CITY OF GRAND FORKS

UNIVERSAL WATER METERING FEASIBILITY ASSESSMENT

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1. INTRODUCTION

1.1 BACKGROUND

In 1999, the City of Grand Forks completed a review of its water and sewer utility rates. The review included a number of recommendations with respect to the long term operation and upgrading of water and sewer infrastructure in Grand Forks. One of the review's key recommendations was that the City of Grand Forks should conduct an assessment of water demand management strategies generally, and universal water metering specifically as a means to reduce water consumption and thus delay costly infrastructure upgrades. In addition to the cost saving benefits that may accrue through universal water metering, four other key benefits would be achieved:

1. ***Water meters would allow for the equitable distribution of costs to service beneficiaries.*** As such, users would pay for the water they consume. Water meters would improve the fairness and equity components of the City of Grand Forks' existing water and sewer rate structures.

2. ***Water metering would result in a reduction in delivery costs.*** The City of Grand Forks presently pumps water to a reservoir located to the east of the community. The electricity costs associated with pumping as well as the wear on the pumps would be reduced if water demand could be managed. This reduction in water consumption would also result in a decreased volume of sewage requiring treatment. Reduced sewage generation would enable the City to delay a future upgrade to the sewage treatment plant. Smaller volumes of sewage requiring treatment will result in more efficient operation of the City's sewage treatment facility. This reduction would decrease treatment costs for both water produced and sewage treated.

3. ***Water metering would enhance the City's ability to detect and repair leaks in the water system.*** The City's ability to detect losses within specific sectors of the water system is presently limited. Water metering would greatly enhance the information available to the City of Grand Forks and could ultimately result

in significant operating cost savings through the remedy of existing system deficiencies.

4. ***An integrated water demand management strategy would result in the conservation of a precious resource.*** Water is a limited and valuable resource. The City of Grand Forks presently draws its water from a well system. A water conservation program, including universal water metering as a core step, would represent an opportunity to provide for stewardship and wise use of the City's water resources.

1.2 PURPOSE

A recent review of water consumption in Grand Forks has indicated that the community has one of the highest per capita water consumption rates of all municipalities in British Columbia. If this water consumption trend continues unchecked, the City of Grand Forks will be required to complete a number of costly expansions to existing water and wastewater facilities.

The *Universal Water Metering Feasibility Assessment and Public Education Program* is designed to achieve four key goals:

1. To develop a comprehensive water use efficiency planning strategy. This strategy will be based on a water audit that will examine whether water is being used efficiently.

2. To undertake a universal water metering feasibility assessment to determine the economic viability of a universal water metering program.

3. To review and select an appropriate metered water rate structure.

4. To develop and conduct a public education program in conjunction with the technical project work. A strategy will also be required for ongoing public education.

The purpose of this report is threefold:

1. To conduct a water audit to examine the efficiency of water use in Grand Forks.

2. To review the proposed water and sewer capital projects and conduct a benefit/cost analysis to determine the economic feasibility of a universal water metering program in Grand Forks.

3. To provide recommendations as to the preferred course of action for the City of Grand Forks.

1.3 FORMAT

This report is organized in six sections:

- Section 2 includes an analysis detailing water demand and water use efficiency in Grand Forks.

- Section 3 includes an overview of the water conservation methods the City of Grand Forks may consider as part of an overall water demand management strategy.

- Section 4 provides an overview of the capital planning for future water and sewer infrastructure upgrades that will be required as a result of existing water consumption trends in Grand Forks.

- Section 5 includes a benefit/cost analysis to examine the economics associated with a water conservation strategy that would include universal water metering as its core component.

- Section 6 outlines the recommended direction for the City of Grand Forks with respect to water demand management generally and universal water metering specifically.

2. BACKGROUND

2.1 OVERVIEW OF THE WATER SYSTEM

The recently completed *Westside Reservoir Predesign Report* includes an overview of the existing water system. This overview is presented below as it provides an indication of future capital projects that may be delayed or eliminated through universal water metering and a water conservation program.

2.1.1 Water Supply

The City of Grand Forks' water supply system is comprised of four groundwater wells, located on the west side of the City. Two east-west feedermains deliver water from these four wells to the City's distribution system. Level detection in the Eastside Reservoir controls the starting and stopping of the well pumps.

2.1.2 Pressure Zones

The City's water system includes two pressure zones:

1. The Main Pressure Zone
2. The High Pressure Zone

The Main Pressure Zone serves the majority of the City in the low lying areas. The High Pressure Zone serves only the Valley Heights Subdivision on the benchland area above the Granby River.

2.1.3 Water Storage

The City has two existing reservoirs:

1. The Eastside Reservoir
2. The High Zone Reservoir

Both reservoirs are located on the City's eastern boundary. The Eastside Reservoir and the High Zone Reservoir provide balancing and fireflow storage for the Main and High Pressure Zones respectively. The Eastside Water Reservoir is the main water source for the High Zone. A booster pump station is used to pump water from the Main Pressure Zone to the Valley Heights area.

Water system planning since 1981 has identified the need for a new reservoir in the western portion of the City of Grand Forks. A predesign for this reservoir has been completed. Once constructed, the Westside Reservoir will provide a number of benefits:

- Better balancing of the water system;
- Enhanced fire flows for fire protection purposes;
- Emergency storage in the event that the feedermain service from the Eastside Reservoir is interrupted;
- Additional storage capacity for the demands created by future population growth.

2.1.4 Water Distribution

Water in Grand Forks is distributed to users through a distribution system that consists of approximately 43 km of water mains. Water is distributed primarily to residential, commercial, industrial and institutional users. Irrigation occurs primarily through sprinkling of lawns rather than through irrigation for agricultural uses.

2.2 PER CAPITA WATER DEMAND

Water use data providing an indication of water demand per capita in the City of Grand Forks is available for the years 1995 and 1999/2000. Although weather conditions in a given year play a role in the amount of water consumed in a community, the water consumption data available has been reviewed to gain perspective on per capita water demands in Grand Forks. Analysis indicates that average annual daily per capita water demand was as follows:

1995:	1,725 litres per capita water demand per day
August 1999 to July 2000:	1,705 litres per capita water demand per day

For analysis purposes, it is assumed that Grand Forks' average annual daily per capita water demand is 1,700 litres per capita per day. It should be noted that the per capita water demand in Grand Forks is in the high range of other comparable communities. The following table summarizes per capita water demand from other communities.

Sample of Per Capita Demand in Other Communities

Municipality	Gross Per Capita Water Demand (Litres/Capita/Day)
• Grand Forks	1,700
• Cranbrook[1]	1,034
• Elkford[1]	1,639
• Golden[1]	806
• Sparwood[1]	635
• Invermere[2]	1,100
• Fernie[3]	1,900
• Vernon[4]	630

[1] Source – Water Use Survey (1988)
[2] Source – District of Invermere Universal Water Metering Program
[3] Source – City of Fernie Water System Analysis
[4] Source – City of Vernon Universal Water Metering Program

The table presented above indicates that Grand Forks has a relatively high daily water demand per capita when compared with other B.C. municipalities. Of the communities surveyed, only Fernie has higher daily water demand per capita than Grand Forks.

However, the high per capita water demand in Fernie is the result of significant leaks and losses in the municipal water system. It is not the result of high consumption by residential, commercial, industrial and institutional users.

It is important to note that Golden, Invermere, and Vernon all employ water metering programs (universal metering in Vernon and Invermere and industrial/commercial/institutional metering in Golden). It is also recognized that an "apples to apples" comparison is difficult given the climactic differences between municipalities in British Columbia.

2.2.1 Water Consumption

Water consumption has been defined as the total amount of water used by residential, commercial, industrial, and institutional users for "inside" consumption. This does not include water used for irrigation or other outside uses, except for businesses that provide this as part of their operations, such as commercial car washes.

City records have been reviewed to determine average water consumption. Based on recently collected 1999/2000 data, the amount of consumption, on average, has been determined to be 5.8 million litres per day.

2.2.2 Irrigation

Irrigation is defined as the water used by residential, industrial, institutional and commercial buildings for "outside" use, such as irrigation. Also included is irrigation for uses such as golf courses, parks and open spaces.

In order to determine the average annual irrigation, a comparison of the average summer demand and the demand in the shoulder seasons was made. The shoulder seasons are the late spring and early fall months when it is expected that the outdoor water use is at a minimum. The shoulder season may vary from year to year depending on temperature, etc. Generally the fall shoulder season consists of October and November, and the spring shoulder season occurs between March and May.

Based on available water demand data from 1995 and 1999/2000 a determination of irrigation demand has been established and is presented in the following table.

Irrigation Demand

Year	Spring Shoulder (m^3 / Day)	Fall Shoulder (m^3 / Day)	Average of Spring and Fall Shoulder Seasons (m^3 / Day)	Summer Season (m^3 / Day)	Difference Between Shoulder and Summer Seasons (m^3 / day)
1995	4,600	4,670	4,635	10,888	6,253
1999/2000	5,503	5,817	5,660	11,083	5,423

Shoulder season demands are based on average day demand over the month.

The difference between the shoulder season demand and the summer demand ranges between 5.42 million litres per day and 6.25 million litres per day. Thus, the summer demand is roughly twice the demand in the shoulder season. This range generally represents the average additional water demand that is required over the summer months as a result of irrigation.

It should be noted that the above noted range is based on the total volume of water used for irrigation over a summer season, averaged over the number of days in the summer. Thus, it does not reflect large peaks in the irrigation demand at specific dry periods in the summer, or at times in the evening when more residential users tend to irrigate. The high peak usage in irrigation leads to a different set of problems for the water system than a high average summer irrigation rate. A reduction in peak usage would enable the deferral of capital upgrades to the water system designed to meet peak demand. This reduction may also enable for facility design downsizing which would further reduce costs for the City of Grand Forks.

2.2.3 System Losses

In any water supply network, there will generally be a percentage of total water supplied that is "lost" in the pipe system due to leaks and other losses. The following items contribute, in varying degrees, to water system losses throughout the year:

- Watermain leakage;
- Air conditioning, industrial cooling, and refrigeration units that use a continuous flow of water for cooling;
- Winter "bleeding" of water lines; and
- Building plumbing losses.

Large leaks in the water system will generally cause erosion of soil in the area surrounding the leak, or will cause water to make its way to the ground surface. As such, large leaks in the system generally become apparent at surface level. However, in any water distribution system there are also numerous smaller leaks in which the water leaked is absorbed into the soil. These leaks do not always become apparent at surface level. Thus, it is difficult to precisely estimate leakage in a system.

The method used to estimate system losses generally includes a review of the minimum water flow rate through the night. This is particularly effective in smaller communities that tend to have lower water use between the late evening and early morning hours. It should be noted that the minimum flow rate of water supplied to the system in these time periods includes both leakage and other losses. If refrigeration and air conditioning units in the City use a continuous flow of water, this flow would be included in overall night time water flows. The water used by these units is included in the minimum flow supplied to the system.

Based on the City of Grand Forks' SCADA data, minimum night time flows could not be determined as a means to illustrate potential system losses. Instead, a review of water production data and sewage flows in the winter months was conducted. The investigation is conducted using data from the winter months as it includes no irrigation component. For engineering purposes, a general rule of thumb indicates that there should be close to a 1:1 ratio between water produced and sewage generated in the winter months as no irrigation occurs at this time of year.

The analysis highlighted the following:

- Approximately 5,000,000 litres of water are used per day in the winter months.

- Only 2,000,000 litres of water are returned per day as sewage in the winter months.

- A remainder of 3,000,000 litres of water per day is unaccounted for in the system.

Given the standard 1:1 ratio of water produced to sewage generated, the loss of 60% of the water produced in the system in the winter months raised some issues that required further investigation from an engineering perspective.

Industrial and institutional users in Grand Forks were contacted to determine their water use and to assess the volume of water they either recycle or do not return to the sewage system. This investigation was conducted to gain a better perspective on system losses.

- It was determined that Canpar uses approximately 1,000,000 litres of water per day that is not returned as sewage for treatment. Canpar's use of municipal water for cooling processes represents approximately 15% of all water produced in Grand Forks annually. In the winter months, Canpar's water use represents 20% of all water produced by the municipal water utility.

- Pope and Talbot uses approximately 200,000 litres of water per shift. In cases, where two shifts are running daily, Pope and Talbot would be using 400,000 litres of water per day.

- The arena's cooling system and the aquatic centre use approximately 75,000 litres of water per day that is not returned as sewage for treatment.

This investigation illustrates that approximately 1,500,000 to 1,700,000 litres of water per day (more than 30% of water produced daily in the winter months) is unaccounted for in the system. There may be other users that use water which is not returned as sewage that have not been accounted for, however, it is not possible to assess actual losses in the system vs. user losses without the use of water meters. Improved data that would be generated by a universal metering program would allow the City of Grand Forks to clearly identify water losses in the system and consequently improve system operations. Increased water use efficiency would result in operations and maintenance cost savings for the City of Grand Forks and water users.

This investigation also illustrates that all commercial, industrial and institutional water users should be metered. As noted previously, Canpar, an unmetered water user, uses approximately 1,000,000 litres of water per day for cooling process purposes. Presently, Canpar pays flat water charges of approximately $6,000 per year for water. Based on existing metered rates for water in Grand Forks, if Canpar was metered, it would be paying in the range of $200,000 to $250,000 annually for water. It is anticipated that rather than pay this significant amount annually for water used for cooling, Canpar could potentially change their cooling process. This change alone could result in overall water demand reductions of 10% to 20% annually in Grand Forks.

In some communities, when the ground freezes, some water users may be required to run a faucet to prevent freezing of shallow bury service pipes. This is known as winter bleeding. As noted previously, there is a significant amount of water being produced that is unaccounted for in the winter months. Some water may be lost to winter bleeding. However, it is not believed that this is a major cause of water loss in the community's water system.

Building plumbing losses are also a factor in water lost in the system. Faulty plumbing in residences or commercial premises can account for a significant volume of water losses. Faucets that leak, as well as toilets that run continually are the key sources of these problems. For instance:

- A leaky tap that drips continuously can waste up to 55 litres of water in one day.
- A leaky tap that emits a constant dribble of water can waste up to 220 litres of water in one day.
- A leaky tap that produces a constant drool of water can waste up to 880 litres of water in one day.

2.2.4 Summary

Tracking water use trends throughout the year is a complicated process. There are a number of factors that affect water use at any given time throughout the day and on any given day throughout the year.

The peak water demand in the summer months presents a different set of issues than overall average water demand which occurs throughout the year. The peak instantaneous demand provided by the system is limited by the water supply, as well as the feeder watermains and network of water distribution mains. The data provided in section 3 will illustrate that Grand Forks has significant peak water demand, that if managed, would result in significant cost savings through the ability to downsize water capital projects that must be designed to accommodate peak flows.

Preliminary investigations have demonstrated that unmetered industrial users are using a disproportionate amount of water relative to the user fees they are currently paying. This situation would be rectified by the immediate implementation of water metering for all industrial, institutional, and commercial water users.

The City's existing water data also illustrates that the implementation of a universal metering program would provide better utility management information than presently exists. This would help the City to identify problems and to improve operating efficiency. Improved data collection that would occur through water metering would also enable the City to design upgrades based on actual data rather than conservative engineering assumptions. This would ultimately result in the ability to downsize capital upgrades and reduce costs to the utility and users.

3. WATER CONSERVATION METHODS

3.1 WATER METERING

A variety of communities in Western Canada have completed a range of water metering programs. Some communities such as Invermere, Vernon and Kelowna have completed a universal water metering program while others such as Calgary have relied on voluntary meter installation.

Based on the experience in other communities, water meters have proven to be an effective means of reducing water demand. Water demand reduction in the range of 25% to 50% has been experienced in communities that have completed universal water metering programs. A comparison of demand in metered and unmetered communities is illustrated in the following table.

Comparison of Demand – Metered vs. Unmetered Municipalities

Municipality	Average Day Demand (Litres/Capita/Day)	Maximum Day Demand (Litres/Capita/Day)	Maximum Hour (Litres/Capita/Day)
METERED			
Edmonton, AB	480	830	1,310
South Peel, ON	485	785	1,260
Ottawa, ON	555	875	1,485
London, ON	475	530	1,200
Chatham, ON	510	1,025	1,330
Average Metered	**500**	**810**	**1,315**
UNMETERED			
Calgary, AB	765	1,435	2,265
Kamloops, BC	820	2,050	n/a
Vancouver, BC	690	1,525	2,365
Niagara Falls, ON	680	1,250	2,280
Peterborough, ON	820	1,500	2,210
Average Unmetered	**755**	**1,552**	**2,280**

Source: *City of Calgary Water Conservation Study* – Acres Consulting Services Ltd. In association with Gore & Storrie Ltd. And with assistance from R.M. Lounden Ltd.

Comparison to Grand Forks

Municipality	Average Day Demand (Litres/Capita/Day)	Maximum Day Demand (Litres/Capita/Day)	Maximum Hour (Litres/Capita/Day)
Grand Forks	1,700	4,700	5,550

City of Grand Forks 1999/2000 Water Consumption Data

The tables presented above indicate that Grand Forks has both high average water demands and high peak water demands when compared with other communities. The reduction in average and peak demands through a universal metering program would enable the City to defer and downsize future capital projects.

3.1.1 Experience in Other Communities

A number of communities in British Columbia have completed universal water metering programs. The results of these programs have been positive with respect to reduction in water demand. Experiences elsewhere suggest the following:

- Demand reductions in the range of 25% to 50% appear reasonable; and
- Demand reductions will occur with respect to average as well as maximum day and peak hour use.

The City of Vernon has undertaken water demand management initiatives since the early 1980s, with reductions in wastewater flows providing the impetus. While some savings were realized through efforts such as alternate day sprinkling restrictions and public awareness activities, the reductions were not significant enough to reach the community's objectives. As such, a universal water metering program was initiated in 1992. The results are summarized in the following table.

City of Vernon
Universal Water Metering Results

Year	Average Daily Demand (Litres Per Capita)	Maximum Day Demand (Litres Per Capita)
Prior to Meters		
1991	695	2,070
1992	700	1,610
Average (rounded)	**700**	**1,840**
After Meters		
1993	580	1,290
194	700	1,585
1995	615	1,475
Average (rounded)	**630**	**1,450**

Source: City of Vernon

The table presented above demonstrates that the City of Vernon has witnessed some reduction in average daily water demand. More importantly, however, the universal metering program has resulted in significant reductions in maximum day demand (the demand for which water systems are designed to accommodate).
The City of Kelowna implemented its universal water metering program in 1998. Since that time, the City has reduced overall water use by 20%.

The Town of High River in Alberta has also recently implemented a universal water metering program and has experienced a 50% reduction in water demand.

3.1.2 Cost of a Universal Water Metering Program in Grand Forks

The cost of a universal water metering program in Grand Forks is based on the cost to acquire and install meters in residences, as well as in commercial, industrial, and institutional premises.

Generally, three types of meters would be installed depending on the water user's characteristics:

1. Standard Residential Meters

Approximately 90% of Canadian municipalities using water meters use meters with a meter register transmitter that is connected by a signal transmission cable to a remote encoder or "Touch Pad" system. This system works as follows:

- A water meter is installed inside the residence generally at the point where water enters the residence.
- The water meter described above includes a meter register transmitter.
- The meter register transmitter is connected to a signal transmission cable that sends data to a remote encoder unit or "touch pad" located on the side of the residence. The touch pad is only about the size of a deck of cards and is not obtrusive.
- Meter reading is accomplished by touching a hand held device to the touch pad.

This is a relatively simple and cost effective option for water meter reading. Access does not need to be gained to the household to read a meter. Based on experience in other B.C. municipalities, the supply and installation cost for these types of meters and the touch pad reading device for residential installation is about $220.

2. Residential Meter Pits

In some properties, users are connected to the water system to feed in-ground irrigation systems prior to the water entering into the home. In these cases, a meter installed in the home would not measure the water used for irrigation. Instead of a standard meter, a meter pit is used for these water users. In cases where in residence installations are difficult, meters are sometimes installed in meter pits.

A meter pit is installed in the municipality's right-of-way where the property is connected to the water system. This form of metering, allows the measurement of all water used by a specific property (including water used by in-ground irrigation systems).

While the meter pits are not installed in the home (which is sometimes preferrable for some water users), they cost approximately three times as much ($600 vs. $220) as a typical basement water meter installation. For cost estimate purposes, it has been assumed that 10% of users in Grand Forks will require meter pit installations. This is a standard assumption employed by water metering companies in costing processes.

3. Industrial, Commercial and Institutional (ICI) Meters

Typical industrial, commercial and institutional water meter installations do not differ significantly from normal residential installations. However, the difference in cost occurs as many ICI uses have larger water services than residential uses. Larger pipes require larger water meters. Larger water meters come at increased cost when compared with residential water meters.

An average cost of $1,000 for ICI water meters is assumed. Without a detailed accounting of each unmetered property line size, an average must be used for cost estimating. Some users will require larger meters costing over $1,000 while others will require smaller meters costing less than $1,000. The $1,000 average is a standard applied for cost estimating purposes.

Based on recent experiences elsewhere in British Columbia, the approximate cost for the supply and installation of water meters in Grand Forks would be as follows:

Residential Meters – Standard:	1,440 x $220 =	$288,000
Residential Meters – Meter Pit (Assumed):	160 x $600 =	$ 96,000
ICI Meters (Assumed):	83 x $220 =	$ 18,260
	40 x $1,000 =	$ 40,000
	SUB-TOTAL =	*$442,260*
	3% GST =	*$ 13,268*
	TOTAL =	***$455,528***

Based on the assumptions provided above, the cost of a universal water metering program in Grand Forks would be in the order of $460,000.

3.1.3 Metering Program Benefits

Universal water metering programs offer a number of benefits to a community. The following concepts have served as rationale for other communities in B.C. to implement a universal water metering program.

Economic Benefits

Universal water metering accompanied by an appropriate rate structure is an effective means of reducing water demands. Reductions in water demands can be achieved with respect to both peak and average use. This reduction in demand helps to extend the life of existing water infrastructure and reduces the need for and size of future infrastructure upgrades to accommodate increased demands. Reciprocally, a reduction in water demand also results in a reduction in the amount of sewage generated requiring treatment. This reduction in sewage allows a municipality to delay sewage treatment plant upgrades and may also result in the ability to downsize facility designs resulting in both net present value savings through project deferral and overall capital cost savings through reductions in facility sizing.

Improved Fairness and Equity

In the context of utilities management, the concept of fairness and equity is concerned with the fair distribution of costs to service beneficiaries. As such, service users pay for the service they receive. Existing flat rate water pricing structures in Grand Forks are inherently inequitable. For example, a small family residing on a 500 square metre lot may consume 6,000 litres of water per day on an average summer day. In contrast, a larger family residing on a 900 square metre lot may use 12,000 to 15,000 litres of water per day on an average summer day. Under existing water rates, both properties would pay the same amount despite the disparity in water consumed. This situation is both unfair and inequitable.

An attractive feature of water metering is the ability to directly measure the amount of water consumed by a specific user.

This will allow the water utility to charge for water based on actual use rather than on engineering assumptions regarding average level of water demand created by a consumer. In this case, equity is achieved. This principle is the standard among many other utilities (such as electricity and gas) where consumers pay for the resources consumed.

Enhanced Utility Information Management

At present, the water utility operates under a number of engineering assumptions. The recent installation of the SCADA system somewhat improves the data collection process. However, a lack of specific information on certain geographic areas and users continues to necessitate the use of engineering assumptions in system design.

The introduction of a universal water metering program would provide the water utility with greater detail on a number of issues:

- Meter readings from individual residences could provide data on peak hourly and daily demands, average daily demands and other selected parameters.
- Cumulative water meter records could be compared with water supply records to determine whether all water supplied is reaching the customers or if a portion is being lost in the system through leakage.
- Consumption data is useful for developing fair, equitable, and highly defensible cost recovery mechanisms such as development cost charges for future infrastructure upgrades that will be required as a result of new development.

Environmental Benefits

Water is a limited resource. Universal water metering and the resulting reduction in water demand results in conservation of this precious resource. Reduced sewage generated through decreased water usage is also beneficial from an environmental perspective.

In summary, the information generated by a universal water metering program will allow the City of Grand Forks to make more informed, cost saving decisions with respect to the City's water utility.

3.2 FACILITIES RETROFIT

Facilities retrofit can be categorized into residential and commercial retrofits.

3.2.1 Residential Retrofits

Residential retrofit programs consist of the installation of low flow showerheads, faucet aerators and toilet dams. These are modifications to plumbing fixtures in individual residences that serve to reduce water consumption. Retrofit kits can be provided to residents along with detailed installation instructions.

Low flow plumbing fixtures are a proven means of reducing both average and peak water demand. The following tables provide a comparison between conventional plumbing fixtures and low flow fixtures.

Toilets and Urinals
Water Use

Plumbing Fixture	Conventional	"Water Saver"	"Low Consumption" Ultra Low Flush
Toilets	23 litres per flush	13.25 litres per flush	6.0 litres per flush
Urinals	> 5.7 litres per flush	5.7 litres per flush	3.8 litres per flush

Faucets and Showerheads
Water Use

Plumbing Fixture	Conventional	"Water Saver"
Faucets	Min. 20 litres per minute (at 20 psi)	Max. 8.3 litres per minute (at 60 psi)
Showerheads	Min. 20 litres per minute (at 20 psi)	Max. 9.5 litres per minute (at 80 psi)

The potential water savings resulting from low flow plumbing fixtures is substantial. Toilets account for approximately 45% of household water consumption. If an average household converted from a conventional 23 litres per flush toilet to a "water saver" type toilet at 13.25 litres per flush, this would result in a 42% savings in water used by toilets in the house and a 20% reduction in overall household water use.

The cost to the City of Grand Forks for this type of residential retrofit program is reasonable. The education could occur through pamphlets distributed to water users. Other communities have also implemented retrofit programs that include distribution of a package of retrofit items such as low flow showerheads, faucet aerators and toilet dams. The City of Vernon completed the installation of these fixtures in homes and businesses in conjunction with the installation of water meters. The cost of these packages could be shared by the homeowner and the municipality or could be incorporated as part of the cost of the universal water metering program. The cost of the retrofit kits is approximately $30. Based on approximately 1,600 connections, retrofit kits for all residential dwellings to be installed in conjunction with a universal water metering program would cost in the order of $48,000.

In order to provide for increased water reduction, the City may also consider implementing a bylaw requiring that low flow fixtures be installed in all new construction.

The primary drawback to a retrofit program is that there is no means to enforce the continued use of water saving devices. However, the implementation of a retrofit program in conjunction with a universal water metering program offers water users an economic incentive (reduced water use =

reduced water consumption charges) to continue using the water saving devices.

3.2.2 Commercial and Institutional Retrofits

Commercial retrofit programs could involve replacing cooler and air conditioning units with more modern units. This can be incorporated into the approval of new facilities to ensure continuous flow units are not used. The City of Grand Forks should work with businesses or institutions to replace existing units. This could involve providing information to business owners about the negative impacts of continuous flow cooling units on the water and wastewater systems.

Water savings through the use of low flow plumbing fixtures can also be realized through retrofits of existing commercial and institutional buildings. Upgrading plumbing fixtures will reduce water consumption. However, more significant savings will occur through the elimination of any cooler units that use a continuous flow of water. The City of Grand Forks should encourage any businesses with these cooler units to replace them. If universal water metering is implemented, there will be an increased economic incentive for businesses and institutions to replace cooler units.

3.3 LEAK DETECTION AND REPAIR

As discussed in section 2, there is an amount of water produced by the City of Grand Forks that is unaccounted for in the system. It is possible that some of this water is being lost from the City's water system. There are several factors that may contribute to these losses:

- Main leaks
- Winter bleeding;
- Building plumbing;
- Commercial air conditioning and cooling units.

It is likely that some water loss occurs through leaks in the water distribution system. Leaks occur as pipes corrode or are damaged by root or other intrusions. The extent of the damage depends on water and soil chemistry. Pipe leakage can also be caused by settlement forces that cause pipes to crack, and joints to separate.

Although leakage from pipes may be a significant factor contributing to Grand Forks' high per capita water usage, leak detection and repair can be expensive with limited water savings. A leak detection program performed by a consultant is estimated to cost between $25,000 and $50,000. When the leaks have been identified and a repair program has been developed, the cost of repairing leaks varies according to the severity of the problem. Generally, the cost of repair can range from $300 to $1,100 per metre. The results in terms of water savings from a leak detection and repair program will vary significantly, depending on the severity of the leaks.

As an added benefit, a leak detection and repair program will reduce baseline demand or average water demand. However, it is less effective at reducing peak water demand. The cost of a leak detection program needs to be considered within the scope of an overall water conservation strategy to help prioritize problem areas and quantify system losses.

Universal water metering data would enable the City of Grand Forks to track water produced and distributed by the system. This data would enhance the City's ability to isolate leaks in the system. Thus, the implementation of a universal water metering program would negate the need to conduct a leak detection study.

3.4 Public Education

Public education is a relatively low cost means of promoting water conservation. Public education can take several different forms. Other communities have initiated the following types of public education initiatives:

- *Demonstration gardens* – The City of Kamloops has constructed a demonstration xeriscape garden which incorporates plants native to the region, drought tolerant planting and other landscape features that reduce irrigation needs.

- *Elementary school presentations* – This can include a video or multi-media presentation to students with handouts for distribution.

- *Mailers* – a pamphlet or short brochure can be included with utility bills or inserted in the local paper as a means of offering suggestions to reduce household water consumption.

- *Public service announcements* on TV or radio.

- *Display booths* can be incorporated into community events.

- *Student monitoring.* Some communities hire students in the summer months to "patrol" the community on bicycles searching for specific water use practices (e.g. irrigation on the wrong day, watering during peak heat periods, etc.) The students leave a hanging notice on the door knob of the premises explaining the City's bylaws with respect to watering. The hanging message also provides some tips on water conservation.

The above noted public education items have been used with success in other communities. Public education is an important component of a comprehensive water conservation strategy. The City of Vernon has reduced its water consumption by one third as a result of its comprehensive conservation program which features universal water metering, water conservation devices, and a public education program.

The public education program should focus on methods of reducing both average demand and peak demand. In order to reduce peak demand, information provided to water users should encourage the use of water in off-peak hours. This will reduce peak flow resulting in savings from capital project deferral. The cost of a public education campaign can vary depending on its comprehensiveness.

3.5 SPRINKLING RESTRICTIONS

Many municipalities in British Columbia have implemented sprinkling restrictions as a means to reduce water demand.

Typically sprinkling restrictions work as follows:

- Properties with an even house number are only permitted to water on even numbered days of the month.

- Properties with an odd house number are only permitted to water on odd numbered days of the month.

The City of Grand Forks has a sprinkling restriction that is similar to that described above.

However, restrictions such as this are only effective if adequate enforcement is provided. Anecdotal evidence suggests that enforcement of sprinkling restrictions in Grand Forks does not occur on a regular basis. Infrequent enforcement may perhaps be worse than no enforcement as water users view municipal tickets as arbitrary when they are issued. This raises questions of fairness in the process.

Generally, enforcement can occur through two means:

1. As noted in the public education section, students may be hired to patrol the City and provide "soft enforcement" or reminders of the sprinkling restrictions and public education on water conservation.

2. The other form of enforcement would include traditional bylaw enforcement with corresponding penalties for non-compliance.

Sprinkling restrictions are only effective if they are enforced. The type of enforcement in Grand Forks will depend largely on the nature and scope of the water conservation program. An effective sprinkling restriction program can result in a potential decrease in irrigation demand in the order of 50%.

Municipal bylaws are adopted as a means of regulating practices within a municipality's jurisdiction. Bylaws must be enforced regularly to be fair and effective. Enforcement of sprinkling restrictions would require the City to adequately resource a bylaw enforcement officer and to clearly establish fair practices with respect to sprinkling restriction enforcement. If a bylaw, such as the sprinkling restriction bylaw, is not or cannot be enforced due to a lack of enforcement resources, the City should consider repealing the bylaw.

3.6 OTHER REGULATORY CONTROLS

There are also other regulatory controls a municipality may employ as a means to reduce water consumption.

3.6.1 Requiring Low Flow Plumbing Fixtures

As discussed previously, a municipality can require low flow plumbing fixtures in all new construction as a means to reduce water consumption.

3.6.2 Requiring Water Meter Installation

A municipality may also require water meter installation in new construction. Presently, the City of Grand Forks requires meter horn installation in all new residential development but does not require water meter installation. Meter horn installation reduces the effort involved in meter installation at a later date. However, as new residential development is not metered, this policy does not result in immediate water demand reductions.

3.6.3 Requiring Drought Tolerant Landscaping

As part of the development permit process, the City of Grand Forks could consider requiring drought tolerant landscaping as a requirement to reduce water demand created by irrigation.

4. CAPITAL PLANNING

As required by the *Local Government Act*, the City of Grand Forks has completed 5 year capital plans for the City's water and sewer utilities. A major benefit of universal water metering is the ability to delay or eliminate future water and sewer infrastructure upgrades as a result of the reduction in water demand created. An examination of the City of Grand Forks' future water and sewer capital works projects has been completed to determine which specific infrastructure projects could be delayed or eliminated through the implementation of a universal water metering and water conservation program.

4.1 WATER PROJECTS – 5 YEAR CAPITAL PLAN

The following table provides an overview of the City of Grand Forks' 5 year capital plan (prepared for 2000) for water infrastructure.

City of Grand Forks
Water Utility Five Year Capital Plan

Project	2000	2001	2002	2003	2004
Rehab Well #3&#5	$300,000				
Replace Granby River Water Main		$200,000			
Small Equipment	$2,850	$2,500	$2,500	$2,500	$2,500
Hydrant Replacement	$7,500	$7,500	$7,500	$7,500	$7,500
Water Line Replacement	$30,900	$50,000	$50,000	$50,000	$50,000
Water/Sewer Metering Analysis	$23,900				
#6 Well Study	$2,500				
Westside Reservoir Pre-Design	$1,000				
Westside Reservoir			$1,900,000		
Main Reservoir Cover			$120,000		
Roxul Water Line	$15,000				
Strengthen West Side Feedermain System		$150,000	$150,000	$150,000	$150,000
TOTAL CAPITAL	**$383,650**	**$410,000**	**$2,230,000**	**$210,000**	**$210,000**

The 5 year capital plan for the water utility outlines capital project requirements in excess of $3.4 million.

The water capital projects identified for the short term (5 year horizon) are required primarily to address existing deficiencies and potential safety issues (e.g. The Westside Reservoir is required to provide adequate fire flow and system balancing. Water lines will also need to be replaced on an annual basis as a result of aging and deterioration). The need for a second reservoir in Grand Forks was identified in 1981. Population and development growth over the past 20 years and the need to enhance system safety and operating capacity would dictate that the projects included in the 5 year capital plan cannot be delayed as a result of water metering.

However, beyond the 5 year capital plan, savings could be realized through a reduction in water demand if future water supply sources such as wells can be delayed. A reduction in water demand would also result in reduced water pumping (electricity) costs and reduced wear on pumps.

4.2 Sewer Projects – 5 Year Capital Plan

The following table provides an overview of the City of Grand Forks' 5 year capital plan (prepared for 2000) for sewer infrastructure.

City of Grand Forks
Sewer Utility Five Year Capital Plan

Project	2000	2001	2002	2003	2004
Small equipment	$2,850	$2,500	$2,500	$2,500	$2,500
Boundary Lift Station	$110,429				
Inflow/Infiltration Study	$25,000				
Generator and Building	$80,000				
Sewer Extension Study	$9,500				
Venting of Existing Lift Stations	$80,000				
Upgrade and Automate Sludge Transfer	$42,000				
Granby Lift Station Repairs	$200,000				
Rehabilitate Sewage Lagoon					$250,000
Rehabilitate and Upgrade Sewer Lines		$50,000	$50,000	$50,000	$50,000
TOTAL CAPITAL	**$549,779**	**$52,500**	**$52,500**	**$52,500**	**$302,500**

The 5 year capital plan for the sewer utility outlines capital project requirements in excess of $1 million.

The sewer capital projects identified for the short term (5 year horizon) are required primarily to address existing deficiencies and potential environmental safety issues (e.g. Sewer line repair of aging sewer lines). Population and development growth over the past 20 years and the need to enhance system safety and operating capacity would dictate that the projects included in the 5 year capital plan cannot be delayed as a result of water metering.
However, beyond the 5 year capital plan, savings could be realized through a reduction in water demand if future sewer system

upgrades such as the Sewage Treatment Plant upgrade can be delayed. A reduction in water demand would result in a reduction in sewage generated thus enabling the City of Grand Forks to delay the sewage treatment plant upgrade (projected for 2009) and the associated operating costs (electricity, chemicals, etc.).

5. BENEFIT/COST ANALYSIS

A benefit/cost analysis has been conducted to determine the benefits and costs associated with a universal water metering program.

5.1 BENEFIT/COST ANALYSIS ASSUMPTIONS

- Population growth over the next 10 years is projected to be in the order of 2% per annum.
- The implementation of the universal water metering program will result in a 20% reduction in water demand. A 20% reduction in water demand is a conservative estimate based on the experience in other B.C. communities. If the water demand reduction is greater than 20%, the corresponding economic benefits increase. It is important to note, that if water use by Canpar alone was reduced or eliminated through a change to its cooling process, overall water demand would be reduced by about 15% annually. Any decreases in use in the community would be in addition to the decrease experienced at Canpar.
- A 20% reduction in water demand will create the ability to delay growth related water capital projects and operating costs for 8 years.
- The implementation of a universal water metering program will result in a 10% reduction in sewage generated. This will create the ability to delay growth related sewer capital projects and operating costs for 8 years.
- An annual interest rate of 8% is assumed as the cost of borrowing in determining annualized costs.
- A discount factor of 5% for a 17 year return period is used in determining Present Worth.

5.2 WATER UTILITY CAPITAL PLANNING ASSUMPTIONS

If water demand in Grand Forks can be reduced by 20% through a universal water metering program (a relatively conservative demand reduction estimate given the experience in other communities), capital projects and attendant operating costs could be delayed for 8 or more years based on present population projections.

The draft report entitled *Groundwater Development Study* prepared for the City of Grand Forks identified the need to upgrade existing water well #3 or the need to install a new well source on 22nd Street (Pine Street). This project would be required as a result of increased water demand created by population growth.

- It is assumed that the capital cost of the development of a new well would be in the order of $600,000.
- Operating costs associated with the operation of the well are estimated at $2,500 annually.
- A 20% reduction in water demand would also reduce existing annual electricity costs by $9,500.
- As linemen from the City's electrical utility already read existing electrical meters, it is assumed that economies of scale could be achieved in the meter reading process if two meters were read during the same visit. Thus, additional meter reading costs have not been included in the benefit/cost analysis.

5.3 WATER UTILITY BENEFIT/COST ANALYSIS

Assuming that the development of a new well could be delayed for 8 years through a 20% reduction in water demand, the following present worth savings would result:

- Capital Project Deferral: $287,535
- Operating Cost Deferral: $ 85,294
- **Present Worth Savings: $372,829**

The benefit cost analysis demonstrates that the deferral of only one major water project through demand management that would be achieved by a universal metering program would result in present worth savings of approximately $373,000.

5.4 Sewer Utility Capital Planning Assumptions

Decreased demand for water results in improved operating efficiencies for the City's sewage facilities. If water demand in Grand Forks can be reduced by 20% through a combination of a universal water metering program and a comprehensive demand management strategy, a major sewer capital project, the Sewage Treatment Plant upgrade could be delayed for 8 or more years.

- Presently, it is assumed based on population growth projections that the City of Grand Forks will need to complete a sewage treatment plant upgrade in 2009.
- The cost of the sewage treatment plant upgrade is estimated to be $1.4 million.
- Based on a reduction in water demand, it is assumed that the Sewage Treatment Plant upgrade could be delayed until 2017.
- Operating costs associated with the operation of the sewage treatment plant upgrade are assumed to be negligible

5.5 Sewer Utility Benefit/Cost Analysis

If the sewage treatment plant upgrade can be delayed for 8 years through reduced water demand achieved by a universal water metering program, the following present worth savings would occur:

- Capital Project Deferral: $361,991
- **Present Worth Savings: $361,991**

Approximately $362,000 in present worth savings would occur through the deferral of sewage treatment plant upgrades.

5.6 BENEFIT/COST SUMMARY

5.6.1 Benefits

Based only on the deferral of two water and sewer capital upgrade projects, the following present worth savings would occur through the implementation of a universal water metering program:

• Water Capital Project Deferral:	$287,535
• Water Operating Cost Deferral:	$ 85,294
• Sewer Capital Project Deferral:	$361,991
• **Present Worth Savings:**	**$734,820**

The present worth savings that would occur as a result of a 20% reduction in water demand would create present worth savings of approximately $735,000 for the City of Grand Forks.

5.6.2 Costs

As noted in Section 3.1.2 of this report, the capital cost of supply and installation of water meters is estimated at $455,528. The universal water metering program alone is projected to result in a 20% demand in water reduction.

Further water demand reductions, above and beyond the 20% reduction project to result from universal water metering would occur through the installation of residential retrofit kits. The cost of residential retrofit kits, noted in Section 3.2.1 is approximately $48,000. The resulting further reduction in water use resulting from a retrofit kit program would allow the City of Grand Forks to further delay water and sewer system upgrades – thereby enhancing the benefit portion of this analysis.

If the cost of the universal water metering program and retrofit kits are considered in tandem, the following costs result:

- Universal Water Metering Program Costs: $455,528
- Retrofit Kits: $ 48,000
- **Total Cost: $503,528**

5.6.3 Benefit/Cost Summary

As noted previously, the water demand reduction benefits associated with a universal water metering program would be further enhanced by a retrofit kit program. However, in order to be conservative, the benefits have been projected solely based on the water demand reduction that may occur as a result of universal water metering.

Based on the benefit and cost analysis, the City of Grand Forks could achieve present worth savings of approximately $279,000 through the implementation of a universal water metering program.

- Universal Water Metering Program Savings: $734,820
- Universal Water Metering Program Costs: ($455,528)
- **Universal Water Metering Savings (Costs): $279,292**

A portion of the present worth savings could be allocated to purchase residential retrofit kits at a cost of $48,000 for installation in conjunction with the universal water metering program. The installation of these kits will result in additional reduction in water demand and will allow the City to further delay and downsize capital upgrades to the water and sewer system.

Based on a 17 year return period and the deferral of only two capital projects, the universal water metering program would pay for itself in 10.5 years.

($455,528 Project Cost/$734,820 Deferral Savings) x 17 Years = **10.5 years**

As noted previously, there are several other key benefits to the implementation of a universal water metering program:

1. ***Improved Fairness and Equity.*** A universal metering program will allow the City of Grand Forks to fairly charge water users for the water they consume. This will eliminate existing inequities in the City's rate schedules.

2. ***Improved Utility Operations.*** The data that can be generated as a result of a universal water metering program will allow the City of Grand Forks to identify losses in the system and to improve operating efficiency. These improvements will result in cost savings.

3. ***Improved Engineering Design Capability.*** Presently, designs for water and sewer upgrades are based on standard design assumptions. Meter data will improve the engineering design process and consequently allow the City to more accurately design water and sewer upgrades, resulting in further cost savings. Reduced water demand that occurs through metering will also enable the City to downsize the design of capital facilities in the future resulting in cost savings.

4. ***Environmental Benefits.*** Cities in British Columbia are beginning to take a stewardship role with respect to water conservation and preservation. Grand Forks could be a leader in this regard.

6. RECOMMENDATIONS

The benefit/cost analysis indicates that the City of Grand Forks would derive present worth savings that are significantly greater than the cost of a universal water metering program through the ability to delay only 2 water and sewer capital projects. In addition to the economic benefits outlined in Section 5, several other key benefits would result from a universal water metering program:

1. Improved fairness and equity in user rates;
2. Improved utility information that would result in cost savings in terms of operations and maintenance of the water and sewer utilities;
3. Strong empirical data that would improve engineering design of new facilities and reduce capital costs through the ability to downsize infrastructure;
4. Reduced cost of water delivery to users;
5. Reduced cost of sewage treatment;
6. Environmental stewardship and water quality enhancement.

Based on the foregoing analysis, the following recommendations are provided:

It is recommended:

- *THAT,* given the amount of water being used by industrial and other unmetered users and the amount of water unaccounted for in the system, Council immediately instruct staff to review and select an appropriate water meter for industrial, commercial and institutional water users.

- *THAT,* once an appropriate water meter is selected, the City of Grand Forks amend its existing building bylaw and water regulations and rates bylaw to require the installation of water meters for all industrial, commercial, and institutional water users.

- *THAT* Council instruct staff to proceed with the implementation of the residential portion of a universal water metering program.

- *THAT* Council instruct staff to proceed with the public education campaign associated with water conservation generally and universal water metering specifically.

- *THAT* Council instruct staff to research funding programs that would provide wage subsidies required to hire students for summer water use enforcement.

- *THAT* Council amend the building bylaw to require the installation of water meters in all new construction.

- *THAT* Council amend the building bylaw to require low flow plumbing fixtures in all new construction.

- *THAT* Council consider the inclusion of retrofit kits as part of the universal water metering program.

- *THAT* Council consider amending the development permit area provisions in the Official Community Plan for multiple family, commercial, and industrial development to require drought tolerant landscaping.