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# Development of a Collaborative Approach to Industrial Water Conservation

by

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for the Degree of

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Department of Civil/Geological Engineering  
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**A Practicum submitted to the Faculty of Graduate Studies of the University of Manitoba  
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## Abstract

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The objective of this practicum is to apply the concept of collaboration between two parties to encourage water conservation. The two parties are the water utility of the City of Winnipeg and a local industry. Presently no formal communication strategy exists between these two groups. The hypothesis of this practicum is that a collaborative effort would result in a greater empathy between the partners which should result in a greater level of industrial water conservation. The mandate of the utility is to provide a range of services including the supply of water to ensure a . . . healthy and vibrant City (City of Winnipeg, 1994). This practicum is an extension of that mission by providing a service that can assist industry to reduce their operating costs incurred by water consumption.

The information used in the preparation of this practicum includes various literature on management and collaboration. In addition, existing information from the City of Winnipeg, Waterworks, Waste & Disposal Department was used to describe the existing conditions of water consumption in Winnipeg and to develop and target a survey of industrial users in Winnipeg.

The first step of this work was to determine if there exists a need to improve the understanding of industrial water consumption and the second step was to identify a process for a collaborative strategy between the utility and industry. A literature review of collaboration and systems management provided the foundation for the collaborative strategy. The final step was to develop a conceptual outline for implementation of the strategy.

The results of this work indicate that based on the present situation there exists a need to better understand industrial consumption. The utility's historic

database (prior to 1992) did not accurately monitor industrial consumption. As a result the utility does not have a clear understanding of the industrial demand nor an accurate picture to predict future demands.

The industrial survey carried out indicated a very strong interest by industry to participate in future conservation initiatives with the City. Twenty six of the twenty eight responding industries indicated that the survey was in their opinion worthwhile and twenty three of these respondents indicated a willingness to share ideas about water conservation with other industries.

The application of collaboration to this situation would address the questions of understanding current industrial water consumption patterns and future plans as well as establish the necessary groundwork to continue working together to improve water use efficiency.

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Finally I would like to acknowledge the many great minds listed in the References that have inspired this work. I hope I have correctly interpreted their intent and that this practicum has forwarded some of their thoughts and ideas that may benefit future work in this field.

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# Abbreviations & Nomenclature

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The following abbreviations appeared in the text of this practicum:

Lcd - Litres per capita per day

c.f. - cubic feet

Xavg. - the average value of X

3-R's - Reduce, Recover, Reuse

TQM - Total Quality Management

City - refers to the entire organization of the City of Winnipeg

Utility - refers to the department of the City of Winnipeg which is mandated to supply water to the City

Industry - refers to any industry located in the City of Winnipeg

Mission - the overall aim of the organization

Objective - something an organization or group is continually trying to achieve

Strategy - is a plan to achieve the objective

Goal - an accomplishment that is required to meet an objective

# 1. Introduction

---

Society today is facing many serious issues including choices on health care, social assistance, environmental protection and infrastructure that require important decisions regarding the spending of public funds. Our economies do not enjoy the extravagant spending as many have witnessed in the past decades. We have all been exposed to the phrase "do more with less". In addition, there is a greater awareness and attention given to our environment. The situation described above is a perfect setting for the discussion of water conservation. Water conservation is a viable means to help both environmental and economic aspects associated with water supply. From the utility's perspective water conservation is a demand management approach to water supply problems as compared to our historical measures of system expansion to meet increased demands.

In management today we hear many acronyms and buzz words that describe "new" approaches to management. Whether it is the Deming philosophy, Total Quality Management or Learning Organizations there seems to be a common theme within these methods. The message is clear, you must understand your system and strive to continually improve it, thus providing a better service or product to your customer. One key aspect of these approaches is to understand your customer and work together to try to satisfy their needs. If you meet your customers needs and are always improving you will no doubt meet your needs. Our economic reach today is very limited and doing more with less is truly a reality for all organizations who want to remain in business.

Water conservation in simple terms can be defined as mechanical and attitudinal methods designed to improve water use efficiency. Expansion of the City of Winnipeg's water supply system has been estimated at approximately \$400

million. The cost of the interest on a capital investment of this magnitude far exceeds the cost of inflation over the time the construction of the project is deferred. Deferral of expansion is what drives the benefits of the water conservation program. Additional to the economic benefits of water conservation are the environmental benefits. There is a magnitude of environmental benefits from not constructing a second aqueduct. The City of Winnipeg is very concerned and committed to preserving the integrity of the environment for future generations. Sustainable development has been defined as a balance of the needs of the environment, society and the economy. Water conservation tries to balance those needs for the benefit of all.

Referral to the City in this practicum represents the total City organization. The term utility is used to refer to the department mandated to provide water to the citizens of Winnipeg.

As new approaches to conserving water emerge so do new opportunities for innovative program management. Water conservation includes many stakeholders and many diverse groups. Decisions require input from many of these stakeholders requiring the development and nurturing of working relationships important for support and participation. It is the development of these relationships that the principles of continuous improvement provide guidance and a rationale for this practicum. The concept of collaboration and a team effort for this work seems appropriate.

Industrial water conservation is one specific initiative that in my opinion requires the development of a working relationship between the customer (in this case) industry and the utility. The hypothesis of this practicum is that a collaborative effort to this problem would produce a better solution than would individual efforts.

Huxham (1992) defined collaborative process as “. . . developing synergy between organizations towards the achievement of common goals”. He further clarifies the collaborative advantage as “. . . meeting an objective which no individual organization could have met alone and achieving the objectives of each collaborating organization better than it could alone”.

Huxham (1992) discussed the origination of collaboration from work conducted by public organizations in Glasgow. A situation like industrial water conservation where a public and a private organization can work together is ideal for the collaboration process. No direct competition exists between these two groups. Both groups would like to reduce water consumption. Industry is striving to reduce consumption to reduce operating costs while the utility is striving to reduce consumption to defer system expansion.

The process should not be considered as cooperation or coordination. Huxham (1992) defined cooperation as “. . . the interaction of organizations so that each may achieve its own mission better”. Collaboration may also make possible the achievement of some higher level meta-objectives of the collaborative effort where meta-objectives are objectives that are mutually set by the collaborators. There exists the opportunity for additional benefits to both parties in this case. Huxham (1992) defined coordination as the process an organization uses to ensure its own activities take into account those of others. If coordination was used for industrial conservation it is unlikely that support and participation would be gained.

The purpose of this practicum is to introduce the existing water conservation program; characterize industrial water consumption; discuss the need for industrial water conservation; discuss the process of collaboration; and will

conceptually apply the process of collaboration to industrial water conservation illustrating the process, relationships and information transfer requirements.

## 1.1 Water Conservation in Winnipeg

---

Winnipeg receives its water from Shoal Lake located approximately 135 km southeast of Winnipeg in the Lake of the Woods watershed. The source is a surface water which is of very high water quality and it was this reason together with the isolation of the lake that drew Professor Schlicter to Shoal Lake in 1919 (City of Winnipeg, 1994). The selection of Shoal Lake as a water supply source was a visionary decision in its time and still remains an engineering marvel today. Water is transported via the seventy five year old aqueduct, a gravity flow non-reinforced concrete pipe.

The aqueduct is in very good condition overall, however, there exists several kilometers which are in need of rehabilitation. Rehabilitation is currently underway and takes place each fall over a two week shutdown period when demand is low. During the shutdown period the City receives water from Deacon Reservoir. The reservoirs in Winnipeg are used for balancing storage during peak demand conditions. During shutdown the Aqueduct is dewatered and rehabilitation commences on a prioritized basis.

Winnipeg's demand for water is increasing due to an increasing population and more importantly due to an increasing per capita demand. As demand increases we move towards the available supply capacity of the aqueduct. Figure 1 illustrates the historic water consumption and the projected demand which is a regression analysis of the entire historical record (City of Winnipeg, 1993). In 1992 the annual consumption decreased significantly. The demand for water continued to decrease in 1993 and leveled off in 1994. The total decrease in consumption represented approximately 20% when compared to the demand prior to 1990. Several factors have been suggested that may have contributed to the decline. Unusually wet summer months had a direct impact on outdoor

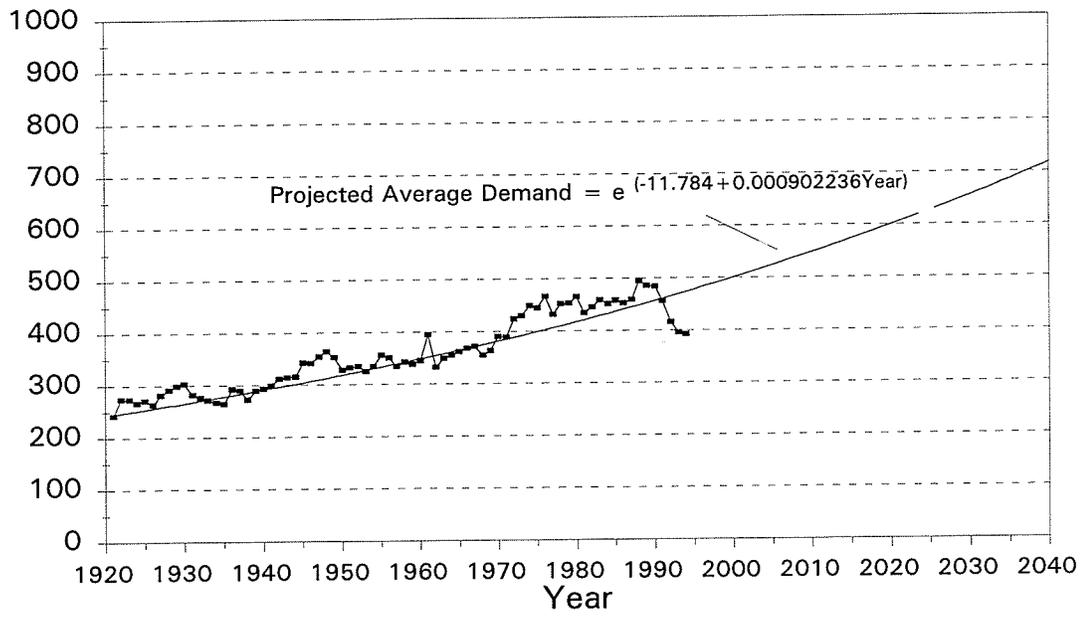


FIG. 1. City of Winnipeg Historic & Projected Per Capita Consumption

water use in 1993 and 1994. Watermain breaks were also significantly decreased. It is speculated that the cathodic protection program for iron watermains is a contributing factor to the decrease of approximately 50% of the number of breaks per year. Other factors contributing to the decrease in demand include recalibration of pumps, natural variation and water conservation. It is important to note that although there has been a decrease in demand from the projected demand in the last three years it is not enough information to predict a long term reduction.

The population in Winnipeg is projected to grow primarily due to an increase in the immigration to the City from other countries. The water conservation program will be very important in later years to the City of Winnipeg. Water conservation is an integral part of the water supply plan to increase water use efficiency and defer expansion of the aqueduct. As previously mentioned Winnipeg's demand for water is approaching the capacity of the aqueduct. As Shoal Lake is the City's sole supply source and the aqueduct is the only means of transport, it becomes the limiting factor of our water supply system.

Expansion of the aqueduct has been estimated in the order of \$400 million (City of Winnipeg, 1994). The City will most likely require a water treatment facility by the end of the decade to meet more stringent water quality guidelines. The estimated cost of a water treatment facility is approximately \$180 million. In addition, the aqueduct rehabilitation program is expected to cost approximately \$50 million over a 10 to 15 year period. Current water rates are increasing annually at 10% to cover existing and planned capital works. These increases include a 3% and 4.5% charge that is collected and amortized for the future capital costs of water treatment and the rehabilitation of the aqueduct. The City is moving towards a "pay as you go" financing plan which builds up cash reserves to fund such expenditures.

The Regional Water Supply Study, recently completed in 1994, identified the benefits of water conservation. Phase 1 of the report completed in 1991 indicated that water conservation could defer the need for expansion if the citizens of Winnipeg are willing to modify their water use habits (City of Winnipeg, 1991). Deferment of expansion is very advantageous as the cost of interest on a capital investment of the magnitude of this far exceeds the cost of inflation. The annual budget of the water conservation program is approximately \$680,000 per year. The annualized benefit of a 5% water conservation program is one to \$1.2 million per year (City of Winnipeg, 1992).

In 1992, the City of Winnipeg officially embarked on a long term water conservation program with the mission of improving water use efficiency in Winnipeg to defer expansion to the water supply system. Some early opinion surveys of Winnipeggers indicated a significant amount of interest and support existed for the program. One of the biggest challenges of the program is the modification of habits and attitudes towards water use.

The water conservation program includes many activities that cover a broad spectrum of work. Over the two years of the program these initiatives have been expanded to include the following activities:

- public education programs
- retrofit programs
- outdoor water use
- water rate study
- study of unaccounted for water
- database development
- external government liaison
- industrial conservation programs

The public education component of the program is intended to provide the

important "why" for water conservation. Many programs have indicated that the long term success of the program depends on the understanding of its participants. The City has initiated education programs on all three levels including broad based, community education and the formal education system. One of the toughest challenges of the program is the education of the citizens of Winnipeg to understand the complexities of the water supply system and to learn how to preserve it. The objectives of the water conservation program are aimed at the habits of people.

The City of Winnipeg has initiated several retrofit programs. Retrofitting is the modification of existing water using fixtures to water efficient fixtures. This program is intended to provide the mechanical tools necessary for water conservation. An important point is that the retrofit program's success is very dependent on education so people understand why they should use these devices. Retrofit programs presently include multi-family and single family residences. The City offers devices at cost to these people, due to the large quantity of purchases by the City these savings can be passed on to the consumer. By retrofitting residences the program could reach almost 60% of the water demand in Winnipeg. This is the reason that retrofit programs are rated highly in many cities. Although the City is targeting large areas for retrofitting the City encourages others to sell such devices.

The City also conducts various activities with the objective of understanding and decreasing outdoor water use. Typically the outdoor water use in Winnipeg varies between 3 and 13% of the annual demand depending on weather. An example of an internal program is the assessment of water use by City Departments to help reduce water consumption. An example of a program to help citizens reduce outdoor consumption is the water efficient landscaping demonstration project at the Fort Whyte Centre. The exhibit provides people with an example of alternative water conserving practices.

A water rate study is also presently ongoing to identify a rate structure that provides equitable rates that are cost based and provide a greater incentive for conservation. The City presently utilizes a declining block structure which has been widely criticized for not promoting water conservation. With a declining structure higher volumes of water consumption pay less per unit of water. This work is presently in the public consultation phase.

Unaccounted for water includes initiatives such as leak detection and repair. The City's unaccounted for water typically varies between 14 to 20% of total annual demand. This is an acceptable level for a City of this size based on reported values across Canada. The previous thinking was that any leaks that occurred would be detected as they surfaced due to the clay soils in Winnipeg. However pilot work indicated significant leaks were occurring and not being detected. The City is in the planning phase of implementing a formal leak detection program.

The City has assembled a database to analyze and evaluate water consumption and water conservation programs. The database was constructed from customer records and presently holds three years of data.

The City also participates on inter-governmental committees to address water consumption and water conservation. The City is actively involved with the Canadian Council of Ministers of the Environment to promote and implement the National Water Use Efficiency Action Plan. The objective of the plan is to promote and implement water conservation initiatives in municipalities across Canada.

Last but not least is the industrial use initiatives the City is undertaking. There is a great need to understand how industry is using water and what their plans are for water use in the future. This use category has significant impacts upon