKING A BUSINESS CASE FOR INTEGRATED WATER CYCLE MANAGEMENT AND RWH IN CALGARY**

3.1.1 Introduction

The Bow River contributes about 43% or 9.5 billion cubic meters of water annually to Alberta and Saskatchewan, and is part of the South Saskatchewan River Basin. As stated previously it receives much of its resource in summer from glacial melt, peaking in June and reaching the lowest flow rate in January. (Bow River Basin Council (web), 2010)

This paper has brought up the numerous challenges faced by Alberta in general and Calgary specifically, concerning water quality and quantity based on anticipated population growth and environmental projections. This chapter considers the 'why' of the project. Why should the City of Calgary respond to these problems? Is there a business case for taking this approach? What are the existing policies at the City of Calgary and do they align with the proposed research and implementation of such a concept as residential and commercial rainwater harvesting (RWH) being part of a whole integrated water cycle management approach?

Current urban water management practices are focused around a centralized system where infrastructure provides treated, potable water and collects wastewater and storm water for cleaning and disposal into the river system. The City of Calgary Utilities manages about $38 billion dollars of assets between the water, wastewater and drainage systems. "*60 per cent of the*

City's asset value" (City of Calgary Utilities & Environmental Protection, 2014). See Figure 1 Proposed Calgary Metro Plan with water infrastructure noted (CH2MHILL, 2009)

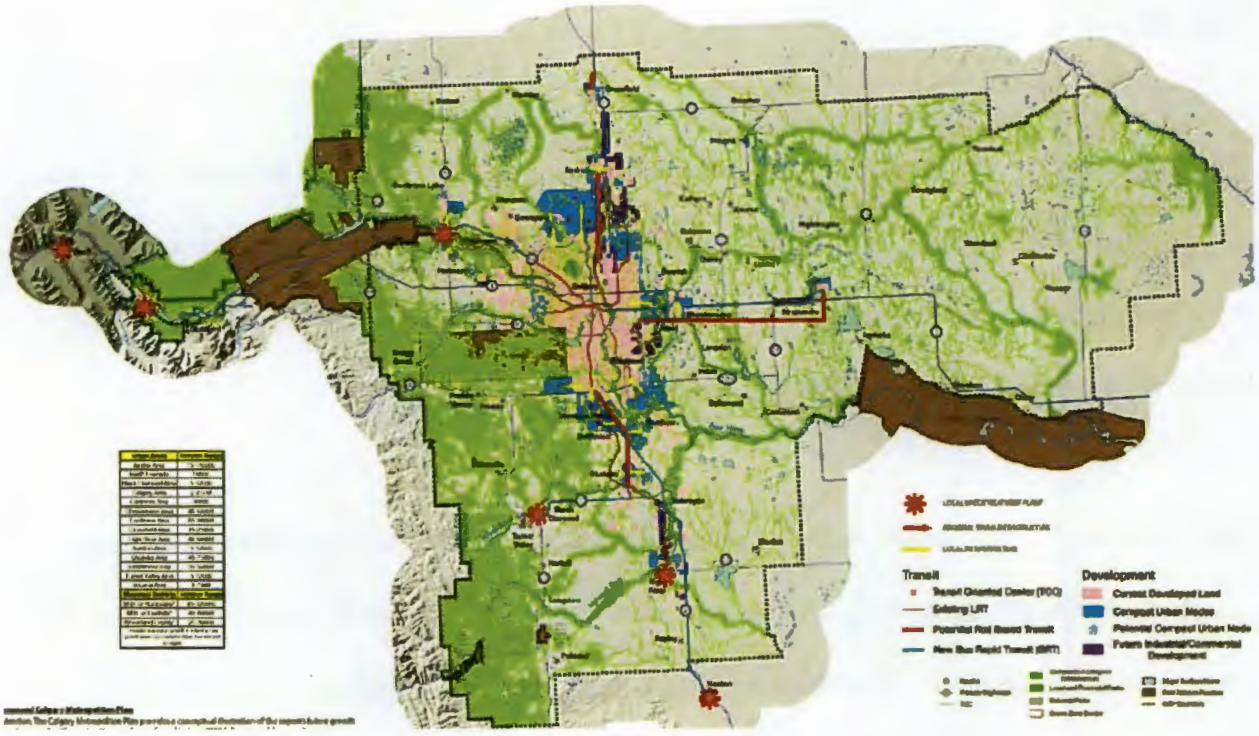


Figure 1 Proposed Calgary Metro Plan with water infrastructure noted (CH2MHILL, 2009)

According to the CH2M Hill study titled ***Summary Report Planning and Technical Study on Water & Wastewater Servicing in the Calgary Region-Phase 2*** "*there are currently times when the flows in the Bow River are less that the Water Conservation Objective (WCO), which is set currently at 45% of the natural flow or 10% of the current-in-stream objectives, whichever is greater*". This study was done in 2009 and they recommended that "*a need for a study to compare the availability of water during various water years of demand*" …"*including the Bow, Elbow Sheep and Highwood Rivers*" was in order. (CH2MHILL, 2009)

The ***Calgary Metropolitan Plan*** written in 2014, under the sub-title ***infrastructure system design***, 3.b.7 states "*CRP*[1] *and member municipalities will endeavour to design, construct and operate regional systems using the most current environmental and sustainable practices*" (CRP, 2014). The plan speaks of 'regional infrastructure and regional water, wastewater and storm systems.' Based on global experience noted in the UK, Germany, Australia and other counties who are leaders in this area, they are going away from a centralized water delivery model and moving to a decentralised water, stormwater and wastewater model that reduces greenhouse gasses generated from long distance pumping of water to and from the River, and reducing stormwater impact by using low impact development (LID) and water collection and consumption at source.

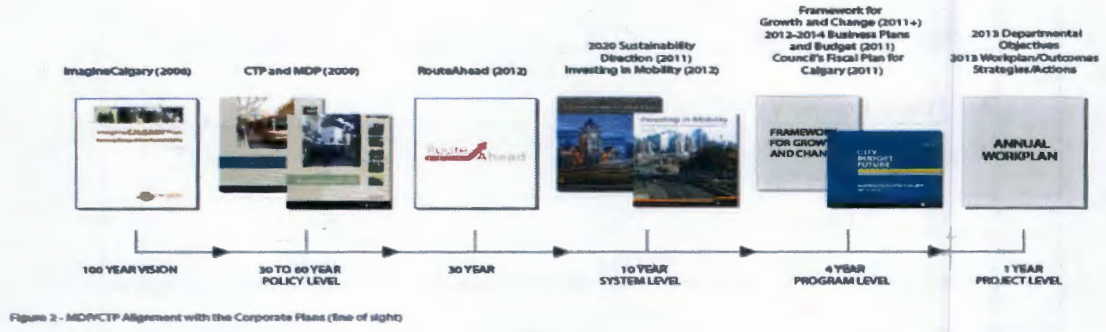


Figure 2 Corporate Plans driven by Council for the City of Calgary (City of Calgary Action Plan (web), 2014)

Collaboration between neighbouring communities makes sense, however as CH2M Hill noted in their 2009 report ***Planning and Technical Study on Water & Wastewater Servicing in the Calgary Region-Phase 2*** *"the Regional Water Infrastructure System is intended to support the provisions of the regional water infrastructure and services to existing and new Compact Urban*

[1] CRP Calgary Regional Plan

Nodes, corridors and rural employment areas (commercial and industrial areas)"...."*the proposed WID*" (western irrigation district) regional water storage project found that when a "*potable water treatment plant is located a significant distance* (from) *the City of Calgary and the main Compact Urban Nodes proposed for development in the CMP*[2] *...supply water to these Compact Urban Nodes,...* (to) *augment the Calgary-based CRP*[3] *regional system, treated water would need to be pumped back uphill*". See Table 1 Comparison of infrastructure requirements & lifecycle costs to supply potable water via compact urban nodes through the WID system and CRP System

Infrastructure	**WID System**	**CPR System**
Pumping horsepower	6391 hp[4]	199 hp
Pumping length	60 km	6 km
New WTP Capacity	102 ML/d[5]	supplied by City of Calgary
Life Cycle Costs (NPV)[6]		
City of Calgary Outside User Fees	NA	$37M
Treatment	$127M[7]	NA
Pipelines	$341M	2P1M
Total	$468M	$58M

Table 1 Comparison of infrastructure requirements & lifecycle costs to supply potable water via compact urban nodes through the WID system and CRP System (CH2MHILL, 2009)

Taking this decentralization further with a new more decentralized integrated water cycle management mean more savings in these areas and a more reliable water supply. By decentralizing to the community level many additional benefits can be obtained.

[2] CMP Calgary Municipal Plan
[3] CRP: Calgary Regional Plan
[4] Hp horsepower
[5] ML/d Million litres per day
[6] NPV Net Present Value
[7] M Millions of dollars

3.1.2 Importance of the project

3.2 The City of Calgary Perspective on the water supply

Consumption

"Calgary is situated in one of the driest regions in Canada, with potential evapotranspiration rates exceeding precipitation" (CitySpace Consulting Ltd., 2007)

The average Calgarian uses about 7,000 liters of water per month for indoor and outdoor use (City of Calgary UEP Water (web), 2014). In 2013 typical residential water consumption was 231 liters per day (City of Calgary UEP Water Pages (web), 2013). See Figure 3 Litres of water consumed by Calgarians per day, . It is important to remember that water consumption can increase by as much as fifty percent in a dry summer, largely due to watering lawns and gardens. (StsatsCanada Environment Accounts, 2007)

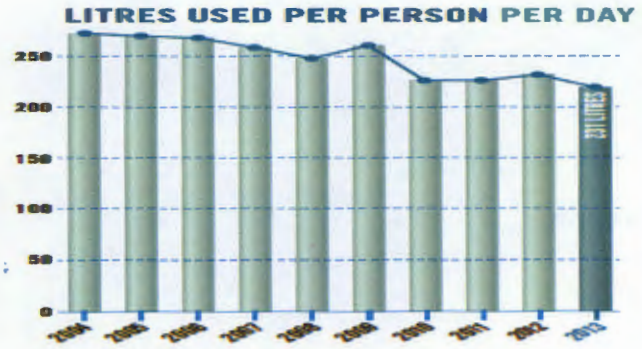


Figure 3 Litres of water consumed by Calgarians per day, (City of Calgary UEP Water Pages (web), 2013)

3.2.1 Types of Consumption

Residential consumption takes up about 52% of Calgary's water demands. Over the past few years industrial, commercial and institutional water consumption has been increasing more than expected according to the Water Utilities Department. See Figure 4 Consumption by sector

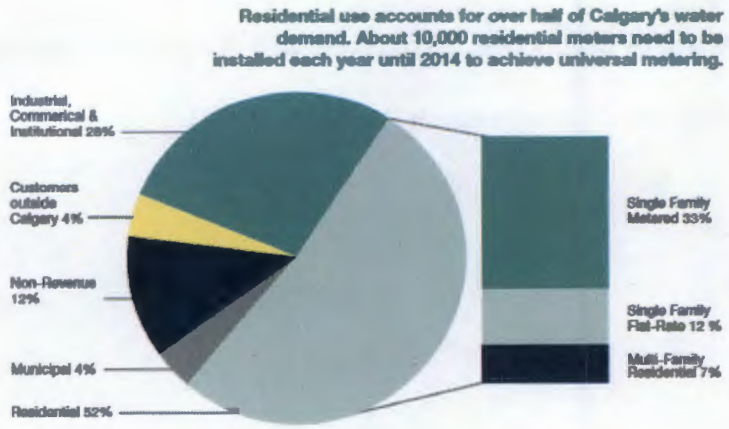


Figure 4 Consumption by sector (City of Calgary Env & Safety Mgmt., 2011)

This same research report looked at where the consumption was taking place and determined about 60 percent of the indoor consumption took place in the bathroom and 30-34 percent of

that, went straight down the toilet. See Figure 5 Household consumption by use type . The City has been approaching the water consumption problem by installing meters, increasing rates, supporting educational programs and providing some financial incentives for water saving technology like the high efficiency toilet rebate of $50 (City of Calgary Utilities & Environmental Protection, 2014) to increase water awareness. The bottom line however is that population growth is stripping away the gains being made in existing conservation approaches. The current target is "*by 2036 per capita water consumption is reduced by 40 percent* " (imagineCalgary, 2013). "*The message is clear: it's becoming increasingly obvious that our city's current water use is not sustainable. The environmental health of our water resources is under pressure, our water supply is limited, and our demand is increasing*" (City of Calgary UEP conservation (web), 2014)

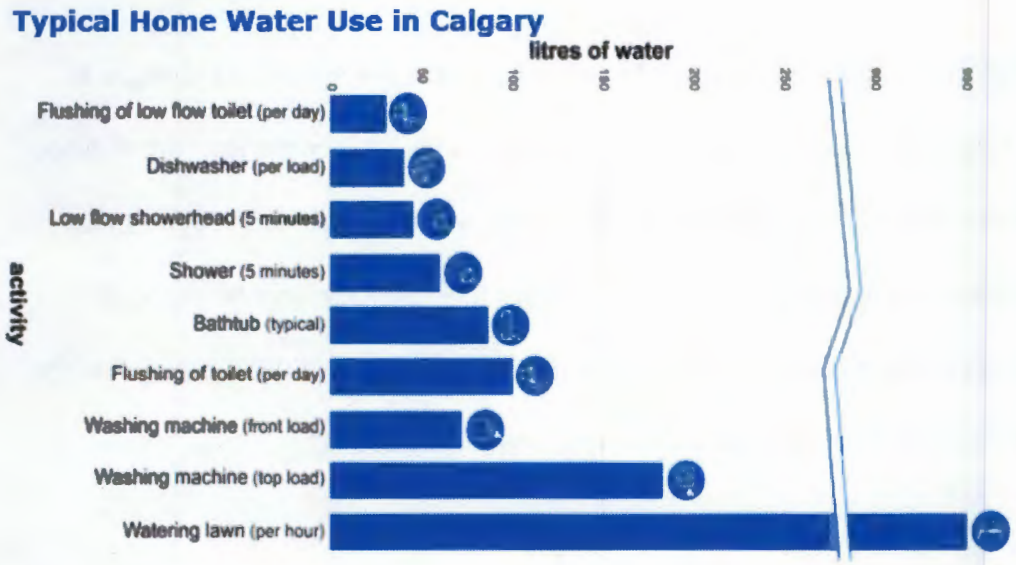


Figure 5 Household consumption by use type (WaterSMART, Chris Godwalt , 2008)(City of Calgary UEP Water (web), 2014)

3.2.2 Population Expansion

In the past year Calgary has grown by 38,508 residents, increasing 3.3% year over year. (City of Calgary, 2014) See Figure 6 Dwellings and population % change from 1999 to 2014

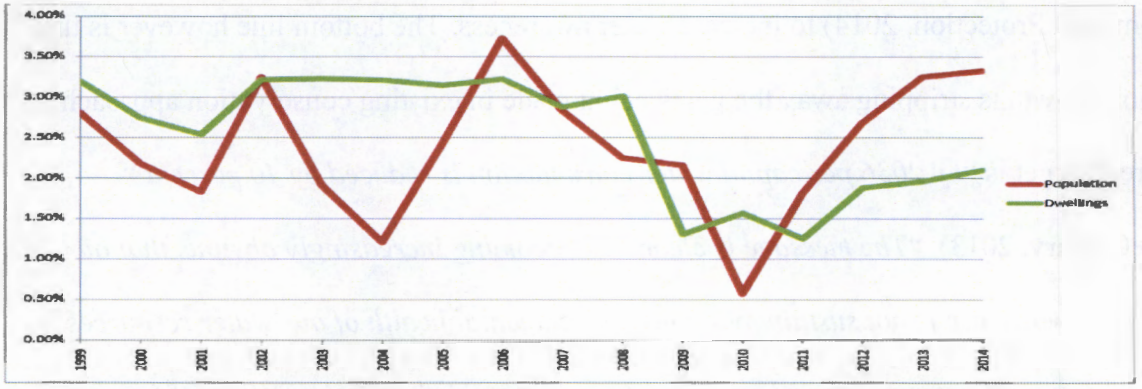


Figure 6 Dwellings and population % change from 1999 to 2014 (City of Calgary Census, 2014)

Many new dwellings are required for this growth and unless there is a significant increase in upgrading the existing infrastructure by individual building owners (when the laws are in place to do so), new options need to be considered. "*Calgary will require conservation efforts that reduce per capita water use to less than half of the current level over the next 60 years, an interval when the expected population is expected to double*." (Z. Chen, 2006)"Calgary *has few options to increase supply*" (Pacific Climate Impacts Consortium, 2010).

"*Calgary is located in one of Canada's driest regions*". The findings in this report are clear "*The research confirms unmistakably that the Calgary area is already experiencing climate variability, and has been doing so since records were first kept a century ago... the vulnerabilities are significantly magnified*" (CitySpace Consulting Ltd., 2007)

3.2.3 Water Licensing

The City of Calgary holds a water license with the Province to withdraw about 1000 Megaliters (ML/day), yet "*summer water production had almost reached this limit*" in 2006. It is expected that the limit will be unsustainable after 2020 based on 2006 projections. (Z. Chen, 2006). Both population expansion and temperature elevations have exceeded the assumptions based in this study undertaken in 2006.

3.2.4 Water Storage Challenges

The City of Calgary has approximately 16-20 billion liters in reserve, at the Glenmore Reservoir, built in 1933. (Associated Engineering of Alberta Ltd., 2011) The average amount of water used in the city including all uses (industrial, commercial, residential) was 406 litres per capita as of 2010. (Carolyn Brown, Manager Office of Sustainability, 2013) This means a steady river flow is essential since the reserves could be used up in less a month under existing conditions. (City of Calgary, 2007). "*The* (Glenmore) *reservoir has limited storage capacity, and* (is) *not designed for ...providing flood control* (Associated Engineering of Alberta Ltd., 2011). More water storage is needed to build resilience in the system. Winter water supply in the Glenmore reservoir is targeted to be 150 ML/day. (Klohn Crippen Berger, 2014) . Withdrawal is about 1,000 ML/day municipally and the Elbow is estimated to contribute 400 ML/day. (CitySpace Consulting Ltd., 2007)

3.2.5 Existing Infrastructure and Delivery Costs

3.2.5.1 The infrastructure challenge

A Calgary Water Resource report states "*61 percent of the City's infrastructure exists for the purpose of treating and distributing water and waste water.*" (City of Calgary, 2005) The City of Calgary has 4,678 km of water pipe with some of the transmission mains built in the early 1900's. See Figure 7 - Major infrastructure and the dates they entered the system . There is no accurate way at this time, to reliable know just how much loss there is from the aging water delivery infrastructure, although a new aggressive municipal plan to work on this water loss is making a difference. There is a water main replacement program in place that has reduced water main repairs by 73 percent. (Calgary UEP, 2014)

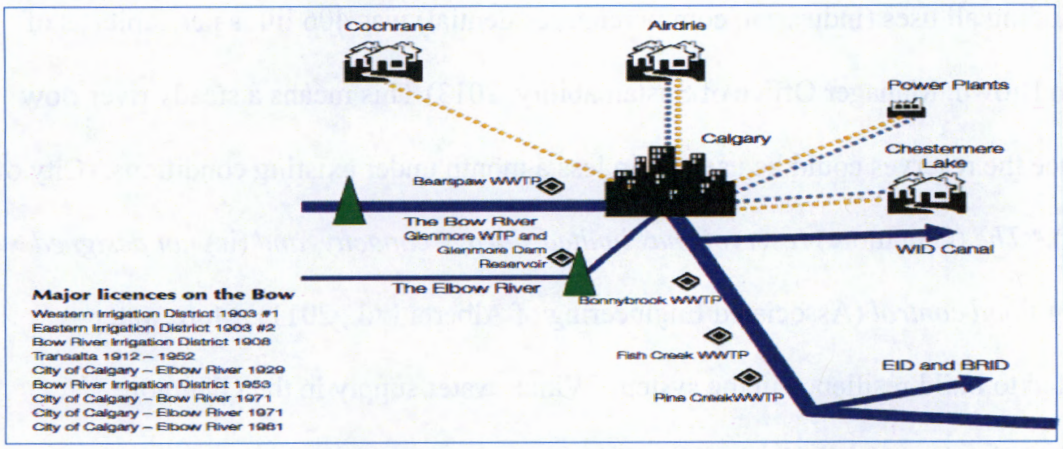


Figure 7 - Major infrastructure and the dates they entered the system (City of Calgary, 2005)

The present water infrastructure investment plan can been seen graphically in Figure 8 Waterworks infrastructure investment plan for the City of Calgary,. Using the concept of LID it

is suggested that an additional element be built into this plan to address decentralization, so that water does not have to all flow to the Bow or Elbow Rivers, but can be collected and consumes where it falls to aid in flood reduction and transportation infrastructure and energy for things like pump and lift stations.

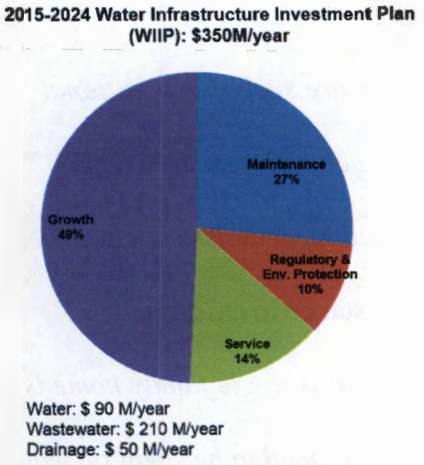


Figure 8 Waterworks infrastructure investment plan for the City of Calgary, (SPC on Utilities and Corporate Services, 2014)

3.2.5.2 Growth

In the report ***Financing Municipal Infrastructure*** it states "*The report acknowledged that economic growth drives population growth. The population growth then leads to necessary physical growth through land development. There are also significant infrastructure requirements associated with the growth of new industrial and commercial developments in addition to residential developments*" (FMI Steering Committee, 2010)

At this time publicly funded improvements that are committed to be provided for subdivisions like East Springbank and the Northeast Industrial Area have construction timelines held back due to City Council budget constraints. This is not helping the City to grow efficiently or responsively since it can take many years for the funding to be budgeted so construction can commence.

"*The City is at a point where its overall size and growth dimensions are such that additional expansion at its perimeters may require substantially more infrastructure investment than previously anticipated*"... "*there could be as many as 30 new communities under development*...(who) *require infrastructure investment up front*" Distance to existing infrastructure affects service costs. "*The average annual utility bill for a single family home is about $900 for water and sanitary sewer services. About $9,000 is planned to be spent on water and sanitary sewer infrastructure, including treatment plants, for every new home built. About 25% of the utility bill or approximately $225 from each new home is available to pay for that infrastructure. This amount is insufficient to service the debt and conclude payment in 25 years. …The current approach for the funding of growth related infrastructure is not sustainable and immediate changes must be made to address both the funding shortfall and the burden on the City debt of financing the infrastructure*. (FMI Steering Committee, 2010)

3.2.5.2.1 Impacts of Growth on the Existing System

According to a press report from the Calgary Herald

> *"Suburban growth and redevelopment projects have pushed a key sewer pipe underneath Bowness to capacity, and city hall has confirmed it can't complete a roughly $50-million secondary system until 2017.*
>
> *To prevent more home sewer backups in the meantime, the city may put a four-year freeze on approving any new developments in that large area. It's a move that covers 17 existing communities and undeveloped fringe lands, affecting everything from new homes in Crestmont to a condo project in Tuscany and an affordable housing project in Bowness.*
>
> *"Right now, they're saying can we afford any new flushes, as opposed to allowing what we've already approved for land use," said Norm Trapp, an engineering consultant working on two Tuscany projects now in limbo".*

(Jason Markusoff, 2013)

3.2.5.3 Grit and Runoff

If we look at just one line item in the 2014 infrastructure capital project budget, the Bonnybrook Headworks Grit Removal is estimated to cost $96,609,000 in this budget cycle. This one project has cost $174,894,000 since it commenced in 2009. (City of Calgary, 2014). See Figure 9, Bonnybrook Headworks Grit Removal (City of Calgary Infrastructure, 2014)

Currently rain is intercepted "*by reducing stormwater runoff and improving water quality*". In an amendment to the ***Stormwater Management and Design Manual*** Burt VanDuin noted there was a need "*to start addressing problems caused by inadequate erosion and sediment control*" (ALIDP and Bert van Duin(City of Calgary), 2014). "*Rainwater and snowmelt…carry sediment and debris from roofs, lawns, roadways, pavements and construction sites to our rivers*" (City of Calgary, 2009). Integrated water cycle management can reduce this through a broad toolbox of practices such as rainwater harvesting, swales and rain gardens.

If something like a fire in the watershed were to occur and erosion upstream were to increase water turbidity, the City system would have a hard time keeping to its water quality mandates, since grit removal would increase potentially exponentially in a fire event scenario.

PROJECT NAME	Bonnybrook Headworks Grit Removal
DESCRIPTION	Construction of new headworks at Bonnybrook Waste Water Treatment Plant
ADDRESS	Bonnybrook WWTP
SERVICE TYPE ⓘ	Environmental Sustainability
ESTIMATED TOTAL PROJECT COST ⓘ	$96,609,000
PROJECT BUDGET SINCE 2009 ⓘ	$174,894,000 (This amount may support more than one project within a Program.)
DESIGN / TENDER / BID START ⓘ	
CONSTRUCTION / PURCHASE START ⓘ	Fall 2011
PROJECT COMPLETION ⓘ	Winter 2014
PROJECT STATUS	Structural concrete pours continue. Grit removal equipment arriving on site. Started with grit pumps installation. Commissioning plan under development. Structural concrete pours. Work on utilidor and prep work for electrical duct. Continue with grit pump installaton. Project on schedule.
PROJECT STATUS UPDATED ON	July 31st, 2014

Bonnybrook Headworks Grit Removal	Environmental Sustainability	Bonnybrook WWTP	$96,609,000	$174,894,000	Fall 2011

Figure 9, Bonnybrook Headworks Grit Removal (City of Calgary Infrastructure, 2014)

For a sample of a few of the other water infrastructure costs, see Figure 10, Excerpt from the Capital Infrastructure Budget 2014-2018 and project costs for the City of Calgary for water related projects (City of Calgary, 2014).

Project Name	Project Type	Project Location	Est. Project Cost	2014-2018 Budget	Construction/Purchase Start
Bonnybrook Wastewater Network Line	Environmental Sustainability	Inglewood	$32,963,000	$49,000	Winter 2005
Capital Maintenance for Bearspaw Water Treatment Plant	Environmental Sustainability	1634 56 Av SW	$18,246,000	$95,352,000	ongoing
Capital Maintenance for Bonnybrook Wastewater Treatment Plant	Environmental Sustainability	Bonnybrook WWTP	$15,955,000	$174,894,000	ongoing
Capital Maintenance for Fish Creek Wastewater Treatment Plant	Environmental Sustainability		$5,321,000	$174,894,000	ongoing
Capital Maintenance for Glenmore Water Treatment Plant	Environmental Sustainability	North Glenmore	$6,166,000	$95,352,000	ongoing
Nose Creek Wastewater Network	Environmental Sustainability		$61,120,000	$91,597,000	Summer 2010
Spyhill Landfill Stormwater Management	Environmental Sustainability	NW Calgary	$73,583,000	$73,583,000	July 2012
Stormwater Management at Shepard Landfill	Environmental Sustainability	SE Calgary	$44,215,000	$44,215,000	April 2013

Figure 10, Excerpt from the Capital Infrastructure Budget 2014-2018 and project costs for the City of Calgary for water related projects (City of Calgary, 2014)

3.2.5.4 Biosolids

A big reason for the increased operation and maintenance portion of the budget results from "*increased volumes of biosolids...while long term solutions are being investigated to ensure appropriate handling and storage that protects the environment*" Key trends for this department include "*growth, financial pressures, regulatory changes, infrastructure management, communication and workforce*" (Utilities & Environmental Protection, 2014) See Figure 11, Capital Projects for Water Utilities to , the blue indicates where additional funding has been asked for, to cover additional costs.

Program-Project	Project Description	Type	Cat.	Prev. Approved Budget up to 2011	(A) Prev. Approved Budget for Future Years	(B) New Budget Request	2012	2013	2014	2015	2016	(C)=(A)+(B) 2012-2016
891-302	Water Treatment Plants	M	A	37,722	35,192	24,508	19,760	1,080	8,960	29,900	0	59,700
891-302	Water Treatment Plants	M	C	0	0	78,896	17,836	35,583	25,477	0	0	78,896
Total Program 891 : Water Treatment Plants				37,722	35,192	103,404	37,596	36,663	34,437	29,900	0	138,596
892-290	Water Distribution Systems	M	C	0	0	60,580	19,446	20,193	20,941	0	0	60,580
892-291	Greenfield Utility Cost Recovery (Roads)	G	C	0	0	1,412	453	471	488	0	0	1,412
892-295	Water Efficiency and Metering	G	A	78,825	2,000	30,400	10,400	10,800	11,200	0	0	32,400
892-305	Feedermains, Pumpstations & Reservoirs	G	A	254,015	51,716	(19,580)	8,237	13,365	10,534	0	0	32,136
892-305	Feedermains, Pumpstations & Reservoirs	G	C	0	0	41,846	4,293	18,715	18,838	0	0	41,846
892-SER	Service Connections	M	C	0	0	3,240	1,040	1,080	1,120	0	0	3,240
Total Program 892 : Water Distribution Systems				332,840	53,716	117,898	43,869	64,624	63,121	0	0	171,614
893-292	Equipment	U	C	0	0	918	295	306	317	0	0	918
Total Program 893 : Water Equipment & Others				0	0	918	295	306	317	0	0	918
894-348	Wastewater Treatment Plants	U	C	0	0	130,665	39,515	39,973	51,177	0	0	130,665
Total Program 894 : Wastewater Treatment				0	0	130,665	39,515	39,973	51,177	0	0	130,665
895-321	Replacements and Extensions	M	C	0	0	36,089	11,781	11,943	12,385	0	0	36,089
895-322	Greenfield Utility Cost Recovery (Roads)	G	C	0	0	551	177	184	190	0	0	551
895-329	Wastewater Trunks Lift Station	G	A	189,130	56,139	(33,369)	3,089	7,484	12,197	0	0	22,770
895-329	Wastewater Trunks Lift Station	G	C	0	0	31,294	6,537	20,766	3,991	0	0	31,294
895-604	Bonnybrook Trunk	U	A	25,290	9,500	(9,500)	0	0	0	0	0	0
895-SER	Service Connections	M	C	0	0	1,976	634	659	683	0	0	1,976
Total Program 895 : Wastewater Collection System				214,420	65,639	27,041	22,198	41,036	29,446	0	0	92,680
896-320	Equipment	U	C	0	0	3,370	1,082	1,123	1,165	0	0	3,370
Total Program 896 : Wastewater Equipment_Others				0	0	3,370	1,082	1,123	1,165	0	0	3,370

Figure 11, Capital Projects for Water Utilities to 2016 (City fo Calgary UEP Plans & Budgets, 2011)

3.2.5.5 Maitenance

$60.5 million additional money is being requested for water distribution systesm from 2012-2014 to cover "*ongoing monitoring, rehabilitation, replacement and corrosion protection for distribution mains, hydrants, services and valves*".- program 892-290 (Utilities & Environmental Protection, 2014). It is important to remember that in Calgary, no tax money is is used to support these systems, each user must pay, yet there is little control over expensitures for the homeowner, RWH would give them back some control.

3.2.6 Current and Future Costs

Water Resources and Water services have very large budgets. "T*he 2012-2014 strategies and actions continue Utilities & Environmental Protection (UEP's) efforts to support longer-term goals and the future envisioned in imagineCALGARY. UEP will work with The Corporation and community to achieve objectives including: the 80/20 by 2020 waste diversion strategy; brownfield strategy; greenhouse gas reduction; water efficiency plan; and stormwater management strategy.*" (City fo Calgary UEP Plans & Budgets, 2011)RWH when implemented at the conceptual phase of a neighbourhood or subdivision, makes sound business sense.

3.2.6.1 Rates

Water rates in Calgary have gone from \$1.4876 to \$1.7175 in 2014 for usage $/m^3$. Service charges have gone from \$13.64 in 2012 to \$15.75 per 30 day period and sanitary wastewater charges have gone from \$12.53 per 30 days to \$16.15. Sanitary usage rates have gone from 0.7836 to 1.0094 per m^3 between 2012 and 2014. The effluent rate is calculated as "*the equivalent amount of water with which the property is served from other sources*". To calculate this the City "*effluent meter reading is divided by the return factor and multiplied by the rate*". The effluent meter rate in 2012 per 30 days was \$12.53 and has gone up to \$16.15 in 2014. The usage rate has gone from \$0.9112 to \$1.1738 per m^3 in 2014. The wastewaer surcharge rates for 2012 were \$12.53 for service charges and in 2014 increased to \$16.15 per 30 days. Usage rates per m^3 used have gone from \$0.82 in 2012 to \$1.0563 in 2014. [There is also a drainage service

charge which has gone from $8.36 per 30 days to $9.20 in 2014]. See Figure 12, Rates based on single family, residential dwelling. Data, (Ungerson) graphic

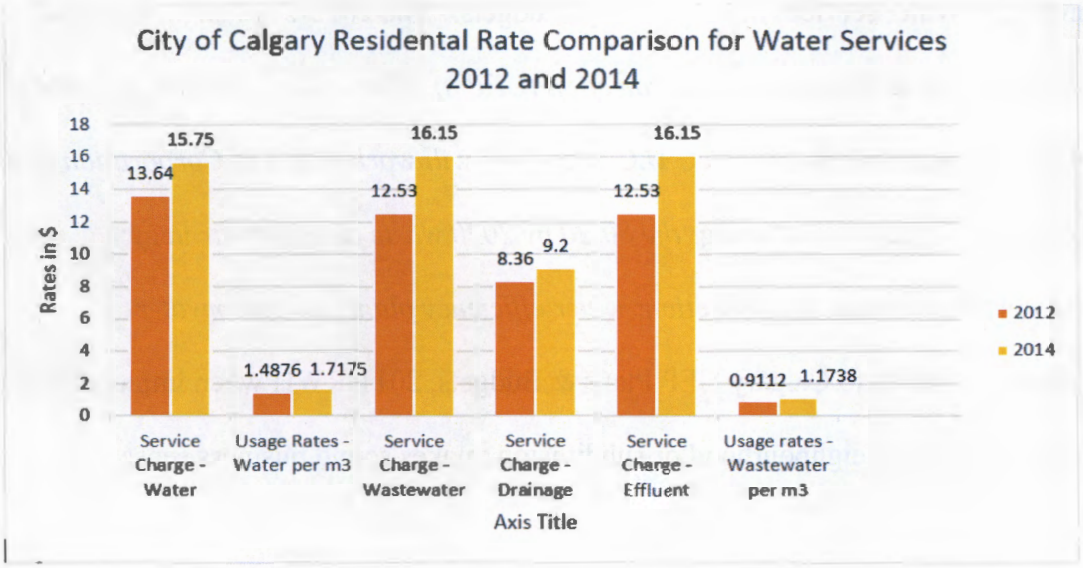


Figure 12, Rates based on single family, residential dwelling. (City of Calgary (web), 2014) Data, (Ungerson) graphic

Figure 13 Proposed rate increases with a "blended rate = the weighted average of water and wastewater rates illustrates the average rate increase projected from the document. The current Development Agreement will expire in 2015. "*Preliminary results using updated 2015-2024 WIIP* (Water Infrastructure Investment Plan) *show that the acreage assessment rates for wastewater would double, assuming that the Utilities continue to share the costs of growth.*" (Utilities & Environmental Protection, 2014)

Recommended 2015-2018 Annual Indicative Rate Increase						
Year	*2015*	*2016*	*2017*	*2018*	*Most Customers*	*4 year cumulative increase*
Blended	*8.30%*	*8.30%*	*8.30%*	*8.30%*	*33.20%*	*33.20%*
Water	*2.00%*	*2.00%*	*2.00%*	*2.00%*	*8.00%*	*8.00%*
Wastewater	*16.90%*	*15.80%*	*14.90%*	*14.90%*		*62.50%*
Totals	27.20%	26.10%	25.20%	25.20%	41.20%	103.70%

Figure 13 Proposed rate increases with a "blended rate = the weighted average of water and wastewater rates Data from (Water and Wastewater Utilities City of Calgary, 2014)

3.2.6.2 Capital Spending

The anticipated budget for these services is 3.5 billion dollars for water, wastewater and drainage services. Figure 14 Utilities capital investment allocation by drivers in millions of $, clearly shows where the investment dollars are going in the water department

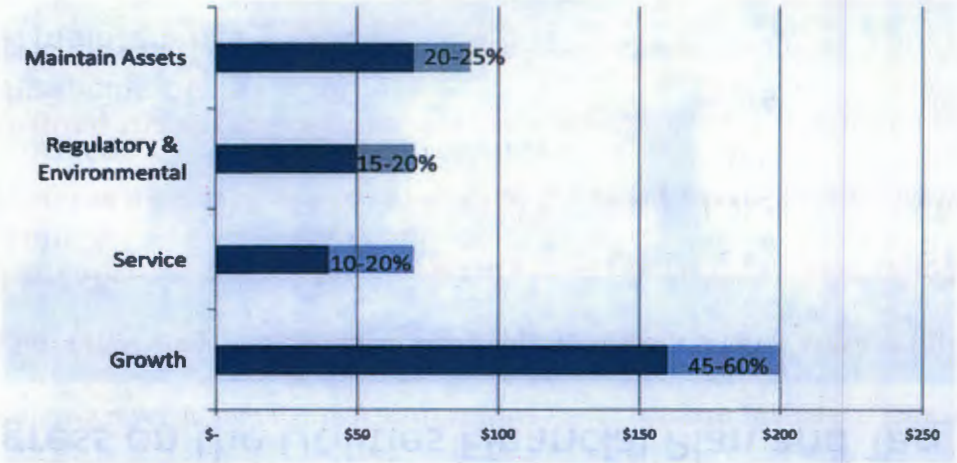


Figure 14 Utilities capital investment allocation by drivers in millions of $
(Utilities & Environmental Protection, 2014)

In the indicative rates section of the proposed future budget, the cost projections look as follows:

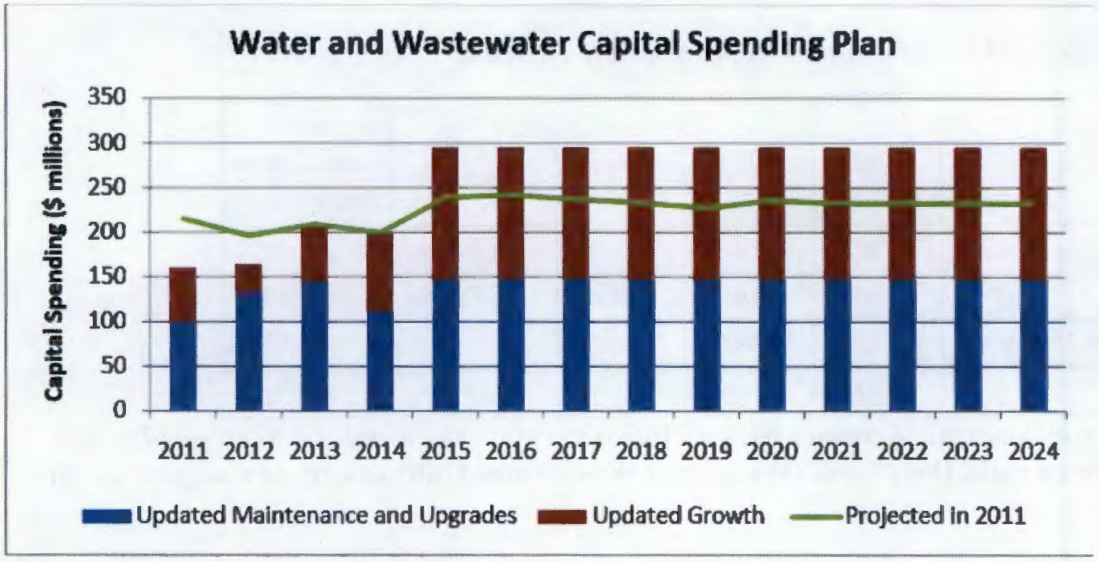


Figure 15 Water and Wastewater capital spending plan between 2011 and 2024 (Water and Wastewater Utilities City of Calgary, 2014)

3.2.6.3 Water Pricing Lag

Calgary has been using a flat rate for wastewater services rather than a utilities model for many applications. There are serious impact costs, such as increased water treatment demands for **facilities like hospitals that have high bio-pharmaceutical waste. Toxicity burden should be a consideration for rate payers, because it impacts the cost of treatment, as should load size and permeability access to ground. The less permeable the ground the more run-off, the more run-off the more impact there is on the storm sewer system. One could think of it as an impermeable pavement penalty** "*The City has since learned that diverting rainwater directly back into the river is not an effective strategy*" (Grecu, 2013)**. Charging for impermeable surfaces is a way to recoup stormwater handling costs.**

In the Utilities & Environmental Protection UEP-Action-Plan-2015-2018 water capacity was considered. As one can see from Figure 16 Anticipated water treatment capacity lifespan between 2012 and 2014, ***water treatment capacity was halved from 10 years to 5 years.*** Based on the research considered in this paper, the actual performance levels have been reduced due to a combination of stress from things like grit due to flooding, runoff, biosolids and population growth. If projected growth rates continue at the exiting pace, this timeline lifespan analysis will be cut down even more.

Performance Measures Related to Council Outcome	2012 Actual	2013 Actual	2014 Estimated	2015 Target	2016 Target	2017 Target	2018 Target
N.PM1 Projected remaining years of water treatment capacity.	10	6	5	5	5	5	5
N.PM2 Projected remaining years of wastewater treatment capacity.	6	5	4	3	4	3	3

Figure 16 Anticipated water treatment capacity lifespan (City of Calgary Action Plan UEP, 2014)

3.2.7 The perceived need for Low Impact Development and Decentralization

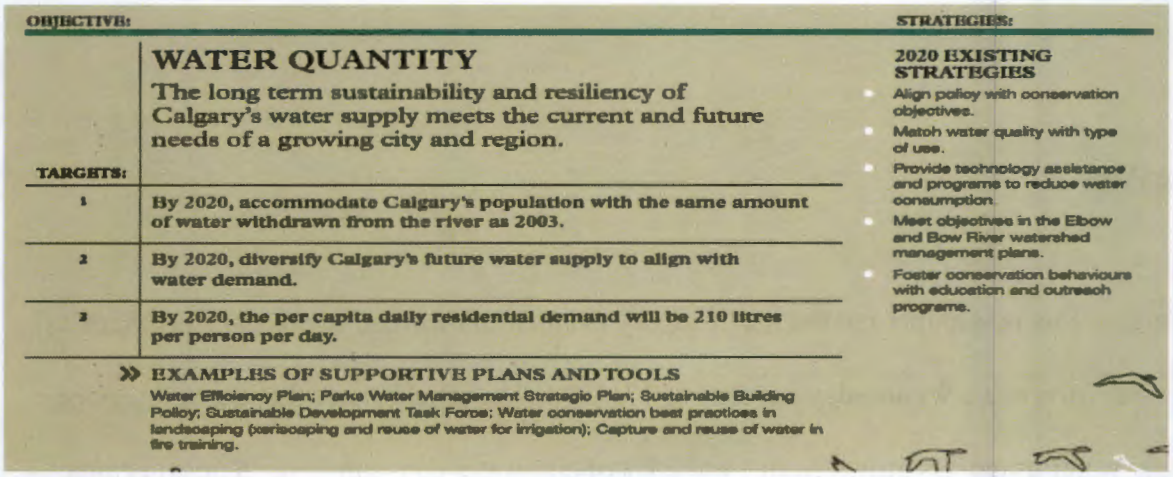
In a report commissioned by the City in 2007, the IBI Group determined that dispersed communities required significantly more piping and "*capital costs for expansion of the distribution system for the Dispersed Scenario are more than twice those of the more Compact Recommended Direction.*" They go on to say, the water treatment facilities expenditures grow, based on the population they serve. (IBI Group Report, 2009)

3.2.7.1 Land Use Planning & Policy: Planning Development & Assessment

Taking a look at the ***North Regional Context Study*** prepared June 2010, the Stormwater Management section states "*Stormwater source control practices and approved Low Impact Development (LID) strategies will need to be implemented within the study area to meet stormwater targets*" (Land Use Planning & Policy: Planning Development & Assessment, 2010) The ***East Springbank Area Structure Plan*** states "*Private sanitary sewage treatment systems may be considered where adequate assurance is provided to the Approval Authority that such systems will be operated properly and will not negatively impact the quality of surface and/or groundwater.*" Although there is no mention of LID principles or practices being specified in this plan. Basic "*stormwater management will be required to control the 1:100 year runoff. It may be possible to reduce the cost of the storm sewer system and protect the natural environment by using drainage ditches and stormwater management ponds.*" is noted. It also notes in the section under ***Subdivision prior to urban service*** that: "*A water supply that is satisfactory to the Approval Authority must be provided for any new lot. Compliance with Alberta Environmental Protection guidelines is to be demonstrated prior to redesignation. All new water supply systems that serve the public must supply residents with potable water, in compliance with the Guidelines for Canadian Drinking Water Quality*". (Land Use Planning & Policy: Planning, Development & Assessment, 2014)

3.2.7.2 2020 Sustainability Direction

In the ***2020 Sustainability Direction***, the City of Calgary's 10 year plan towards ***imagineCALGAY*** water quality and quantity are noted and note that "*by 2020, diversify Calgary's future water supply to align with water demand" and "Calgary's public health and the health of its watershed are protected by delivering safe and reliable drinking water, collecting and treating wastewater, and minimizing the impact of Calgary's urban form.*" (The City of Calgary Onward Sustainability, 2012)



OBJECTIVE:	WATER QUANTITY The long term sustainability and resiliency of Calgary's water supply meets the current and future needs of a growing city and region.	STRATEGIES:
TARGETS:		2020 EXISTING STRATEGIES
1	By 2020, accommodate Calgary's population with the same amount of water withdrawn from the river as 2003.	• Align policy with conservation objectives. • Match water quality with type of use. • Provide technology assistance and programs to reduce water consumption. • Meet objectives in the Elbow and Bow River watershed management plans. • Foster conservation behaviours with education and outreach programs.
2	By 2020, diversify Calgary's future water supply to align with water demand.	
3	By 2020, the per capita daily residential demand will be 210 litres per person per day.	
	» EXAMPLES OF SUPPORTIVE PLANS AND TOOLS Water Efficiency Plan; Parks Water Management Strategic Plan; Sustainable Building Policy; Sustainable Development Task Force; Water conservation best practices in landscaping (xeriscaping and reuse of water for irrigation); Capture and reuse of water in fire training.	

Figure 17, Water Sustainability to 2020 objectives, (The City of Calgary Onward Sustainability, 2012)

3.2.8 Public Awareness

A 2013 study conducted on rural Albertans who source their drinking water from wells, found 450,000 people were consuming water from 215,000 wells without testing the water, although the Province of Alberta provides testing which costs the well owner little or nothing. (Hall, 2013)

This is troubling because it indicates water is being taken for granted and assumptions are being made that could affect people's health.

The Royal Bank has been conducting studies across Canada for a number of years. In 2013 the poll found Canadians ranked the economy number one and water supply number 16 among the most important national issues. (RBC Blue Water Project, 2013) There are key elements of shared rituals and traditions, a sense of belonging and moral obligation that are required to affect long term community perceptions. The chapter on best practices goes into this subject in some detail.

3.2.8.1 The Press

The Calgary Sun newspaper ran the tile "*Calgary Councillors warned of possible pushback as water rates increase*", Wednesday September 17, 2014. The article states that general service customer water usage has grown from 14 to 23% of city water consumption. "*Some on council say they're ready for any flak...over the increased rates*" (Dormer, 2014)

In the Cochrane Eagle newspaper dated Thursday September 18, 2014 the byline was, "*Cochrane Lake water levels continue to decline*". The article opens with "*Pumping of flooded Cochrane Lake into the Bow River has resulted in a drastic increase in the amount of water that has been getting removed from the lake since the last week of August – from around one-inch per week to an inch a day" Canadian Dewatering is pumping about 3,000 gallons per minute. The grant provided for this project is 2.3 million and the long term solution rests solely on the*

county". The goal of this project is to bring the water table down before freeze up, but the long term implications are unknown at this time. (Seewalt, 2014). Water impacts that affect communities upstream, affect Calgary. If Cochrane has an excessively high water table and this were to continue through to spring, the threat of flooding in Calgary will increase, if other climatic factors like excessive melt or rain create further stresses on our water system.

3.2.9 Current Practices and Policies in the City of Calgary

3.2.9.1 The City of Calgary Municipal Development Plan

In the ***City of Calgary Municipal Development Plan*** under the Goal; "*Conserve, protect and restore the natural environment*" the policy includes "*recognizing the interconnectedness of air, water, climate, ecosystems habitat and people*" and "*reducing the amount of effective impervious areas by incorporating site level and neighbourhood level stormwater source control practices*". Under 2.6.1 Green Infrastructure Calgary recognizes that the City is an "*interconnected network of natural green and engineered green elements that provide ecological services... in urban environments*" and. "*must become part of the underlying framework that is used to guide future development patterns." ..." Ensuring that approval standards are linked to water quality and quantity objectives of water management plans. g. Promote water conservation initiatives, including on-site stormwater and wastewater reuse and treatment*". (City of Calgary PD&A, 2013) This is done through decentralized, green, low impact (LID) water management that includes RWH. Figure 18, Urban vs. natural land/ water ; by building water harvesting into the urban environment like proposed in this paper.

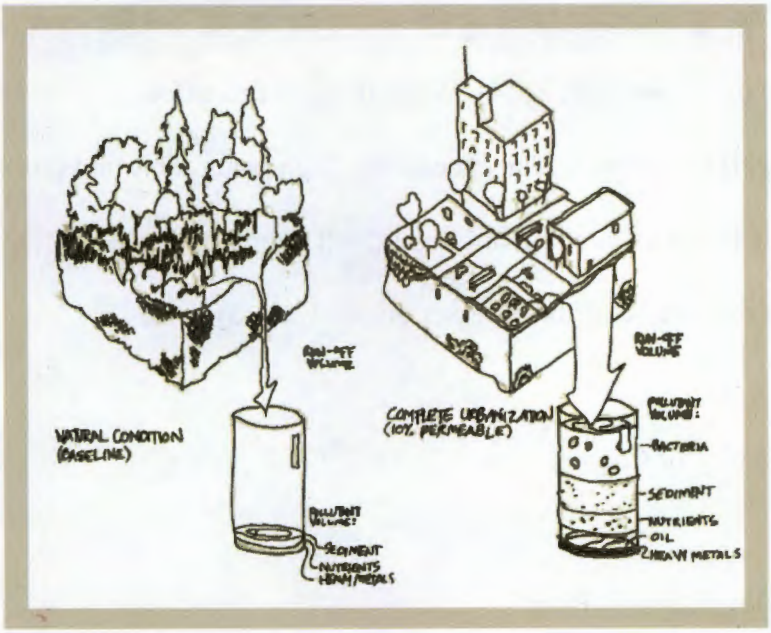


Figure 18, Urban vs. natural land/ water management (City of Calgary PD&A, 2013)

The City of Calgary wrote in "***The City of Calgary Municipal Development Plan*** "Water *is a basic human need, critical for survival. ...However, rivers are far more than the waters in their banks – they are the hearts of the watershed...and decisions made ...impact regional water quality*" (City Bylaw, 2014).

3.2.9.2 Sustainable Suburbs

The City of Calgary conducted a ***Sustainable Suburbs*** Study in 1995 (City of Calgary Planning & Building Department, 1995), adopted by City Council July 17, 1995. In that report waste reduction and reduced consumption are the focus, together with affordable supportive infrastructure to build operate and maintain new communities. Today Calgary has avoided the aspect of decentralization largely in favour of densification, yet many new developments are

proposed, that could be a perfect fit for reducing extensive infrastructure and flood mitigation costs through RWH[8] Urban villages are decentralized places that support decentralized services. The report specifically mentions "*alternative stormwater management techniques*" (City of Calgary Planning & Building Department, 1995). RWH is a method to achieve this objective.

3.2.9.3 Calgary Snapshot 2014

In the document titled ***Calgary Snapshots 2014*** it states "The *key objective of the City of Calgary is to avoid premature extensions of municipal infrastructure*". Yet on the list of factors influencing development only public lands, wastewater treatment plants and sludge lagoons, then floodway, flood plain areas are mentioned. (City of Calgary Planning, Development & Assessment, 2014)There is nothing on fresh water supply.

3.2.9.4 Sustainable Best Practices Policy

The City of Calgary ***Sustainable Best Practices Policy*** (CSBPP) promotes design integration, reinforcement of natural systems material stewardship, environmental quality, water protection, sustain communities, and sustainable business practices. (City of Calgary Sustainable Policy, 2008) "*all new occupied City-owned and City funded buildings in excess of 500m2 must meet or exceed the Gold level of LEED®* (City of Calgary IIS, 2014) In the CSBPP it states; *"Harvest on-site flows by reclaiming greywater, roof runoff and groundwater"* Yet this practice is not permitted today, without Provincial Directors Approval since the existing ***Rainwater***

[8] . See http://www.calgary.ca/PDA/pd/Pages/Current-studies-and-ongoing-activities/Current-studies-ongoing-activities.aspx

Harvesting (RWH) ***Guidelines*** and ***Handbook*** are for residential application only and there are no Provincial guidelines or handbook on greywater. In Calgary's bylaws there is density bonus for "*incorporating sustainable building features into the development*" that ended December 31, 2011. However under Section 128 there is still a point for "(g) *eliminating the use of potable water for irrigation of landscaping* and (a) *1 point for every 15 per cent of total roof area that is not eligible to be counted towards minimum landscaped area requirements, installed with a vegetated green roof, up to a maximum of 5 points.*" (City of Calgary Planning & Development, 2007)

3.2.9.5 Bylaw 40M2006

Under Part XVI of Bylaw 40M2006 it states

PART XVI: ALTERNATE SOURCES OF WATER

45. (1) No person shall use any source of water to supply water to any residential, commercial, industrial or institutional premises through a plumbing system, other than the Water System without the written consent of the Director of Water Resources.

(2) The Director of Water Resources may authorize the use of an alternate source of water subject to such terms and conditions as he deems is necessary, and notwithstanding the generality of the foregoing he may set a limit on the period of time for which an alternate supply of water may be used.

(3) No person who has been granted permission by the Director of Water Resources to use an alternate source of water shall allow that alternate source of water, or any pipes or devices connected to such alternate water source, to be connected to the Water System.

Figure 19 Part XVI Alternate Sources of Water (City of Calgary Planning & Development, 2011)

3.2.9.6 Bylaw 37M2005

Bylaw number 37M2005 covers storm drainage which is defined as "*runoff that is the result of rainfall and other natural precipitation or from the melting of snow or ice*". There is a provision for "*retention and treatment...permanently or temporarily...to control volume or ensure water quality*"

USE AND RE-USE OF STORM DRAINAGE

10. (1) Storm Drainage must not be used or re-used for any purpose without written approval from the Director, Water Resources or the Director, Water Services.

(2) The Director, Water Resources or the Director, Water Services may impose conditions on an approval granted for Storm Drainage re-use, including any of the following:

(a) limits on the types of applications for which Storm Drainage may be re-used;

(b) requirements on applications, risks, volumes, and any other information the Director, Water Resources or the Director, Water Services may require.

Figure 20 Storm Sewers and Storm Drainage Bylaw number 37-M2005 (City of Calgary PD&A, 2012)

To illustrate how provisions could come into play

(3) Notwithstanding subsections (1) and (2), the approval of the Director, Water Resources or the Director, Water Services is not required for the use of Storm Drainage captured by one or more water barrels located above ground and intended for outdoor use.

(B/L 13M2012, 2012 March 12)

Figure 21 Storm Sewers and Storm Drainage Bylaw number 37-M2005 10(3) (City of Calgary PD&A, 2012)

3.2.9.7 City of Calgary Land Use Bylaw

Under Part 5 of T***he City of Calgary Land Use Bylaw 1P2007*** a section could be entered for Rainwater Harvesting, since solar collectors and low water landscaping are already in this section, Part 7 includes solar, wind energy conservation and low water irrigation systems. Part 8 and 9 includes solar and wind energy systems (City of Calgary PD&A, 2014)

City Council's priorities for water management include asset management that has "*long range infrastructure planning and a full lifecycle approach to provide capacity for growth, management potential impacts from climate change, meet regulatory requirements and manage risk*". (City of Calgary CA, 2011)

3.2.9.8 Rainwater Harvesting Guidelines

Rainwater Harvesting Guidelines by the City of Calgary were written in 2013. This guideline is intended only for non-potable internal use in residences. Under this guideline water cannot be used for drinking, showering or dishwashing, as per provincial Municipal Affairs Ministry directions. Other applications require special variances. The guide notes "*there is no standards outlined in the Alberta Building Code (2006) for the quality of rainwater for the permitted non-potable uses*" (City of Calgary Water Resources, 2013)

3.2.10 The Flood impacts

Calgary experienced the most serious flood on the Elbow River on record and the most serious flood to have occurred on the Bow River since 1897 (City of Calgary, 2014)

First Nations, the City and the Province all were financially impacted by the 2013 flood event. The Siksika Nation water treatment system was damaged from the flood. The repairs for this were covered through a provincial grant program. Dams, reservoirs and water treatment plants were all affected by the flood. The province has proposed to implement a major mitigation plan to reduce future catastrophic damage.

One of the projects proposed is the Springbank Road Off-Stream Reservoir, which is intended to manage the Elbow River flow rates, during a flood event. It will protect residents in Rocky View County and Calgary. It is to be designed in a way that permits flood water to be stored temporarily and released in a controlled manner, when the flood event subsides. They are seeking a capacity of 59 million cubic meters and anticipate it will work in tandem with the proposed McLean Creek dry dam upstream that would be designed to hold 49 million m^3. (Alberta Government, 2014). Various Calgary media outlets (CBC and the Calgary Herald) report that "*Landowners west of Calgary are gearing up for what could be a protracted battle with the Alberta Government over its bid to build a massive, off-stream reservoir in Springbank to mitigate future flooding in communities downstream*" (Howell, 2014). Some local residents are very opposed to this project. (Eng, 2014)

Other water projects related to the flood include; installing a $500 million underground diversion from the Glenmore Reservoir to the Elbow River and building a 49 million m^3 capacity McLean Creek Dry Dam to help reduce the flooding potential in the Elbow River. The Glenmore Dam is 81 years old. (Calgary Herald, 2014) (Alberta Government, 2014)

The Province has committed $104 million dollars to protect dams and handle floodwaters through new and improved emergency spillways in the area. (Alberta Government, 2014)
A flood mitigation panel struck to consider innovative ways to reduce catastrophic future flooding does not note use of RWH to manage ground saturation issues, faced by the City of Calgary, to "*build resiliency*" (City of Calgary, 2014). Nor is there a mention about integrated water cycle management. A document titled ***The 2013 Great Alberta Flood: Actions to Mitigate, Manage and Control Future Floods*** states "*flood and drought planning are interconnected*"..."*develop a better understanding of the relationship between flooding and groundwater, gain a better understanding of the hydrological cycle on a regional scale and "re-evaluate the potential for slumps, and mudslides during flooding events*". (Alberta WaterSMART Solutions, 2013)Natural and physical infrastructure is significant to preventing catastrophic flood damage. RWH is an important aspect of that infrastructure as can be seen in the case studies noted in this report. The recommendations state "*Consider flood risks in municipal planning and strengthen building codes for new development*" It recommends looking to Australia, Europe and other North American jurisdictions for ideas. (Alberta WaterSMART Solutions, 2013)

3.2.11 Why Rainwater Harvesting?

The idea of taking storm water and managing it differently, by collecting it before it has time to contact the earth and come in contact with road chemicals, pesticides and other toxins has already been done in many places globally in areas faced with similar water challenges. RWH would help Calgary make up for the population increases to hedge against agricultural impacts in case of drought.

In ancient times there were not so many water contaminants. Once rain hit the ground the hydrological system had time and natural ground systems like bogs, fens, swamps and ponds to clean what ran across the ground. Today with more intense rainfall, dryer conditions between moisture events and toxins in our urban environment, we need to take a more sustainable, less energy intensive approach to our water management, if we are to keep it remotely cost effective and accessible to everyone who needs it. One simply needs to look to the United States to see scarcity, rationing and financial implications of poor water policy in urban/ agricultural environment. "*NASA finds dramatic loss of underground water in the Colorado River Basin*" (Millward, 2014)National Geographic reports "*If you think the water crisis can't get any worse, wait until the aquifers are drained, we're pumping irreplaceable groundwater to counter the drought. When it's gone, the real crisis begins*". (Dimick, 2014)

Calgary does not have very much usable groundwater supply. As illustrated in this report, rainfall, snowfall and glacier melt is all that is practically and readily available to the City of Calgary. The city must recharge the rivers and send one half of the watershed volume forward,

across the prairies as per the ***Master Agreement on Apportionment***, 1969 with water quality amendments implemented in 1992. (Alberta Environment and Sustainable Resources, 1995-2014), (Prairie Province Water Board, 2009). RWH would help the City of Calgary to bridge the gap of population and industrial/commercial growth and the finite water supply in the Bow and Elbow Rivers.

The ***Bow Basin Flood Mitigation and Watershed Management Project***, published in 2014 found "*In the 2013 event, rains fell heavily, however rain may fall in different parts of the catchment, reducing the flood mitigation value of infrastructure in this location.*" The advantage of RWH is that it can be spread across a larger area than any one structure like a dry dam and it would address the concerns presented by the panel "*If dry dams are used intermittently, public safety*" "*could become an issues if the dams fills quickly*". They also noted debris management and ecological impacts. (Alberta WaterSMART, Alberta Innovates, 2014)

The Alberta Urban Municipalities Association (AUMA) in 2014 set the target of "*Alberta's urban municipal sector will achieve an average per capita residential water use of 195 litres/person/day and a total per capita use of 341 litres/person/day by 2020.*" (AUMA/ AMSC, 2014). In another AUMA document titled 2014 ***Municipal Water Policy on Stormwater***, they state "*stormwater reuse has the potential to decrease reliance on drainage infrastructure, reduce runoff volumes and flow rates, and to result in more efficient use of water resources*". They too admit however "*There are regulatory barriers to overcome*" (AUMA/ AMSC Policy, 2014)

3.2.12 Technology and information to help the City better understand the future

Recently engineers at the Schulich School of Engineering, have been working on modeling the Elbow River watershed, which supplies about half of Calgary's drinking water. According to Danielle Marceau professor and chair of the GIS and Environmental Modeling department "*there is a shift in peak flows from late spring/early summer to late winter/early spring*" (UToday reporter, 2014). If this hypothesis proves correct, it will profoundly affect the water assets in Calgary, since peak consumption is in the summer and runoff can be as much as 47.4% of what Calgarians consume in August. Because glacial melt is such an important aspect of Calgary's water supply, it is imperative that despite changing temperature and precipitation patterns the City has enough water for everyone. See **Error! Reference source not found.** water flows, for more information on this topic.

3.2.13 Has rainwater use been considered in Calgary's public policy?

Yes, in the City of Calgary, Land Use Planning & Policy:

"*Innovative storm water management approaches should protect the Bow River Watershed, including source control methods, bio-swales, re-use of rain water for irrigation and other Low Impact Development measures*" (City of Calgary, Planning, Development & Assessment, 2010)

In the September 2007 ***imagine CALGARY*** plan for Long Range Sustainability it states;

"*Promote rooftop rainwater catchment systems and gardens, and water-retaining eco-roofs.*" (Calgary, 2007)

See Appendix G – for Sustainable Design Declaration form that lists "*rainwater reuse (3 points)*" (City of Calgary Development & Building Approvals, 2014)

The ***Water Management Strategic Plan*** from June 25, 2007 for parks "*supports good water management by reduced use, retrofit, repair and reuse (looking for opportunities to move towards other non-potable water resources – e.g. irrigating from rainfall-fed dugouts/reservoirs, grey water reuse)*" (City of Calgary Parks & City of Calgary Water Services, Land Use Planning, Recreation, Roads, Development & Building, Approvals, Corporate Properties and Buildings and Calgary Transit, 2007).

City of Calgary, Water Resources Source Control Practices Reference Manual (May 2007) and ***Stormwater Source Control Practices Handbook (***Westhoff Engineering Resources, Inc., 2007) "*The* (Bow) *River is approaching assimilative capacity for some pollutants. Sediments are of particular concern as over 85 percent of sediment loads come from stormwater. These results highlight the importance of developing new stormwater management practices in new and existing communities to meet our regulatory requirements and protect the health of our streams, rivers and drinking water reservoirs. .* "[9] (Westhoff Engineering Resources Inc., 2007)

[9] http://www.calgary.ca/UEP/Water/Documents/Water-Documents/Stormwater%20Source%20Control%20Practices%20Handbook%20-%20November%202007.pdf

Chapter 6.0 of the Handbook is titled **Rainwater Harvesting and Reuse** "*The capture and reuse of rainwater is a viable source control practice*" (SCP) (Westhoff Engineering Resources Inc., 2007)

The ***Stormwater Management and Design Manual*** references RWH as a best management practice source control. (Calgary Water Resources, 2011).

Municipal Affairs has a factsheet on reclaimed water reuse (what some call RWH) which states "*If the capacity of a reclaimed water reuse system is greater than 25 cubic meters per day or involves more than one property, Alberta Environment and Sustainable Resource Development (AERSD) will become the lead approving authority for collection and treatment. However, the National Plumbing Code still applies to plumbing systems within buildings. The information required in support of an approval is very similar to the requirements for a system with a capacity under 25 cubic meters per day*" and "*The local authority having jurisdiction (i.e. Safety Codes Officer) must be certified to administer the Safety Codes Act"* as they are the only individual who can consider deviations from codes identified under the plumbing code regulation. Only a Technical Administrator may issue a variance in respect to a product or equipment" (Municipal Affairs Alberta, 2012).

3.2.14 Examples of Water Reuse and Rainwater Catchment in Calgary

3.2.14.1 The Calgary Water Centre

Figure 22 Calgary Water Centre Photo (Ungerson S)

The Water Centre not only has water conserving fixtures it also uses water from the "*on-site water meter testing facility ...reused to flush toilets in the building*" and "*rainwater from the main roof and the green roof is treated in constructed wetlands on-site and stored in an underground cistern. In a typical season, harvested rainwater will provide more than enough water to meet our irrigation needs*" (City of Calgary Web, 2014). It is interesting to note the Water Centre "*will pay for itself in 15 years*" (City of Calgary Water Centre UEP, 2014)

Water Centre quick facts

100% daylight
72 % reduction in waste water
59% reduction in water use
58% savings in annual energy consumption (~$108,000/yr)
~800 metric tonnes of CO2 equivalent reduction
~700,000 kg reinforced steel was recycled product

(City of Calgary UEP, 2014)

3.2.14.2 Nose Creek Recreation Centre

"*The water management strategic plan requires us to look for sites that can be designated to use non-potable water for irrigation. Currently eight large sites are using either untreated river water, well water or storm water from runoff.*" "*Overland drainage from the surrounding developed area is captured in the storm pond*" at the Nose Creek Recreation Centre.

3.2.14.3 Calgary Fire Department Training Centre

The Inland Athletic Park has a water harvesting irrigation system and the Fire Training Centre has a water re-use system. (Gourdeau, 2013)

Figure 23 Calgary Fire Training Center (Gourdeau, 2013)

3.2.15 Sub-divisions

Alberta Environmental Protection wrote draft ***Environmental Guidelines for Subdivisions in Alberta***, in that document they specifically speak about "*proposed water supply systems for small municipal developments will likely require approvals or authorizations"* from the *"Environmental Protection and Enhancement Act, Water Resources Act and possibly Public Lands*" "and tied to environmental provisions in the ***Municipal Government Act, Plumbing Code*** and the ***Environmental Protection and Enhancement Act***. (Richard Bramm, 1999). In the ***Wastewater and storm drainage Regulation*** "*storm drainage" "means drainage which may include industrial runoff, resulting from precipitation in a city, town, specialized municipality, village, summer village…*" and a *"storm drainage collection system" means any system of sewers, valves, fittings, pumping stations and appurtenances that is used to collect storm drainage, up to and including service connections;* and a *"storm drainage treatment facility*" "*means any structure or thing used for the physical, chemical or biological treatment of storm drainage, and includes any of the storage or management facilities which buffer the effects of the peak runoff.*" (Province of Alberta, 2012)

With the prospect of a City Charter being developed there can be a real opportunity to integrate RWH into the building code, plumbing code, wastewater and storm drainage regulations, and subdivision and development regulation. Municipal by-laws could all positively impact the implementation of RWH into the City of Calgary, based on the ***Provincial Rainwater Harvesting Guidelines*** and Handbook in addition to adoption of CAN/CSA 128.1,

3.2.15.1 EchoHaven

EchoHaven is a development in Calgary that has moved away from centralized utilities "*the storm water will be 100% stored on-site eliminating the need to connect to the City Storm Water System"* and requires "*no gas hookups* (has) *rainwater collection* (and) *solar panels* as well as *on-demand hot water and LED lighting* They have found water consumption reductions of "*72% from the typical Calgary home*". This development has faced challenges because there is no City mandate for this type of development', yet the costs of constructing "*a stick frame house* (is) *roughly $190 sq ft in the city*"… while green buildings at this site cost "*as little as $205 sq ft*". (EchoHaven, 2014). This project happened because of a "*precedent setting agreement*" This must become the norm for the City of Calgary, not a one-off.

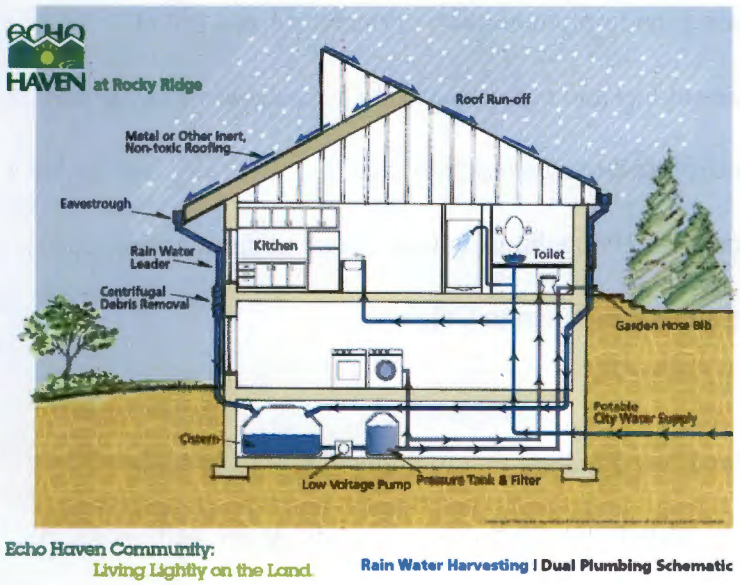


Figure 24 Rainwater harvesting dual plumbing schematic (EchoHaven, 2014)

3.2.16 Neighbouring Counties' Approach

Rocky View County is taking the necessary steps to "*treat and manage stormwater runoff close to the area where rain falls*" and use "*stormwater capture and reuse*" in addition to installing surfaces that increase the absorption and filtration of rainwater using LID concepts. (Rocky View County, 2013).

3.2.17 Other cities around the world

Since urbanized environments create a large demand for water from a concentrated population, it is important to see what cities in other parts of the world have done to respond to the issues of water scarcity. A recent paper that assessed the implementation of decentralized RWH management systems, looked at two case studies and considered "*the paradigm shift in urban water management*' to address flood control, resource protection, healthier hydrological cycles, for the cities of Almere in the Netherlands and Hsingchu in Taiwan. (Thorsten Schuetze, 2013). Cities around the world are faced with a similar problem to Calgary.

Using innovative integrated water resource management that includes RWH to address stormwater and rainwater issues is demonstrated globally to reap benefits. Many authors, researchers and experts see decentralized water management systems as being adaptable, and practical for collection, storage and reuse of the water resource. The concept challenges readers to see the water cycle as an emerging management tool, to promote resilience and sustainability

that does not depended on an endless supply, but sound stewardship. This is especially true when water supply and demand to not correlated accurately, as in the case of Calgary.

3.2.18 Summary

What can be seen from existing practices, plans and bylaws in the City of Calgary is that there is room to bring RWH into mainstream construction techniques for residential, multi-residential, commercial, industrial and special applications. As long as the building bylaw, water utilities bylaw and drainage bylaw is executable under existing provincial Municipal Government Act direction.

A report by the C.D. Howe Institute, in their Water Series stated "*Municipal water and wastewater utilities are not serving Canadians well, and lack the resources to address challenges ahead*" (Brubaker, 2011). This report argues the status quo "*is not viable*" and goes on to state "*Many of the systems that treat and distribute drinking water perform poorly, many of those that collect and treat sewage are substandard, and many of both systems need more capital investment*". (Brubaker, 2011). Although the incidence of substandard water release is low in Calgary, according to the City, it still happens. A great deal of money will be required to bring existing systems up to anticipated regulatory capacities.

There are alternatives to centralized systems; you can stick with the status quo, find alternate or additional water resources (when available) or better yet utilize the water you have in more efficient ways (United Nations Environment Programme, 2002). Water management includes a

number of functions including rainwater, ground water (which is not discussed in this paper), drinking water, storm water, greywater and wastewater. (UNEP, 2008)

Costs are growing and the water supply is and will very likely continue to shift, in ways that are going to impact the population. Water is the only commodity with no substitute. What we have is, what we have.

Calgary's sustainability report clearly indicates that Calgary is looking forward to creating a healthy, sustainable urban environment. By rethinking the sub division and looking at it as an ecosystem to improve water management, opportunities open up for RWH. Many cities around the world have done this successfully. The key is to look at the constraints and specific issues Calgary faces, to make implementation possible. Calgary's Municipal Development Plan is an excellent place to put the framework together for this initiative. It assists Calgary in its goals to compact the city, provide a more natural environment through better urban design, green the city and manage the costs of growth, by decentralizing water management, in a cost effective and responsible way. (City of Calgary, 2014). The WestCampus Development at the University of Calgary site could be a great project to begin this process.

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Key point summary:

- *"there are currently times when the flows to the Bow River are less than the Water Conservation Objectives, which is set currently at 45% of natural flow or 10% of the current-in-stream objectives"* (CH2MHILL, 2009)

- For every centimetre of rain that falls in the Calgary area 761 mm of that evaporates (mm average) between 1980-2009 (ESRD & Golder Associates Ltd., 2013)

- Agriculture *consumes "71% of the water used in the South Saskatchewan River"* (Environment Canada, 2013)

- Power Plant consumption: Using Enmax's own figures, approximately 11 million liters of water per day will be lost to the river system, because *"80% evaporated"* within the process. (ENMAX, 2014). This is only one of about 11 such facilities in proximity to the city and the Enmax technology is considered better than many.

- *"Alberta appears to be lagging behind other jurisdictions in Canada and around the world in providing a legislative framework to support water reuse"* (SRDC, 2013)

- Countries like Australia have come to realise existing water management strategies are insufficient to address these pressing issues. They have adopted the ***Australian Guidelines for Water Recycling*** (AGWR) 2009 which includes rainwater, wastewater, reclaimed water, greywater and stormwater together to augment their water supply (Environment Protection and Heritage Council, National Health and Medical Research Council, Natural Resources Management Minsterial Council, 2008), (Water Quality Unit, Scientific Services, Public Health Services, PHCS, 2012)

- **Australia now looks at whole water policy considering all inflows and outflows and takes into account potential changes in the water supply and include a water cost-benefit analysis and opportunity cost of the resource**. (Australian Government, 2012)

With the arrival of the Calgary Charter, the City is in a unique place to make <u>real practical changes</u> to how the City accounts for, uses and manages water and water policy.